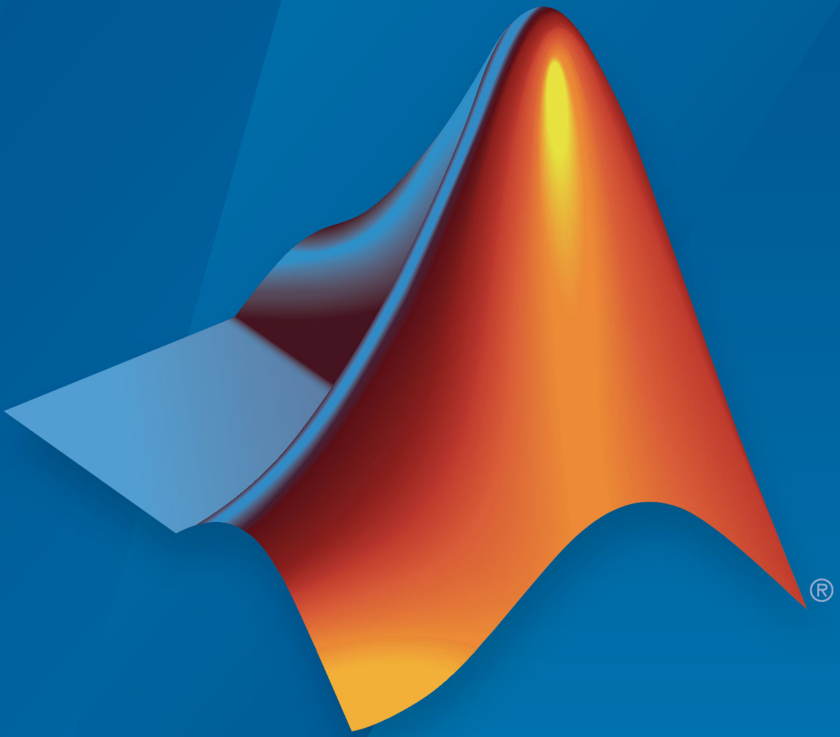
# Polyspace® Bug Finder™

## Reference



MATLAB® & SIMULINK®

R2017b

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*Polyspace® Bug Finder™ Reference*

### Trademarks

### Patents

## Revision History

| | | |
|---|---|---|
| September 2013 | Online only | New for Version 1.0 (Release 2013b) |
| March 2014 | Online only | Revised for Version 1.1 (Release 2014a) |
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| March 2015 | Online only | Revised for Version 1.3 (Release 2015a) |
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| September 2016 | Online only | Revised for Version 2.2 (Release 2016b) |
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| September 2017 | Online Only | Revised for Version 2.4 (Release 2017b) |

# Contents

## 10 Approximations Used During Bug Finder Analysis

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# Option Descriptions

# Source code language (`-lang`)

Specify language of source files

## Description

Specify the language of your source files. Before specifying other configuration options, choose this option because other options change depending on your language selection.

If you add files during project setup, the language selection can change from the default.

| Files Added | Source Code Language |
|---|---|
| Only files with extension `.c` | `C` |
| Only files with extension `.cpp` or `.cc` | `CPP` |
| Files with extension `.c`, `.cpp`, and `.cc` | `C-CPP` |

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node. See "Dependencies" on page 1-3 for ways in which the source code language can be automatically determined.

**Command line**: Use the option `-lang`. See "Command-Line Information" on page 1-4.

## Settings

**Default:** `C-CPP` for hand code and `C` for model-generated code

`C`

If your project contains only C files, choose this setting. This value restricts the verification to C language conventions. All files are interpreted as C files, regardless of their file extension.

CPP

If your project contains only C++ files, choose this setting. This value restricts the verification to C++ language conventions. All files are interpreted as C++ files, regardless of their file extension.

C-CPP

If your project contains C and C++ source files, choose this setting. This value allows for C and C++ language conventions. .c files are interpreted as C files. Other file extensions are interpreted as C++ files.

## Dependencies

- The language option allows and disallows many options and option values. Some options change depending on your language selection. For more information, see the individual analysis option pages.
- If you create a Polyspace project or options file from your build system, the value of this option is determined by:
  - The argument to the -lang option. For more information, see “Create Project Automatically” or “Create Project Automatically at Command Line”.
  - If you do not specify the -lang option, the source code language is determined by whether your source files are compiled as C or C++ files.

| -lang Argument | C or C++ | Source Code Language |
|---|---|---|
| c | | C |
| cpp | | CPP |
| cpp11 | | CPP<br>The option C++11 extensions (-cpp11-extension) is also enabled. |
| auto or no argument | C | C |
| auto or no argument | C++ | CPP |
| auto or no argument | Both | C-CPP |

## Command-Line Information

**Parameter:** `-lang`
**Value:** `c | cpp | c-cpp`
**Default:** `c-cpp`
**Example:** `polyspace-bug-finder-nodesktop -lang c-cpp -sources "file1.c,file2.cpp"`
**Example:** `polyspace-bug-finder-nodesktop -lang c -sources "file1.c,file2.c"`

# Compiler (`-compiler`)

Specify the compiler that you use to build your source code

## Description

Specify the compiler that you use to build your source code.

Polyspace fully supports the most common compilers used to develop embedded applications. See the list below. For these compilers, you can run analysis simply by specifying your compiler and target processor. For other compilers, specify `generic` as compiler name. If you face compilation errors, explicitly define compiler-specific extensions to work around the errors.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option `-compiler`. See “Command-Line Information” on page 1-9.

### Why Use This Option

Polyspace uses this information to interpret syntax that is not part of the C/C++ Standard, but comes from language extensions.

For example, the option allows additional language keywords, such as `sfr`, `sbit`, and `bit`. If you do not specify your compiler, these additional keywords can cause compilation errors during Polyspace analysis.

## Settings

**Default:** `generic`

`generic`

Analysis allows only standard syntax.

For C code, syntax must follow the ANSI® C standard.

For C++ code, syntax must follow ISO®/IEC 14882:2003 C++ (C++ 2003). If you want to allow C++ 11 syntax (ISO/IEC 14882:2011 C++), also select **C++ 11 extensions**.

`gnu3.4`

Analysis allows GCC 3.4 syntax.

`gnu4.6`

Analysis allows GCC 4.6 syntax.

`gnu4.7`

Analysis allows GCC 4.7 syntax.

For more information, see “Limitations” on page 1-8.

`gnu4.8`

Analysis allows GCC 4.8 syntax.

For more information, see “Limitations” on page 1-8.

`gnu4.9`

Analysis allows GCC 4.9 syntax.

For more information, see “Limitations” on page 1-8.

`clang3.5`

Analysis allows Clang 3.5 syntax.

The Clang `__attribute__(vector_size())` is not supported.

`visual9.0`

Analysis allows Microsoft® Visual C++® 2008 syntax.

`visual10.0`

Analysis allows Microsoft Visual C++ 2010 syntax.

This option implicitly enables the option `-no-stl-stubs`.

`visual11.0`

Analysis allows Microsoft Visual C++ 2012 syntax.

This option implicitly enables the option -no-stl-stubs.

visual12.0

Analysis allows Microsoft Visual C++ 2013 syntax.

This option implicitly enables the option -no-stl-stubs.

visual14.0

Analysis allows Microsoft Visual C++ 2015 syntax (supports Microsoft Visual Studio®update 2).

This option implicitly enables the option -no-stl-stubs.

keil

Analysis allows non-ANSI C syntax and semantics associated with the Keilo products from ARM (www.keil.com).

iar

Analysis allows non-ANSI C syntax and semantics associated with the compilers from IAR Systems (www.iar.com).

diab

Analysis allows non-ANSI C syntax and semantics associated with the Wind River® Diab compiler.

If you select diab, the option Target processor type (-target) shows only the targets that are allowed for the Diab compiler. See Diab Compiler (-compiler diab).

tasking

Analysis allows non-ANSI C syntax and semantics associated with the TASKING compiler.

If you select tasking, the option Target processor type (-target) shows only the targets that are allowed for the TASKING compiler. See TASKING Compiler (-compiler tasking).

greenhills

Analysis allows non-ANSI C syntax and semantics associated with a Green Hills® compiler.

If you select greenhills, the option Target processor type (-target) shows only the targets that are allowed for a Green Hills compiler. See Green Hills Compiler (-compiler greenhills).

## Tips

- If you use a Visual Studio compiler, you must use a Target processor type (-target) option that sets long long to 64 bits. Compatible targets include: i386, sparc, m68k, powerpc, tms320c3x, sharc21x61, mpc5xx, x86_64, or mcpu with long long set to 64 (-long-long-is-64bits at the command line).
- If you enable Check JSF C++ rules (-jsf-coding-rules), select the compiler generic. If you use another compiler, Polyspace cannot check the JSF® coding rules that require conforming to the ISO standard. For example, AV Rule 8: “All code shall conform to ISO/IEC 14882:2002(E) standard C++.”

## Limitations

Polyspace does not support certain features of these compilers:

- GNU® compilers (version 4.7 or later):
  - Nested functions.

    For instance, the function bar is nested in function foo:

    ```
    void foo (int a, int b)
    {
      void bar (int c) { return c * c; }

      return bar (a) + bar (b);
    }
    ```
  - Forward declaration of function parameters.

    For instance, the parameter len is forward declared:

    ```
    void func (int len; char data[len][len], int len)
    {
      /* … */
    }
    ```

  - Complex integer data types.

    However, complex floating point data types are supported.
  - Structures with flexible array members.

    For instance, the structure S has a flexible array member tab.

    ```
    struct S {
        int x;
        int tab[];           /* flexible array member - not supported */
    };
    ```
- Visual Studio compilers:
  - C++ Accelerated Massive Parallelism (AMP).

    C++ AMP is a Visual Studio feature that accelerates your C++ code execution for certain types of data-parallel hardware on specific targets. You typically use the restrict keyword to enable this feature.

    ```
    void Buffer() restrict(amp)
    {
      ...
    }
    ```
  - __assume statements.

    You typically use __assume with a condition that is false. The statement indicates that the optimizer must assume the condition to be henceforth true. Code Prover cannot reconcile this contradiction. You get the error:

    ```
    Asked for compulsory presence of absent entity : assert
    ```
  - Managed Extensions for C++ (required for the .NET Framework)
  - __declspec keyword with attributes other than noreturn, nothrow, selectany or thread.

## Command-Line Information

**Parameter:** -compiler
**Value:** generic | gnu3.4 | gnu4.6 | gnu4.7 | gnu4.8 | gnu4.9 | clang3.5 | visual9.0 | visual10.0 | visual11.0 | visual12.0 | visual14.0 | keil | iar | diab | tasking

**Default:** `generic`

**Example:** `polyspace-bug-finder-nodesktop -lang c -sources` `"*file1.c,file2.c*" -OS-target Linux -compiler gnu4.6`

**Example:** `polyspace-bug-finder-nodesktop -lang cpp -sources` `"*file1.cpp,file2.cpp*" -OS-target Visual -compiler visual7.1`

## See Also

`Target processor type (-target)` | `C++11 extensions (-cpp11-extension)` | `Block char16/32_t types (-no-uliterals)`

### Topics

"Analyze Keil or IAR Compiled Code"
"Supported C++ 2011 Extensions"
"Troubleshooting in Polyspace Bug Finder"

# Target processor type (-target)

Specify size of data types and endianness by using predefined target processor list

## Description

Specify the processor on which you deploy your code.

The target processor determines the sizes of fundamental data types and the endianness of the target machine. You can analyze code intended for an unlisted processor type by using one of the other processor types, if they share common data properties.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node. To see the sizes of types, click the **Edit** button to the right of the **Target processor type** drop-down list.

If you select `diab`, `tasking` or `greenhills` for `Compiler (-compiler)`, in the user interface, you see only the processors allowed for that compiler. To find the data type sizes for each processor, see `Diab Compiler (-compiler diab)`. Unlike the processors for other compilers, you cannot see the data type sizes in the user interface.

**Command line**: Use the option `-target`. See “Command-Line Information” on page 1-14.

### Why Use This Option

You specify a target processor so that some of the Polyspace run-time checks are tailored to the data type sizes and other properties of that processor.

For instance, a variable can overflow for smaller values on a 32-bit processor such as i386 compared to a 64-bit processor such as x86_64. If you select x86_64 for your Polyspace analysis, but deploy your code to the i386 processor, your Polyspace results are not always applicable.

Once you select a target processor, you can specify if the default sign of char is signed or unsigned. To determine which signedness to specify, compile this code using the compiler settings that you typically use:

```
#include <limits.h>
int array[(char)UCHAR_MAX]; /* If char is signed, the array size is -1
```

If the code compiles, the default sign of char is unsigned. For instance, on a GCC compiler, the code compiles with the `-fsigned-char` flag and fails to compile with the `-funsigned-char` flag.

## Settings

**Default:** `i386`

This table shows the size of each fundamental data type that Polyspace considers. For some targets, you can modify the default size by clicking the **Edit** button to the right of the **Target processor type** drop-down list. The optional values for those targets are shown in [brackets] in the table.

| Target | char | short | int | long | long long | float | double | long double[a] | ptr | Default sign of char | endian | Alignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| `i386` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 96 | 32 | signed | Little | 32 |
| `sparc` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 128 | 32 | signed | Big | 64 |
| `m68k`[b] | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 96 | 32 | signed | Big | 64 |
| `powerpc` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 128 | 32 | unsigned | Big | 64 |
| `c-167` | 8 | 16 | 16 | 32 | 32 | 32 | 64 | 64 | 16 | signed | Little | 64 |
| `tms320c3x` | 32 | 32 | 32 | 32 | 64 | 32 | 32 | 64 | 32 | signed | Little | 32 |
| `sharc21x61` | 32 | 32 | 32 | 32 | 64 | 32 | 32 [64] | 32 [64] | 32 | signed | Little | 32 |
| `necv850` | 8 | 16 | 32 | 32 | 32 | 32 | 32 | 64 | 32 | signed | Little | 32 [16, 8] |
| `hc08`[c] | 8 | 16 | 16 [32] | 32 | 32 | 32 | 32 [64] | 32 [64] | 16[d] | unsigned | Big | 32 [16] |

| Target | char | short | int | long | long long | float | double | long double[a] | ptr | Default sign of char | endian | Alignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| `hc12` | 8 | 16 | 16 [32] | 32 | 32 | 32 | 32 [64] | 32 [64] | 32[6] | signed | Big | 32 [16] |
| `mpc5xx` | 8 | 16 | 32 | 32 | 64 | 32 | 32 [64] | 32 [64] | 32 | signed | Big | 32 [16] |
| `c18` | 8 | 16 | 16 | 32 [24][e] | 32 | 32 | 32 | 32 | 16 [24] | signed | Little | 8 |
| `x86_64` | 8 | 16 | 32 | 64 [32][f] | 64 | 32 | 64 | 128 | 64 | signed | Little | 64 [32] |
| `mcpu... (Advanced)`[g] | 8 [16] | 8 [16] | 16 [32] | 32 | 32 [64] | 32 | 32 [64] | 32 [64] | 16 [32] | signed | Little | 32 [16, 8] |
| Targets for Diab compiler | See `Diab Compiler (-compiler diab).` | | | | | | | | | | | |
| Targets for TASKING compiler | See `TASKING Compiler (-compiler tasking).` | | | | | | | | | | | |
| Targets for Green Hills Compiler | See `Green Hills Compiler (-compiler greenhills).` | | | | | | | | | | | |

a. For targets where the size of `long double` is greater than 64 bits, the size used for computations is not always the same as the size listed in this table. The exceptions are:

- For targets `i386`, `x86_64` and `m68k`, 80 bits are used for computations, following the practice in common compilers.
- For the target `tms320c3x`, 40 bits are used for computation, following the TMS320C3x specifications.
- If you use a Visual compiler, the size of `long double` used for computations is the same as size of `double`, following the specification of Visual C++ compilers.

b. The M68k family (68000, 68020, and so on) includes the “ColdFire” processor

c. Non-ANSI C specified keywords and compiler implementation-dependent pragmas and interrupt facilities are not taken into account by this support

d. All kinds of pointers (near or far pointer) have 2 bytes (hc08) or 4 bytes (hc12) of width physically.

e. The `c18` target supports the type `short long` as 24 bits in size.

f. Use option `-long-is-32bits` to support Microsoft C/C++ Win64 target.

g. `mcpu` is a reconfigurable Micro Controller/Processor Unit target. You can use this type to configure one or more generic targets. For more information, see `Generic target options`.

## Tips

If your processor is not listed, use a similar processor that shares the same characteristics, or create an `mcpu` generic target processor. If your target processor does not match the characteristics of a predefined processor, contact MathWorks® technical support.

## Command-Line Information

**Parameter:** `-target`
**Value:** `i386 | sparc | m68k | powerpc | c-167 | x86_64 | tms320c3x | sharc21x61 | necv850 | hc08 | hc12 | mpc5xx | c18 | mcpu`
**Default:** `i386`
**Example:** `polyspace-bug-finder-nodesktop -target m68k`

You can override the default values for some targets by using specific command-line options. See the section **Command-Line Options** in `Generic target options`.

## See Also

### Polyspace Results

`Lower Estimate of Local Variable Size` | `Higher Estimate of Local Variable Size`

### Topics

"Specify Analysis Options"
"Modify Predefined Target Processor Attributes"
"Specify Generic Target Processors"

# Diab Compiler (-compiler diab)

Specify the Wind River Diab compiler

## Description

Specify diab for Compiler (-compiler) if you compile your code using the Wind River Diab compiler. By specifying your compiler, you can avoid compilation errors from syntax that is not part of the Standard but comes from language extensions.

Then, specify your target processor type. If you select diab for **Compiler**, in the user interface, you see only the processors allowed for the Diab compiler. Your choice of target processor determines the size of fundamental data types, the endianness of the target machine and certain keyword definitions.

If you specify the diab compiler, you must specify the path to your compiler header files.

- In the user interface, add the folder containing your compiler headers to the project.

  For more information, see “Update Project”.
- At the command line, use the flag -I with the polyspace-bug-finder-nodesktop command.

  For more information, see -I.

The software supports version 5.9.6 and older versions of the Diab compiler.

## Settings

The targets use the following default sizes in bits for the fundamental types. Unlike targets for other compilers, you do not see these sizes in the user interface.

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| i386 | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 96 | 32 | signed | Little | 32 |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| `powerpc` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | unsigned | Big | 64 |
| `powerpc64` | 8 | 16 | 32 | 64 | 64 | 32 | 64 | 64 | 64 | unsigned | Big | 64 |
| `arm` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | unsigned | Big | 64 |
| `coldfire` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Big | 64 |
| `mips` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Big | 64 |
| `mcore` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | unsigned | Big | 64 |
| `rh850` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Little | 32 |
| `superh` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Big | 64 |
| `tricore` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Little | 64 |
| `68k`, `sparc` | Not supported. | | | | | | | | | | | |

In addition, `wchar_t` is interpreted as `unsigned short` and `size_t` is interpreted as `unsigned int`.

If you use Diab compiler flags to change any of these default specifications and want to emulate these flags, contact Technical Support.

## Tips

If you encounter errors during Polyspace analysis, see “Errors Related to Diab Compiler”.

## Command-Line Information

**Parameter:** `-compiler diab -target`
**Value:** `i386 | powerpc | arm | coldfire | mips | mcore | rh850 | superh | tricore`
**Default:** `powerpc`

**Example:** `polyspace-bug-finder-nodesktop -compiler diab -target tricore`

## See Also

`Target processor type (-target)` | `Target processor type (-target)`

### Topics

"Specify Analysis Options"

Introduced in R2016b

# TASKING Compiler (`-compiler tasking`)

Specify the Altium TASKING compiler

## Description

Specify `tasking` for `Compiler (-compiler)` if you compile your code using the Altium® TASKING compiler. By specifying your compiler, you can avoid compilation errors from syntax that is not part of the Standard but comes from language extensions.

Then, specify your target processor type. If you select `tasking` for **Compiler**, in the user interface, you see only the processors allowed for the TASKING compiler. Your choice of target processor determines the size of fundamental data types, the endianness of the target machine and certain keyword definitions.

If you specify the `tasking` compiler, you must specify the path to your compiler header files.

- In the user interface, add the folder containing your compiler headers to the project.

  For more information, see “Update Project”.
- At the command line, use the flag `-I` with the `polyspace-bug-finder-nodesktop` command.

  For more information, see `-I`.

The software supports different versions of the TASKING compiler, depending on the target:

- TriCore: 6.0 and older versions
- C166: 4.0 and older versions
- ARM: 5.2 and older versions
- RH850: 2.2 and older versions

## Settings

The targets use the following default sizes in bits for the fundamental types. Unlike targets for other compilers, you do not see these sizes in the user interface.

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tricore | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Little | 32 |
| c166 | 8 | 16 | 16 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Little | 16 |
| rh850 | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Little | 64 |
| arm | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Big | 64 |

In addition, `wchar_t` is interpreted as `unsigned short` and `size_t` is interpreted as `unsigned int`.

If you use TASKING compiler flags to change any of these default specifications and want to emulate these flags, contact Technical Support.

## Tips

- Polyspace does not support some constructs specific to the TASKING compiler.

  For the list of unsupported constructs, see `codeprover_limitations.pdf` in *`matlabroot`*`\polyspace\verifier\code_prover`. Here, *`matlabroot`* is the MATLAB® installation folder, for instance, `C:\Program Files\MATLAB\R2017b`.
- The CPU used is TC1793. If you use a different CPU, set the following analysis options in your project:
  - `Disabled preprocessor definitions (-U)`: Undefine the macro `__CPU_TC1793B__`.
  - `Preprocessor definitions (-D)`: Define the macro `__CPU__`. Enter `__CPU__=`*`xxx`*, where *`xxx`* is the name of your CPU.

    Additionally, define the equivalent of the macro `__CPU_TC1793B__` for your CPU. For instance, enter `__CPU_TC1793A__`.

Instead of manually specifying your compiler, if you trace your build command (makefile), Polyspace can detect your CPU and add the required definitions in your project. For more information, see:

  - “Create Project Automatically”
  - “Create Project Automatically at Command Line”
- For some errors related to TASKING compiler-specific constructs, see solutions in “Errors Related to TASKING Compiler”.

## Command-Line Information

**Parameter:** `-compiler tasking -target`
**Value:** `tricore | c166 | rh850 | arm`
**Default:** `tricore`
**Example:** `polyspace-bug-finder-nodesktop -compiler tasking -target tricore`

## See Also

`Target processor type (-target)` | `Target processor type (-target)`

### Topics

“Specify Analysis Options”

Introduced in R2017a

# Green Hills Compiler (`-compiler greenhills`)

Specify Green Hills compiler

## Description

Specify `greenhills` for `Compiler (-compiler)` if you compile your code using a Green Hills compiler. By specifying your compiler, you can avoid compilation errors from syntax that is not part of the Standard but comes from language extensions.

Then, specify your target processor type. If you select `greenhills` for **Compiler**, in the user interface, you see only the processors allowed for aGreen Hills compiler. Your choice of target processor determines the size of fundamental data types, the endianness of the target machine and certain keyword definitions.

If you specify the `greenhills` compiler, you must specify the path to your compiler header files.

- In the user interface, add the folder containing your compiler headers to the project.

  For more information, see “Update Project”.
- At the command line, use the flag `-I` with the `polyspace-bug-finder-nodesktop` command.

  For more information, see `-I`.

## Settings

The targets use the following default sizes in bits for the fundamental types. Unlike targets for other compilers, you do not see these sizes in the user interface.

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| powerpc | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | unsigned | Big | 64 | unsigned int | signed long |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| powerpc64 | 8 | 16 | 32 | 64 | 64 | 32 | 64 | 64 | 64 | unsigned | Big | 64 | unsigned long | signed int |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| `arm` | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | unsigned | Little | 32 | unsigned int | unsigned short |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| arm64 | 8 | 16 | 32 | 64 | 64 | 32 | 64 | 64 | 64 | unsigned | Little | 64 | unsigned long | signed int |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| tricore | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Little | 32 | unsigned int | signed long |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rh850 | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 64 | 32 | signed | Little | 64 | unsigned int | signed long |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| i386 | 8 | 16 | 32 | 32 | 64 | 32 | 64 | 96 | 32 | signed | Little | 32 | unsigned int | signed long |

| Target | char | short | int | long | long long | float | double | long double | ptr | Default sign of char | Endianness | Alignment | Definition of size_t | Definition of wchar_t |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| x86_64 | 8 | 16 | 32 | 64 | 64 | 32 | 64 | 128 | 64 | signed | Little | 128 | unsigned long | signed int |

If you use the Green Hills compiler flags to change any of these default specifications and want to emulate these flags, contact Technical Support.

## Tips

- Polyspace supports the embedded configuration for the i386 target. If your x86 Green Hills compiler is configured for native Windows® development, you can see compilation errors or incorrect analysis results with Code Prover. Contact Technical Support.

  For instance, Green Hills compilers consider a size of 12 bytes for `long double` for embedded targets, but 8 bytes for native Windows. Polyspace considers 12 bytes by default.
- If you create a Polyspace project from a build command that uses a Green Hills compiler, the compiler options `-filetype` and `-os_dir` are not implemented in the project. To emulate the `-os_dir` option, you can explicitly add the path argument of the option as an include folder to your Polyspace project.

## Command-Line Information

**Parameter:** `-compiler greenhills -target`
**Value:** `powerpc | powerpc64 | arm | arm64 | tricore | rh850 | arm | i386 | x86_64`
**Default:** `powerpc`
**Example:** `polyspace-bug-finder-nodesktop -compiler greenhills -target arm`

## See Also

`Target processor type (-target)` | `Target processor type (-target)`

### Topics

"Specify Analysis Options"

**Introduced in R2017b**

# Generic target options

Specify size of data types and endianness by creating your own target processor

## Description

The **Generic target options** dialog box opens when you set the **Target processor type** to `mcpu`.

Allows the specification of a generic “Micro Controller/Processor Unit" target. Use the dialog box to specify the name of a new `mcpu` target, for example *`MyTarget`*. That new target is added to the **Target processor type** option list.

Changing the genetic target has consequences for:

- Detection of overflow
- Computation of `sizeof` objects

The **Target processor type** option is available on the **Target & Compiler** node in the **Configuration** pane.

## Settings

**Default characteristics of a new target:** listed as *type* `[size]`

- *char* `[8]`
- *short* `[16]`
- *int* `[16]`
- *long* `[32]`
- *long long* `[32]`
- *float* `[32]`
- *double* `[32]`
- *long double* `[32]`

- *pointer* [16]
- *char* is signed
- *endianness* is little-endian

## Dependency

A custom target can only be created when `Target processor type (-target)` is set to `mcpu`.

A custom target is not available when `Compiler (-compiler)` is set to one of the `visual*` options.

## Command-Line Options

When using the command line, specify your target with the other target specification options.

| Option | Description | Available With | Example |
|---|---|---|---|
| `-little-endian` | Little-endian architectures are Less Significant byte First (LSF). For example: i386.<br>Specifies that the less significant byte of a short integer (e.g. 0x00FF) is stored at the first byte (0xFF) and the most significant byte (0x00) at the second byte. | `mcpu` | `polyspace-bug-finder-nodesktop -target mcpu -little-endian` |

| Option | Description | Available With | Example |
|---|---|---|---|
| -big-endian | Big-endian architectures are Most Significant byte First (MSF). For example: SPARC, m68k.<br>Specifies that the most significant byte of a short integer (e.g. 0x00FF) is stored at the first byte (0x00) and the less significant byte (0xFF) at the second byte. | mcpu | polyspace-bug-finder-nodesktop -target mcpu -big-endian |
| -default-sign-of-char [signed \| unsigned] | Specify default sign of char.<br>signed: Specifies that char is signed, overriding target's default.<br>unsigned: Specifies that char is unsigned, overriding target's default. | All targets | polyspace-bug-finder-nodesktop -default-sign-of-char unsigned -target mcpu |
| -char-is-16bits | char defined as 16 bits and all objects have a minimum alignment of 16 bits<br>Incompatible with –short-is-8bits and -align 8 | mcpu | polyspace-bug-finder-nodesktop -target mcpu -char-is-16bits |

| Option | Description | Available With | Example |
|---|---|---|---|
| `-short-is-8bits` | Define `short` as 8 bits, regardless of sign | `mcpu` | `polyspace-bug-finder-nodesktop -target mcpu -short-is-8bits` |
| `-int-is-32bits` | Define `int` as 32 bits, regardless of sign. Alignment is also set to 32 bits. | `mcpu`, `hc08`, `hc12`, `mpc5xx` | `polyspace-bug-finder-nodesktop -target mcpu -int-is-32bits` |
| `-long-is-32bits` | Define `long` as 32 bits, regardless of sign. Alignment is also set to 32 bits.<br>If your project sets `int` to 64 bits, you cannot use this option. | All targets | `polyspace-bug-finder-nodesktop -target mcpu -long-is-32bits` |
| `-long-long-is-64bits` | Define `long long` as 64 bits, regardless of sign. Alignment is also set to 64 bits. | `mcpu` | `polyspace-bug-finder-nodesktop -target mcpu -long-long-is-64bits` |
| `-double-is-64bits` | Define `double` and `long double` as 64 bits, regardless of sign. | `mcpu`, `sharc21x61`, `hc08`, `hc12`, `mpc5xx` | `polyspace-bug-finder-nodesktop -target mcpu -double-is-64bits` |
| `-pointer-is-24bits` | Define pointer as 24 bits, regardless of sign. | `c18` | `polyspace-bug-finder-nodesktop -target c18 -pointer-is-24bits` |
| `-pointer-is-32bits` | Define pointer as 32 bits, regardless of sign. | `mcpu` | `polyspace-bug-finder-nodesktop -target mcpu -pointer-is-32bits` |

| Option | Description | Available With | Example |
|---|---|---|---|
| `-align [32\|16\|8]` | Specifies the largest alignment of struct or array objects to the 32, 16 or 8 bit boundaries.<br>Consequently, the array or struct storage is strictly determined by the size of the individual data objects without member and end padding. | `mcpu`,<br>Only 16 or 32 bits for: `hc08`, `hc12`, `mpc5xx` | `polyspace-bug-finder-nodesktop -target mcpu -align 16` |

## Common Generic Targets

The following tables describe the characteristics of common generic targets.

### ST7 (Hiware C compiler : HiCross for ST7)

| ST7 | char | short | int | long | long long | float | double | long double | ptr | char is | endian |
|---|---|---|---|---|---|---|---|---|---|---|---|
| size | 8 | 16 | 16 | 32 | 32 | 32 | 32 | 32 | 16/32 | unsigned | Big |
| alignment | 8 | 16/8 | 16/8 | 32/16/8 | 32/16/8 | 32/16/8 | 32/16/8 | 32/16/8 | 32/16/8 | N/A | N/A |

### ST9 (GNU C compiler : gcc9 for ST9)

| ST9 | char | short | int | long | long long | float | double | long double | ptr | char is | endian |
|---|---|---|---|---|---|---|---|---|---|---|---|
| size | 8 | 16 | 16 | 32 | 32 | 32 | 64 | 64 | 16/64 | unsigned | Big |
| alignment | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | N/A | N/A |

### Hitachi H8/300, H8/300L

| Hitachi H8/300, H8/300L | char | short | int | long | long long | float | double | long double | ptr | char is | endian |
|---|---|---|---|---|---|---|---|---|---|---|---|
| size | 8 | 16 | 16/32 | 32 | 64 | 32 | 654 | 64 | 16 | unsigned | Big |
| alignment | 8 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | N/A | N/A |

### Hitachi H8/300H, H8S, H8C, H8/Tiny

| Hitachi H8/300H, H8S, H8C, H8/Tiny | char | short | int | long | long long | float | double | long double | ptr | char is | endian |
|---|---|---|---|---|---|---|---|---|---|---|---|
| size | 8 | 16 | 16/32 | 32 | 64 | 32 | 64 | 64 | 32 | unsigned | Big |
| alignment | 8 | 16 | 32/16 | 32/16 | 32/16 | 32/16 | 32/16 | 32/16 | 32/16 | N/A | N/A |

## See Also

`Target processor type (-target)`

## Topics

"Specify Generic Target Processors"
"Common Generic Targets"

# Respect C90 standard (`-no-language-extensions`)

Restrict analysis to C language specified in ANSI C standard

## Description

Restrict the analysis to the C language specified in the ANSI C standard (ISO/IEC 9899:1990). Language extensions added in later standards such as C99 generate compilation errors.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node. See “Dependencies” on page 1-38 for other options you must also enable.

**Command line**: Use the option `-no-language-extensions`. See “Command-Line Information” on page 1-38.

### Why Use This Option

Use this option if you compile your code by using the C90 standard.

For instance, if you compile with the GCC option `-ansi` or `-std=c90`, use this option.

## Settings

☑ On

Restrict the analysis to the C90 standard. Code must conform to the ANSI C standard (ISO/IEC 9899:1990).

□ Off (default)

Allow language extensions from the C99 standard (ISO/IEC 9899:1999).

## Dependencies

This option is available only when `Source code language (-lang)` is set to `C` or `C-CPP`.

If you enable this option, you cannot use `Compiler (-compiler)` settings `keil` and `iar`.

## Command-Line Information

**Parameter:** `-no-language-extensions`
**Default:** off
**Example:** `polyspace-bug-finder-nodesktop -lang c -no-language-extensions`

Introduced in R2015b

# Sfr type support (`-sfr-types`)

Specify sizes of `sfr` types for code developed with Keil or IAR compilers

## Description

Specify sizes of `sfr` types (types that define special function registers).

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node. See “Dependency” on page 1-39 for other options you must also enable.

**Command line**: Use the option `-sfr-types`. See “Command-Line Information” on page 1-40.

### Why Use This Option

Use this option if you have statements such as `sfr addr = 0x80;` in your code. `sfr` types are not standard C types. Therefore, you must specify their sizes explicitly for the Polyspace analysis.

## Settings

**No Default**

List each sfr name and its size in bits.

## Dependency

This option is available only when `Compiler (-compiler)` is set to `keil` or `iar`.

## Command-Line Information

**Syntax:** `-sfr-types` *`sfr_name=size_in_bits`*`,...`
**No Default**
**Name Value:** an sfr name such as `sfr16`.
**Size Value:** `8 | 16 | 32`
**Example:**

```
polyspace-bug-finder-nodesktop -lang c -compiler iar -sfr-types sfr=8,sfr16=16 ...
```

## See Also

### Topics

"Specify Target Environment and Compiler Behavior" (Polyspace Code Prover)
"Supported Keil or IAR Language Extensions" (Polyspace Code Prover)

# Division round down (`-div-round-down`)

Round down quotients from division or modulus of negative numbers instead of rounding up

## Description

Specify whether quotients from division and modulus of negative numbers are rounded up or down.

**Note** `a = (a / b) * b + a % b` is always true.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option `-div-round-down`. See “Command-Line Information” on page 1-42.

### Why Use This Option

Use this option to emulate your compiler.

The option is relevant only for compilers following C90 standard (ISO/IEC 9899:1990). The standard stipulates that "*if either operand of / or % is negative, whether the result of the / operator, is the largest integer less or equal than the algebraic quotient or the smallest integer greater or equal than the quotient, is implementation defined, same for the sign of the % operator*". The standard allows compilers to choose their own implementation.

For compilers following the C99 standard ((ISO/IEC 9899:1999), this option is not required. The standard enforces division with rounding towards zero (section 6.5.5).

## Settings

☑ On

If either operand / or % is negative, the result of the / operator is the largest integer less than or equal to the algebraic quotient. The result of the % operator is deduced from `a % b = a - (a / b) * b`.

*Example*: `assert(-5/3 == -2 && -5%3 == 1);` is true.

□ Off (default)

If either operand of / or % is negative, the result of the / operator is the smallest integer greater than or equal to the algebraic quotient. The result of the % operator is deduced from `a % b = a - (a / b) * b`.

This behavior is also known as rounding towards zero.

*Example*: `assert(-5/3 == -1 && -5%3 == -2);` is true.

## Command-Line Information

**Parameter:** `-div-round-down`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -div-round-down`

# Enum type definition (-enum-type-definition)

Specify how to represent an enum with a base type

## Description

Allow the analysis to use different base types to represent an enumerated type, depending on the enumerator values and the selected definition. When using this option, each enum type is represented by the smallest integral type that can hold its enumeration values.

This option is available on the **Target & Compiler** node in the **Configuration** pane.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option -enum-type-definition. See “Command-Line Information” on page 1-45.

### Why Use This Option

Your compiler represents enum variables as constants of a base integer type. Use this option so that you can emulate your compiler.

To check your compiler settings, compile this code using the compiler settings that you typically use:

```
#include <assert.h>
#include <limits.h>

enum { MAXSIGNEDBYTE=127 } mysmallenum_t;
int dummy[(int)sizeof(mysmallenum_t) - (int)sizeof(int)]; /* Breakpoint 1 */

enum { MYMAXINT = INT_MAX } myintenum_t;
int main(void) {
    assert((MYMAXINT + 1) < 0);  /* Breakpoint 2 */
    assert((MYMAXINT + 1) >= 0); /* Breakpoint 3 */
    assert(0);  /* Breakpoint 4 */

    return 0;
}
```

If compilation does not fail even at breakpoint 4, your `assert` statements do not behave as expected. Check your compiler documentation and change your compiler settings. If compilation fails at:

- Breakpoint 1: Use `defined-by-compiler` for this option.
- Breakpoint 2: Use `auto-signed-first` for this option.
- Breakpoint 3: Use `auto-unsigned-first` for this option.

## Settings

**Default:** `defined-by-compiler`

`defined-by-compiler`

Uses the signed integer type for all compilers except gnu.

For the gnu compilers, it uses the first type that can hold all of the enumerator values from this list: `signed int`, `unsigned int`, `signed long`, `unsigned long`, `signed long long`, and `unsigned long long`.

`auto-signed-first`

Uses the first type that can hold all of the enumerator values from this list: `signed char`, `unsigned char`, `signed short`, `unsigned short`, `signed int`, `unsigned int`, `signed long`, `unsigned long`, `signed long long`, and `unsigned long long`.

`auto-unsigned-first`

Uses the first type that can hold all of the enumerator values from these lists:

- If enumerator values are positive: `unsigned char`, `unsigned short`, `unsigned int`, `unsigned long`, and `unsigned long long`.
- If one or more enumerator values are negative: `signed char`, `signed short`, `signed isnt`, `signed long`, and `signed long long`.

## Command-Line Information

**Parameter:** `-enum-type-definition`
**Value:** `defined-by-compiler | auto-signed-first | auto-unsigned-first`
**Default:** `defined-by-compiler`
**Example:** `polyspace-bug-finder-nodesktop -enum-type-definition auto-signed-first`

# Signed right shift (`-logical-signed-right-shift`)

Specify how to treat the sign bit for logical right shifts on signed variables

## Description

Choose between arithmetic and logical shift for right shift operations on negative values.

This option does not modify compile-time expressions. For more details, see “Limitation” on page 1-47.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option `-logical-signed-right-shift`. See “Command-Line Information” on page 1-47.

### Why Use This Option

The C99 Standard (sec 6.5.7) states that for a right-shift operation `x1>>x2`, if `x1` is signed and has negative values, the behavior is implementation-defined. Different compilers choose between arithmetic and logical shift. Use this option to emulate your compiler.

## Settings

**Default:** `Arithmetical`

`Arithmetical`

The sign bit remains:

```
(-4) >> 1 = -2
(-7) >> 1 = -4
  7  >> 1 = 3
```

`Logical`

0 replaces the sign bit:

```
(-4) >> 1 = (-4U) >> 1 = 2147483646
(-7) >> 1 = (-7U) >> 1 = 2147483644
  7  >> 1 = 3
```

## Limitation

In compile-time expressions, this Polyspace option does not change the standard behavior for right shifts.

For example, consider this right shift expression:

```
int arr[ ((-4) >> 20) ];
```

The compiler computes array sizes, so the expression `(-4) >> 20` is evaluated at compilation time. Logically, this expression is equivalent to 4095. However, arithmetically, the result is -1. This statement causes a compilation error (arrays cannot have negative size) because the standard right-shift behavior for signed integers is arithmetic.

## Command-Line Information

When using the command line, arithmetic is the default computation mode. When this option is set, logical computation is performed.
**Parameter:** `-logical-signed-right-shift`
**Default:** Arithmetic signed right shifts
**Example:** `polyspace-bug-finder-nodesktop -logical-signed-right-shift`

# C++11 extensions (-cpp11-extension)

Allow C++11 language extensions

## Description

Allow C++11 language extensions.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node. See “Dependencies” on page 1-49 for other options you must also enable.

**Command line**: Use the option -cpp11-extension. See “Command-Line Information” on page 1-49.

### Why Use This Option

If your compiler allows C++11 language extensions, enable this option.

To check if your compiler allows the extensions, compile this code using the compiler settings that you typically use:

```
#if defined(__cplusplus) && __cplusplus >= 201103L
    /* C++11 compiler */
#else
    void* ptr = nullptr;
#endif
```

If the code compiles, enable this option.

For instance, on a GCC compiler, the code compiles with the -std=c++11 flag but fails to compile without the flag. If you typically use the flag, enable this option.

## Settings

☑ On

The analysis allows C++11 syntax.

□ Off (default)

The analysis does not allow C++11 syntax.

## Dependencies

This analysis option is available only when both these conditions are true:

- `Source code language (-lang)` is `CPP` or `C-CPP`.
- `Compiler (-compiler)` is `generic`, `gnu4.6`, or `gnu4.7`.

## Command-Line Information

**Parameter:** `-cpp11-extension`
**Default:** off
**Example:** `polyspace-bug-finder-nodesktop -lang cpp -cpp11-extension`

## See Also

`Compiler (-compiler)` | `Block char16/32_t types (-no-uliterals)`

### Topics

"Supported C++ 2011 Extensions"

# Block char16/32_t types (-no-uliterals)

Disable Polyspace definitions for char16_t or char32_t

## Description

Specify that the analysis must not define char16_t or char32_t types.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node. See “Dependencies” on page 1-51 for other options you must also enable.

**Command line**: Use the option -no-uliterals. See “Command-Line Information” on page 1-51.

### Why Use This Option

If your compiler defines char16_t and/or char32_t through a typedef statement or by using includes, use this option to turn off the standard Polyspace definition of char16_t and char32_t.

To check if your compiler defines these types, compile this code using the compiler settings that you typically use:

```
typedef unsigned short char16_t;
typedef unsigned long char32_t;
```

If the file compiles, it means that your compiler has already defined char16_t and char32_t. Enable this Polyspace option.

## Settings

☑ On

The analysis does not allow char16_t and char32_t types.

□ Off (default)

The analysis allows `char16_t` and `char32_t` types.

## Dependencies

You can select this option only when these conditions are true:

- `Source code language (-lang)` is `CPP` or `C-CPP`.
- `Compiler (-compiler)` is either `generic` or a `gnu` version.

## Command-Line Information

**Parameter:** `-no-uliterals`
*Default:* off
**Example:**
```
polyspace-bug-finder-nodesktop -lang cpp -compiler gnu4.7 -cpp11-extension -no-uliterals
```

## See Also

`Compiler (-compiler)` | `C++11 extensions (-cpp11-extension)`

### Topics

"Supported C++ 2011 Extensions"

# Pack alignment value (`-pack-alignment-value`)

Specify default structure packing alignment for code developed in Visual C++

## Description

Specify the default packing alignment (in bytes) for structures, unions, and class members.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option `-pack-alignment-value`. See “Command-Line Information” on page 1-53.

### Why Use This Option

If you use compiler options to specify how members of a structure are packed into memory, use this option to emulate your compiler.

For instance, if you use the Visual Studio option /Zp to specify an alignment, use this option for your Polyspace analysis.

If you use `#pragma pack` directives in your code to specify alignment, and also specify this option for analysis, the `#pragma pack` directives take precedence. See “#pragma Directives” (Polyspace Code Prover).

## Settings

**Default**: 8

You can enter one of these values:

- 1
- 2
- 4
- 8
- 16

## Command-Line Information

**Parameter:** `-pack-alignment-value`
**Value:** `1 | 2 | 4 | 8 | 16`
**Default:** `8`
**Example:** `polyspace-bug-finder-nodesktop -compiler visual10 -pack-alignment-value 4`

# Ignore pragma pack directives (`-ignore-pragma-pack`)

Ignore `#pragma pack` directives

## Description

Specify that the analysis must ignore `#pragma pack` directives in the code.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option `-ignore-pragma-pack`. See “Command-Line Information” on page 1-55.

### Why Use This Option

Use this option if `#pragma pack` directives in your code cause linking errors.

For instance, you have two structures with the same name in your code, but one declaration follows a `#pragma pack(2)` statement. Because the default alignment is 8 bytes, the different packing for the two structures causes a linking error. Use this option to avoid such errors. See also “#pragma Directives” (Polyspace Code Prover).

## Settings

☑ On

The analysis ignores the `#pragma` directives.

□ Off (default)

The analysis takes into account specifications in the `#pragma` directives.

## Command-Line Information

**Parameter:** `-ignore-pragma-pack`
**Default**: Off
**Example:** `polyspace-bug-finder-nodesktop -ignore-pragma-pack`

## See Also

# Management of size_t (-size-t-type-is)

Specify the underlying data type of size_t

## Description

Specify the underlying data type of size_t explicitly: unsigned int, unsigned long or unsigned long long. If you do not specify this option, your choice of compiler determines the underlying type.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option -size-t-type-is. See "Command-Line Information" on page 1-57.

### Why Use This Option

The analysis associates a data type with size_t when you specify your compiler. If you use a compiler option that changes this default type, emulate your compiler option by using this analysis option.

If you run into compilation errors during Polyspace analysis and trace the error to the definition of size_t, it is possible that you use a compiler option and change your compiler default. To probe further, compile this code with your compiler using the options that you typically use:

```
/* Header defines malloc as void* malloc (size_t size)
#include <stdio.h>

void* malloc (unsigned int size);
```

If the file does not compile, your compiler options cause size_t to be defined as unsigned long or unsigned long long. Replace unsigned int with unsigned long and try again.

## Settings

**Default:** defined-by-compiler

defined-by-compiler

Your specification for Compiler (-compiler) determines the underlying type of size_t.

unsigned-int

The analysis considers unsigned int as the underlying type of size_t.

unsigned-long

The analysis considers unsigned long as the underlying type of size_t.

unsigned-long-long

The analysis considers unsigned long long as the underlying type of size_t.

## Command-Line Information

**Parameter:** -size-t-type-is
**Value:** defined-by-compiler | unsigned-int | unsigned-long | unsigned-long-long
**Default:** defined-by-compiler
**Example:** polyspace-bug-finder-nodesktop -size-t-type-is unsigned-long

# Management of wchar_t (`-wchar-t-type-is`)

Specify the underlying data type of `wchar_t`

## Description

Specify the underlying data type of `wchar_t` explicitly. If you do not specify this option, your choice of compiler determines the underlying type.

### Set Option

**User interface**: In your project configuration, the option is on the **Target & Compiler** node.

**Command line**: Use the option `-wchar-t-type-is`. See “Command-Line Information” on page 1-59.

### Why Use This Option

The analysis associates a data type with `wchar_t` when you specify your compiler. If you use a compiler option that changes this default type, emulate your compiler option by using this analysis option.

## Settings

**Default:** `defined-by-compiler`

`defined-by-compiler`

Your specification for `Compiler (-compiler)` determines the underlying type of `wchar_t`.

`signed-short`

The analysis considers `signed short` as the underlying type of `wchar_t`.

`unsigned-short`

The analysis considers `unsigned short` as the underlying type of `wchar_t`.

`signed-int`

The analysis considers `signed int` as the underlying type of `wchar_t`.

`unsigned-int`

The analysis considers `unsigned int` as the underlying type of `wchar_t`.

`signed-long`

The analysis considers `signed long` as the underlying type of `wchar_t`.

`unsigned-long`

The analysis considers `unsigned long` as the underlying type of `wchar_t`.

## Command-Line Information

**Parameter:** `-wchar-t-type-is`
**Value:** `defined-by-compiler | signed-short | unsigned-short | signed-int | unsigned-int | signed-long | unsigned-long`
**Default:** `defined-by-compiler`
**Example:** `polyspace-bug-finder-nodesktop -wchar-t-type-is signed-int`

# Ignore link errors (`-no-extern-c`)

Ignore certain linking errors

## Description

Specify that the analysis must ignore certain linking errors.

### Set Option

**User interface**: In your project configuration, the option is on the **Environment Settings** node. See “Dependency” on page 1-61 for other options that you must also enable.

**Command line**: Use the option `-no-extern-C`. See “Command-Line Information” on page 1-61.

### Why Use This Option

Some functions may be declared inside an `extern "C" { }` block in some files and not in others. Then, their linkage is not the same and it causes a link error according to the ANSI standard.

Applying this option will cause Polyspace to ignore this error. This permissive option may not resolve all the extern C linkage errors.

## Settings

☑ On

Ignore linking errors if possible.

□ Off (default)

Stop analysis for linkage errors.

## Dependency

This option is available only if you set `Source code language (-lang)` to `CPP` or `C-CPP`.

## Command-Line Information

**Parameter:** `-no-extern-C`
**Default:** off
**Example:** `polyspace-bug-finder-nodesktop -lang cpp -no-extern-C`

# Preprocessor definitions (-D)

Replace macros in preprocessed code

## Description

Replace macros with their definitions in preprocessed code.

### Set Option

**User interface**: In your project configuration, the option is on the **Macros** node.

**Command line**: Use the option -D. See “Command-Line Information” on page 1-64.

### Why Use This Option

Use this option to emulate your compiler behavior. For instance, if your compiler considers a macro _WIN32 as defined when you build your code, it executes code in a #ifdef _WIN32 statement. If Polyspace does not consider that macro as defined, you must use this option to replace the macro with 1.

Depending on your settings for Compiler (-compiler), some macros are defined by default. Use this option to define macros that are not implicitly defined.

Typically, you recognize from compilation errors that a certain macro is not defined. For instance, the following code does not compile if the macro _WIN32 is not defined.

```
#ifdef _WIN32
  int env_var;
#endif

void set() {
  env_var=1;
}
```

The error message states that env_var is undefined. However, the definition of env_var is in the #ifdef _WIN32 statement. The underlying cause for the error is that the macro _WIN32 is not defined. You must define _WIN32.

## Settings

**No Default**

Using the ✚ button, add a row for the macro you want to define. The definition must be in the format *`Macro`*=*`Value`*. If you want Polyspace to ignore the macro, leave the *`Value`* blank.

For example:

- `name1=name2` replaces all instances of `name1` by `name2`.
- `name=` instructs the software to ignore `name`.
- `name` with no equals sign or value replaces all instances of `name` by 1. To define a macro to execute code in a `#ifdef` *`macro_name`* statement, use this syntax.

## Tips

- IfPolyspace does not support a non-ANSI keyword and shows a compilation error, use this option to replace all occurrences of the keyword with a blank string in preprocessed code. The replacement occurs only for the purposes of the analysis. Your original source code remains intact.

  For instance, if your compiler supports the `__far` keyword, to avoid compilation errors:

  - In the user interface, enter `__far=`.
  - On the command line, use the flag `-D __far`.

  The software replaces the `__far` keyword with a blank string during preprocessing. For example:

  ```
  int __far* pValue;
  ```

  is converted to:

  ```
  int * pValue;
  ```

- Polyspace recognizes keywords such as `restrict` and does not allow their use as identifiers. If you use those keywords as identifiers (because your compiler does not recognize them as keywords), replace the disallowed name with another name using this option. The replacement occurs only for the purposes of the analysis. Your original source code remains intact.

For instance, to allow use of `restrict` as identifier:

- In the user interface, enter `restrict=my_restrict`.
- On the command line, use the flag `-D restrict=my_restrict`.

## Command-Line Information

You can specify only one flag with each `-D` option. However, you can specify the option multiple times.
**Parameter:** `-D`
**No Default**
**Value:** *`flag=value`*
**Example:** `polyspace-bug-finder-nodesktop -D HAVE_MYLIB -D int32_t=int`

## See Also

`Disabled preprocessor definitions (-U)`

# Disabled preprocessor definitions (-U)

Undefine macros in preprocessed code

## Description

Undefine macros in preprocessed code.

### Set Option

**User interface**: In your project configuration, the option is on the **Macros** node.

**Command line**: Use the option -U. See “Command-Line Information” on page 1-66.

### Why Use This Option

Use this option to emulate your compiler behavior. For instance, if your compiler considers a macro _WIN32 as undefined when you build your code, it executes code in a #ifndef _WIN32 statement. If Polyspace considers that macro as defined, you must explicitly undefine the macro.

Some settings for Compiler (-compiler) enable certain macros by default. This option allows you undefine the macros.

Typically, you recognize from compilation errors that a certain macro must be undefined. For instance, the following code does not compile if the macro _WIN32 is defined.

```
#ifndef _WIN32
  int env_var;
#endif

void set() {
  env_var=1;
}
```

The error message states that env_var is undefined. However, the definition of env_var is in the #ifndef _WIN32 statement. The underlying cause for the error is that the macro _WIN32 is defined. You must undefine _WIN32.

## Settings

**No Default**

Using the ✚ button, add a new row for each macro being undefined.

## Command-Line Information

You can specify only one flag with each `-U` option. However, you can specify the option multiple times.
**Parameter:** `-U`
**No Default**
**Value:** *`macro`*
**Example:** `polyspace-bug-finder-nodesktop -U HAVE_MYLIB -U USE_COM1`

## See Also

`Preprocessor definitions (-D)`

# Code from DOS or Windows file system (-dos)

Consider that file paths are in MS-DOS style

## Description

Specify that DOS or Windows files are provided for analysis.

### Set Option

**User interface**: In your project configuration, the option is on the **Environment Settings** node.

**Command line**: Use the option `-dos`. See "Command-Line Information" on page 1-68.

### Why Use This Option

Use this option if the contents of the **Include** or **Source** folder come from a DOS or Windows file system. The option helps you resolve case sensitivity and control character issues.

## Settings

☑ On (default)

Analysis understands file names and include paths for Windows/DOS files

For example, with this option,

```
#include "..\mY_TEst.h"^M
```

```
#include "..\mY_other_FILE.H"^M
```

resolves to:

```
#include "../my_test.h"
```

```
#include "../my_other_file.h"
```

□ Off

Characters are not controlled for files names or paths.

## Command-Line Information

**Parameter:** `-dos`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -dos -I ./my_copied_include_dir -D test=1`

# Stop analysis if a file does not compile (`-stop-if-compile-error`)

Specify that a compilation error must stop the analysis

## Description

Specify that even a single compilation error must stop the analysis.

### Set Option

**User interface**: In the **Configuration** pane, the option is on the **Environment Settings** node.

**Command line**: Use the option `-stop-if-compile-error`. See “Command-Line Information” on page 1-70.

### Why Use This Option

Use this option to first resolve all compilation errors and then perform the Polyspace analysis. This sequence ensures that all files are analyzed.

Otherwise, only files without compilation errors are fully analyzed. The analysis might return some results for files that do not compile. If a file with compilation errors contains a function definition, the analysis considers the function undefined. This assumption can sometimes make the analysis less precise.

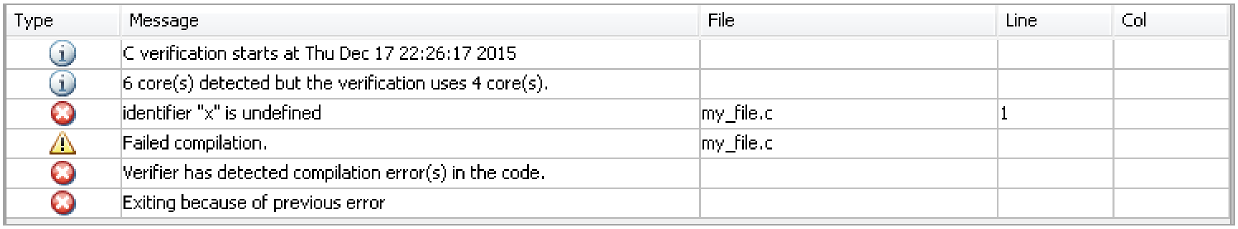
The option is more useful for a Code Prover analysis because the Code Prover run-time checks rely more heavily on range propagation across functions.

## Settings

☑ On

The analysis stops even if a single compilation error occurs.

You see the compilation errors on the **Output Summary** pane.



| Type | Message | File | Line | Col |
|---|---|---|---|---|
| ⓘ | C verification starts at Thu Dec 17 22:26:17 2015 | | | |
| ⓘ | 6 core(s) detected but the verification uses 4 core(s). | | | |
| ⊗ | identifier "x" is undefined | my_file.c | 1 | |
| ⚠ | Failed compilation. | my_file.c | | |
| ⊗ | Verifier has detected compilation error(s) in the code. | | | |
| ⊗ | Exiting because of previous error | | | |

For information on how to resolve the errors, see “Troubleshoot Compilation and Linking Errors” (Polyspace Code Prover).

Despite compilation errors, you can see some analysis results, for instance, coding rule violations.

□ Off (default)

The analysis does not stop because of compilation errors, but only files without compilation errors are analyzed. The analysis does not consider files that do not compile. If a file with compilation errors contains a function definition, the analysis considers the function undefined. If the analysis needs the definition of such a function, it makes broad assumptions about the function.

- The function return value can take any value in the range allowed by its data type.
- The function can modify arguments passed by reference so that they can take any value in the range allowed by their data types.

If the assumptions are too broad, the analysis can be less precise. For instance, a run-time check can flag an operation in orange even though it does not fail in practice.

If compilation errors occur, the **Dashboard** pane has a link, which shows that some files failed to compile. You can click the link and see the compilation errors on the **Output Summary** pane.

## Command-Line Information

**Parameter:**`-stop-if-compile-error`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -sources` *`filename`* `-stop-if-compile-error`

Introduced in R2017a

# Command/script to apply to preprocessed files (-post-preprocessing-command)

Specify command or script to run on source files after preprocessing phase of analysis

## Description

Specify a command or script to run on each source file after preprocessing.

### Set Option

**User interface**: In your project configuration, the option is on the **Environment Settings** node.

**Command line**: Use the option `-post-preprocessing-command`. See "Command-Line Information" on page 1-74.

### Why Use This Option

You can run scripts on preprocessed files to work around compilation errors or imprecisions of the analysis while keeping your original source files untouched. For instance, suppose Polyspace does not recognize a compiler-specific keyword. If you are certain that the keyword is not relevant for the analysis, you can run a Perl script to remove all instances of the keyword. When you use this option, the software removes the keyword from your preprocessed code but keeps your original code untouched.

Use a script only if the existing analysis options do not meet your requirements. For instance:

- For direct replacement of one keyword with another, use the option `Preprocessor definitions (-D)`.

  However, the option does not allow search and replacement involving regular expressions. For regular expressions, use a script.
- For mapping your library function to a standard library function, use the option `-function-behavior-specifications`.

However, the option supports mapping to only a subset of standard library functions. To map to an unsupported function, use a script.

*If you are unsure about removing or replacing an unsupported construct, do not use this option.* Contact MathWorks Support for guidance.

## Settings

**No Default**

Enter full path to the command or script or click 📁 to navigate to the location of the command or script. After the verification, this script is executed.

## Tips

- Your script must be designed to process the standard output from preprocessing and produce its results in accordance with that standard output.
- Your script must preserve the number of lines in the preprocessed file. In other words, it must not add or remove entire lines to or from the file.

  Adding a line or removing one can potentially result in some unpredictable behavior on the location of checks and macros in the Polyspace user interface.
- For a Perl script, in Windows, specify the full path to the Perl executable followed by the full path to the script.

  For example:

  - To specify a Perl command that replaces all instances of the `far` keyword, enter *`matlabroot`*`\sys\perl\win32\bin\perl.exe -p -e "s/far//g"`.
  - To specify a Perl script `replace_keyword.pl` that replaces all instances of a keyword, enter *`matlabroot`*`\sys\perl\win32\bin\perl.exe` *`<absolute_path>`*`\replace_keyword.pl`.

  Here, *`matlabroot`* is the location of the current MATLAB installation such as `C:\Program Files\MATLAB\R2015b\` and *`<absolute_path>`* is the location of the Perl script.

- Use this Perl script as template. The script removes all instances of the far keyword.

```
#!/usr/bin/perl

binmode STDOUT;

# Process every line from STDIN until EOF
while ($line = <STDIN>)
{

  # Remove far keyword
  $line =~ s/far//g;

  # Print the current processed line to STDOUT
  print $line;
}
```

  You can use Perl regular expressions to perform substitutions. For instance, you can use the following expressions.

| Expression | Meaning |
|---|---|
| . | Matches any single character except newline |
| [a-z0-9] | Matches any single letter in the set a-z, or digit in the set 0-9 |
| [^a-e] | Matches any single letter not in the set a-e |
| \d | Matches any single digit |
| \w | Matches any single alphanumeric character or _ |
| x? | Matches 0 or 1 occurrence of x |
| x* | Matches 0 or more occurrences of x |
| x+ | Matches 1 or more occurrences of x |

  For complete list of regular expressions, see Perl documentation.

- When you specify this option, the Compilation Assistant is automatically disabled.

## Command-Line Information

**Parameter:** -post-preprocessing-command
**Value:** Path to executable file or command in quotes
**No Default**

**Example in Linux®:** `polyspace-bug-finder-nodesktop -sources *file_name* -post-preprocessing-command `pwd`/replace_keyword.pl`

**Example in Windows:** `polyspace-bug-finder-nodesktop -sources *file_name* -post-preprocessing-command "C:\Program Files\MATLAB\R2015b\sys\perl\win32\bin\perl.exe" "C:\My_Scripts\replace_keyword.pl"`

## See Also

Command/script to apply after the end of the code verification (-post-analysis-command)

### Topics

"Specify Analysis Options"

# Include (`-include`)

Specify files to be `#include`-ed by each C file in analysis

## Description

Specify files to be `#include`-ed by each C file involved in the analysis. The software enters the `#include` statements in the preprocessed code used for analysis, but does not modify the original source code.

### Set Option

**User interface**: In your project configuration, the option is on the **Environment Settings** node.

**Command line**: Use the option `-include`. See “Command-Line Information” on page 1-77.

### Why Use This Option

There can be many reasons why you want to `#include` a file in all your source files.

For instance, you can collect in one header file all workarounds for compilation errors. Use this option to provide the header file for analysis. Suppose you have compilation issues because Polyspace does not recognize certain compiler-specific keywords. To work around the issues, `#define` the keywords in a header file and provide the header file with this option.

## Settings

**No Default**

Specify the file name to be included in every file involved in the analysis.

Polyspace still acts on other directives such as `#include <include_file.h>`.

## Command-Line Information

**Parameter:** `-include`
**Default:** None
**Value:** *`file`* (Use `-include` multiple times for multiple files)
**Example:** `polyspace-bug-finder-nodesktop -include `pwd`/sources/a_file.h -include /inc/inc_file.h`

## See Also

# Include folders (`-I`)

View include folders used for analysis

## Description

View the include folders used for analysis.

### Set Option

This is not an option that you set in your project configuration. You can only view the include folders in the configuration associated with a result. For instance, in the user interface:

- To add include folders, on the **Project Browser**, right-click your project. Select **Add Source**.
- To view the include folders that you used, with your results open, select **Window** > **Show/Hide View** > **Configuration**. Under the node **Environment Settings**, you see the folders listed under **Include folders**.

## Settings

This is a read-only option available only when viewing results. Unlike other options, you do not specify include folders on the **Configuration** pane. Instead, you add your include folders on the **Project Browser** pane.

## Command-Line Information

**Parameter:** `-I`
**Value:** Folder name
**Example:** `polyspace-bug-finder-nodesktop -I /com1/inc -I /com1/sys/inc`

## See Also

`-I` | `Include (-include)`

# Constraint setup (`-data-range-specifications`)

Constrain global variables, function inputs and return values of stubbed functions

## Description

Specify constraints (also known as data range specifications or DRS) for global variables, function inputs and return values of stubbed functions using a **Constraint Specification** template file. The template file is an `XML` file that you can generate in the Polyspace user interface.

### Set Option

**User interface**: In your project configuration, the option is on the **Inputs & Stubbing** node.

**Command line**: Use the option `-data-range-specifications`. See “Command-Line Information” on page 1-81.

### Why Use This Option

Use this option for specifying constraints outside your code.

Polyspace uses the code that you provide to make assumptions about items such as variable ranges and allowed buffer size for pointers. Sometimes the assumptions are broader than what you expect because:

- You have not provided the complete code. For example, you did not provide some of the function definitions.
- Some of the information about variables is available only at run time. For example, some variables in your code obtain values from the user at run time.

Because of these broad assumptions, Polyspace can sometimes produce false positives.

To reduce the number of such false positives, you can specify additional constraints on global variables, function inputs, and return values of stubbed functions.

After you specify your constraints, you can save them as an XML file to use them for subsequent analyses. If your source code changes, you can update the previous constraints. You do not have to create a new constraint template.

## Settings

**No Default**

Enter full path to the template file. Alternately, click Edit to open a **Constraint Specification** wizard. This wizard allows you to generate a template file or navigate to an existing template file.

For more information, see “Specify External Constraints”.

## Command-Line Information

**Parameter:** `-data-range-specifications`
**Value:** *`file`*
**No Default**
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-data-range-specifications "C:\DRS\range.xml"`

## See Also

`Functions to stub (-functions-to-stub)`

### Topics

“Specify Analysis Options”
“Constraints”

# Ignore default initialization of global variables (`-no-def-init-glob`)

Consider global variables as uninitialized

## Description

*This option applies to Code Prover only. It does not affect a Bug Finder analysis.*

Specify that Polyspace must not consider global and static variables as initialized.

### Set Option

**User interface**: In your project configuration, the option is on the **Inputs & Stubbing** node.

**Command line**: Use the option `-no-def-init-glob`. See "Command-Line Information" on page 1-83.

### Why Use This Option

The C99 Standard specifies that global variables are implicitly initialized. The default analysis follows the Standard and considers this implicit initialization.

If you want to initialize specific global variables explicitly, use this option to find the instances where global variables are not explicitly initialized.

## Settings

☑ On

Polyspace ignores implicit initialization of global and static variables. The verification generates a red **Non-initialized variable** error if your code reads a global or static variable before writing to it.

□ Off (default)

Polyspace considers global variables and static variables to be initialized according to C99 or ISO C++ standards. For instance, the default values are:

- 0 for `int`
- 0 for `char`
- 0.0 for `float`

## Tips

- If you initialize a global variable using the generated `main`:
  - Polyspace does not produce a red **Non-initialized variable** error if your code reads the variable before writing to it. The error is not produced even if you turn on the option **Ignore default initialization of global variables**.
  - Polyspace considers that before the first write operation on the variable in a function, the variable can take any value allowed by its type.

  For more information on initializing global variables using the generated `main`, see `Variables to initialize (-main-generator-writes-variables).`
- Static local variables have the same lifetime as global variables even though their visibility is limited to the function where they are defined. Therefore, the option applies to static local variables.

## Command-Line Information

**Parameter:** `-no-def-init-glob`
**Default:** Off

## See Also

### Topics

“Specify Analysis Options”

# No STL stubs (`-no-stl-stubs`)

Do not use Polyspace implementations of functions in the Standard Template Library

## Description

*This option applies to Code Prover only. It does not affect a Bug Finder analysis.*

Specify that the verification must not use Polyspace implementations of the Standard Template Library.

### Set Option

**User interface**: In your project configuration, the option is on the **Inputs & Stubbing** node. See “Dependency” on page 1-85 for other options that you must also enable.

**Command line**: Use the option `-no-stl-stubs`. See “Command-Line Information” on page 1-85.

### Why Use This Option

The analysis uses an efficient implementation of all class templates from the Standard Template Library (STL). If your compiler redefines the templates, in some cases, your compiler implementation can conflict with the Polyspace implementation.

Use this option to prevent Polyspace from using its implementations of STL templates. You must also explicitly provide the path to your compiler includes. See “C++ Standard Template Library Stubbing Errors” (Polyspace Code Prover).

## Settings

☑ On

The verification does not use Polyspace implementations of the Standard Template Library.

□ Off (default)

The verification uses efficient Polyspace implementations of the Standard Template Library.

## Dependency

This option is available only if you set `Source code language (-lang)` to `CPP` or `C-CPP`.

## Command-Line Information

**Parameter:** `-no-stl-stubs`
**Default**: Off

## See Also

# Functions to stub (`-functions-to-stub`)

Specify functions to stub during analysis

## Description

*This option affects a Code Prover analysis only.*

Specify functions to stub during analysis.

For specified functions, Polyspace :

- Ignores the function definition even if it exists.
- Assumes that the function inputs and outputs have full range of values allowed by their type.

### Set Option

**User interface**: In your project configuration, the option is on the **Inputs & Stubbing** node.

**Command line**: Use the option `-functions-to-stub`. See “Command-Line Information” on page 1-88.

### Why Use This Option

If you want the analysis to ignore the code in a function body, you can stub the function.

For instance:

- Suppose you have not completed writing the function and do not want the analysis to consider the function body. You can use this option to stub the function and then specify constraints on its return value and modifiable arguments.
- Suppose the analysis of a function body is imprecise. The analysis assumes that the function returns all possible values that the function return type allows. You can use this option to stub the function and then specify constraints on its return value.

## Settings

**No Default**

Enter function names or choose from a list.

- Click ✚ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

When entering function names, use either the basic syntax or, to differentiate overloaded functions, the argument syntax. For the argument syntax, separate function arguments with semicolons. See the following code and table for examples.

```
//simple function

void test(int a, int b);

//C++ template function

Template <class myType>
myType test(myType a, myType b);

//C++ class method

class A {
    public:
    int test(int var1, int var2);
};


//C++ template class method

template <class myType> class A
{
    public:
    myType test(myType var1, myType var2);
};
```

| Function Type | Basic Syntax | Argument Syntax |
|---|---|---|
| Simple function | `test` | `test(int; int)` |

| Function Type | Basic Syntax | Argument Syntax |
|---|---|---|
| C++ template function | `test` | `test(myType; myType)` |
| C++ class method | `A::test` | `A::test(int;int)` |
| C++ template class method | `A<myType>::test` | `A<myType>::test(myType;myType)` |

## Command-Line Information

**Parameter:** `-functions-to-stub`
**No Default**
**Value:** *`function1`*`[,`*`function2`*`[,...]]`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-functions-to-stub function_1,function_2`

## See Also

`Constraint setup (-data-range-specifications)`

### Topics

"Specify Analysis Options"

# Generate stubs for Embedded Coder lookup tables (`-stub-embedded-coder-lookup-table-functions`)

Stub autogenerated functions that use lookup tables and model them more precisely

## Description

*This option is available only for model-generated code. The option is relevant only if you generate code from a Simulink® model that uses Lookup Table blocks using MathWorks code generation products.*

Specify that the verification must stub autogenerated functions that use certain kinds of lookup tables in their body. The lookup tables in these functions use linear interpolation and do not allow extrapolation. That is, the result of using the lookup table always lies between the lower and upper bounds of the table.

### Set Option

If you are running verification from Simulink, use the option “Stub lookup tables” (Polyspace Code Prover) in Simulink Configuration Parameters, which performs the same task.

**User interface**: In your Polyspace project configuration, the option is on the **Inputs & Stubbing** node.

**Command line**: Use the option `-stub-embedded-coder-lookup-table-functions`. See “Command-Line Information” on page 1-91.

### Why Use This Option

If you use this option, the verification is more precise and has fewer orange checks. The verification of lookup table functions is usually imprecise. The software has to make certain assumptions about these functions. To avoid missing a run-time error, the verification assumes that the result of using the lookup table is within the full range allowed by the result data type. This assumption can cause many unproven results (orange checks) when a lookup table function is called. By using this option, you narrow down the assumption. For functions that use lookup tables with linear interpolation and no extrapolation, the result is at least within the bounds of the table.

The option is relevant only if your model has Lookup Table blocks. In the generated code, the functions corresponding to Lookup Table blocks also use lookup tables. The function names follow specific conventions. The verification uses the naming conventions to identify if the lookup tables in the functions use linear interpolation and no extrapolation. The verification then replaces such functions with stubs for more precise verification.

## Settings

☑ On (default)

For autogenerated functions that use lookup tables with linear interpolation and no extrapolation, the verification:

- Does not check for run-time errors in the function body.
- Calls a function stub instead of the actual function at the function call sites. The stub ensures that the result of using the lookup table is within the bounds of the table.

To identify if the lookup table in the function uses linear interpolation and no extrapolation, the verification uses the function name. In your analysis results, you see that the function is not analyzed. If you place your cursor on the function name, you see the following message:

```
Function has been recognized as an Embedded Coder Lookup-Table function.
It was stubbed by Polyspace to increase precision.
Unset the -stub-embedded-coder-lookup-table-functions option to analyze
   the code below.
```

□ Off

The verification does not stub autogenerated functions that use lookup tables.

## Tips

- The option applies to only autogenerated functions. If you integrate your own C/C++ S-Function using lookup tables with the model, these functions do not follow the naming conventions for autogenerated functions. The option does not cause them to be stubbed. If you want the same behavior for your handwritten lookup table functions as the autogenerated functions, use the option `-function-behavior-specifications` and map your function to the `__ps_lookup_table_clip` function.
- If you run verification from Simulink, the option is on by default. For certification purposes, if you want your verification tool to be independent of the code generation tool, turn off the option.

## Command-Line Information

**Parameter:** `-stub-embedded-coder-lookup-table-functions`
**Default**: On
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-stub-embedded-coder-lookup-table-functions`

## See Also

Introduced in R2016b

# Generate results for sources and (`-generate-results-for`)

Specify files on which you want analysis results

## Description

Specify files on which you want analysis results.

### Set Option

**User interface**: In your project configuration, the option is on the **Inputs & Stubbing** node.

**Command line**: Use the option `-generate-results-for`. See “Command-Line Information” on page 1-94.

### Why Use This Option

Use this option to see results in header files that are most relevant to you.

For instance, by default, results are generated on header files that are located in the same folder as the source files. Often, other header files belong to a third-party library. Though these header files are required for a precise analysis, you are not interested in reviewing findings in those headers. Therefore, by default, results are not generated for those headers. If you *are interested* in certain headers from third-party libraries, change the default value of this option.

## Settings

**Default**: `source-headers`

`source-headers`

> Results appear on source files and header files in the same folder as the source files or in subfolders of source file folders.

The source files are the files that you add to the **Source** folder of your Polyspace project (or use with the argument `-sources` at the command line).

`all-headers`

Results appear on source files and all header files. The header files can be in the same folder as source files, in subfolders of source file folders or in include folders.

The source files are the files that you add to the **Source** folder of your Polyspace project (or use with the argument `-sources` at the command line).

The include folders are the folders that you add to the **Include** folder of your Polyspace project (or use with the argument `-I` at the command line).

`custom`

Results appear on source files and the files that you specify. If you enter a folder name, results appear on header files in that folder.

Click ➕ to add a field. Enter a file or folder name.

## Tips

1 Use this option in combination with appropriate values for the option `Do not generate results for (-do-not-generate-results-for)`.

If you choose `custom` and the values for the two options conflict, the more specific value determines the display of results. For instance, in the following examples, the value for the option **Generate results for sources and** is more specific.

| Generate results for sources and | Do not generate results for | Final Result |
|---|---|---|
| `custom`:<br>`C:\Includes\Custom_Library\` | `custom`:<br>`C:\Includes` | Results are displayed on header files in `C:\Includes\Custom_Library\` but not generated for other header files in `C:\Includes` and its subfolders. |

| Generate results for sources and | Do not generate results for | Final Result |
|---|---|---|
| `custom:`<br>`C:\Includes\my_header.h` | `custom:`<br>`C:\Includes\` | Results are displayed on the header file `my_header.h` in `C:\Includes\` but not generated for other header files in `C:\Includes\` and its subfolders. |

Using these two options together, you can suppress results from all files in a certain folder but unsuppress select files in those folders.

2 If you choose `all-headers` for this option, results are displayed on all header files irrespective of what you specify for the option **Do not generate results for**.

## Command-Line Information

**Parameter:** `-generate-results-for`
**Value:** `all-headers` | `custom=`*`file1`*`[,`*`file2`*`[,...]]` | *`folder1`*`[,`*`folder2`*`[,...]]`
**Example:** `polyspace-bug-finder-nodesktop -lang c -sources` *`file_name`* `-misra2 required-rules -generate-results-for "C:\usr\include"`

## See Also

### Topics

“Exclude Files from Analysis”

Introduced in R2016a

# Do not generate results for (-do-not-generate-results-for)

Specify files on which you do not want analysis results

## Description

Specify files on which you do not want analysis results.

### Set Option

**User interface**: In your project configuration, the option is on the **Inputs & Stubbing** node.

**Command line**: Use the option `-do-not-generate-results-for`. See "Command-Line Information" on page 1-99.

### Why Use This Option

Use this option to see results in header files that are most relevant to you.

For instance, by default, results are generated on header files that are located in the same folder as the source files. If you are not interested in reviewing the findings in those headers, change the default value of this option.

## Settings

**Default**: `include-folders`

`include-folders`

Results are not generated for header files in include folders.

The include folders are the folders that you add to the **Include** folder of your Polyspace project (or use with the argument `-I` at the command line).

`all-headers`

Results are not generated for all header files. The header files can be in the same folder as source files, in subfolders of source file folders or in include folders.

The source files are the files that you add to the **Source** folder of your Polyspace project (or use with the argument `-sources` at the command line).

The include folders are the folders that you add to the **Include** folder of your Polyspace project (or use with the argument `-I` at the command line).

`custom`

Results are not generated for the files that you specify. If you enter a folder name, results are suppressed from files in that folder.

Click ➕ to add a field. Enter a file or folder name.

## Tips

1 Use this option appropriately in combination with appropriate values for the option `Generate results for sources and (-generate-results-for).`

If you choose `custom` and the values for the two options conflict, the more specific value determines the display of results. For instance, in the following examples, the value for the option **Generate results for sources and** is more specific.

| Generate results for sources and | Do not generate results for | Final Result |
|---|---|---|
| `custom`:<br>`C:\Includes\Custom_Library\` | `custom`:<br>`C:\Includes` | Results are displayed on header files in `C:\Includes\Custom_Library\` but not generated for other header files in `C:\Includes` and its subfolders. |

| Generate results for sources and | Do not generate results for | Final Result |
|---|---|---|
| custom:<br>C:\Includes \my_header.h | custom:<br>C:\Includes\ | Results are displayed on the header file my_header.h in C:\Includes\ but not generated for other header files in C:\Includes\ and its subfolders. |

Using these two options together, you can suppress results from all files in a certain folder but unsuppress select files in those folders.

2 If you choose all-headers for this option, results are suppressed from all header files irrespective of what you specify for the option **Generate results for sources and**.

3 If a defect or coding rule violation involves two files and you do not generate results for one of the files, the defect or rule violation still appears. For instance, if you define two variables with similar-looking names in files myFile.cpp and myFile.h, you get a violation of the MISRA® C++ rule 2-10-1, even if you do not generate results for myFile.h. MISRA C++ rule 2-10-1 states that different identifiers must be typographically unambiguous.

The following results can involve more than one file:

### MISRA C: 2004 Rules

- MISRA C®: 2004 Rule 5.1 — Identifiers (internal and external) shall not rely on the significance of more than 31 characters.
- MISRA C: 2004 Rule 5.2 — Identifiers in an inner scope shall not use the same name as an identifier in an outer scope, and therefore hide that identifier.
- MISRA C: 2004 Rule 8.8 — An external object or function shall be declared in one file and only one file.
- MISRA C: 2004 Rule 8.9 — An identifier with external linkage shall have exactly one external definition.

### MISRA C: 2012 Directives and Rules

- MISRA C: 2012 Directive 4.5 — Identifiers in the same name space with overlapping visibility should be typographically unambiguous.

- MISRA C: 2012 Rule 5.2 — Identifiers declared in the same scope and name space shall be distinct.
- MISRA C: 2012 Rule 5.3 — An identifier declared in an inner scope shall not hide an identifier declared in an outer scope.
- MISRA C: 2012 Rule 5.4 — Macro identifiers shall be distinct.
- MISRA C: 2012 Rule 5.5 — Identifiers shall be distinct from macro names.
- MISRA C: 2012 Rule 8.5 — An external object or function shall be declared once in one and only one file.
- MISRA C: 2012 Rule 8.6 — An identifier with external linkage shall have exactly one external definition.

### MISRA C++ Rules

- MISRA C++ Rule 2-10-1 — Different identifiers shall be typographically unambiguous.
- MISRA C++ Rule 2-10-2 — Identifiers declared in an inner scope shall not hide an identifier declared in an outer scope.
- MISRA C++ Rule 3-2-2 — The One Definition Rule shall not be violated.
- MISRA C++ Rule 3-2-3 — A type, object or function that is used in multiple translation units shall be declared in one and only one file.
- MISRA C++ Rule 3-2-4 — An identifier with external linkage shall have exactly one definition.
- MISRA C++ Rule 7-5-4 — Functions should not call themselves, either directly or indirectly.
- MISRA C++ Rule 15-4-1 — If a function is declared with an exception-specification, then all declarations of the same function (in other translation units) shall be declared with the same set of type-ids.

### JSF C++ Rules

- JSF C++ Rule 46 — User-specified identifiers (internal and external) will not rely on significance of more than 64 characters.
- JSF C++ Rule 48 — Identifiers will not differ by only a mixture of case, the presence/absence of the underscore character, the interchange of the letter `O` with the number 0 or the letter `D`, the interchange of the letter `I` with the number 1 or the letter `l`, the interchange of the letter `S` with the number 5, the interchange of

the letter Z with the number 2 and the interchange of the letter n with the letter h.

- JSF C++ Rule 137 — All declarations at file scope should be static where possible.
- JSF C++ Rule 139 — External objects will not be declared in more than one file.

### Polyspace Bug Finder Defects

- `Variable shadowing` — Variable hides another variable of same name with nested scope.
- `Declaration mismatch` — Mismatch occurs between function or variable declarations.

4. If a result (coding rule violation or Bug Finder defect) is inside a macro, Polyspace typically shows the result on the macro definition instead of the macro occurrences so that you review the result only once. Even if the macro is used in a suppressed file, the result is still shown on the macro definition, *if the definition occurs in an unsuppressed file*.

## Command-Line Information

**Parameter:** `-do-not-generate-results-for`
**Value:** `all-headers` | `custom=`*`file1`*`[,`*`file2`*`[,...]]` | *`folder1`*`[,`*`folder2`*`[,...]]`
**Example:** `polyspace-bug-finder-nodesktop -lang c -sources` *`file_name`* `-misra2 required-rules -do-not-generate-results-for "C:\usr\include"`

## See Also

### Topics

“Exclude Files from Analysis”

**Introduced in R2016a**

# OSEK multitasking configuration (`-osek-multitasking`)

Set up multitasking configuration from OIL file definition

## Description

Specify the OIL files that Polyspace parses to set up the multitasking configuration of your OSEK project.

### Set Option

**User interface:** In the **Configuration** pane, the option is available on the **Multitasking** pane.

**Command line:** Use the option `-osek-multitasking`. See “Command-Line Information” on page 1-104.

### Why Use This Option

If your project includes OIL files, Polyspace can parse these files to set up entry points, interrupts, cyclical tasks, and critical sections. You do not have to set them up manually.

## Settings

☑ On

Polyspace looks for and parses OIL files to set up your multitasking configuration.

`auto`

Look for OIL files in your project source and include folders, but not in their subfolders.

`custom`

Look for OIL files on the specified path and the path subfolders. You can specify a path to the OIL files or to the folder containing the files.

When you select this option, in your source code, Polsypace supports these OSEK multitasking keywords:

- `TASK`
- `DeclareTask`
- `ActivateTask`
- `DeclareResource`
- `GetResource`
- `ReleaseResource`
- `ISR`
- `DeclareEvent`
- `DeclareAlarm`

Polyspace parses the OIL files that you provide for `TASK`, `ISR`, `RESOURCE`, and `ALARM` definitions. The analysis uses these definitions and the supported multitasking keywords to configure entry points, interrupts, cyclical tasks, and critical sections.

### Example: Analyze Your OSEK Multitasking Project

This table lists a source code and corresponding OIL file for an OSEK multitasking application.

OIL File

```
CPU mySystem {

    OS myOs {

        EE_OPT = " EXMAPLE";
        CPU_DATA = modelCPU {

            APP_SRC = " file1.c";
            MULTI_STACK = FALSE;
            ICD2 = TRUE;
        };
        MCU_DATA = modelCPU {

            MODEL = 11 AA12345678;
        };

    };
    TASK init {
         AUTOSTART = TRUE;
        PRIORITY = 1;
        STACK = SHARED ;
        SCHEDULE = FULL;

    };
    TASK afterinit1 {
       AUTOSTART = TRUE;
        PRIORITY = 1;
        STACK = SHARED ;
        SCHEDULE = FULL;

    };


    RESOURCE res1 {
        RESOURCEPROPERTY = STANDARD;
    };



};
```

Source Code

```
#include <assert.h>
#include "Header_file"

int var1;
int var2;
int var3;

DeclareAlarm(Cyclic_task_activate);
DeclareResource(res1);
DeclareTask(init);
TASK(afterinit1);

TASK(init) // entry point
{


  var2++;
  ActivateTask(afterinit1);
  var3++;
  GetResource(res1); // critical section begins
  var1++;
  ReleaseResource(res1); // critical section ends
}

TASK(afterinit1) // entry point
{
  var3++;
  var2++;
  GetResource(res1); // critical section begins
  var1++;
  ReleaseResource(res1); // critical section ends

}

void main()
{}
```

To set up your multitasking configuration and analyze the code:

1. Copy the preceding code examples and save them on your machine as `osek.oil` and `osek.c`, for instance in `C:\Polyspace_worskpace\OSEK`.
2. Run an analysis on your OSEK project by using the command:

   ```
   polyspace-bug-finder-nodesktop -sources C:\Polyspace_workspace\OSEK\osek.c ^
   -I Include_Path -osek-multitasking auto
   ```

   *`Include_Path`* is the path to the include folder containing *`Header_file`*, your header files with OSEK function declarations.

Polyspace detects a data race on page 3-85 on variable `var3` because of multiple read and write operation from tasks `init` and `afterinit1`.

```
#include <assert.h>
#include "Header_file"

int var1;
int var2;
int var3;
```

There is no defect on `var2` since `afterinit1` goes to an active state (`ActivateTask()`) after `init` increments `var2`. Similarly, there is no defect on `var1` because it is protected by the `GetResource()` and `ReleaseResource()` calls.

To see how Polyspace models the `TASK`, `ISR`, and `RESOURCE` definitions from your OIL files, search the result log file for "`OSEK configuration from oil-files`". To access the log file from the user interface, select **Window** > **Show/Hide View** > **Run Log**. The log file is located inside your project results folder.

□ Off (default)

Polyspace does not set up a multitasking configuration for your OSEK project.

## Additional Considerations

- The analysis ignores `TerminateTask()` declarations in your source code and considers that subsequent code is executed.
- Polyspace ignores syntax elements of your OIL files that do not follow the syntax defined here.

## Command-Line Information

**Parameter:** `-osek-multitasking`
**Value:** `auto` | `custom='`*`file1 [,file2, dir1,...]`*`'`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -sources` *`source_path`* `-I` *`include_path`* `-osek-multitasking custom='path\to\file1.oil, path\to\dir'`

## See Also

### Topics

"Set Up Multitasking Analysis Manually"
"Modeling Multitasking Code"

Introduced in R2017b

# Configure multitasking manually

Consider that code is intended for multitasking

## Description

Specify whether your code is a multitasking application. This option allows you to manually configure the multitasking structure for Polyspace.

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node.

**Command line**: See “Command-Line Information” on page 1-106.

### Why Use This Option

In cases where automatic concurrency detection is not supported, you can explicitly specify your multitasking model by using this option. Once you select this option, you can explicitly specify your entry point functions, cyclic tasks, interrupts and protection mechanisms for shared variables, such as critical section details.

The analysis uses your specifications to look for concurrency defects. For more information, see “Concurrency Defects”.

## Settings

☑ On

The code is intended for a multitasking application.

□ Off (default)

The code is not intended for a multitasking application.

## Tips

If you run a file by file verification in Code Prover, your multitasking options are ignored. See `Verify files independently (-unit-by-unit)`.

## Command-Line Information

There is no single command-line option to turn on multitasking analysis. By using the `-entry-points` option, you turn on multitasking analysis.

## See Also

`Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Topics

"Set Up Multitasking Analysis Manually"

# Enable automatic concurrency detection for Code Prover (`-enable-concurrency-detection`)

Automatically detect certain families of multithreading functions

## Description

*This option affects a Code Prover analysis only.*

Specify whether to use the automatic concurrency detection for POSIX®, VxWorks®, Windows, and µC/OS II multithreading functions.

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node.

**Command line**: Use the option `-enable-concurrency-detection`. See “Command-Line Information” on page 1-111.

### Why Use This Option

If you use this option, Polyspace determines your multitasking model from your use of multithreading functions.

In some cases, using automatic concurrency detection can slow down the Code Prover analysis. In those cases, you can explicitly specify your multitasking model using the option `Configure multitasking manually`.

## Settings

☑ On

If you use POSIX, VxWorks, Windows, or µC/OS II functions for multitasking, the analysis automatically detects your multitasking model from your code.

The supported multitasking functions are the following:

| Family | Thread Creation | Critical Section Begins | Critical Section Ends |
|---|---|---|---|
| POSIX | `pthread_create` | `pthread_mutex_lock` | `pthread_mutex_unlock` |
| VxWorks | `taskSpawn` | `semTake` | `semGive` |
| Windows | `CreateThread` | `EnterCriticalSection` | `LeaveCriticalSection` |
| µC/OS II | `OSTaskCreate` | `OSMutexPend` | `OSMutexPost` |

To activate automatic detection of concurrency primitives for VxWorks, use the `VxWorks` template. For more information on templates, see “Create Project Using Configuration Template” (Polyspace Code Prover).

---

**Note** For VxWorks, concurrency detection is possible only if the multitasking functions are created from an entry point named `main`. If the entry point has a different name, such as `vxworks_entry_point`, do the following:

1. `Verify whole application`: Select verify the whole application.
2. `Preprocessor definitions (-D)`: In preprocessor definitions, set `vxworks_entry_point=main`.
3. `Enable automatic concurrency detection for Code Prover (-enable-concurrency-detection)`: Enable automatic concurrency detection.

---

□ Off (default)

The analysis does not attempt to detect the multitasking model from your code.

If you want to manually configure your multitasking model, see `Configure multitasking manually`.

## Limitations

The multitasking model extracted by Polyspace does not include some features. Polyspace cannot model:

- Thread priorities and attributes — Ignored by Polyspace
- Recursive semaphores
- Unbounded thread identifiers — Warning

  For example:

  ```
  extern pthread_t ids[]
  ```

  Or

  ```
  pthread_t* ids = (pthread_t* malloc(n*sizeof(pthread_t))
  ```
- Calls to concurrency primitive through high-order calls — Warning.
- Termination of threads — Polyspace ignores pthread_join, and replaces pthread_exit by a standard exit.
- Shared local variables — Only global variables are considered shared. If a local variable is accessed by multiple threads, the analysis does not take into account the shared nature of the variable.

### Example

In this example, the analysis does not take into account that the local variable x can be accessed by both task1 and task2 (after the new thread is created).

```
#include <pthread.h>
#include <stdlib.h>


void* task2(void* args) {
    int* x = (int*) args;
    *x = 1;
    return (void*)x;
}

void task1() {
    int x;
    x = 2;
    pthread_t id;
    (void)pthread_create(&id,NULL,task2,(void*) &x);
                        /* x (local var) passed to task2 */
    x = 3 ;

    /* Unknown thread priority means x = 1 OR x = 3.*/
```

```
    /* However, the analysis considers  x = 3 */
    /* Assertion below is green */
    assert(x==3);
}

int main(void) {
    task1();
    return 0;
}
```

- Shared dynamic memory — Only global variables are considered shared. If a dynamically allocated memory region is accessed by multiple threads, the analysis does not take into account its shared nature.

### Example

In this example, the analysis does not take into account that `lx` points to a shared memory region. The region can be accessed by both `task1` and `task2` (after the new thread is created). The Code Prover analysis also reports `lx` as a non-shared variable.

```
#include <pthread.h>
#include <stdlib.h>

static int *lx;

void* task2(void* args) {
    int* x = (int*) args;
    *x = 1;
    return (void*)x;
}

void task1() {
    pthread_t id;
    lx = (int *)malloc(sizeof(int));

    if(lx==NULL) exit(1);

    (void)pthread_create(&id,NULL,task2,(void*) lx);

    *lx = 3 ;

    /* Unknown thread priority means *lx = 1 OR *lx = 3.*/
    /* However, the analysis considers  *lx = 3 */
    /* Assertion below is green */
    assert(*lx==3);
}

int main(void) {
    task1();
    return 0;
}
```

## Command-Line Information

**Parameter:** `-enable-concurrency-detection`
**Default:** Off
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-enable-concurrency-detection`

## See Also

`Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

# Entry points (`-entry-points`)

Specify functions that serve as entry points to your multitasking application

## Description

Specify functions that serve as entry points to your code. If the function does not exist, the verification warns you and continues the verification.

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node. See “Dependencies” on page 1-113 for other options you must also enable.

**Command line**: Use the option `-entry-points`. See “Command-Line Information” on page 1-113.

### Why Use This Option

Use this option when your code is intended for multitasking.

To specify cyclic tasks and interrupts, use the options `Cyclic tasks (-cyclic-tasks)` and `Interrupts (-interrupts)`. Use this option to specify other tasks.

The analysis uses your specifications to look for concurrency defects. For more information, see “Concurrency Defects”.

## Settings

**No Default**

Enter function names or choose from a list.

- Click ➕ to add a field and enter the function name.

- Click ✚ to list functions in your code. Choose functions from the list.

## Dependencies

To enable this option, first select the option `Configure multitasking manually`.

## Tips

If you specify a function as an entry point, you must provide its definition. Otherwise, the analysis does not consider the function as an entry point.

## Command-Line Information

**Parameter:** `-entry-points`
**No Default**
**Value:** `*function1*[,*function2*[,...]]`
**Example:** `polyspace-bug-finder-nodesktop -sources *file_name* -entry-points func_1,func_2`

## See Also

`Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Topics

"Specify Analysis Options"
"Set Up Multitasking Analysis Manually"

# Cyclic tasks (`-cyclic-tasks`)

Specify functions that represent cyclic tasks

## Description

Specify functions that represent cyclic tasks. The analysis assumes that operations in the function body:

- Can execute any number of times.
- Can be interrupted by noncyclic entry points on page 1-112, other cyclic tasks and interrupts on page 1-117.

  To model a cyclic task that cannot be interrupted by other cyclic tasks, specify the task as nonpreemptable. See `-non-preemptable-tasks`.

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node. See "Dependencies" on page 1-115 for other options you must also enable.

**Command line**: Use the option `-cyclic-tasks`. See "Command-Line Information" on page 1-115.

### Why Use This Option

Use this option to specify cyclic tasks in your multitasking code. The functions that you specify must have the prototype:

```
void function_name(void);
```

The analysis uses your specifications to look for concurrency defects. For the `Data race` defect, the software establishes the following relations between preemptable tasks and other tasks.

- *Data race between two preemptable tasks*:

Unless protected, two operations in different preemptable tasks can interfere with each other. If the operations use the same shared variable without protection, a data race can occur.

If both operations are atomic, to see the defect, you have to enable `Data race including atomic operations`.

- *Data race between a preemptable task and a nonpreemptable task or interrupt*:
  - An atomic operation in a preemptable task cannot interfere with an operation in a nonpreemptable task or an interrupt. Even if the operations use the same shared variable without protection, a data race cannot occur.
  - A nonatomic operation in a preemptable task also cannot interfere with an operation in a nonpreemptable task or an interrupt. However, the latter operation can interrupt the former. Therefore, if the operations use the same shared variable without protection, a data race can occur.

For more information, see “Concurrency Defects”.

## Settings

**No Default**

Enter function names or choose from a list.

- Click ➕ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

## Dependencies

To enable this option, first select the option `Configure multitasking manually`.

## Command-Line Information

**Parameter:** `-cyclic-tasks`
**No Default**

**Value:** `*function1*[,*function2*[,...]]`
**Example:** `polyspace-bug-finder-nodesktop -sources *file_name* -cyclic-tasks func_1,func_2`

## See Also

`-preemptable-interrupts` | `-non-preemptable-tasks` | `Interrupts (-interrupts)` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Topics

"Specify Analysis Options"
"Set Up Multitasking Analysis Manually"

Introduced in R2016b

# Interrupts (`-interrupts`)

Specify functions that represent nonpreemptable interrupts

## Description

Specify functions that represent nonpreemptable interrupts. The analysis assumes that operations in the function body:

- Can execute any number of times.
- Cannot be interrupted by noncyclic entry points on page 1-112, cyclic tasks on page 1-114 or other interrupts.

  To model an interrupt that can be interrupted by other interrupts, specify the interrupt as preemptable. See `-preemptable-interrupts`.

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node. See “Dependencies” on page 1-118 for other options you must also enable.

**Command line**: Use the option `-interrupts`. See “Command-Line Information” on page 1-119.

### Why Use This Option

Use this option to specify interrupts in your multitasking code. The functions that you specify must have the prototype:

```
void function_name(void);
```

The analysis uses your specifications to look for concurrency defects. For the `Data race` defect, the analysis establishes the following relations between interrupts and other tasks:

- *Dace race between two interrupts*:

Two operations in different interrupts cannot interfere with each other (unless one of the interrupts is preemptable). Even if the operations use the same shared variable without protection, a data race cannot occur.

- *Data race between an interrupt and another task*:

  - An operation in an interrupt cannot interfere with an atomic operation in any other task. Even if the operations use the same shared variable without protection, a data race cannot occur.
  - An operation in an interrupt can interfere with a nonatomic operation in any other task unless the other task is also a nonpreemptable interrupt. Therefore, if the operations use the same shared variable without protection, a data race can occur.

See “Concurrency Defects”.

## Settings

**No Default**

Enter function names or choose from a list.

- Click ➕ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

## Dependencies

To enable this option, first select the option `Configure multitasking manually`.

## Tips

If you specify a function as an interrupt, you must provide its definition. Otherwise, the analysis does not consider the function as an interrupt.

## Command-Line Information

**Parameter:** -interrupts<br>
**No Default**<br>
**Value:** *function1*[,*function2*[,...]]<br>
**Example:** polyspace-bug-finder-nodesktop -sources *file_name* -interrupts func_1,func_2

## See Also

-preemptable-interrupts | -non-preemptable-tasks | Cyclic tasks (-cyclic-tasks) | Entry points (-entry-points) | Critical section details (-critical-section-begin -critical-section-end) | Temporally exclusive tasks (-temporal-exclusions-file)

### Topics

"Specify Analysis Options"<br>
"Set Up Multitasking Analysis Manually"

Introduced in R2016b

# Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)

Specify routines that disable and reenable interrupts.

## Description

*This option affects a Bug Finder analysis only.*

Specify a routine that disables all interrupts and a routine that reenables all interrupts.

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node. See “Dependencies” on page 1-121 for other options you must also enable.

**Command line**: Use the option -routine-disable-interrupts and -routine-enable-interrupts. See “Command-Line Information” on page 1-122.

### Why Use This Option

The analysis uses the information to look for data race defects. For instance, in the following code, the function disable_all_interrupts disables all interrupts until the function enable_all_interrupts is called. Even if task, isr1 and isr2 run concurrently, the operations x=0 or x=1 cannot interrupt the operation x++. There are no data race defects.

```
int x;

void isr1() {
   x = 0;
}

void isr2() {
   x = 1;
}
```

```
void task() {
   disable_all_interrupts();
   x++;
   enable_all_interrupts();
}
```

## Settings

**No Default**

- In **Disabling routine**, enter the routine that disables all interrupts.
- In **Enabling routine**, enter the routine that reenables all interrupts.

Enter function names or choose from a list.

- Click ✚ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

## Dependencies

To enable this option, you must select the option, `Configure multitasking manually`.

## Tips

- The routine that you specify for the option disables preemption by all:

  - Noncylic entry points on page 1-112
  - Cyclic tasks on page 1-114
  - Interrupts on page 1-117

  In other words, the analysis considers that the body of operations between the disabling routine and the enabling routine is atomic and not interruptable at all.
- Protection via disabling interrupts is conceptually different from protection via critical sections.

In the Polyspace multitasking model, to protect two sections of code *from each other* via critical sections, you have to embed them in the same critical section. In other words, you have to place the two sections between calls to the same lock and unlock function.

For instance, suppose you use critical sections as follows:

```
void isr1() {
   begin_critical_section();
   x = 0;
   end_critical_section();
}

void isr2() {
   x = 1;
}

void task() {
   begin_critical_section();
   x++;
   end_critical_section();
}
```

Here, the operation `x++` is protected from the operation `x=0` in `isr1`, but not from the operation `x=1` in `isr2`. If the function `begin_critical_section` disabled *all interrupts*, calling it before `x++` would have been sufficient to protect it.

Typically, you use one pair of routines in your code to disable and reenable interrupts, but you can have many pairs of lock and unlock functions that implement critical sections.

## Command-Line Information

**Parameter:** `-routine-disable-interrupts` | `-routine-enable-interrupts`
**No Default**
**Value:** *`function_name`*
**Example:** `polyspace-bug_finder-nodesktop -sources` *`file_name`* `-routine-disable-interrupts atomic_section_begins -routine-enable-interrupts atomic_section_ends`

## See Also

Configure multitasking manually | Entry points (-entry-points) | Temporally exclusive tasks (-temporal-exclusions-file) | Data race | Data race including atomic operations

### Topics

"Specify Analysis Options"
"Set Up Multitasking Analysis Manually"

Introduced in R2017a

# Critical section details (`-critical-section-begin -critical-section-end`)

Specify functions that begin and end critical sections

## Description

When verifying multitasking code, Polyspace considers that a critical section lies between calls to a lock function and an unlock function.

```
lock();
/* Critical section code */
unlock();
```

Specify the lock and unlock function names for your critical sections (for instance, `lock()` and `unlock()` in above example).

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node. See “Dependencies” on page 1-125 for other options you must also enable.

**Command line**: Use the option `-critical-section-begin` and `-critical-section-end`. See “Command-Line Information” on page 1-126.

### Why Use This Option

When a task `my_task` calls a lock function `my_lock`, other tasks calling `my_lock` must wait till `my_task` calls the corresponding unlock function. Therefore, critical section operations in the other tasks cannot interrupt critical section operations in `my_task`.

For instance, the operation `var++` in `my_task1` and `my_task2` cannot interrupt each other.

```
int var;
```

```
void my_task1() {
   my_lock();
   var++;
   my_unlock();
}

void my_task2() {
   my_lock();
   var++;
   my_unlock();
}
```

The analysis uses the critical section information to look for concurrency defects such as data race and deadlock. See “Concurrency Defects”.

## Settings

**No Default**

Click ✚ to add a field.

- In **Starting routine**, enter name of lock function.
- In **Ending routine**, enter name of unlock function.

Enter function names or choose from a list.

- Click ✚ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

## Dependencies

To enable this option, first select the option `Configure multitasking manually`.

## Tips

- For function calls that begin and end critical sections, Polyspace ignores the function arguments.

  For instance, Polyspace treats the two code sections below as the same critical section.

| | |
|---|---|
| **Starting routine**: `func_begin` | **Starting routine**: `func_begin` |
| **Ending routine**: `func_end` | **Ending routine**: `func_end` |
| `void my_task1() {`<br>`   my_lock(1);`<br>`   /* Critical section code */`<br>`   my_unlock(1);`<br>`}` | `void my_task2() {`<br>`   my_lock(2);`<br>`   /* Critical section code */`<br>`   my_unlock(2);`<br>`}` |

- The functions that begin and end critical sections must be functions. For instance, if you define a function-like macro:

  ```
  #define init() num_locks++
  ```

  You cannot use the macro `init()` to begin or end a critical section.

## Command-Line Information

**Parameter:** `-critical-section-begin` | `-critical-section-end`
**No Default**
**Value:** *`function1`*`:cs1[,`*`function2`*`:cs2[,...]]`
**Example:** `polyspace-bug_finder-nodesktop -sources` *`file_name`* `-critical-section-begin func_begin:cs1 -critical-section-end func_end:cs1`

## See Also

`Configure multitasking manually` | `Entry points (-entry-points)` | `Temporally exclusive tasks (-temporal-exclusions-file)` | `Data race` | `Data race including atomic operations`

### Topics

"Specify Analysis Options"
"Set Up Multitasking Analysis Manually"

# Temporally exclusive tasks (`-temporal-exclusions-file`)

Specify entry point functions that cannot execute concurrently

## Description

Specify entry point functions that cannot execute concurrently. The execution of the functions cannot overlap with each other.

### Set Option

**User interface**: In your project configuration, the option is available on the **Multitasking** node. See “Dependencies” on page 1-128 for other options you must also enable.

**Command line**: Use the option `-temporal-exclusions-file`. See “Command-Line Information” on page 1-128.

### Why Use This Option

Use this option to implement temporal exclusion in multitasking code.

The analysis uses the temporal exclusion information to look for concurrency defects such as data race. See `Data race`.

## Settings

**No Default**

Click ✚ to add a field. In each field, enter a space-separated list of functions. Polyspace considers that the functions in the list cannot execute concurrently.

Enter the function names manually or choose from a list.

- Click ✚ to add a field and enter the function names.
- Click 🔍 to list functions in your code. Choose functions from the list.

## Dependencies

To enable this option, first select the option `Configure multitasking manually`.

## Command-Line Information

For the command-line option, create a temporal exclusions file in the following format:

- On each line, enter one group of temporally excluded tasks.
- Within a line, the tasks are separated by spaces.

**Parameter:** `-temporal-exclusions-file`
**No Default**
**Value:** Name of temporal exclusions file
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-temporal-exclusions-file "C:\exclusions_file.txt"`

## See Also

`Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Data race` | `Data race including atomic operations`

### Topics

"Specify Analysis Options"
"Set Up Multitasking Analysis Manually"

# Check MISRA C:2004 (`-misra2`)

Check for violation of MISRA C:2004 rules

## Description

Specify whether to check for violation of MISRA C:2004 rules. Each value of the option corresponds to a subset of rules to check.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependencies” on page 1-131 for other options that you must also enable.

**Command line**: Use the option `-misra2`. See “Command-Line Information” on page 1-131.

### Why Use This Option

Use this option to specify the subset of MISRA C:2004 rules to check for.

After analysis, the **Results List** pane lists the coding rule violations. On the **Source** pane, for every coding rule violation, Polyspace assigns a ▽ symbol to the keyword or identifier relevant to the violation.

## Settings

**Default:** `required-rules`

`required-rules`

Check required coding rules.

`all-rules`

Check required and advisory coding rules.

`SQO-subset1`

Check only a subset of MISRA C rules. In Polyspace Code Prover™, observing these rules can reduce the number of unproven results. For more information, see "Software Quality Objective Subsets (C:2004)".

`SQO-subset2`

Check a subset of rules including `SQO-subset1` and some additional rules. In Polyspace Code Prover, observing these rules can further reduce the number of unproven results. For more information, see "Software Quality Objective Subsets (C: 2004)".

`custom`

Specify coding rules to check. Click Edit to create a coding rules file. After creating and saving the file, to reuse it for another project, do one of the following:

- Enter full path to the file in the space provided.
- Click Edit. Click 📁 to load the file.

Format of the custom file:

```
rule number off|on
```

Use # to enter comments in the file. For example:

```
10.5 off # rule 10.5: type conversion
17.2 on # rule 17.2: pointers
```

`single-unit-rules`

Check a subset of rules that apply only to single translation units. These rules are checked in the compilation phase of the analysis.

`system-decidable-rules`

Check rules in the `single-unit-rules` subset and some rules that apply to the collective set of program files. The additional rules are the less complex rules that apply at the integration level. These rules can be checked only at the integration level because the rules involve more than one translation unit. These rules are checked in the compilation and linking phases of the analysis.

## Dependencies

- This option is available only if you set `Source code language (-lang)` to `C` or `C-CPP`.

  For projects with mixed C and C++ code, the MISRA C:2004 checker analyzes only `.c` files.
- If you set `Source code language (-lang)` to `C-CPP`, you can activate a C coding rule checker **and** a C++ coding rule checker. When you have both C and C++ coding rule checkers active, to avoid duplicate results, Polyspace does not produce the C coding rules found in the linking phase (such as MISRA C:2012 Rule 8.3).

## Tips

- To reduce unproven results in Polyspace Code Prover:

  1. Find coding rule violations in `SQO-subset1`. Fix your code to address the violations and rerun verification.
  2. Find coding rule violations in `SQO-subset2`. Fix your code to address the violations and rerun verification.
- If you select the option `single-unit-rules` or `system-decidable-rules` and choose to detect coding rule violations only, the analysis can complete quicker than checking other rules. For more information, see “Coding Rule Subsets Checked Early in Analysis”.

## Command-Line Information

**Parameter:** `-misra2`
**Value:** `required-rules | all-rules | SQO-subset1 | SQO-subset2 | single-unit-rules | system-decidable-rules |` *`file`*
**Default:** `required-rules`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-misra2 all-rules`

## See Also

`Generate results for sources and (-generate-results-for)`

## Topics

“Specify Analysis Options”
“Activate Coding Rules Checker”
“Select Specific MISRA or JSF Coding Rules”
“Polyspace MISRA C 2004 and MISRA AC AGC Checkers”
“Software Quality Objective Subsets (C:2004)”

# Check MISRA AC AGC (`-misra-ac-agc`)

Check for violation of MISRA AC AGC rules

## Description

Specify whether to check for violation of rules specified by *MISRA AC AGC Guidelines for the Application of MISRA-C:2004 in the Context of Automatic Code Generation*. Each value of the option corresponds to a subset of rules to check.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependencies” on page 1-135 for other options that you must also enable.

**Command line**: Use the option `-misra-ac-agc`. See “Command-Line Information” on page 1-135.

### Why Use This Option

Use this option to specify the subset of MISRA C:2004 AC AGC rules to check for.

After analysis, the **Results List** pane lists the coding rule violations. On the **Source** pane, for every coding rule violation, Polyspace assigns a ▽ symbol to the keyword or identifier relevant to the violation.

## Settings

**Default**: `OBL-rules`

`OBL-rules`

Check required coding rules.

`OBL-REC-rules`

Check required and recommended rules.

`all-rules`

Check required, recommended and readability-related rules.

`SQO-subset1`

Check a subset of rules. In Polyspace Code Prover, observing these rules can reduce the number of unproven results. For more information, see “Software Quality Objective Subsets (AC AGC)”.

`SQO-subset2`

Check a subset of rules including `SQO-subset1` and some additional rules. In Polyspace Code Prover, observing these rules can further reduce the number of unproven results. For more information, see “Software Quality Objective Subsets (AC AGC)”.

`custom`

Specify coding rules to check. Click Edit to create a coding rules file.

After creating and saving the file, to reuse it for another project, do one of the following:

- Enter full path to the file in the space provided.
- Click Edit. Click 📁 to load the file.

Format of the custom file:

```
rule number off|on
```

Use # to enter comments in the file. For example:

```
10.5 off # rule 10.5: type conversion
17.2 on # rule 17.2: pointers
```

`single-unit-rules`

Check a subset of rules that apply only to single translation units. These rules are checked in the compilation phase of the analysis.

This setting is not available from the drop-down list in the user interface. To choose this setting, enter the option `-misra-ac-agc single-unit-rules` in the field `Other`.

`system-decidable-rules`

Check rules in the `single-unit-rules` subset and some rules that apply to the collective set of program files. The additional rules are the less complex rules that apply at the integration level. These rules can be checked only at the integration level because the rules involve more than one translation unit. These rules are checked in the compilation and linking phases of the analysis.

This setting is not available from the drop-down list in the user interface. To choose this setting, enter the option `-misra-ac-agc system-decidable-rules` in the field `Other`.

## Dependencies

- This option is available only if you set `Source code language (-lang)` to `C` or `C-CPP`.

  For projects with mixed C and C++ code, the MISRA AC AGC checker analyzes only `.c` files.
- If you set `Source code language (-lang)` to `C-CPP`, you can activate a C coding rule checker **and** a C++ coding rule checker. When you have both C and C++ coding rule checkers active, to avoid duplicate results, Polyspace does not produce the C coding rules found in the linking phase (such as MISRA C:2012 Rule 8.3).

## Tips

- To reduce unproven results in Polyspace Code Prover:

  1. Find coding rule violations in `SQO-subset1`. Fix your code to address the violations and rerun verification.
  2. Find coding rule violations in `SQO-subset2`. Fix your code to address the violations and rerun verification.
- If you select the option `single-unit-rules` or `system-decidable-rules` and choose to detect coding rule violations only, the analysis can complete quicker than checking other rules. For more information, see “Coding Rule Subsets Checked Early in Analysis”.

## Command-Line Information

**Parameter:** `-misra-ac-agc`

**Value:** `OBL-rules` | `OBL-REC-rules` | `all-rules` | `SQO-subset1` | `SQO-subset2` | `single-unit-rules` | `system-decidable-rules` | *`file`*
**Default:** `OBL-rules`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-misra-ac-agc all-rules`

## See Also

`Generate results for sources and (-generate-results-for)`

### Topics

"Specify Analysis Options"
"Activate Coding Rules Checker"
"Select Specific MISRA or JSF Coding Rules"
"Polyspace MISRA C 2004 and MISRA AC AGC Checkers"
"MISRA C:2004 and MISRA AC AGC Coding Rules"
"Software Quality Objective Subsets (AC AGC)"

# Check MISRA C:2012 (`-misra3`)

Check for violations of MISRA C:2012 rules and directives

## Description

Specify whether to check for violations of MISRA C:2012 guidelines. Each value of the option corresponds to a subset of guidelines to check.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependencies” on page 1-139 for other options that you must also enable.

**Command line**: Use the option `-misra3`. See “Command-Line Information” on page 1-140.

### Why Use This Option

Use this option to specify the subset of MISRA C:2012 rules to check for.

After analysis, the **Results List** pane lists the coding rule violations. On the **Source** pane, for every coding rule violation, Polyspace assigns a ▽ symbol to the keyword or identifier relevant to the violation.

## Settings

**Default:** `mandatory-required`

`mandatory-required`

Check for mandatory and required guidelines.

- Mandatory guidelines: Your code must comply with these guidelines.
- Required guidelines: You may deviate from these these guidelines. However, you must complete a formal deviation record, and your deviation must be authorized.

See Section 5.4 of the MISRA C:2012 guidelines. For an example of a deviation record, see Appendix I of the MISRA C:2012 guidelines.

**Note** To turn off some required guidelines, instead of `mandatory-required` select `custom`. To clear specific guidelines, click Edit. In the **Comment** column, enter your rationale for disabling a guideline. For instance, you can enter the Deviation ID that refers to a deviation record for the guideline. The rationale appears in your generated report.

`mandatory`

Check for mandatory guidelines.

`CERT-rules`

Check for a subset of coding rules that corresponds to CERT-C rules.

See “CERT C Coding Standard and Polyspace Results”.

`CERT-all`

Check for a subset of coding rules that corresponds to CERT-C rules and recommendations.

See “CERT C Coding Standard and Polyspace Results”.

`ISO-17961`

Check for a subset of coding rules that corresponds to the ISO/IEC TS 17961 coding standard.

`all`

Check for mandatory, required, and advisory guidelines.

`SQO-subset1`

Check for only a subset of guidelines. In Polyspace Code Prover, observing these rules can reduce the number of unproven results. For more information, see “Software Quality Objective Subsets (C:2012)”.

`SQO-subset2`

Check for the subset `SQO-subset1`, plus some additional rules. In Polyspace Code Prover, observing these rules can further reduce the number of unproven results. For more information, see “Software Quality Objective Subsets (C:2012)”.

`custom`

Specify guidelines to check. Click Edit to create a coding rules file. Save the file. To reuse it for another project, do one of the following:

- Enter full path to the file in the space provided.
- Click Edit. Click 📁 to load the file.

Custom file format:

```
rule number off|on
```

Use # to enter comments in the file. For example:

```
10.5 off # rule 10.5: essential type model
17.2 on # rule 17.2: functions
```

`single-unit-rules`

Check a subset of rules that apply only to single translation units. These rules are checked in the compilation phase of the analysis.

`system-decidable-rules`

Check rules in the `single-unit-rules` subset and some rules that apply to the collective set of program files. The additional rules are the less complex rules that apply at the integration level. These rules can be checked only at the integration level because the rules involve more than one translation unit. These rules are checked in the compilation and linking phases of the analysis.

## Dependencies

- This option is available only if you set `Source code language (-lang)` to `C` or `C-CPP`.

  For projects with mixed C and C++ code, the MISRA C:2012 checker analyzes only `.c` files.
- If you set `Source code language (-lang)` to `C-CPP`, you can activate a C coding rule checker **and** a C++ coding rule checker. When you have both C and C++ coding rule checkers active, to avoid duplicate results, Polyspace does not produce the C coding rules found in the linking phase (such as MISRA C:2012 Rule 8.3).

## Tips

- To reduce unproven results in Polyspace Code Prover:

  1. Find coding rule violations in `SQO-subset1`. Fix your code to address the violations and rerun verification.
  2. Find coding rule violations in `SQO-subset2`. Fix your code to address the violations and rerun verification.
- If you select the option `single-unit-rules` or `system-decidable-rules` and choose to detect coding rule violations only, the analysis can complete quicker than checking other rules. For more information, see “Coding Rule Subsets Checked Early in Analysis”.
- Polyspace Code Prover does not support checking of the following:

  - MISRA C:2012 Directive 4.13 and 4.14
  - MISRA C:2012 Rule 21.13, 21.14, and 21.17 - 21.20
  - MISRA C:2012 Rule 22.1 - 22.4 and 22.6 - 22.10

  For support of all MISRA C: 2012 rules including the security guidelines in Amendment 1, use Polyspace Bug Finder.

## Command-Line Information

**Parameter:** `-misra3`
**Value:** `mandatory` | `mandatory-required` | `CERT-rules` | `CERT-all` | `ISO-17961` | `all` | `SQO-subset1` | `SQO-subset2` | `single-unit-rules` | `system-decidable-rules` | *`file`*
**Default:** `mandatory-required`
**Example:** `polyspace-bug-finder-nodesktop -lang c -sources` *`file_name`* `-misra3 mandatory-required`

## See Also

`Generate results for sources and (-generate-results-for)`

### Topics

“Specify Analysis Options”

“Activate Coding Rules Checker”
“Select Specific MISRA or JSF Coding Rules”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# Use generated code requirements (`-misra3-agc-mode`)

Check for violations of MISRA C:2012 rules and directives that apply to generated code

## Description

Specify whether to use the MISRA C:2012 categories for automatically generated code. This option changes which rules are mandatory, required, or advisory.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependency” on page 1-144 for other options that you must also enable.

**Command line**: Use the option `-misra3-agc-mode`. See “Command-Line Information” on page 1-144.

### Why Use This Option

Use this option to specify that you are checking for MISRA C:2012 rules in generated code. The option modifies the MISRA C:2012 subsets so that they are tailored for generated code.

## Settings

□ Off (default)

Use the normal categories (mandatory, required, advisory) for MISRA C:2012 coding guideline checking.

☑ On (default for analyses from Simulink)

Use the generated code categories (mandatory, required, advisory, readability) for MISRA C:2012 coding guideline checking.

For analyses started from the Simulink plug-in, this option is the default value.

### Category changed to **`Advisory`**

These rules are changed to advisory:

- 5.3
- 7.1
- 8.4, 8.5, 8.14
- 10.1, 10.2, 10.3, 10.4, 10.6, 10.7, 10.8
- 14.4, 14.4
- 15.2, 15.3
- 16.1, 16.2, 16.3, 16.4, 16.5, 16.6, 16.7
- 20.8

### Category changed to **`Readability`**

These guidelines are changed to readability:

- Dir 4.5
- 2.3, 2.4, 2.5, 2.6, 2.7
- 5.9
- 7.2, 7.3
- 9.2, 9.3, 9.5
- 11.9
- 13.3
- 14.2
- 15.7
- 17.5, 17.7, 17.8
- 18.5
- 20.5

## Dependency

To use this option, first select the `Check MISRA C:2012 (-misra3)` option.

## Command-Line Information

**Parameter:** `-misra3-agc-mode`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-misra3 all -misra3-agc-mode`

## See Also

`Generate results for sources and (-generate-results-for)` | `Check MISRA C:2012 (-misra3)`

### Topics

"Specify Analysis Options"
"Activate Coding Rules Checker"
"Polyspace MISRA C:2012 Checker"

# Check custom rules (`-custom-rules`)

Follow naming conventions for identifiers

## Description

Define naming conventions for identifiers and check your code against them.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node.

**Command line**: Use the option `-custom-rules`. See “Command-Line Information” on page 1-148.

### Why Use This Option

Use this option to impose naming conventions on identifiers. Using a naming convention allows you to easily determine the nature of an identifier from its name. For instance, if you define a naming convention for structures, you can easily tell whether an identifier represents a structured variable or not.

After analysis, the **Results List** pane lists violations of the naming conventions. On the **Source** pane, for every violation, Polyspace assigns a ▼ symbol to the keyword or identifier relevant to the violation.

## Settings

☑ On

Polyspace matches identifiers in your code against text patterns you define. Define the text patterns in a custom coding rules file. To create a coding rules file,

- Use the custom rules wizard:

1. Click Edit. The New File window opens.
2. From the drop-down list **Set the following state to all Custom C**, select `Off`. Click **Apply**.
3. For every custom rule you want to check:

   a. Select **On**●.

   b. In the **Convention** column, enter the error message you want to display if the rule is violated.

      For example, for rule 4.3, **All struct fields must follow the specified pattern**, you can enter `All struct fields must begin with s_`. This message appears on the **Result Details** pane if:

      - You specify the **Pattern** as `s_[A-Za-z0-9_]+`.
      - A structure field in your code does not begin with `s_`.

   c. In the **Pattern** column, enter the text pattern.

      For example, for rule 4.3, **All struct fields must follow the specified pattern**, you can enter `s_[A-Za-z0-9_]+`. Polyspace reports violation of rule 4.3 if a structure field does not begin with `s_`.

      You can use Perl regular expressions to define patterns. For instance, you can use the following expressions.

| Expression | Meaning |
|---|---|
| `.` | Matches any single character except newline |
| `[a-z0-9]` | Matches any single letter in the set `a-z`, or digit in the set `0-9` |
| `[^a-e]` | Matches any single letter not in the set `a-e` |
| `\d` | Matches any single digit |
| `\w` | Matches any single alphanumeric character or `_` |
| `x?` | Matches 0 or 1 occurrence of `x` |
| `x*` | Matches 0 or more occurrences of `x` |
| `x+` | Matches 1 or more occurrences of `x` |

For frequent patterns, you can use the following regular expressions:

- `(?!__)[a-z0-9_]+(?!__)`, matches a text pattern that does not start and end with two underscores.

  ```
  int __text; //Does not match
  int _text_; //Matches
  ```

- `[a-z0-9_]+_(u8|u16|u32|s8|s16|s32)` , matches a text pattern that ends with a specific suffix.

  ```
  int _text_; //Does not match
  int _text_s16; //Matches
  int _text_s33; // Does not match
  ```

- `[a-z0-9_]+_(u8|u16|u32|s8|s16|s32)(_b3|_b8)?` , matches a text pattern that ends with a specific suffix and an optional second suffix.

  ```
  int _text_s16; //Matches
  int _text_s16_b8; //Matches
  ```

For a complete list of regular expressions, see Perl documentation.

- Manually edit an existing custom coding rules file:

  1. Open the file with a text editor.
  2. For every custom rule you want to check, enter the following information in adjacent lines.

     a. Rule number, followed by `on`. For example:

     ```
     4.3 on
     ```

     b. The error message you want to display starting with `convention=`. For example:

     ```
     convention=All struct fields must begin with s_
     ```

     c. The text pattern starting with `pattern=`. For example:

     ```
     pattern=s_[A-Za-z0-9_]
     ```

To use an existing coding rules file, enter the full path to the file in the field provided or use 📁 in the New File window to navigate to the file location.

□ Off (default)

Polyspace does not check your code against custom naming conventions.

## Command-Line Information

**Parameter:** `-custom-rules`
**Value:** Name of coding rules file
**Default**: Off
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-custom-rules "C:\Rules\myrules.txt"`

## See Also

### Topics

“Specify Analysis Options”
“Activate Coding Rules Checker”
“Create Custom Coding Rules”
“Format of Custom Coding Rules File”
“Custom Coding Rules”

# Effective boolean types (`-boolean-types`)

Specify data types that coding rule checker must treat as effectively Boolean

## Description

Specify data types that the coding rule checker must treat as effectively Boolean. You can specify a data type only if you have defined it through a `typedef` statement in your source code.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependencies” on page 1-151 for other options that you must also enable.

**Command line**: Use the option `-boolean-types`. See “Command-Line Information” on page 1-151.

### Why Use This Option

Use this option to allow Polyspace to check the following coding rules:

- MISRA C: 2004 and MISRA AC AGC

| Rule Number | Rule Statement |
|---|---|
| 12.6 | Operands of logical operators, `&&`, `\|\|`, and `!`, should be effectively Boolean. Expressions that are effectively Boolean should not be used as operands to other operators. |
| 13.2 | Tests of a value against zero should be made explicit, unless the operand is effectively Boolean. |
| 15.4 | A `switch` expression should not represent a value that is effectively Boolean. |

- MISRA C: 2012

| Rule Number | Rule Statement |
|---|---|
| 10.1 on page 5-141 | Operands shall not be of an inappropriate essential type |
| 10.3 on page 5-150 | The value of an expression shall not be assigned to an object with a narrower essential type or of a different essential type category |
| 10.5 on page 5-154 | The value of an expression should not be cast to an inappropriate essential type |
| 14.4 on page 5-225 | The controlling expression of an if statement and the controlling expression of an iteration-statement shall have essentially Boolean type. |
| 16.7 on page 5-263 | A switch-expression shall not have essentially Boolean type. |

For example, in the following code, unless you specify `myBool` as effectively Boolean, Polyspace detects a violation of MISRA C: 2012 rule 14.4.

```
typedef int myBool;

void func1(void);
void func2(void);

void func(myBool flag) {
    if(flag)
        func1();
    else
        func2();
}
```

## Settings

**No Default**

Click ✚ to add a field. Enter a type name that you want Polyspace to treat as Boolean.

## Dependencies

This option is available only if you select `Check MISRA AC AGC (-misra-ac-agc)`, `Check MISRA C:2004 (-misra2)`, or `Check MISRA C:2012 (-misra3)`.

## Command-Line Information

**Parameter:** `-boolean-types`
**Value:** `*type1*[,*type2*[,...]]`
**No Default**
**Example:** `polyspace-bug-finder-nodesktop -sources *filename* -misra2 required-rules -boolean-types boolean1_t,boolean2_t`

## See Also

`Check MISRA AC AGC (-misra-ac-agc)` | `Check MISRA C:2004 (-misra2)` | `Check MISRA C:2012 (-misra3)`

### Topics

"Activate Coding Rules Checker"
"Specify Boolean Types"
"MISRA C:2004 and MISRA AC AGC Coding Rules"

# Allowed pragmas (`-allowed-pragmas`)

Specify pragma directives for which MISRA C:2004 rule 3.4 must not be applied

## Description

Specify pragma directives for which MISRA C:2004 rule 3.4 or MISRA C++ rule 16-6-1 must not be applied.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependencies” on page 1-153 for other options that you must also enable.

**Command line**: Use the option `-allowed-pragmas`. See “Command-Line Information” on page 1-153.

### Why Use This Option

MISRA C:2004/MISRA AC AGC rule 3.4 and MISRA C++ rule 16-6-1 require that all pragma directives are documented within the documentation of the compiler. If you list a pragma as documented using this analysis option, Polyspace does not flag use of the pragma as a violation of these rules.

## Settings

**No Default**

Click ✚ to add a field. Enter the pragma name that you want Polyspace to ignore during coding rule checking .

## Dependencies

This option is enabled only if you select one of the following options:

- `Check MISRA C:2004 (-misra2)`
- `Check MISRA AC AGC (-misra-ac-agc).`
- `Check MISRA C++ rules (-misra-cpp)`

## Command-Line Information

**Parameter:** `-allowed-pragmas`
**Value:** `*pragma1*[,*pragma2*[,...]]`
**No Default**
**Example:** `polyspace-bug-finder-nodesktop -sources *filename* -misra-cpp required-rules -allowed-pragmas pragma_01,pragma_02`
**Example:** `polyspace-bug-finder-nodesktop -sources *filename* -misra2 required-rules -allowed-pragmas pragma_01,pragma_02`

## See Also

`Check MISRA C:2004 (-misra2)` | `Check MISRA AC AGC (-misra-ac-agc)` | `Check MISRA C++ rules (-misra-cpp)`

### Topics

"Activate Coding Rules Checker"
"MISRA C:2004 and MISRA AC AGC Coding Rules"
"MISRA C++ Coding Rules"

# Check MISRA C++ rules (`-misra-cpp`)

Check for violations of MISRA C++ rules

## Description

Specify whether to check for violation of MISRA C++ rules. Each value of the option corresponds to a subset of rules to check.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependency” on page 1-155 for other options that you must also enable.

**Command line**: Use the option `-misra-cpp`. See “Command-Line Information” on page 1-156.

### Why Use This Option

Use this option to specify the subset of MISRA C++ rules to check for.

After analysis, the **Results List** pane lists the coding rule violations. On the **Source** pane, for every coding rule violation, Polyspace assigns a ▽ symbol to the keyword or identifier relevant to the violation.

## Settings

**Default:** `required-rules`

`required-rules`

Check required coding rules.

`all-rules`

Check required and advisory coding rules.

`SQO-subset1`

Check only a subset of MISRA C++ rules. In Polyspace Code Prover, observing these rules can reduce the number of unproven results. For more information, see “Software Quality Objective Subsets (C++)”.

`SQO-subset2`

Check a subset of rules including `SQO-subset1` and some additional rules. In Polyspace Code Prover, observing these rules can further reduce the number of unproven results. For more information, see “Software Quality Objective Subsets (C++)”

`custom`

Specify coding rules to check. Click Edit to create a coding rules file.

After creating and saving the file, to reuse it for another project, do one of the following:

- Enter full path to the file in the space provided.
- Click Edit. Click 📁 to load the file.

Format of the custom file:

```
<rule number> off|on
```

Use `#` to enter comments in the file. For example:

```
9-5-1 off # rule 9-5-1: classes
15-0-2 on # rule 15-0-2: exception handling
```

## Dependency

This option is available only if you set `Source code language (-lang)` to `CPP` or `C-CPP`.

For projects with mixed C and C++ code, the MISRA C++ checker analyzes only `.cpp` files.

## Command-Line Information

**Parameter:** `-misra-cpp`
**Value:** `required-rules` | `all-rules` | `SQO-subset1` | `SQO-subset2` | *`file`*
**Default:** `required-rules`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-misra-cpp all-rules`

## See Also

`Generate results for sources and (-generate-results-for)`

### Topics

"Specify Analysis Options"
"Activate Coding Rules Checker"
"Select Specific MISRA or JSF Coding Rules"
"Polyspace MISRA C++ Checker"
"Software Quality Objective Subsets (C++)"
"MISRA C++ Coding Rules"

# Check JSF C++ rules (`-jsf-coding-rules`)

Check for violations of JSF C++ rules

## Description

Specify whether to check for violation of JSF C++ rules (JSF++:2005). Each value of the option corresponds to a subset of rules to check.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node. See “Dependency” on page 1-158 for other options that you must also enable.

**Command line**: Use the option `-jsf-coding-rules`. See “Command-Line Information” on page 1-159.

### Why Use This Option

Use this option to specify the subset of JSF C++ rules to check for.

After analysis, the **Results List** pane lists the coding rule violations. On the **Source** pane, for every coding rule violation, Polyspace assigns a ▽ symbol to the keyword or identifier relevant to the violation.

## Settings

**Default:** `shall-rules`

`shall-rules`

Check all **Shall** rules. **Shall** rules are mandatory requirements and require verification.

`shall-will-rules`

Check all **Shall** and **Will** rules. **Will** rules are intended to be mandatory requirements but do not require verification.

`all-rules`

Check all **Shall**, **Will**, and **Should** rules. **Should** rules are advisory rules.

`custom`

Specify coding rules to check. Click Edit to create a coding rules file.

After creating and saving the file, to reuse it for another project, do one of the following:

- Enter full path to the file in the space provided.
- Click Edit. Click 📁 to load the file.

Format of the custom file:

```
<rule number> off|on
```

Use # to enter comments in the file. For example:

```
67 off # rule 67: classes
202 on # rule 202: expressions
```

## Tips

- If your project uses a setting other than `iso` for `Compiler (-compiler)`, some rules might not be completely checked. For example, AV Rule 8: “All code shall conform to ISO/IEC 14882:2002(E) standard C++.”

## Dependency

This option is available only if you set `Source code language (-lang)` to `CPP` or `C-CPP`.

For projects with mixed C and C++ code, the JSF C++ checker analyzes only `.cpp` files.

## Command-Line Information

**Parameter:** `-jsf-coding-rules`
**Value:** `shall-rules` | `shall-will-rules` | `all-rules` | *`file`*
**Default:** `shall-rules`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-jsf-coding-rules all-rules`

## See Also

`Generate results for sources and (-generate-results-for)`

### Topics

"Specify Analysis Options"
"Activate Coding Rules Checker"
"Select Specific MISRA or JSF Coding Rules"
"Polyspace JSF C++ Checker"
"JSF C++ Coding Rules"

# Calculate code metrics (`-code-metrics`)

Compute and display code complexity metrics

## Description

Specify that Polyspace must compute and display code complexity metrics for your source code. The metrics include file metrics such as number of lines and function metrics such as cyclomatic complexity and estimated size of local variables.

For more information, see “Code Metrics”.

### Set Option

**User interface**: In your project configuration, the option is on the **Coding Rules & Code Metrics** node.

**Command line**: Use the option `-code-metrics`. See “Command-Line Information” on page 1-161.

### Why Use This Option

By default, Polyspace does not calculate code complexity metrics. If you want these metrics in your analysis results, before running analysis, set this option.

High values of code complexity metrics can lead to obscure code and increase chances of coding errors. Additionally, if you run a Code Prover verification on your source code, you might benefit from checking your code complexity metrics first. If a function is too complex, attempts to verify the function can lead to a lot of unproven code. For information on how to cap your code complexity metrics, see “Review Code Metrics”.

## Settings

☑ On

Polyspace computes and displays code complexity metrics on the **Results List** pane.

□ Off (default)

Polyspace does not compute complexity metrics.

## Tips

If you want to compute only the code complexity metrics for your code:

- In Bug Finder, disable checking of defects. See `Find defects (-checkers)`.
- In Code Prover, run verification upto the `Source Compliance Checking` phase. See `Verification level (-to)`.

## Command-Line Information

**Parameter:** `-code-metrics`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -sources file_name -code-metrics`

# Find defects (`-checkers`)

Enable or disable defect checkers

## Description

*This option affects a Bug Finder analysis only.*

Enable checkers for bugs/coding defects.

### Set Option

**User interface**: In your project configuration, the option is on the **Bug Finder Analysis** node.

**Command line**: Use the option `-checkers`. See "Command-Line Information" on page 1-163.

### Why Use This Option

The default set of checkers is designed to find the most meaningful bugs in most software development situations. If you have specific needs, enable or disable individual defect checkers. For instance, if you want to follow a specific security standard, choose a different subset of checkers.

## Settings

**Default:** `default`

`default`

A subset of defects defined by the software. For information on which defects are default, refer to the individual defect reference pages.

`all`

All defects.

`CWE`

A subset of defects that correspond to CWE™ IDs.

See “CWE Coding Standard and Polyspace Results”.

`CERT-rules`

A subset of defects that corresponds to CERT-C rules.

See “CERT C Coding Standard and Polyspace Results”.

`CERT-all`

A subset of defects that corresponds to CERT-C rules and recommendations.

See “CERT C Coding Standard and Polyspace Results”.

`ISO-17961`

A subset of defects that corresponds to ISO/IEC TS 17961 coding standard.

See “ISO/IEC TS 17961 Coding Standard and Polyspace Results”.

`custom`

Choose the defects you want to find by selecting categories of checkers or specific defects.

## Tips

You can use a spreadsheet to keep track of the defect checkers that you enable and add notes explaining why you do not enable the other checkers. A spreadsheet of checkers is provided in *`matlabroot`*`\polyspace\resources`. Here, *`matlabroot`* is the MATLAB installation folder, such as `C:\Program Files\MATLAB\R2017a`.

## Command-Line Information

Regardless of order, the shell script processes the `-checkers` option, and then `-disable-checkers` option.

Refer to the individual defect reference pages for the command-line parameters values.
**Parameter:** `-checkers`

**Value:** `default | all | CWE | CERT-rules | CERT-all | ISO-17961 |` defect group | defect parameters
**Default:** `default`
**Parameter:** `-disable-checkers`
**Value:** defect group | defect parameter
**Example 1:** `polyspace-bug-finder-nodesktop -sources` *`filename`* `-checkers numerical,dataflow -disable-checkers FLOAT_ZERO_DIV`
**Example 2:** `polyspace-bug-finder-nodesktop -sources` *`filename`* `-checkers default -disable-checkers concurrency,dead_code`

## See Also

"Defects"

### Topics

"Specify Analysis Options"
"Bug Finder Defect Groups"

# Class (`-class-analyzer`)

Specify classes that you want to verify

## Description

*This option affects a Code Prover analysis only.*

Specify classes that Polyspace uses to generate a `main`.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-166 for other options that you must also enable.

**Command line**: Use the option `-class-analyzer`. See “Command-Line Information” on page 1-166.

### Why Use This Option

If you are verifying a module or library, Code Prover generates a `main` function if one does not exist. If a `main` exists, the analysis uses the existing `main`.

Use this option and the option `Functions to call within the specified classes (-class-analyzer-calls)` to specify the class methods that the generated `main` must call. Unless a class method is called directly or indirectly from `main`, the software does not analyze the method.

## Settings

**Default**: `all`

`all`

Polyspace can use all classes to generate a `main`. The generated `main` calls methods that you specify using **Functions to call within the specified classes**.

`none`

The generated `main` cannot call any class method.

`custom`

Polyspace can use classes that you specify to generate a `main`. The generated `main` calls methods from classes that you specify using **Functions to call within the specified classes**.

## Dependencies

You can use this option only if all of the following are true:

- Your code does not contain a `main` function.
- `Source code language (-lang)` is set to `CPP`.
- `Verify module or library (-main-generator)` is selected.

## Tips

If you select `none` for this option, Polyspace will not verify class methods that you do not call explicitly in your code.

## Command-Line Information

**Parameter:** `-class-analyzer`
**Value:** `all` | `none` | `custom=`*`class1`*`[,`*`class2`*`,...]`
**Default:** `all`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-main-generator -class-analyzer custom=myClass1,myClass2`

## See Also

`Verify module or library (-main-generator)` | `Functions to call within the specified classes (-class-analyzer-calls)` | `Analyze class contents` only (-class-only) | Skip member initialization check (-no-constructors-init-check)

## Topics

"Specify Analysis Options" (Polyspace Code Prover)
"Verify C++ Classes" (Polyspace Code Prover)

# Functions to call within the specified classes (-class-analyzer-calls)

Specify class methods that you want to verify

## Description

*This option affects a Code Prover analysis only.*

Specify class methods that Polyspace uses to generate a `main`. The generated `main` can call static, public and protected methods in classes that you specify using the **Class** option.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-170 for other options that you must also enable.

**Command line**: Use the option `-class-analyzer-calls`. See “Command-Line Information” on page 1-170.

### Why Use This Option

If you are verifying a module or library, Code Prover generates a `main` function if one does not exist. If a `main` exists, the analysis uses the existing `main`.

Use this option and the option `Class (-class-analyzer)` to specify the class methods that the generated `main` must call. Unless a class method is called directly or indirectly from `main`, the software does not analyze the method.

## Settings

**Default**: `unused`

`all`

The generated `main` calls all public and protected methods. It does not call methods inherited from a parent class.

`all-public`

The generated `main` calls all public methods. It does not call methods inherited from a parent class.

`inherited-all`

The generated `main` calls all public and protected methods including those inherited from a parent class.

`inherited-all-public`

The generated `main` calls all public methods including those inherited from a parent class.

`unused`

The generated `main` calls public and protected methods that are not called in the code.

`unused-public`

The generated `main` calls public methods that are not called in the code. It does not call methods inherited from a parent class.

`inherited-unused`

The generated `main` calls public and protected methods that are not called in the code including those inherited from a parent class.

`inherited-unused-public`

The generated `main` calls public methods that are not called in the code including those inherited from a parent class.

`custom`

The generated `main` calls the methods that you specify.

Enter function names or choose from a list.

- Click ✚ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

If you use the scope resolution operator to specify the function from a particular namespace, enter the fully qualified name, for instance, `myClass::myMethod(int)`.

If the function does not have a parameter, use an empty parenthesis, for instance, `myClass::myMethod()`.

## Dependencies

You can use this option only if:

- `Source code language (-lang)` is set to `CPP`.
- `Verify module or library (-main-generator)` is selected.

## Command-Line Information

**Parameter:** `-class-analyzer-calls`
**Value:** `all` | `all-public` | `inherited-all` | `inherited-all-public` | `unused` | `unused-public` | `inherited-unused` | `inherited-unused-public` | `custom=`*`method1`*`[,`*`method2`*`,...]`
**Default:** `unused`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-main-generator -class-analyzer custom=myClass1,myClass2 -class-analyzer-calls unused-public`

## See Also

`Verify module or library (-main-generator)` | `Class (-class-analyzer)` | `Analyze class contents only (-class-only)` | `Skip member initialization check (-no-constructors-init-check)`

### Topics

"Specify Analysis Options" (Polyspace Code Prover)
"Verify C++ Classes" (Polyspace Code Prover)

# Analyze class contents only (-class-only)

Do not analyze code other than class methods

## Description

*This option affects a Code Prover analysis only.*

Specify that Polyspace must verify only methods of classes that you specify using the option `Class (-class-analyzer)`.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-172 for other options that you must also enable.

**Command line**: Use the option `-class-only`. See “Command-Line Information” on page 1-172.

### Why Use This Option

If you are verifying a module or library, Code Prover generates a `main` function if one does not exist. If a `main` exists, the analysis uses the existing `main`.

Use the following options to specify the class methods that the generated `main` must call:

- `Class (-class-analyzer)`
- `Functions to call within the specified classes (-class-analyzer-calls)`

Unless a class method is called directly or indirectly from `main`, the software does not analyze the method. Use this option to specify that only the class methods must be analyzed and not other functions.

Using these three options, you can check your classes for robustness against run-time errors.

## Settings

☑ On

Polyspace verifies the class methods only. It stubs functions out of class scope even if the functions are defined in your code.

□ Off (default)

Polyspace verifies functions out of class scope in addition to class methods.

## Dependencies

You can use this option only if all of the following are true:

- Your code does not contain a `main` function.
- `Source code language (-lang)` is set to `CPP`.
- `Verify module or library (-main-generator)` is selected.

If you select this option, you must specify the classes using the`Class (-class-analyzer)` option.

## Tips

Use this option:

- For robustness verification of class methods. Unless you use this option, Polyspace verifies methods that you call in your code only for your input combinations.
- In case of scaling.

## Command-Line Information

**Parameter:** `-class-only`
**Default**: Off

## See Also

`Verify module or library (-main-generator)` | `Class (-class-analyzer)` | `Functions to call within the specified classes (-class-analyzer-`

calls) | Skip member initialization check (-no-constructors-init-check)

## Topics

"Specify Analysis Options" (Polyspace Code Prover)
"Verify C++ Classes" (Polyspace Code Prover)

# Initialization functions (`-functions-called-before-main`)

Specify functions that you want the generated `main` to call ahead of other functions

## Description

*This option affects a Code Prover analysis only.*

Specify functions that you want the generated `main` to call ahead of other functions.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-175 for other options that you must also enable.

**Command line**: Use the option `-functions-called-before-main`. See “Command-Line Information” on page 1-176.

### Why Use This Option

If you are verifying a module or library, Code Prover generates a `main` function if one does not exist. If a `main` exists, the analysis uses the existing `main`.

Use this option along with the option `Functions to call (-main-generator-calls)` to specify which functions the generated `main` must call. Unless a function is called directly or indirectly from `main`, the software does not analyze the function.

## Settings

**No Default**

Enter function names or choose from a list.

- Click ➕ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

If the function or method is not overloaded, specify the function name. Otherwise, specify the function prototype with arguments. For instance, in the following code, you must specify the prototypes `func(int)` and `func(double)`.

```
int func(int x) {
 return(x * 2);
}
double func(double x) {
 return(x * 2);
}
```

For C++, if the function is:

- A class method: The generated `main` calls the class constructor before calling this function.
- Not a class method: The generated `main` calls this function before calling class methods.

If you use the scope resolution operator to specify the function from a particular namespace, enter the fully qualified name, for instance, `myClass::init(int)`. If the function does not have a parameter, use an empty parenthesis, for instance, `myClass::init()`.

## Dependencies

This option is enabled only if you select **Verify module or library** under **Code Prover Verification** and your code does not contain a `main` function.

## Tips

Although these functions are called ahead of other functions, they can be called in arbitrary order. If you want to call your initialization functions in a specific order, manually write a `main` function to call them.

## Command-Line Information

**Parameter:** `-functions-called-before-main`
**Value:** `*function1*[,*function2*[,...]]`
**No Default**
**Example:** `polyspace-code-prover-nodesktop -sources *file_name* -main-generator -functions-called-before-main myfunc`
**Example:** `polyspace-code-prover-nodesktop -sources *file_name* -main-generator -functions-called-before-main myClass::init(int)`

## See Also

`Verify module or library (-main-generator)` | `Variables to initialize (-main-generator-writes-variables)` | `Functions to call (-main-generator-calls)` | `Class (-class-analyzer)` | `Functions to call within the specified classes (-class-analyzer-calls)` | `Analyze class contents only (-class-only)`

### Topics

"Verify C Application Without main Function" (Polyspace Code Prover)

# Verify whole application

Stop verification if sources files are incomplete and do not contain a `main` function

## Description

*This option affects a Code Prover analysis only.*

Specify that Polyspace verification must stop if a `main` function is not present in the source files.

If you select a Visual C++ setting for `Compiler (-compiler)`, you can specify which function must be considered as `main`. See `Main entry point (-main)`.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node.

**Command line**: There is no corresponding command-line option. See “Command-Line Information” on page 1-178.

## Settings

● On

Polyspace verification stops if it does not find a `main` function in the source files.

○ Off (default)

Polyspace continues verification even when a `main` function is not present in the source files. If a `main` is not present, it generates a file `__polyspace_main.c` that contains a `main` function.

## Command-Line Information

Unlike the user interface, by default, a verification from the command line stops if it does not find a `main` function in the source files. If you specify the option `-main-generator`, Polyspace generates a `main` if it cannot find one in the source files.

## See Also

`Verify module or library (-main-generator)`

### Topics

"Verify C Application Without main Function" (Polyspace Code Prover)

# Main entry point (-main)

Specify a Microsoft Visual C++ extensions of main

## Description

*This option affects a Code Prover analysis only.*

Specify the function that you want to use as main. If the function does not exist, the verification stops with an error message. Use this option to specify Microsoft Visual C++ extensions of main.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See "Dependencies" on page 1-180 for other options that you must also enable.

**Command line**: Use the option -main. See "Command-Line Information" on page 1-180.

## Settings

**Default:** _tmain

_tmain

Use _tmain as entry point to your code.

wmain

Use wmain as entry point to your code.

_tWinMain

Use _tWinMain as entry point to your code.

wWinMain

Use wWinMain as entry point to your code.

`WinMain`

Use `WinMain` as entry point to your code.

`DllMain`

Use `DllMain` as entry point to your code.

## Dependencies

This option is enabled only if you:

- Set `Source code language (-lang)` to `CPP`.
- Set **Target operation system** (`-target`) to `Visual`.
- Select **Verify whole application**

## Command-Line Information

**Parameter:** `-main`
**Value:** `_tmain` | `wmain` | `_tWinMain` | `wWinMain` | `WinMain` | `DllMain`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-OS-target visual -main _tmain`

## See Also

`Verify module or library (-main-generator)`

# Functions to call (`-main-generator-calls`)

Specify functions that you want the generated `main` to call after the initialization functions

## Description

*This option affects a Code Prover analysis only.*

Specify functions that you want the generated `main` to call. The `main` calls these functions after the ones you specify through the option `Initialization functions (-functions-called-before-main)`.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-182 for other options that you must also enable.

**Command line**: Use the option `-main-generator-calls`. See “Command-Line Information” on page 1-183.

### Why Use This Option

If you are verifying a module or library, Code Prover generates a `main` function if one does not exist. If a `main` exists, the analysis uses the existing `main`.

Use this option along with the option `Initialization functions (-functions-called-before-main)` to specify which functions the generated `main` must call. Unless a function is called directly or indirectly from `main`, the software does not analyze the function.

## Settings

**Default:** `unused`

`none`

The generated `main` does not call any function.

`unused`

The generated `main` calls only those functions that are not called in the source code. It does not call inlined functions.

`all`

The generated `main` calls all functions except inlined ones.

`custom`

The generated `main` calls functions that you specify.

Enter function names or choose from a list.

- Click ➕ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

If you use the scope resolution operator to specify the function from a particular namespace, enter the fully qualified name, for instance, `myClass::myMethod(int)`. If the function does not have a parameter, use an empty parenthesis, for instance, `myClass::myMethod()`.

## Dependencies

This option is available only if you select `Verify module or library (-main-generator)`.

## Tips

- Select `unused` when you use **Code Prover Verification > Verify files independently**.
- If you want the generated `main` to call an inlined function, select `custom` and specify the name of the function.
- To verify a multitasking application without a main, select `none`.

- The generated `main` can call the functions in arbitrary order. If you want to call your functions in a specific order, manually write a `main` function to call them.

## Command-Line Information

**Parameter:** `-main-generator-calls`
**Value:** `none` | `unused` | `all` | `custom=`*`function1`*`[,`*`function2`*`[,...]]`
**Default:** `unused`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-main-generator -main-generator-calls all`

## See Also

`Verify module or library (-main-generator)` | `Variables to initialize (-main-generator-writes-variables)` | `Initialization functions (-functions-called-before-main)` | `Class (-class-analyzer)` | `Functions to call within the specified classes (-class-analyzer-calls)` | `Analyze class contents only (-class-only)`

### Topics

"Verify C Application Without main Function" (Polyspace Code Prover)

# Variables to initialize (`-main-generator-writes-variables`)

Specify global variables that you want the generated `main` to initialize

## Description

*This option affects a Code Prover analysis only.*

Specify global variables that you want the generated `main` to initialize. Polyspace considers these variables to have any value allowed by their type.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-185 for other options that you must also enable.

**Command line**: Use the option `-main-generator-writes-variables`. See “Command-Line Information” on page 1-185.

### Why Use This Option

If you are verifying a module or library, Code Prover generates a `main` function if one does not exist. If a `main` exists, the analysis uses the existing `main`.

Use this option to specify which global variables the generated `main` must initialize.

## Settings

**Default:**

- C code — `public`
- C++ Code — `uninit`

uninit

C++ Only

The generated main only initializes global variables that you have not initialized during declaration.

none

The generated main does not initialize global variables.

public

The generated main initializes all global variables except those declared with keywords static and const.

all

The generated main initializes all global variables except those declared with keyword const.

custom

The generated main only initializes global variables that you specify. Click ➕ to add a field. Enter a global variable name.

## Dependencies

You can use this option only if the following are true:

- Your code does not contain a main function.
- Verify module or library (-main-generator) is selected.

## Command-Line Information

**Parameter:** -main-generator-writes-variables
**Value:** uninit | none | public | all | custom=*variable1*[,*variable2*[,...]]
**Default:** (C) public | (C++) uninit
**Example:** polyspace-code-prover-nodesktop -sources *file_name* -main-generator -main-generator-writes-variables all

## See Also

Verify module or library (-main-generator) | Initialization functions (-functions-called-before-main) | Functions to call (-main-generator-calls) | Class (-class-analyzer) | Functions to call within the specified classes (-class-analyzer-calls) | Analyze class contents only (-class-only)

### Topics

"Verify C Application Without main Function" (Polyspace Code Prover)

# Skip member initialization check (-no-constructors-init-check)

Do not check if class constructor initializes class members

## Description

*This option affects a Code Prover analysis only.*

Specify that Polyspace must not check whether each class constructor initializes all class members.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-188 for other options that you must also enable.

**Command line**: Use the option `-no-constructors-init-check`. See “Command-Line Information” on page 1-188.

### Why Use This Option

Use this option to disable checks for initialization of class members in constructors.

## Settings

☑ On

Polyspace does not check whether each class constructor initializes all class members.

□ Off (default)

Polyspace checks whether each class constructor initializes all class members. It uses the functions `check_NIV()` and `check_NIP()` in the generated `main` to perform these checks. It checks for initialization of:

- Integer types such as `int`, `char` and `enum`, both `signed` or `unsigned`.
- Floating-point types such as `float` and `double`.
- Pointers.

## Dependencies

You can use this option only if all of the following are true:

- Your code does not contain a `main` function.
- `Source code language (-lang)` is set to `CPP`.
- `Verify module or library (-main-generator)` is selected.

If you select this option, you must specify the classes using the`Class (-class-analyzer)` option.

## Command-Line Information

**Parameter:** `-no-constructors-init-check`
**Default**: Off

## See Also

`Verify module or library (-main-generator)` | `Class (-class-analyzer)`

### Topics

"Specify Analysis Options" (Polyspace Code Prover)

# Verify files independently (`-unit-by-unit`)

Verify each source file independently of other source files

## Description

*This option affects a Code Prover analysis only.*

Specify that each source file must be verified independently of other source files. Each file is verified individually, independent of other files in the module. Verification results can be viewed for the entire project or for individual files.

After you open the verification result for one file, you can see a summary of results for all files on the **Dashboard** pane. You can open the results for each file directly from this summary table. For more information, see “Run File-by-File Local Verification” (Polyspace Code Prover).

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-190 for other options that you must also enable.

**Command line**: Use the option `-unit-by-unit`. See “Command-Line Information” on page 1-190.

### Why Use This Option

There are many reasons you might want to verify each source file independently of other files.

For instance, if verification of a project takes very long, you can perform a file by file verification to identify which file is slowing the verification.

## Settings

☑ On

Polyspace creates a separate verification job for each source file.

□ Off (default)

Polyspace creates a single verification job for all source files in a module.

## Dependencies

This option is enabled only if you select `Verify module or library (-main-generator)`.

## Tips

- If you perform a file by file verification, you cannot specify multitasking options.
- If your verification for the entire project takes very long, perform a file by file verification. After the verification is complete for a file, you can view the results while other files are still being verified.
- You can generate a report of the verification results for each file or for all the files together.

  To generate a single report for all the files:

  1. Open the results for one file.
  2. Select **Reporting** > **Run Report**. Before generating the report, select the option **Generate a single report including all unit results**.

## Command-Line Information

**Parameter:** `-unit-by-unit`
**Default**: Off
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-unit-by-unit`

## See Also

`Common source files (-unit-by-unit-common-source)`

### Topics

“Run File-by-File Local Verification” (Polyspace Code Prover)
“Run File-by-File Remote Verification” (Polyspace Code Prover)
“Multiple File Error in File by File Verification” (Polyspace Code Prover)

# Common source files (`-unit-by-unit-common-source`)

Specify files that you want to include with each source file during a file by file verification

## Description

*This option affects a Code Prover analysis only.*

For a file by file verification, specify files that you want to include with each source file verification. These files are compiled once, and then linked to each verification.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node. See “Dependencies” on page 1-193 for other options that you must also enable.

**Command line**: Use the option `-unit-by-unit-common-source`. See “Command-Line Information” on page 1-193.

### Why Use This Option

There are many reasons you might want to verify each source file independently of other files. For instance, if verification of a project takes very long, you can perform a file by file verification to identify which file is slowing the verification.

If you perform a file by file verification, some of your files might be missing information present in the other files. Place the missing information in a common file and use this option to specify the file for verification. For instance, if multiple source files call the same function, use this option to specify a file that contains the function definition or a function stub. Otherwise, Polyspace uses its own stubs for functions that are called but not defined in the source files. The assumptions behind the Polyspace stubs can be broader than what you want, leading to orange checks.

## Settings

**No Default**

Click ✚ to add a field. Enter the full path to a file. Otherwise, use the 📁 button to navigate to the file location.

## Dependencies

This option is enabled only if you select `Verify files independently (-unit-by-unit)`.

## Command-Line Information

**Parameter:** `-unit-by-unit-common-source`
**Value:** `*file1*[,*file2*[,...]]`
**No Default**
**Example:** `polyspace-code-prover-nodesktop -sources *file_name* -unit-by-unit -unit-by-unit-common-source definitions.c`

## See Also

`Verify files independently (-unit-by-unit)`

### Topics

"Run File-by-File Local Verification" (Polyspace Code Prover)
"Run File-by-File Remote Verification" (Polyspace Code Prover)

# Verify model generated code (`-main-generator`)

Specify that a `main` function must be generated if it is not present in source files

## Description

*This option is available only for model-generated code.*

Specify that Polyspace must generate a `main` function if it does not find one in the source files.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node.

**Command line**: Use the option `-main-generator`. See “Command-Line Information” on page 1-195.

## Settings

This option is always enabled for code generated from models.

Polyspace generates a `main` function for the analysis. The generated `main` contains cyclic code that executes in a loop. The loop can run an unspecified number of times.

The `main` performs the following functions before the loop begins:

- Initializes variables specified by `Parameters (-variables-written-before-loop)`.
- Calls the functions specified by `Initialization functions (-functions-called-before-loop)`.

The `main` then performs the following functions in the loop:

- Calls the functions specified by `Step functions (-functions-called-in-loop)`.
- Writes to variables specified by `Inputs (-variables-written-in-loop)`.

Finally, the `main` calls the functions specified by `Termination functions (-functions-called-after-loop)`.

## Command-Line Information

**Parameter:** `-main-generator`
**Default:** On
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator ...`

## See Also

`Parameters (-variables-written-before-loop)` | `Inputs (-variables-written-in-loop)` | `Initialization functions (-functions-called-before-loop)` | `Step functions (-functions-called-in-loop)` | `Termination functions (-functions-called-after-loop)`

### Topics

"Specify Analysis Options"
"Configure Simulink Model"
"Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
"Main Generation for Model Analysis"

# Initialization functions (`-functions-called-before-loop`)

Specify functions that the generated `main` must call before the cyclic code loop

## Description

*This option is available only for model- generated code.*

Specify functions that the generated `main` must call before the cyclic code begins.

### Set Option

**User interface**: In your project configuration, the option is available on the **Main Generator** node.

**Command line**: Use the option `-functions-called-before-loop`. See “Command-Line Information” on page 1-196.

## Settings

**No Default**

Click ➕ to add a field. Enter function name.

If you use the scope resolution operator to specify the function from a particular namespace, enter the fully qualified name, for instance, `myClass::init(int)`. If the function does not have a parameter, use an empty parenthesis, for instance, `myClass::init()`.

## Command-Line Information

**Parameter:** `-functions-called-before-loop`

**No Default**
**Value:** *function1*[,*function2*[,...]]
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator -functions-called-before-loop myfunc`

## See Also

`Parameters (-variables-written-before-loop)` | `Inputs (-variables-written-in-loop)` | `Step functions (-functions-called-in-loop)` | `Termination functions (-functions-called-after-loop)`

### Topics

"Specify Analysis Options"
"Configure Simulink Model"
"Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
"Main Generation for Model Analysis"

# Step functions (-functions-called-in-loop)

Specify functions that the generated `main` must call in the cyclic code loop

## Description

*This option is available only for model-generated code.*

Specify functions that the generated `main` must call in each cycle of the cyclic code.

### Set Option

**User interface**: In your project configuration, the option is available on the **Main Generator** node.

**Command line**: Use the option `-functions-called-in-loop`. See “Command-Line Information” on page 1-199.

## Settings

**Default:** `none`

`none`

The generated `main` does not call functions in the cyclic code.

`all`

The generated `main` calls all functions except inlined ones. If you specify certain functions for the options **Initialization functions** or **Termination functions**, the generated `main` does not call those functions in the cyclic code.

`custom`

The generated `main` calls functions that you specify. Click ➕ to add a field. Enter function name.

If you use the scope resolution operator to specify the function from a particular namespace, enter the fully qualified name, for instance, `myClass::myMethod(int)`.

If the function does not have a parameter, use an empty parenthesis, for instance, `myClass::myMethod()`.

## Tips

If you have specified a function for the option **Initialization functions** or **Termination functions**, to call it inside the cyclic code, use `custom` and specify the function name.

## Command-Line Information

**Parameter:** `-functions-called-in-loop`
**Value:** `none` | `all` | `custom=`*`function1`*`[,`*`function2`*`[,...]]`
**Default:** `none`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator -functions-called-in-loop all`

## See Also

`Parameters (-variables-written-before-loop)` | `Inputs (-variables-written-in-loop)` | `Initialization functions (-functions-called-before-loop)` | `Termination functions (-functions-called-after-loop)`

### Topics

"Specify Analysis Options"
"Configure Simulink Model"
"Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
"Main Generation for Model Analysis"

# Termination functions (`-functions-called-after-loop`)

Specify functions that the generated `main` must call after the cyclic code loop

## Description

*This option is available only for model-generated code.*

Specify functions that the generated `main` must call after the cyclic code ends.

### Set Option

**User interface**: In your project configuration, the option is available on the **Main Generator** node.

**Command line**: Use the option `-functions-called-after-loop`. See “Command-Line Information” on page 1-201.

## Settings

**No Default**

Click ✚ to add a field. Enter function name.

If you use the scope resolution operator to specify the function from a particular namespace, enter the fully qualified name, for instance, `myClass::myMethod(int)`. If the function does not have a parameter, use an empty parenthesis, for instance, `myClass::myMethod()`.

## Tips

- If you specify a function for the option **Initialization functions**, you cannot specify it for **Termination functions**.

## Command-Line Information

**Parameter:** `-functions-called-after-loop`
**No Default**
**Value:** `*function1*[,*function2*[,...]]`
**Example:** `polyspace-bug-finder-nodesktop -sources *file_name* -main-generator -functions-called-after-loop myfunc`

## See Also

`Parameters (-variables-written-before-loop)` | `Inputs (-variables-written-in-loop)` | `Initialization functions (-functions-called-before-loop)` | `Step functions (-functions-called-in-loop)`

### Topics

"Specify Analysis Options"
"Configure Simulink Model"
"Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
"Main Generation for Model Analysis"

# Parameters (-variables-written-before-loop)

Specify variables that the generated main must initialize before the cyclic code loop

## Description

*This option is available only for model-generated code.*

Specify variables that the generated main must initialize before the cyclic code loop begins. Before the loop begins, Polyspace considers these variables to have any value allowed by their type.

### Set Option

**User interface**: In your project configuration, the option is available on the **Main Generator** node.

**Command line**: Use the option -variables-written-before-loop. See “Command-Line Information” on page 1-203.

## Settings

**Default:** none

none

The generated main does not initialize variables.

all

The generated main initializes all variables except those declared with keyword const.

`custom`

> The generated `main` only initializes variables that you specify. Click ➕ to add a field. Enter variable name. For C++ class members, use the syntax `className::variableName`.

## Command-Line Information

**Parameter:** `-variables-written-before-loop`
**Value:** `none | all | custom=`*`variable1`*`[,`*`variable2`*`[,...]]`
**Default:** `public`
**Example:** `polyspace-bug-finder-nodesktop -sources `*`file_name`*` -main-generator -variables-written-before-loop all`

## See Also

`Inputs (-variables-written-in-loop)` | `Initialization functions (-functions-called-before-loop)` | `Step functions (-functions-called-in-loop)` | `Termination functions (-functions-called-after-loop)`

### Topics

“Specify Analysis Options”
“Configure Simulink Model”
“Recommended Polyspace Bug Finder Options for Analyzing Generated Code”
“Main Generation for Model Analysis”

# Inputs (`-variables-written-in-loop`)

Specify variables that the generated `main` must initialize in the cyclic code loop

## Description

*This option is available only for model-generated code.*

Specify variables that the generated `main` must initialize at the beginning of every iteration of the cyclic code loop. At the beginning of every loop iteration, Polyspace considers these variables to have anyvalue allowed by their type.

### Set Option

**User interface**: In your project configuration, the option is available on the **Main Generator** node.

**Command line**: Use the option `-variables-written-in-loop`. See “Command-Line Information” on page 1-205.

## Settings

**Default:** `none`

`none`

The generated `main` does not initialize variables.

`all`

The generated `main` initializes all variables except those declared with keyword `const`.

`custom`

The generated `main` only initializes variables that you specify. Click ✚ to add a field. Enter variable name. For C++ class members, use the syntax `className::variableName`.

## Command-Line Information

**Parameter:** `-variables-written-in-loop`
**Value:** `none` | `all` | `custom=`*`variable1`*`[,`*`variable2`*`[,...]]`
**Default:** `none`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator -variables-written-in-loop all`

## See Also

`Parameters (-variables-written-before-loop)` | `Initialization functions (-functions-called-before-loop)` | `Step functions (-functions-called-in-loop)` | `Termination functions (-functions-called-after-loop)`

### Topics

"Specify Analysis Options"
"Configure Simulink Model"
"Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
"Main Generation for Model Analysis"

# Verify module or library (`-main-generator`)

Generate a `main` function if source files are modules or libraries that do not contain a `main`

## Description

*This option affects a Code Prover analysis only.*

Specify that Polyspace must generate a `main` function if it does not find one in the source files.

### Set Option

**User interface**: In your project configuration, the option is on the **Code Prover Verification** node.

**Command line**: Use the option `-main-generator`. See “Command-Line Information” on page 1-208.

For the analogous option for model generated code, see `Verify model generated code (-main-generator)`.

### Why Use This Option

Use this option if you are verifying a module or library. A Code Prover analysis requires a `main` function. When verifying a module or library, your code might not have a `main`.

When you use this option, Code Prover generates a `main` function if one does not exist. If a `main` exists, the analysis uses the existing `main`.

## Settings

● On (default)

Polyspace generates a main function if it does not find one in the source files. The generated main:

1. Initializes variables specified by Variables to initialize (-main-generator-writes-variables).
2. Before calling other functions, calls the functions specified by Initialization functions (-functions-called-before-main).
3. In all possible orders, calls the functions specified by Functions to call (-main-generator-calls).
4. (C++ only) Calls class methods specified by Class (-class-analyzer) and Functions to call within the specified classes (-class-analyzer-calls).

If you do not specify the function and variable options above, the generated main:

- Initializes all global variables except those declared with keywords const and static.
- In all possible orders, calls all functions that are not called anywhere in the source files. Polyspace considers that global variables can be written between two consecutive function calls. Therefore, in each called function, global variables initially have the full range of values allowed by their type.

○ Off

Polyspace stops if a main function is not present in the source files.

## Tips

- If a main function is present in your source files, the verification uses that main function, irrespective of whether you enable or disable this option.

  The option is relevant only if a main function is not present in your source files.
- If you specify multitasking options, the verification ignores your specifications for main generation. Instead, the verification introduces an empty main function.

For more information on the multitasking options, see “Verify Multitasking Applications” (Polyspace Code Prover).

## Command-Line Information

**Parameter:** `-main-generator`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -sources *file_name* -main-generator ...`

## See Also

`Parameters (-variables-written-before-loop)` | `Inputs (-variables-written-in-loop)` | `Initialization functions (-functions-called-before-loop)` | `Step functions (-functions-called-in-loop)` | `Termination functions (-functions-called-after-loop)`

### Topics

“Specify Analysis Options”

# Consider volatile qualifier on fields (**-consider-volatile-qualifier-on-fields**)

Assume that `volatile` qualified structure fields can have all possible values at any point in code

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must take into account the `volatile` qualifier on fields of a structure.

### Set Option

**User interface**: In your project configuration, the option is available on the **Verification Assumptions** node.

**Command line**: Use the option `-consider-volatile-qualifier-on-fields`. See “Command-Line Information” on page 1-212.

### Why Use This Option

The `volatile` qualifier on a variable indicates that the variable value can change between successive operations even if you do not explicitly change it in your code. For instance, if `var` is a `volatile` variable, the consecutive operations `res = var; res =var;` can result in two different values of `var` being read into `res`.

Use this option so that the verification emulates the `volatile` qualifier for structure fields. If you select this option, the software assumes that a `volatile` structure field has a full range of values at any point in the code. The range is determined only by the data type of the structure field.

## Settings

☑ On

The verification considers the `volatile` qualifier on fields of a structure.

In the following example, the verification considers that the field `val1` can have all values allowed for the `int` type at any point in the code.

```
struct myStruct {
   volatile int val1;
   int val2;
};
```

Even if you write a specific value to `val1` and read the variable in the next operation, the variable read results in any possible value.

```
struct myStruct myStructInstance;
myStructInstance.val1 = 1;
assert (myStructInstance.val1 == 1); // Assertion can fail
```

□ Off (default)

The verification ignores the `volatile` qualifier on fields of a structure.

In the following example, the verification ignores the qualifier on field `val1`.

```
struct myStruct {
   volatile int val1;
   int val2;
};
```

If you write a specific value to `val1` and read the variable in the next operation, the variable read results in that specific value.

```
struct myStruct myStructInstance;
myStructInstance.val1 = 1;
assert (myStructInstance.val1 == 1); // Assertion passes
```

## Tips

- If your volatile fields do not represent values read from hardware and you do not expect their values to change between successive operations, disable this option. You are using the volatile qualifier for some other reason and the verification does not need to consider full range for the field values.

- If you enable this option, the number of red, gray, and green checks in your code can decrease. The number of orange checks can increase.

  In the following example, a red or green check changes to orange or a gray check goes away when the option is used. Considering the volatile qualifier changes the check color. These examples use the following structure definition:

```
struct myStruct {
   volatile int field1;
   int field2;
};
```

| Color Without Option | Result Without Option | Result With Option |
|---|---|---|
| Green | `void main(){`<br>`   struct myStruct structVal;`<br>`   structVal.field1 = 1;`<br>`   assert(structVal.field1 == 1);`<br>`}` | `void main(){`<br>`   struct myStruct structVal;`<br>`   structVal.field1 = 1;`<br>`   assert(structVal.field1 ==1);`<br>`}` |
| Red | `void main(){`<br>`   struct myStruct structVal;`<br>`   structVal.field1 = 1;`<br>`   assert(structVal.field1 != 1);`<br>`}` | `void main(){`<br>`   struct myStruct structVal;`<br>`   structVal.field1 = 1;`<br>`   assert(structVal.field1 !=1);`<br>`}` |
| Gray | `void main(){`<br>`   struct myStruct structVal;`<br>`   structVal.field1 = 1;`<br>`   if (structVal.field1 != 1)`<br>`   {`<br>`   /* Perform operation */`<br>`   }`<br>`}` | `void main(){`<br>`   struct myStruct structVal;`<br>`   structVal.field1 = 1;`<br>`   if (structVal.field1 != 1)`<br>`   {`<br>`   /* Perform operation */`<br>`   }`<br>`}` |

- In C++ code, the option also applies to class members.

## Command-Line Information

**Parameter:** `-consider-volatile-qualifier-on-fields`
**Default**: Off
**Example**: `polyspace-code-prover-nodesktop -sources` *`file_name`* `-consider-volatile-qualifier-on-fields`

## See Also

### Topics

“Specify External Constraints” (Polyspace Code Prover)

Introduced in R2016b

# Float rounding mode (`-float-rounding-mode`)

Specify rounding modes to consider when determining the results of floating point arithmetic

## Description

*This option affects a Code Prover analysis only.*

Specify the rounding modes to consider when determining the results of floating-point arithmetic.

### Set Option

**User interface**: In your project configuration, the option is available on the **Verification Assumptions** node.

**Command line**: Use the option `-float-rounding-mode`. See “Command-Line Information” on page 1-216.

### Why Use This Option

The default verification uses the round-to-nearest mode.

Use the rounding mode `all` if your code contains routines such as `fesetround` to specify a rounding mode other than round-to-nearest. Although the verification ignores the `fesetround` specification, it considers all rounding modes including the rounding mode that you specified. Alternatively, for targets that can use extended precision (for instance, using the flag `-mfpmath=387`), use the rounding mode `all`. However, for your Polyspace analysis results to agree with run-time behavior, you must prevent use of extended precision through a flag such as `-ffloat-store`.

Otherwise, continue to use the default rounding mode `to-nearest`. Because all rounding modes are considered when you specify `all`, you can have many orange **Overflow** checks resulting from overapproximation.

## Settings

**Default:** `to-nearest`

`to-nearest`

The verification assumes the round-to-nearest mode.

`all`

The verification assumes all rounding modes for each operation involving floating-point variables. The following rounding modes are considered: round-to-nearest, round-towards-zero, round-towards-positive-infinity, and round-towards-negative-infinity.

## Tips

- The Polyspace analysis uses floating-point arithmetic that conforms to the IEEE® 754 standard. For instance, the arithmetic uses floating point instructions present in the SSE instruction set. The GNU C flag `-mfpmath=sse` enforces use of this instruction set. If you use the GNU C compiler with this flag to compile your code, your Polyspace analysis results agree with your run-time behavior.

  However, if your code uses extended precision, for instance using the GNU C flag `-mfpmath=387`, your Polyspace analysis results might not agree with your run-time behavior in some corner cases. See some examples of these corner cases in `codeprover_limitations.pdf` in *`matlabroot`*`\polyspace\verifier\code_prover`. Here, *`matlabroot`* is the MATLAB installation folder, for instance, `C:\Program Files\MATLAB\R2017b`.

  To prevent use of extended precision, on targets without SSE support, you can use a flag such as `-ffloat-store`. For your Polyspace analysis, use `all` for rounding mode to account for double rounding.
- The **Overflow** check uses the rounding modes that you specify. For instance, the following table shows the difference in the result of the check when you change your rounding modes.

| Rounding mode: **to-nearest** | Rounding mode: **all** |
|---|---|
| If results of floating-point operations are rounded to nearest values:<br>• In the first addition operation, `eps1` is just large enough that the value nearest to `FLT_MAX + eps1` is greater than `FLT_MAX`. The **Overflow** check is red.<br>• In the second addition operation, `eps2` is just small enough that the value nearest to `FLT_MAX + eps2` is `FLT_MAX`. The **Overflow** check is green.<br><br>`#include <float.h>`<br>`#define eps1 0x1p103`<br>`#define eps2 0x0.FFFFFFp103`<br><br>`float func(int ch) {`<br>`    float left_op = FLT_MAX;`<br>`    float right_op_1 = eps1, \`<br>`right_op_2 = eps2;`<br>`    switch(ch) {`<br>`    case 1:`<br>`        return (left_op +\`<br>`right_op_1);`<br>`    case 2:`<br>`        return (left_op +\`<br>`right_op_2);`<br>`    default:`<br>`        return 0;`<br>`    }`<br>`}` | Besides to-nearest mode, the **Overflow** check also considers other rounding modes.<br>• In the first addition operation, in to-nearest mode, the value nearest to `FLT_MAX + eps1` is greater than `FLT_MAX`, so the addition overflows. But if rounded towards negative infinity, the result is `FLT_MAX`, so the addition does not overflow. Combining these two rounding modes, the **Overflow** check is orange.<br>• In the second addition operation, in to-nearest mode, the value nearest to `FLT_MAX + eps2` is `FLT_MAX`, so the addition does not overflow. But if rounded towards positive infinity, the result is greater than `FLT_MAX`, so the addition overflows. Combining these two rounding modes, the **Overflow** check is orange.<br><br>`#include <float.h>`<br>`#define eps1 0x1p103`<br>`#define eps2 0x0.FFFFFFp103`<br><br>`float func(int ch) {`<br>`    float left_op = FLT_MAX;`<br>`     float right_op_1 = eps1, \`<br>` right_op_2 = eps2;`<br>`    switch(ch) {`<br>`    case 1:`<br>`        return (left_op +\`<br>`right_op_1);`<br>`    case 2:`<br>`        return (left_op +\`<br>`right_op_2);`<br>`    default:` |

| Rounding mode: **`to-nearest`** | Rounding mode: **`all`** |
|---|---|
|  | `        return 0;`<br>`    }`<br>`}` |

If you set the rounding mode to `all` and obtain an orange **Overflow** check, to determine how the overflow can occur, consider all rounding modes.

## Command-Line Information

**Parameter:** `-float-rounding-mode`
**Value:** `to-nearest` | `all`
**Default:** `to-nearest`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-float-rounding-mode all`

## See Also

`Overflow`

Introduced in R2016a

# Respect types in fields (**`-respect-types-in-fields`**)

Do not cast nonpointer fields of a structure to pointers

## Description

*This option affects a Code Prover analysis only.*

Specify that structure fields not declared initially as pointers will not be cast to pointers later.

### Set Option

**User interface**: In your project configuration, the option is available on the **Verification Assumptions** node.

**Command line**: Use the option `-respect-types-in-fields`. See “Command-Line Information” on page 1-218.

### Why Use This Option

Use this option to identify and forbid casts from nonpointer structure fields to pointers.

## Settings

☑ On

The verification assumes that structure fields not declared initially as pointers will not be cast to pointers later.

<table>
<tr><th>Code with option off</th><th>Code with option on</th></tr>
<tr><td><pre><code>struct {
    unsigned int x1;
    unsigned int x2;
} S;

void funct(void) {
    int var, *tmp;
    S.x1 = &var;
    tmp = (int*)S.x1;
    *tmp = 1;
    assert(var==1);
}</code></pre>
In this example, the fields of <code>S</code> are declared as integers but <code>S.x1</code> is cast to a pointer. With the option turned off, Polyspace allows the cast.</td><td><pre><code>struct {
    unsigned int x1;
    unsigned int x2;
} S;

void funct(void) {
    int var, *tmp;
    S.x1 = &var;
    tmp = (int*)S.x1;
    *tmp = 1;
    assert(var==1);
}</code></pre>
In this example, the fields of <code>S</code> are declared as integers but <code>S.x1</code> is cast to a pointer. With the option turned on, Polyspace ignores the cast. Therefore, it ignores the initialization of <code>var</code> through the pointer <code>(int*)S.x1</code> and produces a red <b>Non-initialized local variable</b> error when <code>var</code> is read.</td></tr>
</table>

☐ Off (default)

The verification assumes that structure fields can be cast to pointers even when they are not declared as pointers.

## Command-Line Information

**Parameter:** `-respect-types-in-fields`
**Default**: Off

## See Also

`Respect types in global variables (-respect-types-in-globals)` | `Non-initialized local variable`

# Respect types in global variables (`-respect-types-in-globals`)

Do not cast nonpointer global variables to pointers

## Description

*This option affects a Code Prover analysis only.*

Specify that global variables not declared initially as pointers will not be cast to pointers later.

### Set Option

**User interface**: In your project configuration, the option is available on the **Verification Assumptions** node.

**Command line**: Use the option `-respect-types-in-globals`. See “Command-Line Information” on page 1-220.

### Why Use This Option

Use this option to identify and forbid casts from nonpointer global variables to pointers.

## Settings

☑ On

The verification assumes that global variables not declared initially as pointers will not be cast to pointers later.

□ Off (default)

The verification assumes that global variables can be cast to pointers even when they are not declared as pointers.

## Tips

If you select this option, the number of checks in your code can change. You can use this option and the change in results to identify cases where you cast nonpointer variables to pointers.

For instance, in the following example, when you select the option, the results have one less orange check and one more red check.

| Code with option off | Code with option on |
|---|---|
| `int global;`<br>`void main(void) {`<br>`    int local;`<br>`    global = (int)&local;`<br>`    *(int*)global = 5;`<br>`    assert(local==5);`<br>`}`<br><br>In this example, `global` is declared as an `int` variable but cast to a pointer. With the option turned off, Polyspace allows the cast. | `int global;`<br>`void main(void) {`<br>`    int local;`<br>`    global = (int)&local;`<br>`    *(int*)global = 5;`<br>`    assert(local==5);`<br>`}`<br><br>In this example, `global` is declared as an `int` variable but cast to a pointer. With the option turned on, Polyspace ignores the cast. Therefore, it ignores the initialization of `local` through the pointer `(int*)global` and produces a red **Non-initialized local variable** error when `local` is read. |

## Command-Line Information

**Parameter:** `-respect-types-in-globals`
**Default**: Off

## See Also

`Respect types in fields (-respect-types-in-fields)` | `Non-initialized local variable`

# Consider environment pointers as unsafe (-stubbed-pointers-are-unsafe)

Specify that environment pointers can be unsafe to dereference unless constrained otherwise

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must consider environment pointers as unsafe unless otherwise constrained. Environment pointers are pointers that can be assigned values outside your code.

Environment pointers include:

- Global or `extern` pointers.
- Pointers returned from stubbed functions.

  A function is stubbed if your code does not contain the function definition or you override a function definition by using the option `Functions to stub (-functions-to-stub)`.
- Pointer parameters of functions whose calls are generated by the software.

  A function call is generated if you verify a module or library and the module or library does not have an explicit call to the function. You can also force a function call to be generated with the option `Functions to call (-main-generator-calls)`.

### Set Option

**User interface**: In your project configuration, the option is available on the **Verification Assumptions** node.

**Command line**: Use the option `-stubbed-pointers-are-unsafe`. See “Command-Line Information” on page 1-224.

## Why Use This Option

Use this option so that the verification makes more conservative assumptions about pointers from external sources.

If you specify this option, the verification considers that environment pointers can have a `NULL` value. If you read an environment pointer without checking for `NULL`, the **Illegally dereferenced pointer** check shows a potential error in orange. The message associated with the orange check shows the pointer can be `NULL`.

# Settings

☑ On

The verification considers that environment pointers can have a `NULL` value.

□ Off (default)

The verification considers that environment pointers:

- Cannot have a `NULL` value.
- Points within allowed bounds.

# Tips

- Enable this option during the integration phase. In this phase, you provide complete code for verification. Even if an orange check originates from external sources, you are likely to place protections against unsafe pointers from such sources. For instance, if you obtain a pointer from an unknown source, you check the pointer for `NULL` value.

  Disable this option during the unit testing phase. In this phase, you focus on errors originating from your unit.
- If you enable this option, the number of orange checks in your code might increase.

| Environment Pointers Safe | Environment Pointers Unsafe |
|---|---|
| The **Illegally dereferenced pointer** check is green. The verification assumes that env_ptr is not NULL and any dereference is within allowed bounds. The verification assumes that the result of the dereference is full range. For instance, in this case, the return value has the full range of type int.<br>`int func (int *env_ptr) {`<br>`    return *env_ptr;`<br>`}` | The **Illegally dereferenced pointer** check is orange. The verification assumes that env_ptr can be NULL.<br>`int func (int *env_ptr) {`<br>`    return *env_ptr;`<br>`}` |

If you enable this option, the number of gray checks might decrease.

| Environment Pointers Safe | Environment Pointers Unsafe |
|---|---|
| The verification assumes that env_ptr is not NULL. The if condition is always true and the else block is unreachable.<br>`#include <stdlib.h>`<br>`int func (int *env_ptr) {`<br>`    if(env_ptr!=NULL)`<br>`            return *env_ptr;`<br>`    else`<br>`            return 0;`<br>`}` | The verification assumes that env_ptr can be NULL. The if condition is not always true and the else block can be reachable.<br>`#include <stdlib.h>`<br>`int func (int *env_ptr) {`<br>`    if(env_ptr!=NULL)`<br>`            return *env_ptr;`<br>`    else`<br>`            return 0;`<br>`}` |

- Instead of considering all environment pointers as safe or unsafe, you can individually constrain some of the environment pointers. See the description of **Initialize Pointer** in “Constraints” (Polyspace Code Prover).

  When you individually constrain a pointer, you first specify an **Init Mode**, and then specify through the **Initialize Pointer** option whether the pointer is Null, Not Null, or Maybe Null. Depending on the **Init Mode**, you can either override the global specification for all environment pointers or not.

  - If you set the **Init Mode** of the pointer to INIT or PERMANENT, your selection for **Initialize Pointer** overrides your specification for this option. For instance, if you specify Not NULL for an environment pointer ptr, the verification assumes that ptr is not NULL even if you specify that environment pointers must be considered unsafe.

  - If you set the **Init Mode** to MAIN GENERATOR, the verification uses your specification for this option.

    For pointers returned from stubbed functions, the option MAIN GENERATOR is not available. If you override the global specification for such a pointer through the **Initialize Pointer** option in constraints, you cannot toggle back to the global specification without changing the **Initialize Pointer** option too.

- If you disable this option, the verification considers that dereferences at all pointer depths are valid.

  For instance, all the dereferences are considered valid in this code:

  ```
  int*** stub(void);

  void func2() {
          int ***ptr = stub();
          int **ptr2 = *ptr;
          int *ptr3 = *ptr2;
  }
  ```

## Command-Line Information

**Parameter:** -stubbed-pointers-are-unsafe
**Default**: Off
**Example**: polyspace-code-prover-nodesktop -sources *file_name* -stubbed-pointers-are-unsafe

## See Also

Constraint setup (-data-range-specifications)

### Topics

"Specify External Constraints" (Polyspace Code Prover)
"Constraints" (Polyspace Code Prover)

Introduced in R2016b

# Allow negative operand for left shifts (`-allow-negative-operand-in-shift`)

Allow left shift operations on a negative number

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must allow left shift operations on a negative number.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-allow-negative-operand-in-shift`. See "Command-Line Information" on page 1-226.

### Why Use This Option

According to the C99 standard (sec 6.5.7), the result of a left shift operation on a negative number is undefined. Following the standard, the verification produces a red check on left shifts of negative numbers.

If your compiler has a well-defined behavior for left shifts of negative numbers, set this option. Note that allowing left shifts of negative numbers can reduce the cross-compiler portability of your code.

## Settings

☑ On

The verification allows shift operations on a negative number, for instance, `-2 << 2`.

□ Off (default)

If a shift operation is performed on a negative number, the verification generates an error.

## Command-Line Information

**Parameter:** `-allow-negative-operand-in-shift`
**Default**: Off

## See Also

`Invalid shift operations`

# Consider non finite floats (`-allow-non-finite-floats`)

Enable a verification mode that incorporates infinities and NaNs

## Description

*This option affects a Code Prover analysis only.*

Enable a verification mode that incorporates infinities and NaNs for floating point operations.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-allow-non-finite-floats`. See “Command-Line Information” on page 1-230.

### Why Use This Option

By default, the verification does not incorporate infinities and NaNs. For instance, the verification terminates the execution thread where a division by zero occurs and does not consider that the result could be infinity.

If you use functions such as `isinf` or `isnan` and account for infinities and NaNs in your code, set this option. When you set this option and a division by zero occurs for instance, the execution thread continues with infinity as the result of the division.

Set this option alone if you are sure that you have accounted for infinities and NaNs in your code. Using the option alone effectively disables many numerical checks on floating point operations. If you have generally accounted for infinities and NaNs, but you are not sure that you have considered all situations, set these additional options:

- `Infinities (-check-infinite)`: Use `warn-first`.

- `NaNs (-check-nan)`: Use `warn-first`.

## Settings

☑ On

The verification allows infinities and NaNs. For instance, in this mode:

- The verification assumes that floating-point operations can produce results such as infinities and NaNs.

  By using options `Infinities (-check-infinite)` and `NaNs (-check-nan)`, you can choose to highlight operations that produce nonfinite results and stop the execution threads where the nonfinite results occur.
- The verification assumes that floating-point variables with unknown values can have any value allowed by their type, including infinite or NaN. Floating-point variables with unknown values include volatile variables and return values of stubbed functions.

☐ Off (default)

The verification does not allow infinities and NaNs. For instance, in this mode:

- The verification produces a red check on a floating-point operation that produces an infinity or a NaN as the only possible result on all execution paths. The verification produces an orange check on a floating-point operation that can potentially produce an infinity or NaN.
- The verification assumes that floating-point variables with unknown values are full-range but finite.

## Tips

- The IEEE 754 Standard allows special quantities such as infinities and `NaN` so that you can handle certain numerical exceptions without aborting the code. Some implementations of the C standard support infinities and `NaN`.
  - If your compiler supports infinities and `NaN`s and you account for them explicitly in your code, use this option so that the verification also allows them.

  For instance, if a division results in infinity, in your code, you specify an alternative action. Therefore, you do not want the verification to highlight division operations that result in infinity.

  - If your compiler supports infinities and NaNs but you are not sure if you account for them explicitly in your code, use this option so that the verification incorporates infinities and NaNs. Use the options `-check-nan` and `-check-infinite` with argument `warn` so that the verification highlights operations that result in infinities and NaNs, but does not stop the execution thread.

- If you select this option, the number and type of checks in your code can change.

  For instance, in the following example, when you select the option, the results have one less red check and three more green checks.

| Infinities and NaNs Not Allowed | Infinities and NaNs Allowed |
|---|---|
| Polyspace produces a **Division by zero** error and stops verification.<br>`double func(void) {`<br>`    double x=1.0/0.0;`<br>`    double y=1.0/x;`<br>`    double z=x-x;`<br>`    return z;`<br>`}` | If you select this option, Polyspace does not check for a **Division by zero** error.<br>`double func(void) {`<br>`    double x=1.0/0.0;`<br>`    double y=1.0/x;`<br>`    double z=x-x;`<br>`    return z;`<br>`}`<br>The verification assumes that dividing by zero results in:<br>• Value of `x` equal to `Inf`<br>• Value of `y` equal to 0.0<br>• Value of `z` equal to `NaN`<br>In your verification results in the Polyspace user interface, if you place your cursor on `y` and `z`, you can see the nonfinite values `Inf` and `NaN` respectively in the tooltip. |

- You cannot run the Automatic Orange Tester if you incorporate non-finites in your verification.

## Command-Line Information

**Parameter:** `-allow-non-finite-floats`
**Default**: Off

## See Also

`Infinities (-check-infinite)` | `NaNs (-check-nan)` | `Division by zero` | `Overflow` | `Invalid shift operations` | `Invalid use of standard library routine`

### Topics

"Specify Analysis Options" (Polyspace Code Prover)

Introduced in R2016a

# Infinities (`-check-infinite`)

Specify how to handle floating-point operations that result in infinity

## Description

*This option affects a Code Prover analysis only.*

Specify how the analysis must handle floating-point operations that result in infinities.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node. See “Dependencies” on page 1-233 for other options you must also enable.

**Command line**: Use the option `-check-infinite`. See “Command-Line Information” on page 1-233.

### Why Use This Option

Use this option to enable detection of floating-point operations that result in infinities.

If you specify that the analysis must consider nonfinite floats, by default, the analysis does not flag these operations. Use this option to detect these operations while still incorporating nonfinite floats.

## Settings

**Default:** `allow`

`allow`

The verification does not produce a check on the operation.

For instance, in the following code, there is no **Overflow** check.

```
double func(void) {
    double x=1.0/0.0;
```

```
        return x;
    }
```

`warn-first`

The verification produces a check on the operation. The check determines if the result of the operation is infinite when the operands themselves are not infinite. The verification does not terminate the execution thread that produces infinity.

If the verification detects an operation that produces infinity as the only possible result on all execution paths and the operands themselves are never infinite, the check is red. If the operation can potentially result in infinity, the check is orange.

For instance, in the following code, there is a nonblocking **Overflow** check for infinity.

```
double func(void) {
    double x=1.0/0.0;
    return x;
}
```

Even though the **Overflow** check on the `/` operation is red, the verification continues. For instance, a green **Non-initialized local variable** check appears on `x` in the `return` statement.

`forbid`

The verification produces a check on the operation and terminates the execution thread that produces infinity.

If the check is red, the verification does not continue for the remaining code in the same scope as the check. If the check is orange, the verification continues but removes from consideration the variable values that produced infinity.

For instance, in the following code, there is a blocking **Overflow** check for infinity.

```
double func(void) {
    double x=1.0/0.0;
    return x;
}
```

The verification stops because the **Overflow** check on the `/` operation is red. For instance, a **Non-initialized local variable** check does not appear on `x` in the `return` statement.

## Dependencies

To use this option, you must enable the verification mode that incorporates infinities and NaNs. See `Consider non finite floats (-allow-non-finite-floats)`.

## Command-Line Information

**Parameter:** `-check-infinite`
**Value:** `allow` | `warn-first` | `forbid`
**Default:** `allow`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-check-infinite forbid`

## See Also

### Polyspace Analysis Options

`Consider non finite floats (-allow-non-finite-floats)` | `NaNs (-check-nan)`

### Polyspace Results

`Overflow`

### Introduced in R2016a

# NaNs (-check-nan)

Specify how to handle floating-point operations that result in NaN

## Description

*This option affects a Code Prover analysis only.*

Specify how the analysis must handle floating-point operations that result in NaN.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node. See "Dependencies" on page 1-236 for other options you must also enable.

**Command line**: Use the option `-check-nan`. See "Command-Line Information" on page 1-236.

### Why Use This Option

Use this option to enable detection of floating-point operations that result in NaN-s.

If you specify that the analysis must consider nonfinite floats, by default, the analysis does not flag these operations. Use this option to detect these operations while still incorporating nonfinite floats.

## Settings

**Default:** `allow`

`allow`

The verification does not produce a check on the operation.

For instance, in the following code, there is no **Invalid operation on floats** check.

```
double func(void) {
    double x=1.0/0.0;
```

```
        double y=x-x;
        return y;
    }
```

`warn-first`

The verification produces a check on the operation. The check determines if the result of the operation is NaN when the operands themselves are not NaN. For instance, the check flags the operation `val1 + val2` only if the result can be NaN when *both* `val1` and `val2` are not NaN. The verification does not terminate the execution thread that produces NaN.

If the verification detects an operation that produces NaN as the only possible result on all execution paths and the operands themselves are never NaN, the check is red. If the operation can potentially result in NaN, the check is orange.

For instance, in the following code, there is a nonblocking **Invalid operation on floats** check for NaN.

```
double func(void) {
    double x=1.0/0.0;
    double y=x-x;
    return y;
}
```

Even though the **Invalid operation on floats** check on the - operation is red, the verification continues. For instance, a green **Non-initialized local variable** check appears on `y` in the `return` statement.

`forbid`

The verification produces a check on the operation and terminates the execution thread that produces NaN.

If the check is red, the verification does not continue for the remaining code in the same scope as the check. If the check is orange, the verification continues but removes from consideration the variable values that produced a NaN.

For instance, in the following code, there is a blocking **Invalid operation on floats** check for NaN.

```
double func(void) {
    double x=1.0/0.0;
    double y=x-x;
    return y;
}
```

The verification stops because the **Invalid operation on floats** check on the `-` operation is red. For instance, a **Non-initialized local variable** check does not appear on `y` in the `return` statement.

The **Invalid operation on floats** check for NaN also appears on the `/` operation and is green.

## Dependencies

To use this option, you must enable the verification mode that incorporates infinities and NaNs. See `Consider non finite floats (-allow-non-finite-floats)`.

## Command-Line Information

**Parameter:** `-check-nan`
**Value:** `allow` | `warn-first` | `forbid`
**Default:** `allow`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-check-nan forbid`

## See Also

### Polyspace Analysis Options

`Consider non finite floats (-allow-non-finite-floats)` | `Infinities (-check-infinite)`

### Polyspace Results

`Invalid operation on floats`

### Introduced in R2016a

# Enable pointer arithmetic across fields (`-allow-ptr-arith-on-struct`)

Allow arithmetic on pointer to a structure field so that it points to another field

## Description

*This option affects a Code Prover analysis only.*

Specify that a pointer assigned to a structure field can point outside its bounds as long as it points within the structure.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node. See “Dependency” on page 1-238 for other options you must also enable.

**Command line**: Use the option `-allow-ptr-arith-on-struct`. See “Command-Line Information” on page 1-238.

### Why Use This Option

Use this option to relax the check for illegally dereferenced pointers. Once you assign a pointer to a structure field, you can use that pointer to access another structure field.

## Settings

☑ On

A pointer assigned to a structure field can point outside the bounds imposed by the field as long as it points within the structure. For instance, in the following code, unless you use this option, the verification will produce a red `Illegally dereferenced pointer` check:

```
void main(void) {
struct S {char a; char b; int c;} x;
char *ptr = &x.b;
ptr ++;
*ptr = 1; // Red on the dereference, because ptr points outside x.b
}
```

□ Off (default)

A pointer assigned to a structure field can point only within the bounds imposed by the field.

## Tips

- The verification does not allow a pointer with negative offset values. This behavior occurs irrespective of whether you choose the option **Enable pointer arithmetic across fields**.

## Dependency

This option is available only if you set `Source code language (-lang)` to `C`.

## Command-Line Information

**Parameter:** `-allow-ptr-arith-on-struct`
**Default**: Off
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-allow-ptr-arith-on-struct`

## See Also

`Allow incomplete or partial allocation of structures (-size-in-bytes)` | `Illegally dereferenced pointer`

# Detect stack pointer dereference outside scope (-`detect-pointer-escape`)

Find cases where a function returns a pointer to one of its local variables

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must detect cases where you access a variable outside its scope via pointers. Such an access can happen, for example, when a function returns a pointer to a local variable and you dereference the pointer outside the function. The dereference causes undefined behavior because the local variable that the pointer points to does not live outside the function.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-detect-pointer-escape`. See “Command-Line Information” on page 1-241.

### Why Use This Option

Use this option to enable detection of pointer escape.

## Settings

☑ On

The **Illegally dereferenced pointer** check performs an additional task, besides its usual specifications. When you dereference a pointer, the check also determines if you are accessing a variable outside its scope through the pointer. The check is:

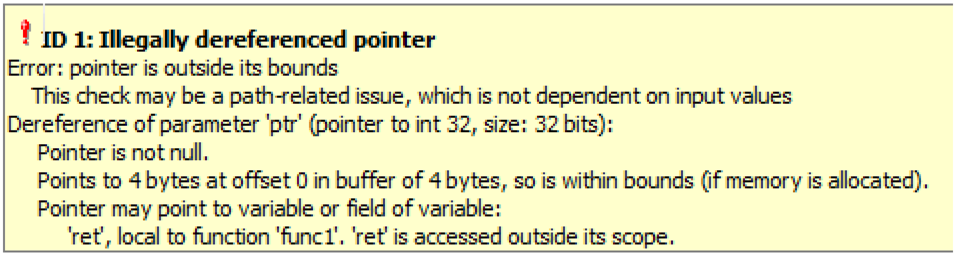
- Red, if all the variables that the pointer points to are accessed outside their scope.

  For instance, you dereference a pointer `ptr` in a function `func` that is called twice in your code. In both calls, when you perform the dereference `*ptr`, `ptr` is pointing to variables outside their scope. Therefore, the **Illegally dereferenced pointer** check is red.
- Orange, if only some of the variables that the pointer points to are accessed outside their scope.
- Green, if none of the variables that the pointer points to are accessed outside their scope, and other requirements of the check are also satisfied.

In the following code, if you enable this option, Polyspace Code Prover produces a red **Illegally dereferenced pointer** check on `*ptr`. Otherwise, the **Illegally dereferenced pointer** check on `*ptr` is green.

```
void func2(int *ptr) {
    *ptr = 0;
}

int* func1(void) {
    int ret = 0;
    return &ret ;
}
void main(void) {
    int* ptr = func1() ;
    func2(ptr) ;
}
```

The **Result Details** pane displays a message indicating that `ret` is accessed outside its scope.



**ID 1: Illegally dereferenced pointer**
Error: pointer is outside its bounds
This check may be a path-related issue, which is not dependent on input values
Dereference of parameter 'ptr' (pointer to int 32, size: 32 bits):
Pointer is not null.
Points to 4 bytes at offset 0 in buffer of 4 bytes, so is within bounds (if memory is allocated).
Pointer may point to variable or field of variable:
'ret', local to function 'func1'. 'ret' is accessed outside its scope.

□ Off (default)

When you dereference a pointer, the **Illegally dereferenced pointer** check does not check for whether you are accessing a variable outside its scope. The check is green even if the pointer dereference is outside the variable scope, as long as it satisfies requirements:

- The pointer is not NULL.
- The pointer points within the memory buffer.

## Command-Line Information

**Parameter**: `-detect-pointer-escape`
**Default**: Off

## See Also

`Illegally dereferenced pointer`

Introduced in R2015a

# Disable checks for non-initialization (`-disable-initialization-checks`)

Disable checks for non-initialized variables and pointers

## Description

*This option affects a Code Prover analysis only.*

Specify that Polyspace Code Prover must not check for non-initialization in your code.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-disable-initialization-checks`. See “Command-Line Information” on page 1-244.

### Why Use This Option

Use this option if you do not want to detect instances of non-initialized variables.

## Settings

☑ On

Polyspace Code Prover does not perform the following checks:

- `Non-initialized local variable`: Local variable is not initialized before being read.
- `Non-initialized variable`: Variable other than local variable is not initialized before being read.
- `Non-initialized pointer`: Pointer is not initialized before being read.

- Return value not initialized: C function does not return value when expected.

Polyspace assumes that, at declaration:

- Variables have full-range of values allowed by their type.
- Pointers can be NULL-valued or point to a memory block at an unknown offset.

□ Off (default)

Polyspace Code Prover checks for non-initialization in your code. The software displays red checks if, for instance, a variable is not initialized and orange checks if a variable is initialized only on some execution paths.

## Tips

- If you select this option, the software does not report most violations of MISRA C: 2004 (Polyspace Code Prover), rule 9.1, and MISRA C:2012 Rule 9.1.
- If you select this option, the number and type of orange checks in your code can change.

  For instance, the following table shows an additional orange check with the option enabled.

| Checks for Non-initialization Enabled | Checks for Non-initialization Disabled |
|---|---|
| `void func(int flag) {`<br>`    int var1,var2;`<br>`    if( flag==0) {`<br>`        var1=var2;`<br>`    }`<br>`    else {`<br>`        var1=0;`<br>`    }`<br>`    var2=var1 + 1;`<br>`}`<br>In this example, the software produces:<br>• A red **Non-initialized local variable** check on `var2` in the `if` branch. The verification continues as if only the `else` branch of the `if` statement exists.<br>• A green **Non-initialized local variable** check on `var1` in the last statement. `var1` has the assigned value 0.<br>• A green **Overflow** check on the + operation. | `void func(int flag) {`<br>`    int var1,var2;`<br>`    if( flag==0) {`<br>`        var1=var2;`<br>`    }`<br>`    else {`<br>`        var1=0;`<br>`    }`<br>`    var2=var1 + 1;`<br>`}`<br>In this example, the software:<br>• Does not produce **Non-initialized local variable** checks. At initialization, the software assumes that `var2` has full range of `int` values. Following the `if` statement, because the software considers both `if` branches, it assumes that `var1` also has full range of `int` values.<br>• Produces an orange **Overflow** check on the + operation. For instance, if `var1` has the maximum `int` value, adding 1 to it can cause an overflow. |

## Command-Line Information

**Parameter:** `-disable-initialization-checks`
**Default**: Off
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-disable-initialization-checks`

## See Also

# Ignore overflowing computations on constants (-ignore-constant-overflows)

Allow overflow in computations involving constants

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must allow overflow in computations involving constants.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-ignore-constant-overflows`. See "Command-Line Information" on page 1-246.

### Why Use This Option

Overflows in computations with compile-time constants can stop the analysis. Use this option to ignore these overflows and continue the analysis.

For instance, `char x = 0xff;` causes an overflow according to the ANSI C standard. However, if you use this option, Polyspace considers that this statement is equivalent to `char x = -1;`.

## Settings

☑ On

The verification allows overflows in computations involving constants.

□ Off (default)

If an overflow occurs in computations involving constants, the verification can stop.

## Tips

- This option applies to computations involving compile-time constants only. For instance, the statement `char x = (rand() ? 0xFF:0xFE);` causes an `Overflow` error irrespective of whether the option is used because the value of `x` is not known at compile-time.

## Command-Line Information

**Parameter:** `-ignore-constant-overflows`
**Default**: Off

## See Also

`Overflow`

# Permissive function pointer calls (`-permissive-function-pointer`)

Allow type mismatch between function pointers and the functions they point to

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must allow function pointer calls where the type of the function pointer does not match the type of the function.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node. See “Dependency” on page 1-248 for other options you must also enable.

**Command line**: Use the option `-permissive-function-pointer`. See “Command-Line Information” on page 1-248.

## Settings

☑ On

The verification must allow function pointer calls where the type of the function pointer does not match the type of the function. For instance, a function declared as `int f(int*)` can be called by a function pointer declared as `int fptr(void*)`.

□ Off (default)

The verification must require that the argument and return types of a function pointer and the function it calls are identical.

## Tips

- With sources that use function pointers extensively, enabling this option can cause loss in performance. This loss occurs because the verification has to consider more execution paths.

## Dependency

This option is available only if you set `Source code language (-lang)` to `C`.

## Command-Line Information

**Parameter:** `-permissive-function-pointer`
**Default**: Off
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-permissive-function-pointer`

## See Also

# Overflow computation mode (`-scalar-overflows-behavior`)

Specify whether result of overflow must be wrapped around or truncated

## Description

*This option affects a Code Prover analysis only.*

Specify whether Polyspace must wrap the result of an integer overflow or restrict it to its extremum value.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-scalar-overflows-behavior`. See "Command-Line Information" on page 1-250.

### Why Use This Option

Use this option to specify the assumptions to make following an integer overflow.

## Settings

**Default:** `truncate-on-error`

`truncate-on-error`

If the **Overflow** check on an operation is:

- Red, Polyspace does not analyze the remaining code in the current scope.
- Orange, Polyspace analyzes the remaining code in the current scope. However, Polyspace considers that:

- After a positive **Overflow**, the result of the operation has an upper bound. This upper bound is the maximum value allowed by the type of the result.
- After a negative **Overflow**, the result of the operation has a lower bound. This lower bound is the minimum value allowed by the type of the result.

`wrap-around`

Polyspace analyzes the remaining code in the current scope even after a red integer **Overflow**. However, Polyspace wraps the result of the overflow. For instance, if you choose this option:

- In the following code, after the red **Overflow**, Polyspace considers that `i` has a value `-2`$^{31}$.

```
#include<stdio.h>

void main() {
 int i=1;
 i = i << 30;
 i = i *2;
 printf("%d",i);
}
```

- In the following code, before the orange **Overflow**, `i` has values in the range `[1..2`$^{31}$`-1]`. But, after the orange **Overflow**, Polyspace considers that `i` has even values in the range `[-2`$^{31}$`..2] or [2..2`$^{31}$`-2]`.

```
#include<stdio.h>
int getVal();

void main() {
 int i=getVal();
 if(i>0) {
  i = i*2;
  printf("%d",i);
 }
}
```

## Command-Line Information

**Parameter:** `-scalar-overflows-behavior`
**Value:** `wrap-around | truncate-on-error`
**Default:** `truncate-on-error`

**Example:** `polyspace-code-prover-nodesktop -sources *file_name* -scalar-overflows-behavior wrap-around`

## See Also

`Detect overflows (-scalar-overflows-checks)` | `Overflow`

# Detect overflows (`-scalar-overflows-checks`)

Specify whether to check for integer overflows on signed and unsigned variables

## Description

*This option affects a Code Prover analysis only.*

Specify whether to check for integer overflows on signed and unsigned variables.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-scalar-overflows-checks`. See “Command-Line Information” on page 1-253.

### Why Use This Option

Use this option to specify the kinds of integer overflows that the verification must detect.

## Settings

**Default:** `signed`

`signed`

The verification checks for overflows in computations involving signed integers alone. This behavior conforms to the ANSI C (ISO C++) standard.

`signed-and-unsigned`

The verification checks for overflows in all integer computations. This behavior is stricter than the ANSI C (ISO C++) standard.

none

The verification does not check for integer overflows. If a computed value exceeds the range of its type, the value is wrapped. For instance, in the following code, x is wrapped to 0 after the sum.

```
unsigned char x;
x = 255;
x = x+1;
```

## Tips

- Following an overflow, unless you select none, Polyspace can either wrap the result or restrict it to its extremum value. Use **Overflow computation mode** to specify how the verification handles results of an overflow.
- Use the option signed-and-unsigned if you are computing the size of a buffer from unsigned integers. Using this option helps you detect an overflow at the buffer computation stage. Otherwise, you might see an error later due to insufficient buffer.
- If you use the option signed-and-unsigned, Polyspace does not produce an overflow error on bitwise NOT operations if you cast the result of the operation back to the operand type. For instance, Polyspace does not produce an overflow error on (uint8_t)(~var) where var is of type uint8_t.

## Command-Line Information

**Parameter:** -scalar-overflows-checks
**Value:** signed | signed-and-unsigned | none
**Default:** signed
**Example:** polyspace-code-prover-nodesktop -sources *file_name* -scalar-overflows-checks signed

## See Also

Overflow computation mode (-scalar-overflows-behavior) | Overflow

### Topics

"Detect Overflows in Buffer Size Computation" (Polyspace Code Prover)

# Allow incomplete or partial allocation of structures (`-size-in-bytes`)

Allow a pointer with insufficient memory buffer to point to a structure

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must allow dereferencing a pointer that points to a structure but has a sufficient buffer for only some of the structure's fields.

This type of pointer results when a pointer to a smaller structure is cast to a pointer to a larger structure. The pointer resulting from the cast has sufficient buffer for only some fields of the larger structure.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node. See "Dependency" on page 1-256 for other options that you must also enable.

**Command line**: Use the option `-size-in-bytes`. See "Command-Line Information" on page 1-256.

### Why Use This Option

Use this option to relax the check for illegally dereferenced pointers. You can point to a structure even when the buffer allowed for the pointer is not sufficient for all the structure fields.

## Settings

☑ On

When a pointer with insufficient buffer is dereferenced,Polyspace does not produce an **Illegally dereferenced pointer** error, as long as the dereference occurs within allowed buffer.

For instance, in the following code, the pointer p has sufficient buffer for the first two fields of the structure BIG. Therefore, with the option on, Polyspace considers that the first two dereferences are valid. The third dereference takes p outside its allowed buffer. Therefore, Polyspace produces an **Illegally dereferenced pointer** error on the third dereference.

```
#include <stdlib.h>

typedef struct _little { int a; int b; } LITTLE;
typedef struct _big { int a; int b; int c; } BIG;

void main(void) {
   BIG *p = malloc(sizeof(LITTLE));

   if (p!= ((void *) 0) ) {
      p->a = 0 ;
      p->b = 0 ;
      p->c = 0 ;   // Red IDP check
     }
}
```

□ Off (default)

Polyspace does not allow dereferencing a pointer to a structure if the pointer does not have sufficient buffer for all fields of the structure. It produces an **Illegally dereferenced pointer** error the first time you dereference the pointer.

For instance, in the following code, even though the pointer p has sufficient buffer for the first two fields of the structure BIG, Polyspace considers that dereferencing p is invalid.

```
#include <stdlib.h>

typedef struct _little { int a; int b; } LITTLE;
typedef struct _big { int a; int b; int c; } BIG;
```

```
void main(void) {
   BIG *p = malloc(sizeof(LITTLE));

   if (p!= ((void *) 0) ) {
      p->a = 0 ;   // Red IDP check
      p->b = 0 ;
      p->c = 0 ;
   }
}
```

## Tips

- The verification also allows partial allocation of structures when you select **Enable pointer arithmetic across fields**.
- If you do not turn on this option, you cannot point to the field of a partially allocated structure.

  For instance, in the preceding example, if you do not turn on the option and perform the assignment

  ```
  int *ptr = &(p->a);
  ```

  Polyspace considers that the assignment is invalid. If you dereference `ptr`, it produces an **Illegally dereferenced pointer** error.

## Dependency

This option is available only if you set `Source code language (-lang)` to `C`.

## Command-Line Information

**Parameter:** `-size-in-bytes`
**Default**: Off
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-size-in-bytes`

## See Also

Enable pointer arithmetic across fields (-allow-ptr-arith-on-struct) | Illegally dereferenced pointer

# Subnormal detection mode (`-check-subnormal`)

Detect operations that result in subnormal floating-point values

## Description

*This option affects a Code Prover analysis only.*

Specify that the verification must check floating-point operations for subnormal results.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-check-subnormal`. See “Command-Line Information” on page 1-261.

### Why Use This Option

Use this option to detect floating-point operations that result in subnormal values.

Subnormal numbers have magnitudes less than the smallest floating-point number that can be represented without leading zeros in the significand. The presence of subnormal numbers indicates loss of significant digits. This loss can accumulate over subsequent operations and eventually result in unexpected values. Subnormal numbers can also slow down the execution on targets without hardware support.

## Settings

**Default:** `allow`

`allow`

The verification does not check operations for subnormal results.

`forbid`

The verification checks for subnormal results.

The verification stops the execution path with the subnormal result and prevents subnormal values from propagating further. Therefore, in practice, you see only the first occurrence of the subnormal value.

`warn-all`

The verification checks for subnormal results and highlights all occurrences of subnormal values. Even if a subnormal result comes from previous subnormal values, the result is highlighted.

The verification continues even if the check is red.

`warn-first`

The verification checks for subnormal results but only highlights first occurrences of subnormal values. If a subnormal value propagates to further subnormal results, those subsequent results are not highlighted.

The verification continues even if the check is red.

For details of the result colors in each mode, see `Subnormal float`.

## Tips

- If you want to see only those operations where a subnormal value originates from non-subnormal operands, use the `warn-first` mode.

  For instance, in the following code, `arg1` and `arg2` are unknown. The verification assumes that they can take all values allowed for the type `double`. This assumption can lead to subnormal results from certain operations. If you use the `warn-first` mode, the first operation causing the subnormal result is highlighted.

| **`warn-all`** | **`warn-first`** |
|---|---|
| `void func (double arg1, double arg2)`<br>`{`<br>`      double difference1 = arg1 - arg2;`<br>`      double difference2 = arg1 - arg2;`<br>`      double val1 = difference1 * 2;`<br>`      double val2 = difference2 * 2;`<br>`}`<br><br>In this example, all four operations can have subnormal results. The four checks for subnormal results are orange. | `void func (double arg1, double arg2)`<br>`{`<br>`      double difference1 = arg1 - arg2;`<br>`      double difference2 = arg1 - arg2;`<br>`      double val1 = difference1 * 2;`<br>`      double val2 = difference2 * 2;`<br>`}`<br><br>In this example, `difference1` and `difference2` can be subnormal if `arg1` and `arg2` are sufficiently close. The first two checks for subnormal results are orange. `val1` and `val2` cannot be subnormal unless `difference1` and `difference2` are subnormal. The last two checks for subnormal results are green.<br><br>Through red/orange checks, you see only the first instance where a subnormal value appears. You do not see red/orange checks from those subnormal values propagating to subsequent operations. |

- If you want to see where a subnormal value originates and do not want to see subnormal results arising from the same cause more than once, use the `forbid` mode.

  For instance, in the following code, `arg1` and `arg2` are unknown. The verification assumes that they can take all values allowed for the type `double`. This assumption can lead to subnormal results for `arg1-arg2`. If you use the `forbid` mode and perform the operation `arg1-arg2` twice in succession, only the first operation is highlighted. The second operation is not highlighted because the subnormal result for the second operation arises from the same cause as the first operation.

| **warn-all** | **forbid** |
|---|---|
| `void func (double arg1, double arg2)`<br>`{`<br>`      double difference1 = arg1 - arg2;`<br>`      double difference2 = arg1 - arg2;`<br>`      double val1 = difference1 * 2;`<br>`      double val2 = difference2 * 2;`<br>`}`<br><br>In this example, all four operations can have subnormal results. The four checks for subnormal results are orange. | `void func (double arg1, double arg2)`<br>`{`<br>`      double difference1 = arg1 - arg2;`<br>`      double difference2 = arg1 - arg2;`<br>`      double val1 = difference1 * 2;`<br>`      double val2 = difference2 * 2;`<br>`}`<br><br>In this example, `difference1` can be subnormal if `arg1` and `arg2` are sufficiently close. The first check for subnormal results is orange. Following this check, the verification excludes from consideration:<br>• The close values of `arg1` and `arg2` that led to the subnormal value of `difference1`.<br>In the subsequent operation `arg1 - arg2`, the check is green and `difference2` is not subnormal. The result of the check on `difference2 * 2` is green for the same reason.<br>• The subnormal value of `difference1`.<br>In the subsequent operation `difference1 * 2`, the check is green. |

- You cannot run the Automatic Orange Tester if you check for subnormals in your verification.

## Command-Line Information

**Parameter:** `-check-subnormal`
**Value:** `allow` | `warn-first` | `warn-all` | `forbid`

**Default:** `allow`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-check-subnormal forbid`

## See Also

### Polyspace Results

`Subnormal float`

### Introduced in R2016b

# Detect uncalled functions (`-uncalled-function-checks`)

Detect functions that are not called directly or indirectly from `main` or another entry point function

## Description

*This option affects a Code Prover analysis only.*

Detect functions that are not called directly or indirectly from `main` or another entry point function during run-time.

### Set Option

**User interface**: In your project configuration, the option is on the **Check Behavior** node.

**Command line**: Use the option `-uncalled-function-checks`. See “Command-Line Information” on page 1-264.

### Why Use This Option

Typically, after verification, the **Dashboard** pane shows functions that are not called during verification. However, you do not see them in your analysis results or reports. You cannot comment on them or justify them.

If you want to see these uncalled functions in your analysis results and reports, use this option.

## Settings

**Default:** `none`

`none`

The verification does not generate checks for uncalled functions.

`never-called`

The verification generates checks for functions that are defined but not called.

`called-from-unreachable`

The verification generates checks for functions that are defined and called from an unreachable part of the code.

`all`

The verification generates checks for functions that are:

- Defined but not called
- Defined and called from an unreachable part of the code.

## Command-Line Information

**Parameter:** `-uncalled-function-checks`
**Value:** `none` | `never-called` | `called-from-unreachable` | `all`
**Default**: `none`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-uncalled-function-checks all`

## See Also

`Function not called` | `Function not reachable`

### Topics

"Specify Analysis Options" (Polyspace Code Prover)
"Review Gray Checks" (Polyspace Code Prover)
"Review and Fix Function Not Called Checks" (Polyspace Code Prover)
"Review and Fix Function Not Reachable Checks" (Polyspace Code Prover)

# Sensitivity context (`-context-sensitivity`)

Store call context information to identify function call that caused errors

## Description

*This option affects a Code Prover analysis only.*

Specify the functions for which the verification must store call context information. If the function is called multiple times, using this option helps you to distinguish between the different calls.

### Set Option

**User interface**: In your project configuration, the option is available on the **Precision** node.

**Command line**: Use the option `-context-sensitivity`. See “Command-Line Information” (Polyspace Code Prover).

### Why Use This Option

Suppose a function is called twice in your code. The check color on each operation in the function body is a combined result of both calls. If you want to distinguish between the colors in the two calls, use this option.

For instance, if a function contains a red or orange check and a green check on the same operation for two different calls, the software combines the contexts and displays an orange check on the operation. If you use this option, you can identify the color of the check for each call. For a tutorial on using this option, see “Identify Function Call with Run-Time Error” (Polyspace Code Prover).

## Settings

**Default:** `none`

`none`

The software does not store call context information for functions.

`auto`

The software stores call context information for checks in:

- Functions that form the leaves of the call tree. These functions are called by other functions, but do not call functions themselves.
- Small functions. The software uses an internal threshold to determine whether a function is small.

`custom`

The software stores call context information for functions that you specify. To enter the name of a function, click ➕.

## Command-Line Information

**Parameter:** `-context-sensitivity`
**Value:** `*function1*[,*function2*,...]`
**Default:** `none`
**Example:** `polyspace-code-prover-nodesktop -sources *file_name* -context-sensitivity myFunc1,myFunc2`

To allow the software to determine which functions receive call context storage, use the option `-context-sensitivity-auto`.

## See Also

# Improve precision of interprocedural analysis (-`path-sensitivity-delta`)

Avoid certain verification approximations for code with fewer lines

## Description

*This option affects a Code Prover analysis only.*

For smaller code, use this option to improve the precision of cross-functional analysis.

### Set Option

**User interface**: In your project configuration, the option is available on the **Precision** node.

**Command line**: Use the option `-path-sensitivity-delta`. See “Command-Line Information” on page 1-268.

### Why Use This Option

Use this option to avoid certain software approximations on execution paths. Avoiding these approximations results in fewer orange checks but a much longer verification time.

For instance, for deep function call hierarchies or nested conditional statements, to complete verification in a reasonable amount of time, the software combines many execution paths and stores less information at each stage of verification. If you use this option, the software stores more information about the execution paths, resulting in a more precise verification.

## Settings

**Default:** Off

Enter a positive integer to turn on this option.

Entering a higher value leads to a greater number of proven results, but also increases verification time exponentially. For instance, a value of 10 can result in very long verification times.

## Tips

Use this option only when you have less than 1000 lines of code.

## Command-Line Information

**Parameter:** `-path-sensitivity-delta`
**Value:** Positive integer

## See Also

### Topics

"Improve Verification Precision" (Polyspace Code Prover)

# Precision level (-O)

Specify a precision level for the verification

## Description

*This option affects a Code Prover analysis only.*

Specify the precision level that the verification must use.

### Set Option

**User interface**: In your project configuration, the option is available on the **Precision** node.

**Command line**: Use the option `-O#`, for instance, `-O0` or `-O1`. See “Command-Line Information” on page 1-270.

### Why Use This Option

Higher precision leads to greater number of proven results but also requires more verification time. Each precision level corresponds to a different algorithm used for verification.

In most cases, you see the optimal balance between precision and verification time at level 2.

## Settings

**Default:** `2`

`0`

This option corresponds to a static interval verification.

`1`

This option corresponds to a complex polyhedron model of domain values.

`2`

This option corresponds to more complex algorithms closely modelling domain values. The algorithms combine both complex polyhedrons and integer lattices.

## Tips

For best results in reasonable time, use the default level `2`. If the verification takes a long time, reduce precision. However, the number of unproven checks can increase. Likewise, to reduce orange checks, you can improve your precision. But the verification can take significantly longer time.

## Command-Line Information

**Parameter:** `-O0` | `-O1` | `-O2` | `-O3`
**Default:** `-O2`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-O1`

## See Also

### Topics

"Specify Analysis Options" (Polyspace Code Prover)
"Improve Verification Precision" (Polyspace Code Prover)

# Specific precision (`-modules-precision`)

Specify source files you want to verify at higher precision than the remaining verification

## Description

*This option affects a Code Prover analysis only.*

Specify source files that you want to verify at a precision level higher than that for the entire verification.

### Set Option

**User interface**: In your project configuration, the option is available on the **Precision** node. See “Dependency” on page 1-272 for other options you must also enable.

**Command line**: Use the option `-modules-precision`. See “Command-Line Information” on page 1-272.

### Why Use This Option

If a specific file is verified imprecisely leading to many orange checks in the file and elsewhere, you can improve the precision for that file.

Note that increasing precision also increases verification time.

## Settings

**Default:** All files are verified with the precision you specified using **Precision** > **Precision level**.

Click ➕ to enter the name of a file without the extension `.c` and the corresponding precision level.

## Dependency

This option is available only if you set `Source code language (-lang)` to `C` or `C-CPP`.

## Command-Line Information

**Parameter:** `-modules-precision`
**Value:** *`file`*`:O0` | *`file`*`:O1` | *`file`*`:O2` | *`file`*`:O3`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-O1 -modules-precision My_File:O2`

## See Also

`Precision level (-O)`

### Topics

"Specify Analysis Options" (Polyspace Code Prover)
"Improve Verification Precision" (Polyspace Code Prover)

# Verification level (`-to`)

Specify number of times the verification process runs on your code

## Description

*This option affects a Code Prover analysis only.*

Specify the number of times the Polyspace verification process runs on your source code. Each run can lead to greater number of proven results but also requires more verification time.

### Set Option

**User interface**: In your project configuration, the option is available on the **Precision** node.

**Command line**: Use the option `-to`. See “Command-Line Information” on page 1-276.

### Why Use This Option

There are many reasons you might want to increase or decrease the verification level. For instance:

- Coding rules are checked early during the compilation phase, with some exceptions (Polyspace Code Prover) only. If you check for coding rules alone, you can lower the verification level.
- If you see many orange checks after verification, try increasing the verification level. However, increasing the verification level also increases verification time.

  In most cases, you see the optimal balance between precision and verification time at level 2.

## Settings

**Default:** `Software Safety Analysis level 2`

`Source Compliance Checking`

Polyspace completes coding rules checking at the end of the compilation phase.

`Software Safety Analysis level 0`

The verification process runs once on your source code.

`Software Safety Analysis level 1`

The verification process runs twice on your source code.

`Software Safety Analysis level 2`

The verification process runs three time on your source code. Use this option for most accurate results in reasonable time.

`Software Safety Analysis level 3`

The verification process runs four times on your source code.

`Software Safety Analysis level 4`

The verification process runs five times on your source code.

`other`

If you use this option, Polyspace verification will make 20 passes unless you stop it manually.

## Tips

- Use a higher verification level for fewer orange checks.

### Difference between Level 0 and 1

The following example illustrates the difference between `Software Safety Analysis level 0` and `Software Safety Analysis level 1`:

Software Safety Analysis Level 0

```
#include <stdlib.h>

void ratio    (float x, float *y)
{
    *y=(abs(x-*y))/(x+*y);
}

void level1 (float x,
                float y, float *t)
{ float v;
    v = y;
    ratio (x, &y);
    *t = 1.0/(v - 2.0 * x);
}

float level2(float v)
{
    float t;
    t = v;
    level1(0.0, 1.0, &t);
    return t;
}

void main(void)
{
    float r,d;
    d= level2(1.0);
    r = 1.0 / (2.0 - d);
}
```

Software Safety Analysis Level 1

```
#include <stdlib.h>

void ratio    (float x, float *y)
{
    *y=(abs(x-*y))/(x+*y);
}

void level1 (float x,
                float y, float *t)
{ float v;
    v = y;
    ratio (x, &y);
    *t = 1.0/(v - 2.0 * x);
}

float level2(float v)
{
    float t;
    t = v;
    level1(0.0, 1.0, &t);
    return t;
}

void main(void)
{
    float r,d;
    d= level2(1.0);
    r = 1.0 / (2.0 - d);
}
```

In the table, verification produces an orange `Division by Zero` check during level 0 verification. The check turns green during level 1. The verification acquires more precise knowledge of `x` in the higher level.

If a higher verification level fails because the verification runs out of memory, but results are available at a lower level, Polyspace displays the results from the lower level.

- For best results, use the option `Software Safety Analysis level 2`. If the verification takes too long, use a lower **Verification level**. Fix red errors and gray code before rerunning the verification with higher verification levels.

- Use the option `Other` sparingly since it can increase verification time by an unreasonable amount. Using `Software Safety Analysis level 2` provides optimal verification of your code in most cases.
- If you want to check for coding rules only, you can run Polyspace on your source code up to the `Source Compliance Checking` phase.

  With the exception of certain rules, (Polyspace Code Prover) Polyspace checks for coding rule violations during the compilation phase.
- If the **Verification Level** is set to `Source Compliance Checking`, do not run verification on a remote server. The source compliance checking, or compilation, phase takes place on your local computer anyway. Therefore, if you are running verification only to the end of compilation, run verification on your local computer.

## Command-Line Information

**Parameter:** `-to`
**Value:** `compile` | `pass0` | `pass1` | `pass2` | `pass3` | `pass4` | `other`
**Default:** `pass2`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-to pass2`

## See Also

### Topics

“Improve Verification Precision” (Polyspace Code Prover)

# Verification time limit (-timeout)

Specify a time limit on your verification

## Description

*This option affects a Code Prover analysis only.*

Specify a time limit for the verification in hours. If the verification does not complete within that limit, it stops.

### Set Option

**User interface**: In your project configuration, the option is available on the **Precision** node.

**Command line**: Use the option -timeout. See "Command-Line Information" on page 1-277.

### Why Use This Option

Use this option to impose a time limit on the verification.

The option is useful only in very specific cases. Suppose your code has certain constructs that might slow down the verification. To check this, Technical Support can ask you to impose a time limit on the verification so that the verification stops if it takes too long.

## Settings

Enter the time in hours. For fractions of an hour, specify decimal form.

## Command-Line Information

**Parameter:** -timeout

**Value:** `time`
**Example:** `polyspace-code-prover-nodesktop -sources file_name -timeout 5.75`

## See Also

### Topics

"Specify Analysis Options" (Polyspace Code Prover)
"Improve Verification Precision" (Polyspace Code Prover)

# Inline (-inline)

Specify functions that must be cloned internally for each function call

## Description

*This option affects a Code Prover analysis only.*

Specify the functions that the verification must clone internally for every function call.

### Set Option

**User interface**: In your project configuration, the option is available on the **Scaling** node.

**Command line**: Use the option `-inline`. See “Command-Line Information” on page 1-281.

### Why Use This Option

Use this option sparingly. Sometimes, using the option helps to work around scaling issues during verification. If your verification takes too long, Technical Support can ask you to use this option for certain functions.

Do not use this option to understand results. For instance, suppose a function is called twice in your code. The check color on each operation in the function body is a combined result of both calls. If you want to distinguish between the colors in the two calls, use the option `Sensitivity context (-context-sensitivity)`.

## Settings

**No Default**

Enter function names or choose from a list.

- Click ✚ to add a field and enter the function name.
- Click 🔍 to list functions in your code. Choose functions from the list.

The verification internally clones the function for each call. For instance, if you specify the function `func` for inlining and `func` is called twice, the software creates two copies of `func` for verification. The copies are named using the convention `func_pst_inlined_`*`ver`* where *`ver`* is the version number. You see both copies on the **Call Hierarchy** pane.

However, for each run-time check in the function body, you see only one color in your verification results. The semantics of the check color is different from the normal specification.

*Red checks*:

- Normally, if a function is called twice and an operation causes a definite error only in one of the calls, the check color is orange.
- If you use this option, the worst color is shown for the check. Therefore, the check is red.

*Gray checks*:

- Normally, if a function is called twice and an `if` statement branch is unreachable in only one of the calls, the branch is shown as reachable.
- If you use this option, the worst color is shown for the check. Therefore, the `if` branch appears gray.

Do not use this option to understand results. Use this option only if a certain function causes scaling issues.

## Tips

- Use this option to identify the cause of a **Non-terminating call** error.
  - **Situation:** Sometimes, a red **Non-terminating call** check can appear on a function call though a red check does not appear in the function body. The function body represents all calls to the function. Therefore, if some calls to a function do not cause an error, an orange check appears in the function body.

  - **Action:** If you use this option, for every function call, there is a corresponding function body. Therefore, you can trace a red check on a function call to a red check in the function body.

- Using this option can sometimes duplicate a lot of code and lead to scaling problems. Therefore choose functions to inline carefully.
- Choose functions to inline based on hints provided by the alias verification.
- Do not use this option for entry point functions, including `main`.
- Using this option can increase the number of gray **Unreachable code** checks.

  For example, in the following code, if you enter `max` for **Inline**, you obtain two **Unreachable code** checks, one for each call to `max`.

  ```
  int max(int a, int b) {
    return a > b ? a : b;
  }

  void main() {
    int i=3, j=1, k;
    k=max(i,j);
    i=0;
    k=max(i,j);
  }
  ```
- If you use the keyword `inline` before a function definition, place the definition in a header file and call the function from multiple source files, you have the same result as using the option **Inline**.
- For C++ code, this option applies to all overloaded methods of a class.

## Command-Line Information

**Parameter:** `-inline`<br>
**Value:** *`function1`*`[,`*`function2`*`[,...]]`<br>
**No Default**<br>
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-inline func1,func2`

## See Also

# Depth of verification inside structures (`-k-limiting`)

Limit the depth of analysis for nested structures

## Description

*This option affects a Code Prover analysis only.*

Specify a limit to the depth of analysis for nested structures.

### Set Option

**User interface**: In your project configuration, the option is available on the **Scaling** node.

**Command line**: Use the option `-k-limiting`. See “Command-Line Information” on page 1-283.

### Why Use This Option

Use this option if the analysis is slow because your code has a structure that is many levels deep.

Typically, you see a warning message when a structure with a deep hierarchy is slowing down the verification.

## Settings

**Default:** Full depth of nested structures is analyzed.

Enter a number to specify the depth of analysis for nested structures. For instance, if you specify 0, the analysis does not verify a structure inside a structure.

If you specify a number less than 2, the verification could be less precise.

## Command-Line Information

**Parameter:** `-k-limiting`
**Value:** *`positive integer`*
**Default:** `polyspace-code-prover-nodesktop -sources file_name -k-limiting 3`

## See Also

# Generate report

Specify whether to generate a report after the analysis

## Description

Specify whether to generate a report after the analysis.

Depending on the format you specify, you can view this report using an external software. For example, if you specify the format `PDF`, you can view the report in a `pdf` reader.

### Set Option

**User interface**: In your project configuration, the option is available on the **Reporting** node.

**Command line**: See “Command-Line Information” on page 1-285.

### Why Use This Option

You can generate a report from your analysis results for archiving purposes. You can provide this report to your management or clients as proof of code quality.

Using other analysis options, you can tailor the report content and format for your specific needs. See `Bug Finder and Code Prover report (-report-template)` and `Output format (-report-output-format)`.

## Settings

☑ On

Polyspace generates an analysis report using the template and format you specify.

☐ Off (default)

Polyspace does not generate an analysis report. You can still view your results in the Polyspace interface.

## Tips

- To generate a report *after* an analysis is complete, select **Reporting** > **Run Report**. Alternatively, at the command line, use the command `polyspace-report-generator` with the options `-template` and `-format`.

## Command-Line Information

There is no command-line option to solely turn on the report generator. However, using the options `-report-template` for template and `-report-output-format` for output format automatically turns on the report generator.

## See Also

`Bug Finder and Code Prover report (-report-template)` | `Output format (-report-output-format)`

### Topics

"Specify Analysis Options"
"Generate Reports"

# Bug Finder and Code Prover report (`-report-template`)

Specify template for generating analysis report

## Description

Specify template for generating analysis report.

`.rpt` files for the report templates are available in *`matlabroot`*`\toolbox\polyspace\psrptgen\templates\`. Here, *`matlabroot`* is the MATLAB installation folder.

### Set Option

**User interface**: In your project configuration, the option is on the **Reporting** node. You have separate options for Bug Finder and Code Prover analysis. See “Dependencies” on page 1-292 for other options you must also enable.

**Command line**: Use the option `-report-template`. See “Command-Line Information” on page 1-293.

### Why Use This Option

Depending on the template that you use, the report contains information about certain types of results from the **Results List** pane. The template also determines what information is presented in the report and how the information is organized. See the template descriptions below.

## Settings – Bug Finder

**Default:** `BugFinderSummary`

`BugFinderSummary`

The report lists:

- **Polyspace Bug Finder Summary**: Number of results in the project. The results are summarized by file. The files that are partially analyzed because of compilation errors are listed in a separate table.
- **Code Metrics Summary**: Summary of the various code complexity metrics. For more information, see “Code Metrics”.
- **Defect Summary**: Defects that Polyspace Bug Finder looks for. For each defect, the report lists the:
  - Defect group.
  - Defect name.
  - Number of instances of the defect found in the source code.
- **Coding Rules Summary**: Coding rules along with number of violations.

`BugFinder`

The report lists:

- **Polyspace Bug Finder Summary**: Number of results in the project. The results are summarized by file. The files that are partially analyzed because of compilation errors are listed in a separate table.
- **Code Metrics Summary**: Summary of the various code complexity metrics. For more information, see “Code Metrics”.
- **Defects**: Defects found in the source code. For each defect, the report lists the:
  - Function containing the defect.
  - Defect information on the **Result Details** pane.
  - Review information, such as **Severity**, **Status** and comments.
- **Coding Rules**: Coding rule violations in the source code. For each rule violation, the report lists the:
  - Rule number and description.
  - Function containing the rule violation.
  - Review information, such as **Severity**, **Status** and comments.
- **Configuration Settings**: List of analysis options that Polyspace uses for analysis. For more information, see “Analysis Options”. If your project has source files with compilation errors, these files are also listed.

If you check for coding rules, an additional **Coding Rules Configuration** section states the rules along with the information whether they were enabled or disabled.

`BugFinder_CWE`

The report contains the same information as the `BugFinder` report. However, in the **Defects** chapter, an additional column lists the CWE identifiers for each defect.

`CodeMetrics`

The report lists the following:

- **Code Metrics Summary**: Various quantities related to the source code. For more information, see "Code Metrics".
- **Code Metrics Details**: Various quantities related to the source code with the information broken down by file and function.

`CodingRules`

For `C` code, the report lists information about compliance with:

- MISRA C rules
- MISRA `AC AGC` rules
- Custom coding rules

For `C++` code, the report lists information about compliance with:

- MISRA `C++` rules
- JSF `C++` rules
- Custom coding rules

This report also contains the Polyspace configuration settings for the analysis. An additional section states the rules along with the information whether they were enabled or disabled.

`Metrics`

*Only available for results downloaded from the Polyspace Metrics interface.*

The report lists information useful to quality engineers and available on the Polyspace Metrics interface, including:

- Information about whether the project satisfies quality objectives

- Time taken in each phase of analysis
- Metrics about the whole project. For each metric, the report lists the quality threshold and whether the metric satisfies this threshold.
- Coding rule violations in the project. For each rule, the report lists the number of violations justified and whether the justifications satisfy quality objectives.
- Definite as well as possible run-time errors in the project. For each type of run-time error, the report lists the number of errors justified and whether the justifications satisfy quality objectives.

The appendices contain further details of Polyspace configuration settings, code metrics, coding rule violations, and run-time errors.

## Settings – Code Prover

**Default:** `Developer`

`CallHierarchy`

The report displays the call hierarchy in your source code. For each function call in your source code, the report displays the following information:

- Level of call hierarchy, where the function is called.

  Each level is denoted by `|`. If a function call appears in the table as `|||->` *`file_name`*`.`*`function_name`*, the function call occurs at the third level of the hierarchy. Beginning from `main` or an entry point, there are three function calls leading to the current call.
- File containing the function call.

  In addition, the line and column is also displayed.
- File containing the function definition.

  In addition, the line and column where the function definition begins is also displayed.

In addition, the report also displays uncalled functions.

This report captures the information available on the **Call Hierarchy** pane in the Polyspace user interface.

`CodeMetrics`

The report contains a summary of code metrics, followed by the complete metrics for an application.

`CodingRules`

For `C` code, the report lists information about compliance with:

- MISRA C rules
- MISRA `AC AGC` rules
- Custom coding rules

For `C++` code, the report lists information about compliance with:

- MISRA `C++` rules
- JSF `C++` rules
- Custom coding rules

This report also contains the Polyspace configuration settings and modifiable assumptions used in the analysis. An additional section states the rules along with the information whether they were enabled or disabled.

`Developer`

The report lists information useful to developers, including:

- Summary of results
- Coding rule violations
- List of proven run-time errors or red checks
- List of unproven run-time errors or orange checks
- List of unreachable procedures or gray checks
- Global variable usage in code. See “Global Variables” (Polyspace Code Prover).

The report also contains the Polyspace configuration settings and modifiable assumptions used in the analysis. If your project has source files with compilation errors, these files are also listed.

`DeveloperReview`

The report lists the same information as the `Developer` report. However, the reviewed results are sorted by severity and status, and unreviewed results are sorted by file location.

`Developer_withGreenChecks`

The report lists the same information as the `Developer` report. In addition, the report lists code proven to be error-free or green checks.

`Quality`

The report lists information useful to quality engineers, including:

- Summary of results
- Statistics about the code
- Graphs showing distributions of checks per file

The report also contains the Polyspace configuration settings and modifiable assumptions used in the analysis. If your project has source files with compilation errors, these files are also listed.

`SoftwareQualityObjectives`

The report lists information useful to quality engineers and available on the Polyspace Metrics interface, including:

- Information about whether the project satisfies quality objectives
- Time taken in each phase of verification
- Metrics about the whole project. For each metric, the report lists the quality threshold and whether the metric satisfies this threshold.
- Coding rule violations in the project. For each rule, the report lists the number of violations justified and whether the justifications satisfy quality objectives.
- Definite as well as possible run-time errors in the project. For each type of run-time error, the report lists the number of errors justified and whether the justifications satisfy quality objectives.

The appendices contain further details of Polyspace configuration settings, code metrics, coding rule violations, and run-time errors.

This template is available only if you generate a report from results downloaded from the Polyspace Metrics web dashboard.

`SoftwareQualityObjectives_Summary`

The report contains the same information as the `SoftwareQualityObjectives` report. However, it does not have the supporting appendices with details of code metrics, coding rule violations and run-time errors.

This template is available only if you generate a report from results downloaded from the Polyspace Metrics web dashboard.

`VariableAccess`

The report displays the global variable access in your source code. The report first displays the number of global variables of each type. For information on the types, see “Global Variables” (Polyspace Code Prover). For each global variable, the report displays the following information:

- Variable name.

  The entry for each variable is denoted by `|`.
- Type of the variable.
- Number of read and write operations on the variable.
- Details of read and write operations. For each read or write operation, the table displays the following information:

  - File and function containing the operation in the form *`file_name.function_name`*.

    The entry for each read or write operation is denoted by `||`. Write operations are denoted by < and read operations by >.
  - Line and column number of the operation.

This report captures the information available on the **Variable Access** pane in the Polyspace user interface.

## Dependencies

This option is available only if you select the `Generate report` check box.

## Tips

The first chapter of the reports contain a summary of the relevant results. You can enter a Pass/Fail status in that chapter for your project based on the summary. If you use the template `SoftwareQualityObjectives` or `SoftwareQualityObjectives_Summary`, the status is automatically assigned based on your objectives and the verification results.

For more information on enforcing objectives using Polyspace Metrics, see “Compare Metrics Against Software Quality Objectives” (Polyspace Code Prover).

## Command-Line Information

**Parameter:** `-report-template`
**Value:** Full path to *`template`*`.rpt`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-report-template` *`matlabroot`*`\toolbox\polyspace\psrptgen\templates\bug_finder\BugFinder.rpt`
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-report-template` *`matlabroot`*`\toolbox\polyspace\psrptgen\templates\Developer.rpt`

## See Also

`Generate report` | `Output format (-report-output-format)`

### Topics

“Generate Reports”

# Output format (`-report-output-format`)

Specify output format of generated report

## Description

Specify output format of analysis report.

### Set Option

**User interface**: In your project configuration, the option is on the **Reporting** node. See “Dependencies” on page 1-295 for other options you must also enable.

**Command line**: Use the option `-report-output-format`. See “Command-Line Information” on page 1-295.

### Why Use This Option

Use this option to specify whether you want a report in PDF, HTML or another format.

## Settings

**Default:** `Word`

`HTML`

  Generate report in `.html` format

`PDF`

  Generate report in `.pdf` format

`Word`

  Generate report in `.docx` format.

## Tips

If the table of contents or graphics in a .docx report appear outdated, select the content of the report and refresh the document. Use keyboard shortcuts **Ctrl+A** to select the content and **F9** to refresh it.

## Dependencies

This option is enabled only if you select the **Generate report** box.

## Command-Line Information

**Parameter:** `-report-output-format`
**Value:** `html | pdf | word`
**Default:** `word`
**Example:** `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-report-output-format pdf`

## See Also

Generate report | Bug Finder and Code Prover report (-report-template)

### Topics

"Specify Analysis Options"
"Generate Reports"

# Run Bug Finder or Code Prover analysis on a remote cluster (`-batch`)

Enable batch remote analysis

## Description

Enable batch remote analysis.

For batch remote analysis, you need:

- Polyspace and MATLAB Distributed Computing Server™ on the cluster
- MATLAB, Polyspace and Parallel Computing Toolbox™ on your local computer.

### Set Option

**User interface**: In your project configuration, the option is on the **Run Settings** node. You have separate options for a Bug Finder and a Code Prover analysis.

**Command line**: Use the option `-batch`. See “Command-Line Information” on page 1-297.

### Why Use This Option

Use this option if you want the analysis to run on a remote cluster instead of your local desktop.

For instance, you can run remote analysis when:

- You want to shut down your local machine but not interrupt the analysis.
- You want to free execution time on your local machine.
- You want to transfer the analysis to a more powerful computer.

## Settings

☑ On

Run batch analysis on a remote computer. In this remote analysis mode, the analysis is queued on a cluster after the compilation phase. Therefore, on your local computer, after the analysis is queued:

- If you are running the analysis from the Polyspace user interface, you can close the user interface.
- If you are running the analysis from the command line, you can close the command-line window.

You can manage the queue from the Polyspace Job Monitor. To use the Polyspace Job Monitor:

- In the Polyspace user interface, select **Tools** > **Open Job Monitor**.
- On the DOS or UNIX® command line, use the `polyspace-jobs-manager` command. For more information, see "Run Remote Analysis at the Command Line".
- On the MATLAB command line, use the `polyspaceJobsManager` function.

After the analysis, you might have to manually download the results from the cluster.

□ Off (default)

Do not run batch analysis on a remote computer.

## Command-Line Information

To run a remote analysis from the command line, use with the `-scheduler` option.
**Parameter:** `-batch`
**Value:** `-scheduler` *`host_name`* if you have not set the **Job scheduler host name** in the Polyspace user interface
**Default:** Off
**Example:** `polyspace-code-prover-nodesktop -batch -scheduler NodeHost`
`polyspace-code-prover-nodesktop -batch -scheduler MJSName@NodeHost`
**Example:** `polyspace-bug-finder-nodesktop -batch -scheduler NodeHost`

```
polyspace-bug-finder-nodesktop -batch -scheduler MJSName@NodeHost
```

## See Also

`Upload results to Polyspace Metrics (-add-to-results-repository)` | `-scheduler`

### Topics

"Specify Analysis Options"
"Set Up Server for Metrics and Remote Analysis"

# Upload results to Polyspace Metrics (`-add-to-results-repository`)

Upload analysis results for viewing on Polyspace Metrics web dashboard

## Description

Specify upload of analysis results to the Polyspace Metrics results repository, allowing Web-based reporting of results and code metrics.

### Set Option

**User interface**: In your project configuration, the option is on the **Run Settings** node. You have separate options for a Bug Finder and a Code Prover analysis. See “Dependencies” on page 1-300 for other options that you must also enable.

**Command line**: Use the option `-add-to-results-repository`. See “Command-Line Information” on page 1-300.

### Why Use This Option

Polyspace Metrics is a web dashboard that generates code quality metrics from your analysis results. Using this dashboard, you can:

- Provide your management a high-level overview of your code quality.
- Compare your code quality against predefined standards.
- Establish a process where you review in detail only those results that fail to meet standards.
- Track improvements or regression in code quality over time.

See “Generate Code Quality Metrics”.

## Settings

☑ On

Analysis results are stored in the Polyspace Metrics results repository. This allows you to use a Web browser to view results and code metrics.

□ Off (default)

Analysis results are stored locally.

## Dependencies

The option to upload to Polyspace Metrics is available only if you select `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`.

If you perform a local analysis on your desktop, you can later upload your results to Polyspace Metrics. Right-click your results file and select **Upload to Metrics**.

## Command-Line Information

**Parameter:** `-add-to-results-repository`
**Default:** Off
**Example:** `polyspace-code-prover-nodesktop -batch -scheduler NodeHost -add-to-results-repository -password` *`passwordName`*
**Example:** `polyspace-bug-finder-nodesktop -batch -scheduler NodeHost -add-to-results-repository -password` *`passwordName`*

The password is optional.

## See Also

“Set Up Server for Metrics and Remote Analysis” | “Set Up Polyspace Metrics” | `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`

### Topics

“Run Remote Batch Analysis”

# Use fast analysis mode for Bug Finder (`-fast-analysis`)

Run analysis using faster local mode

## Description

*This option affects a Bug Finder analysis only.*

Run analysis using faster local mode. The first run analyzes all files, but subsequent runs analyze only the files that you edited since the previous analysis.

Fast analysis mode is a faster way to analyze code for localized defects and coding rules. When you launch a Bug Finder fast-analysis, Polyspace analyzes each file for a subset of defects and coding rules. These defects and rules are coding errors that can be found within a single compilation unit, such as a single function or file. The software does not perform interprocedural or cross-functional analysis.

### Set Option

**User interface**: In your project configuration, the option is available on the **Run Settings** node.

**Command line**: Use the option `-fast-analysis`. See “Command-Line Information” on page 1-303.

### Why Use This Option

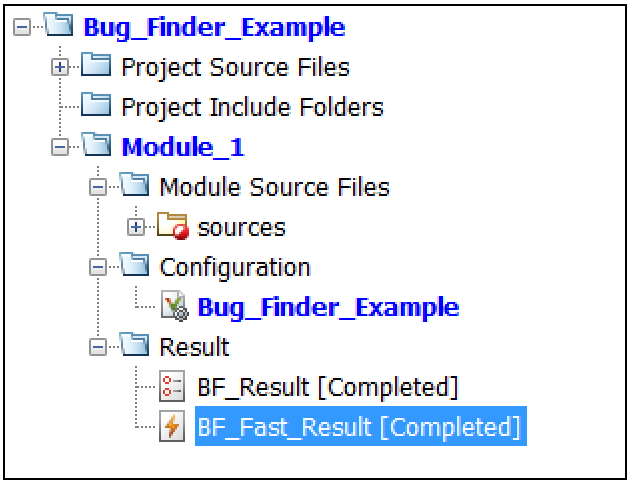
If you use this option, you have to wait less for analysis results from your second analysis onwards. During development, you can frequently run analysis in fast mode and quickly check for new defects or coding rule violations.

Polyspace produces results quickly because the analysis is localized. When you rerun in fast-analysis mode, Polyspace reanalyzes only those files that need to be reanalyzed, regenerating results even more quickly. These situations trigger a reanalysis.

| Situation | What Is Reanalyzed |
|---|---|
| Source file modified | Modified source file |
| Header file modified | Source files that include the modified header file (directly or indirectly) |
| Analysis options added or removed | All files |
| Previous fast-analysis results not found | All files |

For example, consider a Polyspace project with three `.c` files and you fix a bug in one of the files. When you rerun the analysis, Polyspace reanalyzes only the one file that you changed.

The results of fast analysis appear in a folder separate from the results of normal analysis.



## Settings

**Default:** □ Off

☑ On

Polyspace Bug Finder runs in fast-analysis mode. Polyspace analyzes code for only a subset of defects and coding rules. If you have selected any defects or coding rules that are not supported by fast-analysis, you code is not checked for those results.

□ Off

Polyspace Bug Finder runs in the normal mode. Analysis checks for all selected defects, coding rules, and code metrics.

## Tips

In fast analysis mode:

- You cannot create a new results folder for each run. Even if you choose to create a new result folder, each new run overwrites the previous one.
- If you enter comments in your results, the comments are automatically imported to the next analysis in fast mode.

  To import the comments from fast mode results to results of a regular Bug Finder analysis, do one of the following:

  - Select **Tools** > **Import Comments**. Navigate to the sibling results folder `BF_Fast_Result` and import comments from the fast mode results.
  - When reviewing results of fast mode, enter the comments directly into your code. If you run a regular analysis on this code, the comments are imported to your analysis results.

    For details on how to enter code comments, see “Annotate and Hide Known or Acceptable Results”.
- You cannot specify constraints using the option `Constraint setup (-data-range-specifications)`.

## Command-Line Information

**Parameter:** `-fast-analysis`
**Default:** Off
**Example:** `polyspace-bug-finder-nodesktop -sources` *`filename`* `-fast-analysis`

## See Also

“Defects”

### Topics

"Results Found by Fast Analysis"

# Command/script to apply after the end of the code verification (`-post-analysis-command`)

Specify command or script to be executed after analysis

## Description

Specify a command or script to be executed after the analysis.

### Set Option

**User interface**: In your project configuration, the option is on the **Advanced Settings** node.

**Command line**: Use the option `-post-analysis-command`. See “Command-Line Information” on page 1-306.

### Why Use This Option

Create scripts for tasks that you want performed after the Polyspace analysis.

For instance, you want to be notified by email that the Polyspace analysis is over. Create a script that sends an email and use this option to execute the script after the Polyspace analysis.

## Settings

**No Default**

Enter full path to the command or script, or click 📁 to navigate to the location of the command or script. After the analysis, this script is executed.

For a Perl script, in Windows, specify the full path to the Perl executable followed by the full path to the script. For example, to specify a Perl script `send_email.pl` that sends an email once the analysis is over, enter `*matlabroot*\sys\perl\win32\bin\perl.exe *<absolute_path>*\send_email.pl`. Here, *`matlabroot`* is the location of the current MATLAB installation, such as `C:\Program Files\MATLAB\R2015b\`, and *`<absolute_path>`* is the location of the Perl script.

## Tips

If you perform verification on a remote server, after verification, the software executes your command on the server, not on the client desktop. If your command executes a script, the script must be present on the server.

For instance, if you specify the command, `/local/utils/send_mail.sh`, the Shell script `send_email.sh` must be present on the server in `/local/utils/`. The software does not copy the script `send_email.sh` from your desktop to the server before executing the command. If the script is not present on the server, you encounter an error. Sometimes, there are multiple servers that the MATLAB Job Scheduler can run the verification on. Place the script on each of the servers because you do not control which server eventually runs your verification.

## Command-Line Information

**Parameter:** `-post-analysis-command`
**Value:** Path to executable file or command in quotes
**No Default**
**Example in Linux:** `polyspace-bug-finder-nodesktop -sources *file_name* -post-analysis-command `pwd`/send_email.pl`
**Example in Windows:** `polyspace-bug-finder-nodesktop -sources *file_name* -post-analysis-command "C:\Program Files\MATLAB\R2015b\sys\perl\win32\bin\perl.exe" "C:\My_Scripts\send_email"`

## See Also

`Command/script to apply to preprocessed files (-post-preprocessing-command)`

## Topics

"Specify Analysis Options"

# Automatic Orange Tester (`-automatic-orange-tester`)

Specify that Automatic Orange Tester must be executed after verification

## Description

*This option affects a Code Prover analysis only.*

Specify that the Automatic Orange Tester must be executed at the end of the verification.

### Set Option

**User interface**: In your project configuration, the option is on the **Advanced Settings** node. See “Dependency” on page 1-309 for other options you must also enable.

**Command line**: Use the option `-automatic-orange-tester`. See “Command-Line Information” on page 1-309.

### Why Use This Option

The Automatic Orange Tester runs dynamic tests on your code. The dynamic tests help you determine if an orange check represents a real run-time error or an imprecision of Polyspace analysis. For a tutorial, see “Test Orange Checks for Run-Time Errors” (Polyspace Code Prover).

To run the Automatic Orange Tester after verification, you must select this option *before verification*. During verification, Polyspace generates additional source code to test each orange check for errors. When you run the Automatic Orange Tester later, the software uses this instrumented code for testing.

## Settings

☑ On

After verification, when you run the Automatic Orange Tester, Polyspace creates tests for unproven code and runs them.

□ Off (default)

You cannot launch the Automatic Orange Tester after verification.

## Dependency

This option is available only if you set `Source code language (-lang)` to `C` or `C-CPP`.

## Tips

- To launch the Automatic Orange Tester, after verification, open your results. Select **Tools** > **Automatic Orange Tester**.
- When using the automatic orange tester, you cannot:
  - Select **Division round down** under **Target & Compiler**.
  - Select the options `c18`, `tms320c3c`. `x86_64` or `sharc21x61` for **Target & Compiler** > **Target processor type**.
  - Specify the type `char` as 16-bit or `short` as 8-bit using the option `mcpu... (Advanced)` for **Target & Compiler** > **Target processor type**. For the same option, you must specify the type `pointer` as 32-bit.
  - Specify global asserts in the code, having the form `Pst_Global_Assert(A,B)`. In global assert mode, you cannot use **Constraint setup** under **Inputs & Stubbing**.
  - Select these options related to floating-point verification: **Subnormal detection mode** and **Consider non finite floats**.

## Command-Line Information

**Parameter:** `-automatic-orange-tester`
**Default**: Off

**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-lang c -automatic-orange-tester`

## See Also

`Number of automatic tests (-automatic-orange-tester-tests-number)` | `Maximum loop iterations (-automatic-orange-tester-loop-max-iteration)` | `Maximum test time (-automatic-orange-tester-timeout)`

### Topics

"Test Orange Checks for Run-Time Errors" (Polyspace Code Prover)
"Limitations of Automatic Orange Tester" (Polyspace Code Prover)

# Maximum loop iterations (`-automatic-orange-tester-loop-max-iteration`)

Specify number of loop iterations after which Automatic Orange Tester considers infinite loop

## Description

*This option affects a Code Prover analysis only.*

Specify number of loop iterations after which the Automatic Orange Tester considers the loop to be infinite. Specifying a large number decreases the possibility of identifying an infinite loop incorrectly, but takes more time to complete.

### Set Option

**User interface**: In your project configuration, the option is on the **Advanced Settings** node. See “Dependencies” on page 1-311 for other options you must also enable.

**Command line**: Use the option `-automatic-orange-tester-loop-max-iteration`. See “Command-Line Information” on page 1-312.

## Settings

**Default:** 1000

Enter number of loop iterations. The maximum value that the software supports is 1000.

## Dependencies

This option is enabled only if you set the following options:

- Set `Source code language (-lang)` to `C`.

- Turn on `Automatic Orange Tester (-automatic-orange-tester)`.

## Command-Line Information

**Parameter:** `-automatic-orange-tester-loop-max-iteration`
**Value:** *`positive integer`*
**Default:** 1000
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-lang c -automatic-orange-tester -automatic-orange-tester-loop-max-iteration 500`

## See Also

`Automatic Orange Tester (-automatic-orange-tester)` | `Number of automatic tests (-automatic-orange-tester-tests-number)` | `Maximum test time (-automatic-orange-tester-timeout)`

### Topics

"Test Orange Checks for Run-Time Errors" (Polyspace Code Prover)

# Number of automatic tests (`-automatic-orange-tester-tests-number`)

Specify number of tests that Automatic Orange Tester must run

## Description

*This option affects a Code Prover analysis only.*

Specify number of tests that you want the Automatic Orange Tester to run. The more the number of tests, the greater the possibility of finding a run-time error, but longer it takes to complete.

### Set Option

**User interface**: In your project configuration, the option is on the **Advanced Settings** node. See “Dependencies” on page 1-313 for other options you must also enable.

**Command line**: Use the option `-automatic-orange-tester-tests-number`. See “Command-Line Information” on page 1-314.

## Settings

**Default:** 500

Enter number of tests up to a maximum of 100,000.

## Dependencies

This option is enabled only if you set the following options:

- Set `Source code language (-lang)` to `C`.
- Turn on `Automatic Orange Tester (-automatic-orange-tester).`

## Command-Line Information

**Parameter:** `-automatic-orange-tester-tests-number`
**Value:** *`positive integer`*
**Default:** 500
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-lang c -automatic-orange-tester -automatic-orange-tester-tests-number 500`

## See Also

`Automatic Orange Tester (-automatic-orange-tester)` | `Maximum loop iterations (-automatic-orange-tester-loop-max-iteration)` | `Maximum test time (-automatic-orange-tester-timeout)`

### Topics

"Test Orange Checks for Run-Time Errors" (Polyspace Code Prover)

# Maximum test time (`-automatic-orange-tester-timeout`)

Specify time in seconds allowed for a single test in Automatic Orange Tester

## Description

*This option affects a Code Prover analysis only.*

Specify time in seconds allowed for a single test. After this time is over, the Automatic Orange Tester proceeds to the next test. Increasing this time reduces number of tests that do not complete, but increases total verification time.

### Set Option

**User interface**: In your project configuration, the option is on the **Advanced Settings** node. See “Dependencies” on page 1-315 for other options you must also enable.

**Command line**: Use the option `-automatic-orange-tester-timeout`. See “Command-Line Information” on page 1-316.

## Settings

**Default:** 5

Enter time in seconds. The maximum value that the software supports is 60.

## Dependencies

This option is enabled only if you set the following options:

- Set `Source code language (-lang)` to `C`.
- Turn on `Automatic Orange Tester (-automatic-orange-tester)`.

## Command-Line Information

**Parameter:** `-automatic-orange-tester-timeout`
**Value:** *`time`*
**Default:** 5
**Example:** `polyspace-code-prover-nodesktop -sources` *`file_name`* `-lang c -automatic-orange-tester -automatic-orange-tester-test-timeout 10`

## See Also

`Automatic Orange Tester (-automatic-orange-tester)` | `Number of automatic tests (-automatic-orange-tester-tests-number)` | `Maximum loop iterations (-automatic-orange-tester-loop-max-iteration)`

### Topics

"Test Orange Checks for Run-Time Errors" (Polyspace Code Prover)

# Other

Specify additional flags for analysis

## Description

Enter command-line-style flags such as `-max-processes`.

### Set Option

In your project configuration, the option is on the **Advanced Settings** node. You can enter multiple options in this field. If you enter the same option multiple times with different arguments, the analysis uses your last argument.

### Why Use This Option

Use this option to add nonofficial or command-line only options to the analyzer.

## Tip

Nonofficial options: In rare circumstances, to work around very specific issues, MathWorks Technical Support might provide you some undocumented options. If you are running verification from the user interface, you use the **Other** field in the **Configuration** pane to enter the options. Sometimes, the options and their arguments have to be preceded by extra flags. When providing you the option, Technical Support will let you know if the extra flags are required.
**Possible Flags:** `-extra-flags | -c-extra-flags | -cpp-extra-flags | -cfe-extra-flags | -il-extra-flags`
**Example:** `polyspace-bug-finder-nodesktop -extra-flags` *`-option-name`* `-extra-flags` *`option_param`*

# Polyspace Command-Line Options

# -asm-begin -asm-end

Exclude compiler-specific asm functions from analysis

## Syntax

```
-asm-begin "mark1[,mark2,...]" -asm-end "mark1[,mark2,...]"
```

## Description

-asm-begin "*mark1[,mark2,...]*" -asm-end "*mark1[,mark2,...]*" excludes compiler-specific assembly language source code functions from the analysis. You must use these two options together.

Polyspace recognizes most inline assemblers by default. Use the option only if compilation errors occur due to introduction of assembly code.

Mark the offending code block by two #pragma directives, one at the beginning of the assembly code and one at the end. In the command usage, give these marks in the same order for -asm-begin as they are for -asm-end.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See Other.

## Examples

A block of code is delimited by #pragma start1 and #pragma end1. These names must be in the same order for their respective options. Either:

```
-asm-begin "start1" -asm-end "end1"
```

or

```
-asm-begin "mark1,...markN,start1" -asm-end "mark1,...markN,end1"
```

The following example marks two functions for exclusion, foo_1 and foo_2.

Code:

```
#pragma asm_begin_foo
int foo(void) { /* asm code to be ignored by Polyspace */ }
#pragma asm_end_foo

#pragma asm_begin_bar
void bar(void) { /* asm code to be ignored by Polyspace */ }
#pragma asm_end_bar
```

Polyspace Command:

```
polyspace-bug-finder-nodesktop -lang c -asm-begin "asm_begin_foo,asm_begin_bar"
          -asm-end "asm_end_foo,asm_end_bar"
```

`asm_begin_foo` and `asm_begin_bar` mark the beginning of the assembly source code sections to be ignored. `asm_end_foo` and `asm_end_bar` mark the end of those respective sections.

## See Also

`polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -author

Specify project author

## Syntax

```
-author "value"
```

## Description

`-author "value"` assigns an author to the Polyspace project. The name appears as the project owner in Polyspace Metrics and on generated reports.

The default value is the user name of the current user, given by the DOS or UNIX command `whoami`.

In the Polyspace user interface, select to specify the Project name, Version, and Author parameters in the **Polyspace Project – Properties** dialog box.

## Examples

Assign a project author to your Polyspace Project.

```
polyspace-bug-finder-nodesktop -author "John Smith"
```

## See Also

`-date` | `-prog` | `polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -date

Specify date of analysis

## Syntax

```
-date "date"
```

## Description

`-date "date"` specifies the date stamp for the analysis in the format `dd/mm/yyyy`. By default the value is the date the analysis starts.

## Examples

Assign a date to your Polyspace Project.

```
polyspace-bug-finder-nodesktop -date "15/03/2012"
```

## See Also

`-author` | `-prog` | `polyspaceBugFinder` | `polyspaceCodeProver`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -function-behavior-specifications

Map imprecisely analyzed function to standard function for precise analysis

## Syntax

```
-function-behavior-specifications file_path
```

## Description

`-function-behavior-specifications` *`file_path`* specifies the path to an XML file. You can use this XML file to map some of your functions to corresponding standard functions that Polyspace recognizes. If you run verification from the command line, *`file_path`* is the absolute path or path relative to the folder from which you run the command. If you run verification from the user interface, *`file_path`* is the absolute path.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

### Using Option for Precision Improvement

*This section applies only to a Code Prover analysis.*

Use this option to reduce the number of orange checks from imprecise analysis of your function. Sometimes, the verification does not analyze certain kinds of functions precisely because of inherent limitations in static verification. In those cases, if you find a standard function that is a close analog of your function, use this mapping. Though your function itself is not analyzed, the analysis is more precise at the locations where you call the function. For instance, if the verification cannot analyze your function `cos32` precisely and considers full range for its return value, map it to the `cos` function for a return value in [-1,1].

The verification ignores the body of your function. However, the verification emulates your function behavior in the following ways:

- The verification assumes the same return values for your function as the standard function.

  For instance, if you map your function cos32 to the standard function cos, the verification assumes that cos32 returns values in [-1,1].
- The verification checks for the same issues as it checks with the standard function.

  For instance, if you map your function acos32 to the standard function acos, the Invalid use of standard library routine check determines if the argument of acos32 is in [-1,1].

A sample file function-behavior-specifications-sample.xml shows the functions that you can map to. The file is in *matlabroot*\polyspace\verifier\cxx\ where *matlabroot* is the MATLAB installation folder. The functions that you can map to include:

- Standard library functions from math.h.
- Memory management functions from string.h.
- __ps_meminit: A function specific to Polyspace that initializes a memory area.

  Sometimes, the verification does not recognize your memory initialization function and produces an orange Non-initialized local variable check on a variable that you initialized through this function. If you know that your memory initialization function initializes the variable through its address, map your function to __ps_meminit. The check turns green.
- __ps_lookup_table_clip: A function specific to Polyspace that returns a value within the range of the input array.

  Sometimes, the verification considers full range for the return values of functions that look up values in large arrays (look-up table functions). If you know that the return value of a look-up table function must be within the range of values in its input array, map the function to __ps_lookup_table_clip.

  In code generated from models, the verification by default makes this assumption for look-up table functions. To identify if the look-up table uses linear interpolation and no extrapolation, the verification uses the function names. See “Stub lookup tables” (Polyspace Code Prover). Use the mapping only for handwritten functions, for instance, functions in a C/C++ S-Function block. The names of those functions do not follow specific conventions. You must explicitly specify them.

### Using Option for Concurrency Detection

*This section applies both to a Bug Finder and a Code Prover analysis.*

Use this option for automatic detection of thread-creation functions and functions that begin and end critical sections. Polyspace supports automatic detection for certain families of multitasking primitives only. Extend the support using this option.

If your thread-creation function, for instance, does not belong to one of the supported families, map your function to a supported concurrency primitive.

To find which multitasking primitives can be automatically detected, see “Modeling Multitasking Code”.

## Examples

### Specify Mapping to Standard Function

You can adapt the sample mapping XML file provided with your Polyspace installation and map your function to a standard function.

Suppose the default verification produces an orange `User assertion` check on this code:

```
double x = acos32(1.0) ;
assert(x <= 2.0);
```

Suppose you know that the function `acos32` behaves like the function `acos` and the return value is 0. You expect the check on the `assert` statement to be green. However, the verification considers that `acos32` returns any value in the range of type `double` because `acos32` is not precisely analyzed. The check is orange. To map your function `acos32` to `acos`:

1 Copy the file `function-behavior-specifications-sample.xml` from *`matlabroot`*`\polyspace\verifier\cxx\` to another location, for instance, `"C:\Polyspace_projects\Common\Config_files"`. Change the write permissions on the file.

2 To map your function to a standard function, modify the contents of the XML file. To map your function `acos32` to the standard library function `acos`, change the following code:

```
<function name="my_lib_cos" std="acos"> </function>
```

To:

```
<function name="acos32" std="acos"> </function>
```

3 Specify the location of the file for verification.

```
polyspace-code-prover-nodesktop -function-behavior-specifications
  "C:\Polyspace_projects\Common\Config_files
   \function-behavior-specifications-sample.xml"
```

## Specify Mapping to Standard Function with Argument Remapping

Sometimes, the arguments of your function do not map one-to-one with arguments of the standard function. In those cases, remap your function argument to the standard function argument. For instance:

- `__ps_lookup_table_clip`:

  This function specific to Polyspace takes only a look-up table array as argument and returns values within the range of the look-up table. Your look-up table function might have additional arguments besides the look-up table array itself. In this case, use argument remapping to specify which argument of your function is the look-up table array.

  For instance, suppose a function `my_lookup_table` has the following declaration:

  ```
  double my_lookup_table(double u0, const real_T *table,
                                       const double *bp0);
  ```

  The second argument of your function `my_lookup_table` is the look-up table array. In the file `function-behavior-specifications-sample.xml`, add this code:

  ```
  <function name="my_lookup_table" std="__ps_lookup_table_clip">
      <mapping std_arg="1" arg="2"></mapping>
  </function>
  ```

  When you call the function:

```
res = my_lookup_table(u, table10, bp);
```

The verification interprets the call as:

```
res =__ps_lookup_table_clip(table10);
```

The verification assumes that the value of `res` lies within the range of values in `table10`.

- `__ps_meminit`:

  This function specific to Polyspace takes a memory address as the first argument and a number of bytes as the second argument. The function assumes that the bytes in memory starting from the memory address are initialized with a valid value. Your memory initialization function might have additional arguments. In this case, use argument remapping to specify which argument of your function is the starting address and which argument is the number of bytes.

  For instance, suppose a function `my_meminit` has the following declaration:

  ```
       void my_meminit(enum InitKind k, void* dest, int is_aligned,
                                  unsigned int size);
  ```

  The second argument of your function is the starting address and the fourth argument is the number of bytes. In the file `function-behavior-specifications-sample.xml`, add this code:

  ```
  <function name="my_meminit" std="__ps_meminit">
      <mapping std_arg="1" arg="2"></mapping>
      <mapping std_arg="2" arg="4"></mapping>
  </function>
  ```

  When you call the function:

  ```
  my_meminit(INIT_START_BY_END, &buffer, 0, sizeof(buffer));
  ```

  The verification interprets the call as:

  ```
  __ps_meminit(&buffer, sizeof(buffer));
  ```

  The verification assumes that `sizeof(buffer)` number of bytes starting from `&buffer` are initialized.

- `memset`: Variable number of arguments.

If your function has variable number of arguments, you cannot map it directly to a standard function without explicit argument remapping. For instance, say your function is declared as:

```
void* my_memset(void*, int, size_t, ...)
```

To map the function to the memset function, use the following mapping:

```
<function name="my_memset" std="memset">
    <mapping std_arg="1" arg="1"></mapping>
    <mapping std_arg="2" arg="2"></mapping>
    <mapping std_arg="3" arg="3"></mapping>
</function>
```

## Effect of Mapping on Precision

These examples show the result of mapping certain functions to standard functions:

- my_acos → acos:

  If you use the mapping, the User assertion check turns green. The verification assumes that the return value of my_acos is 0.

  - *Before mapping*:

    ```
    double x = my_acos(1.0);
    assert(x <= 2.0);
    ```

  - *Mapping specification*:

    ```
    <function name="my_acos" std="acos">
    </function>
    ```

  - *After mapping*:

    ```
    double x = my_acos(1.0);
    assert(x <= 2.0);
    ```

- my_sqrt → sqrt:

  If you use the mapping, the Invalid use of standard library routine check turns red. Otherwise, the verification does not check whether the argument of my_sqrt is nonnegative.

  - *Before mapping*:

```
res = my_sqrt(-1.0);
```

- *Mapping specification*:

```
<function name="my_sqrt" std="sqrt">
</function>
```

- *After mapping*:

```
res = my_sqrt(-1.0);
```

- my_lookup_table (argument 2) →__ps_lookup_table_clip (argument 1):

  If you use the mapping, the User assertion check turns green. The verification assumes that the return value of my_lookup_table is within the range of the look-up table array table.

  - *Before mapping*:

```
double table[3] = {1.1, 2.2, 3.3}
.
.
double res = my_lookup_table(u, table, bp);
assert(res >= 1.1 && res <= 3.3);
```

  - *Mapping specification*:

```
<function name="my_lookup_table" std="__ps_lookup_table_clip">
    <mapping std_arg="1" arg="2"></mapping>
</function>
```

  - *After mapping*:

```
double table[3] = {1.1, 2.2, 3.3}
.
.
res_real = my_lookup_table(u, table9, bp);
assert(res_real >= 1.1 && res_real <= 3.3);
```

- my_meminit →__ps_meminit:

  If you use the mapping, the Non-initialized local variable check turns green. The verification assumes that all fields of the structure x are initialized with valid values.

  - *Before mapping*:

```
struct X {
  int field1 ;
  int field2 ;
};
.
.
struct X x;
my_meminit(&x, sizeof(struct X));
return x.field1;
```

  - *Mapping specification*:

    ```
    <function name="my_meminit" std="__ps_meminit">
         <mapping std_arg="1" arg="1"></mapping>
         <mapping std_arg="2" arg="2"></mapping>
    </function>
    ```

  - *After mapping*:

    ```
    struct X {
      int field1 ;
      int field2 ;
    };
    .
    .
    struct X x;
    my_meminit(&x, sizeof(struct X));
    return x.field1;
    ```

- `my_meminit` → `__ps_meminit`:

  If you use the mapping, the `Non-initialized local variable` check turns red. The verification assumes that only the field `field1` of the structure `x` is initialized with valid values.

  - *Before mapping*:

    ```
    struct X {
      int field1 ;
      int field2 ;
    };
    .
    .
    struct X x;
    my_meminit(&x, sizeof(int));
    return x.field2;
    ```

  - *Mapping specification*:

```
<function name="my_meminit" std="__ps_meminit">
</function>
```

- *After mapping*:

  ```
  struct X {
    int field1 ;
    int field2 ;
  };
  .
  .
  struct X x;
  my_meminit(&x, sizeof(int));
  return x.field2;
  ```

## Effect of Mapping on Concurrency Detection

In this example, the Polyspace support for automatic concurrency detection is extended by mapping unsupported functions to the supported `Pthreads` functions.

- Thread creation function: `createTask` → `pthread_create`
- Function that begins critical section: `takeLock` → `pthread_mutex_lock`
- Function that ends critical section: `releaseLock` → `pthread_mutex_unlock`

If you use the mapping, a Bug Finder analysis can determine the multitasking model used in your code and find possible race conditions.

- *Before mapping*:

  The analysis does not detect the data race on `var2`.

  ```
  typedef void* (*FUNT) (void*);

  extern int takeLock(int* t);
  extern int releaseLock(int* t);
  // First argument is the function, second the id
  extern int createTask(FUNT,int*,int*,void*);

  int t_id1,t_id2;
  int lock;

  int var1;
  int var2;
  ```

```
void* task1(void* a) {
    takeLock(&lock);
    var1++;
    var2++;
    releaseLock(&lock);
    return 0;
}

void* task2(void* a) {
    takeLock(&lock);
    var1++;
    releaseLock(&lock);
    var2++;
    return 0;
}

void main() {
    createTask(task1,&t_id1,0,0);
    createTask(task2,&t_id2,0,0);
}
```

- *Mapping specification*:

  Based on the number and type of parameters of the function `createTask`, it is convenient to map `createTask` to the thread creation function `pthread_create`. The other available alternatives, `createThread` or `OSTaskCreate`, have different argument types.

  Even when mapping to `pthread_create`, argument remapping is required, because the arguments do not correspond exactly. The thread start routine is the third argument of `pthread_create` but the first argument of `createTask`.

```
<function name="createTask" std="pthread_create" >
    <mapping std_arg="1" arg="2"></mapping>
    <mapping std_arg="3" arg="1"></mapping>
    <mapping std_arg="2" arg="3"></mapping>
    <mapping std_arg="4" arg="4"></mapping>
</function>
<function name="takeLock" std="pthread_mutex_lock" >
</function>
<function name="releaseLock" std="pthread_mutex_unlock" >
</function>
```

For the list of supported functions that you can map to, see the sample mapping file `function-behavior-specifications-sample.xml` in *`matlabroot`*`\polyspace\verifier\cxx\`. *`matlabroot`* is the MATLAB installation folder, such as `C:\Program Files\MATLAB\R2017b`. See also “Modeling Multitasking Code”.

- *After mapping*:

  The analysis detects the data race on `var2`.

```
typedef void* (*FUNT) (void*);

extern int takeLock(int* t);
extern int releaseLock(int* t);
// First argument is the function, second the id
extern int createTask(FUNT,int*,int*,void*);

int t_id1,t_id2;
int lock;

int var1;
int var2;

void* task1(void* a) {
    takeLock(&lock);
    var1++;
    var2++;
    releaseLock(&lock);
    return 0;
}

void* task2(void* a) {
    takeLock(&lock);
    var1++;
    releaseLock(&lock);
    var2++;
    return 0;
}

void main() {
    createTask(task1,&t_id1,0,0);
    createTask(task2,&t_id2,0,0);
}
```

## See Also

“Stub lookup tables” (Polyspace Code Prover)

### Topics

“Reduce Orange Checks” (Polyspace Code Prover)

Introduced in R2016b

# -generate-launching-script-for

Extract information from project file

## Syntax

```
-generate-launching-script-for PRJFILE
```

## Description

`-generate-launching-script-for PRJFILE` extracts information from the project file *`PRJFILE`* so that you can run an analysis from the command line. A folder is created containing the following files:

- `source_command.txt` — List of source files for the `-source-files` option.
- `options_command.txt` — List of the analysis options for the `-options-file` option.
- `temporal_exclusions.txt` — List of temporal exclusions, generated only if you specify the `Temporally exclusive tasks (-temporal-exclusions-file)` option.
- `.polyspace_conf.psprj` — A copy of the project file Polyspace used to generate the scripting files.
- `launchingCommand.sh` (UNIX) or `launchingCommand.bat` (DOS) — shell script that calls the correct commands. The script also calls any options that cannot be given to the `-options-file` command, such as `-batch` or `-add-to-results-repository`. You can give this file additional analysis options as parameters.

**Note** The script that Polyspace generates runs the same analysis that Polyspace runs from the user interface. If your project runs in the Polyspace Bug Finder interface, the script will run from the command line.

## Examples

Extract information to run `myproject` from the command line. Use this option with the desktop binary `polyspace-bug-finder`.

```
polyspace-bug-finder -generate-launching-script-for myproject.bf.psprj
```

## See Also

### Topics

"Create Command-Line Script from Project File"
"Run Local Analysis from DOS or UNIX Command Line"

# -h[elp]

Display list of possible options

## Syntax

```
-h
-help
```

## Description

`-h` and `-help` display the list of possible options in the shell window and the argument syntax.

## Examples

Display the command-line help.

```
polyspace-bug-finder-nodesktop -h
polyspace-bug-finder-nodesktop -help
```

## See Also

`polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -I

Specify include folder for compilation

## Syntax

```
-I folder
```

## Description

`-I folder` specifies a folder that contains include files required for compiling your sources. You can specify only one folder for each instance of `-I`. However, you can specify this option multiple times.

The analysis looks for include files relative to the folder paths that you specify. For instance, if your code contains the preprocessor directive `#include<../mylib.h>` and you include the folder:

```
C:\My_Project\MySourceFiles\Includes
```

the folder `C:\My_Project\MySourceFiles` must contain a file `mylib.h`.

The analysis automatically includes the `./sources` folder (if it exists) after the include folders that you specify.

## Examples

Include two folders with the analysis.

```
polyspace-bug-finder-nodesktop -I /com1/inc -I /com1/sys/inc
```

Because `./sources` is included automatically, this Polyspace command is equivalent to:

```
polyspace-bug-finder-nodesktop -I /com1/inc -I /com1/sys/inc
                                               -I ./sources
```

## See Also

`polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -import-comments

Import comments and justifications from previous analysis

## Syntax

`-import-comments` *`resultsFolder`*

## Description

`-import-comments` *`resultsFolder`* imports the comments and justifications from a previous analysis, as specified by the results folder. *`resultsFolder`* must be the same type of analysis you are running. For example, if you are running a Bug Finder analysis, you cannot import comments from a Code Prover verification.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## Examples

Increment your project's version number (`-version`) and import comments from the previous results.

```
polyspace-bug-finder-nodesktop -version 1.3
       -import-comments C:\Results\myProj\1.2
```

## See Also

`-version` | `polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -no-assumption-on-absolute-addresses

Remove assumption that absolute address usage is valid

## Syntax

```
-no-assumption-on-absolute-addresses
```

## Description

*This option affects Code Prover analysis only.*

`-no-assumption-on-absolute-addresses` removes the default assumption that absolute addresses used in your code are valid. If you use this option, the verification produces an orange `Absolute address usage` check when you assign an absolute address to a pointer. Otherwise, the check is green by default.

The type of the pointer to which you assign the address determines the initial value stored in the address. For instance, if you assign the address to an `int*` pointer, following this check, the verification assumes that the memory zone that the address points to is initialized with an `int` value. The value can be anything allowed for the data type `int`.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## Examples

The use of option `-no-assumption-on-absolute-addresses` can increase the number of orange checks in your code. For instance, the following table shows an additional orange check with the option enabled.

<table>
<thead>
<tr><th>Absolute Address Usage Green</th><th>Absolute Address Usage Orange</th></tr>
</thead>
<tbody>
<tr>
<td>
<pre><code>void main() {
    int *p = (int *)0x32;
    int x;
    x=*p;
}</code></pre>
<p>In this example, the software produces:</p>
<ul>
<li>A green <b>Absolute address usage</b> check when the address <code>0x32</code> is assigned to a pointer <code>p</code>.</li>
<li>A green <b>Illegally dereferenced pointer</b> check when the pointer <code>p</code> is read.
<p><code>x</code> potentially has all values allowed for an <code>int</code> variable.</p></li>
</ul>
</td>
<td>
<pre><code>void main() {
    int *p = (int *)0x32;
    int x;
    x=*p;
}</code></pre>
<p>In this example, the software produces:</p>
<ul>
<li>An orange <b>Absolute address usage</b> check when the address <code>0x32</code> is assigned to a pointer <code>p</code>.</li>
<li>A green <b>Illegally dereferenced pointer</b> check when the pointer <code>p</code> is read.
<p><code>x</code> potentially has all values allowed for an <code>int</code> variable.</p></li>
</ul>
</td>
</tr>
</tbody>
</table>

For best use of the **Absolute address usage** check, leave this check green by default during initial stages of development. During integration stage, use the option `-no-assumption-on-absolute-addresses` and detect all uses of absolute memory addresses. Browse through them and make sure that the addresses are valid.

## See Also

`polyspaceCodeProver`

### Topics

"Run Local Verification at Command Line" (Polyspace Code Prover)

**Introduced in R2016a**

# -max-processes

Specify maximum number of processors for analysis

## Syntax

```
-max-processes num
```

## Description

`-max-processes` *`num`* specifies the maximum number of processors that you want the analysis to use. On a multicore system, the software parallelizes the analysis and uses the specified number of processors to speed up the analysis. The valid range of *`num`* is 1 to 128.

Unless you specify this option, the Bug Finder analysis uses the maximum number of available processors. Use this option to restrict the number of processors used.

The option uses the physical processors available and not the logical processors. For instance, if you have 2 physical cores but 4 logical cores, the option `-max-processes 4` uses the 2 physical cores only. To determine number of physical processors available, check the system information in your operating system.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## Examples

Disable parallel processing during the analysis.

```
polyspace-bug-finder-nodesktop -max-processes 1
```

## Tips

You must have at least 4 GB of RAM per processor for analysis. For instance, if your machine has 16 GB of RAM, do not use this option to specify more than four processors.

## See Also

`polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -non-preemptable-tasks

Specify functions that represent nonpreemptable tasks

## Syntax

```
-non-preemptable-tasks function1[,function2[,...]]
```

## Description

*This option affects a Bug Finder analysis only.*

`-non-preemptable-tasks function1[,function2[,...]]` specifies functions that represent nonpreemptable tasks.

The functions cannot be interrupted by other noncyclic entry points on page 1-112 and cyclic tasks on page 1-114 but can be interrupted by interrupts on page 1-117, preemptable or nonpreemptable.

To specify a function as a nonpreemptable cyclic task, you must first specify the following options:

- `Configure multitasking manually`
- `Entry points (-entry-points)` or `Cyclic tasks (-cyclic-tasks)`: Specify the function name.

The functions that you specify must have the prototype:

```
void function_name(void);
```

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## See Also

`-preemptable-interrupts` | `Cyclic tasks (-cyclic-tasks)` | `Interrupts (-interrupts)` | `Entry points (-entry-points)` | `Critical section details`

`(-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

## Topics

"Specify Analysis Options"
"Set Up Multitasking Analysis Manually"

### Introduced in R2016b

# -options-file

Run Polyspace using list of options

## Syntax

`-options-file` *`file`*

## Description

`-options-file` *`file`* specifies a file which lists your analysis options. The file must be a text file with each option on a separate line. Use `#` to add comments to this file.

## Examples

1 Create an options file called `listofoptions.txt` with your options. For example:

```
#These are the options for MyBugFinderProject
-lang c
-prog MyBugFinderProject
-author jsmith
-sources "mymain.c,funAlgebra.c,funGeometry.c"
-OS-target no-predefined-OS
-target x86_64
-compiler generic
-dos
-misra2 required-rules
-do-not-generate-results-for all-headers
-checkers default
-disable-checkers concurrency
-results-dir C:\Polyspace\MyBugFinderProject
```

2 Run Polyspace using options in the file `listofoptions.txt`.

```
polyspace-bug-finder-nodesktop -options-file listofoptions.txt
```

## See Also

`polyspaceBugFinder` | `polyspaceConfigure`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -preemptable-interrupts

Specify functions that represent preemptable interrupts

## Syntax

```
-preemptable-interrupts function1[,function2[,...]]
```

## Description

*This option affects a Bug Finder analysis only.*

`-preemptable-interrupts function1[,function2[,...]]` specifies functions that represent preemptable interrupts.

The function acts as an interrupt in every way except that it can be interrupted by other interrupts on page 1-117, preemptable or nonpreemptable.

To specify a function as a preemptable interrupt, you must first specify the following options:

- `Configure multitasking manually`
- `Interrupts (-interrupts)`: Specify the function name.

The functions that you specify must have the prototype:

```
void function_name(void);
```

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## See Also

`-non-preemptable-tasks` | `Cyclic tasks (-cyclic-tasks)` | `Interrupts (-interrupts)` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

## Topics

"Specify Analysis Options"
"Set Up Multitasking Analysis Manually"

Introduced in R2016b

# -prog

Specify name of project

## Syntax

```
-prog projectName
```

## Description

`-prog` *`projectName`* specifies the name of your Polyspace project. This name must use only letters, numbers, underscores (_), dashes (-), or periods (.).

## Examples

Assign a session name to your Polyspace Project.

```
polyspace-bug-finder-nodesktop -prog MyApp
```

## See Also

`-author` | `-date` | `polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -report-output-name

Specify name of report

## Syntax

```
-report-output-name reportName
```

## Description

`-report-output-name` *`reportName`* specifies the name of an analysis report.

The default name for a report is *`Prog_Template.Format`*:

- *`Prog`* is the name of the project specified by `-prog`.
- *`TemplateName`* is the type of report template specified by `-report-template`.
- *`Format`* is the file extension for the report specified by `-report-output-format`.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## Examples

Specify the name of the analysis report.

```
polyspace-bug-finder-nodesktop -report-template Developer
      -report-output-name Airbag_v3.doc
```

## See Also

`Output format (-report-output-format)` | `Bug Finder and Code Prover report (-report-template)` | `polyspaceBugFinder`

### Topics

“Run Local Analysis from DOS or UNIX Command Line”
“Generate Reports”

# -results-dir

Specify the results folder

## Syntax

```
-results-dir
```

## Description

`-results-dir` specifies where to save the analysis results. The default location at the command line is the current folder.

If you are running analysis in the user interface, see “Specify Results Folder”.

## Examples

Specify to store your results in the `RESULTS` folder.

```
polyspace-bug-finder-nodesktop -results-dir RESULTS ...
         export RESULTS=results_'date + %d%B_%HH%M_%A'
polyspace-bug-finder-nodesktop -results-dir 'pwd'/$RESULTS
```

## See Also

`polyspaceBugFinder`

### Topics

“Run Local Analysis from DOS or UNIX Command Line”

# -scheduler

Specify cluster or job scheduler

## Syntax

```
-scheduler schedulingOption
```

## Description

`-scheduler` *`schedulingOption`* specifies the head node of the cluster or MATLAB job scheduler on the node host. Use this command to manage the cluster, or to specify where to run batch analyses.

## Examples

Run a batch analysis on a remote server.

```
polyspace-bug-finder-nodesktop -batch -scheduler NodeHost
polyspace-bug-finder-nodesktop -batch -scheduler 192.168.1.124:12400
polyspace-bug-finder-nodesktop -batch -scheduler MJSName@NodeHost

polyspace-job-manager listjobs -scheduler NodeHost
```

## See Also

`polyspaceBugFinder` | `polyspaceJobsManager` | `polyspaceJobsManager`

### Topics

"Run Remote Analysis at the Command Line"

# -sources

Specify source files

## Syntax

```
-sources file1[,file2,...]
-sources file1 -sources file2
```

## Description

`-sources` *`file1[,file2,...]`* or `-sources` *`file1`* `-sources` *`file2`* specifies the list of source files that you want to analyze. You can use standard UNIX wildcards with this option to specify your sources.

The source files are compiled in the order in which they are specified.

## Examples

Analyze the files `mymain.c`, `funAlgebra.c`, and `funGeometry.c`.

```
polyspace-bug-finder-nodesktop -sources mymain.c
     -sources funAlgebra.c -sources funGeometry.c
```

## See Also

`polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -sources-list-file

Specify file containing list of sources

## Syntax

`-sources-list-file` *`file_path`*

## Description

`-sources-list-file` *`file_path`* specifies the absolute path to a text file that lists each file name that you want to analyze.

To specify your sources in the text file, on each line, specify the absolute path to a source file. For example:

```
C:\Sources\myfile.c
C:\Sources2\myfile2.c
```

This option is available only in batch analysis mode.

## Examples

Run analysis on files listed in `files.txt`.

```
polyspace-bug-finder-nodesktop -batch -scheduler NODEHOST
        -sources-list-file "C:\Analysis\files.txt"
polyspace-bug-finder-nodesktop -batch -scheduler NODEHOST
        -sources-list-file "/home/polyspace/files.txt"
```

## See Also

`polyspaceBugFinder`

## Topics

“Run Remote Analysis at the Command Line”

# -submit-job-from-previous-compilation-results

Specify that the analysis job must be resubmitted without recompilation

## Syntax

```
-submit-job-from-previous-compilation-results
```

## Description

`-submit-job-from-previous-compilation-results` specifies that the Polyspace analysis must start after the compilation phase with compilation results from a previous analysis. If a remote analysis stops after compilation, for instance because of communication problems between the server and client computers, use this option.

When you perform a remote analysis:

1. On the local host computer, the Polyspace software performs code compilation and coding rule checking.
2. The Parallel Computing Toolbox™ software submits the analysis job to the MATLAB job scheduler (MJS) on the head node of the MATLAB Distributed Computing Server cluster.
3. The head node of the MATLAB Distributed Computing Server cluster assigns the verification job to a worker node, where the remaining phases of the Polyspace analysis occur.

If an analysis stops after completing the first step and you restart the analysis, use this option to reuse compilation results from the previous analysis. You thereby avoid restarting the analysis from the compilation phase.

If previous compilation results do not exist in the current folder, an error occurs. Remove the option and restart analysis from the compilation phase.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## Examples

Specify remote analysis with compilation results from a previous analysis.

```
polyspace-bug-finder-nodesktop -batch -scheduler localhost
      -submit-job-from-previous-compilation-results
```

## See Also

`polyspaceBugFinder`

### Topics

“Run Remote Batch Analysis”
“Run Remote Analysis at the Command Line”

# -termination-functions

Specify process termination functions

## Syntax

```
-termination-functions function1[,function2[,...]]
```

## Description

`-termination-functions` *`function1`*`[,`*`function2`*`[,...]]` specifies functions that behave like the exit function and terminate your program.

Use this option to specify program termination functions that are declared but not defined in your code.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## Examples

Polyspace detects an **Integer division by zero** defect in the following code because it does not recognize that `my_exit` terminates the program.

```
void my_exit();

double reciprocal(int val) {
  if(val==0)
    my_exit();
  return (1/val);
}
```

To prevent Polyspace from flagging the division operation, use the `-termination-functions` option:

```
polyspace-bug-finder-nodesktop -termination-functions my_exit
```

## See Also

`polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"

# -tmp-dir-in-results-dir

Keep temporary files in results folder

## Syntax

```
-tmp-dir-in-results-dir
```

## Description

`-tmp-dir-in-results-dir` specifies that temporary files must be stored in a subfolder of the results folder. Use this option only when the standard temporary folder does not have enough disk space. If the results folder is mounted on a network drive, this option can slow down your processor.

To learn how Polyspace determines the temporary folder location, see “Storage of Temporary Files”.

If you are running an analysis from the user interface, on the **Configuration** pane, you can enter this option in the **Other** field. See `Other`.

## Examples

Store temporary files in the results folder.

```
polyspace-bug-finder-nodesktop -tmp-dir-in-results-dir
```

## See Also

`polyspaceBugFinder`

### Topics

“Run Local Analysis from DOS or UNIX Command Line”

# -v[ersion]

Display Polyspace version number

## Syntax

```
-v
-version
```

## Description

`-v` or `-version` displays the version number of your Polyspace product.

## Examples

Display the version number and release of your Polyspace product.

```
polyspace-bug-finder-nodesktop -v
```

## See Also

`polyspaceBugFinder`

### Topics

“Run Local Analysis from DOS or UNIX Command Line”

# -xml-annotations-description

Apply custom code annotations to Polyspace analysis results

## Syntax

```
-xml-annotations-description file_path
```

## Description

`-xml-annotations-description` *`file_path`* uses the annotation syntax defined in the XML file located in *`file_path`* to interpret code comments in your source files. You can use the XML file to specify an annotation syntax and map it to the Polyspace annotation syntax. When you run an analysis by using this option, you can justify and hide results with annotations that use your syntax. If you run Polyspace at the command line, *`file_path`* is the absolute path or path relative to the folder from which you run the command. If you run Polyspace through the user interface, *`file_path`* is the absolute path.

If you are running an analysis through the user interface, you can enter this option in the **Other** field, under the **Advanced Settings** node on the **Configuration** pane. See `Other`.

### Why Use This Option

If you have existing annotations from previous code reviews, you can import these annotations to Polyspace. You do not have to review and justify results that you have already annotated. Similarly, if your code comments must adhere to a specific format, you can map and import that format to Polyspace.

# Examples

## Import Existing Annotations for Coding Rule Violations

Suppose that you have previously reviewed source file `zero_div.c` containing the following code, and justified certain MISRA C: 2012 violations by using custom annotations.

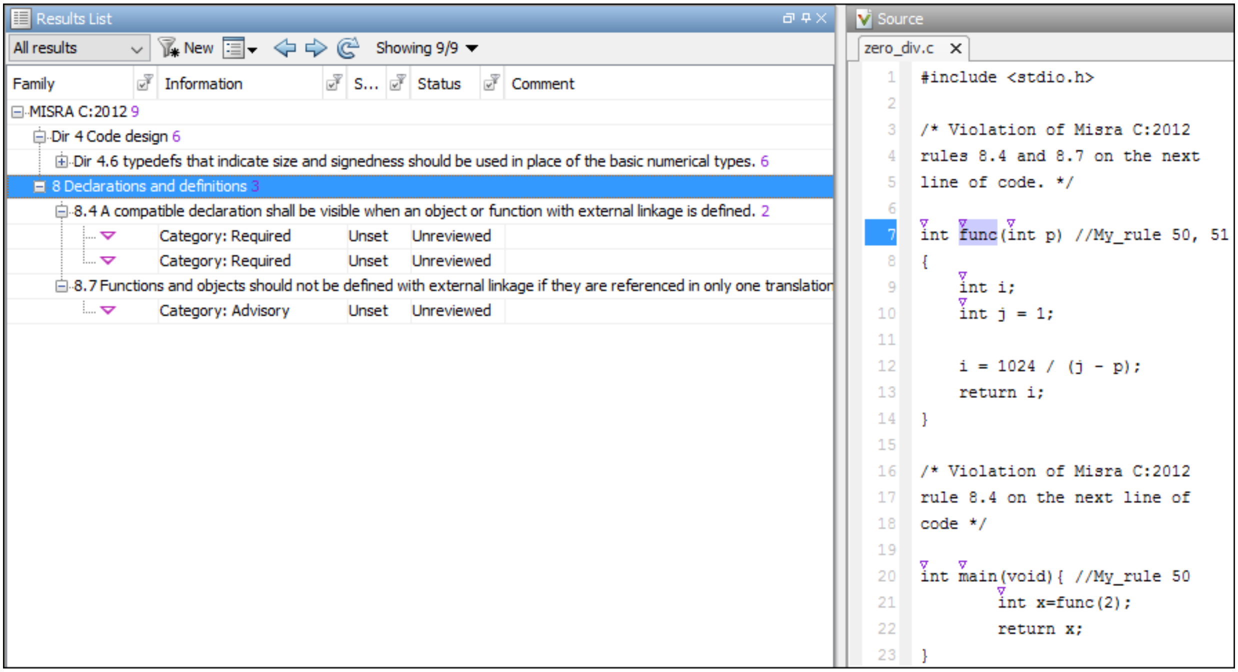
```
#include <stdio.h>

/* Violation of Misra C:2012
rules 8.4 and 8.7 on the next
line of code. */

int func(int p) //My_rule 50, 51
{
    int i;
    int j = 1;

    i = 1024 / (j - p);
    return i;
}

/* Violation of Misra C:2012
rule 8.4 on the next line of
code */

int main(void){ //My_rule 50
    int x=func(2);
    return x;
}
```

The code comments **`My_rule 50, 51`** and **`My_rule 50`** do not use the Polyspace annotation syntax. Instead, you use a convention where you place all MISRA rules in a single numbered list. In this list, rules 8.4 and 8.7 correspond to the numbers 50 and 51.You can check this code for MISRA C: 2012 violations by typing the command:

```
polyspace-bug-finder-nodesktop -sources source_path -misra3 all
```

*`source_path`* is the path to `zero_div.c`.

The annotated violations appear in the **Results List** pane. You must review and justify them again.



| Family | Information | S... | Status | Comment |
|---|---|---|---|---|
| MISRA C:2012 9 | | | | |
| Dir 4 Code design 6 | | | | |
| Dir 4.6 typedefs that indicate size and signedness should be used in place of the basic numerical types. 6 | | | | |
| 8 Declarations and definitions 3 | | | | |
| 8.4 A compatible declaration shall be visible when an object or function with external linkage is defined. 2 | | | | |
| | Category: Required | Unset | Unreviewed | |
| | Category: Required | Unset | Unreviewed | |
| 8.7 Functions and objects should not be defined with external linkage if they are referenced in only one translation | | | | |
| | Category: Advisory | Unset | Unreviewed | |

```
#include <stdio.h>

/* Violation of Misra C:2012
rules 8.4 and 8.7 on the next
line of code. */

int func(int p) //My_rule 50, 51
{
    int i;
    int j = 1;

    i = 1024 / (j - p);
    return i;
}

/* Violation of Misra C:2012
rule 8.4 on the next line of
code */

int main(void){ //My_rule 50
        int x=func(2);
        return x;
}
```

This XML example defines the annotation format used in `zero_div.c` and maps it to the Polyspace annotation syntax:

- The format of the annotation is the keyword `My_rule`, followed by a space and one or more comma-separated alphanumeric rule identifiers.
- Rule identifiers 50 and 51 are mapped to MISRA C: 2012 rules 8.4 and 8.7 respectively. The mapping uses the Polyspace annotation syntax.

```
<?xml version="1.0" encoding="UTF-8"?>

<Annotations xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
             xsi:noNamespaceSchemaLocation="annotations_xml_schema.xsd"
             Group="example annotation">

  <Expressions Search_For_Keywords="My_rule"
              Separator_Result_Name="," >


    <!-- This section defines the annotation syntax format -->
   <Expression Mode="SAME_LINE"
               Regex="My_rule\s(\w+(\s*,\s*\w+)*)"
               Rule_Identifier_Position="1"
               />

 </Expressions>
  <!-- This section maps the user annotation to the Polyspace
  annotation syntax -->
 <Mapping>
    <Result_Name_Mapping  Rule_Identifier="50" Family="MISRA-C3" Result_Name="8.4"/>
    <Result_Name_Mapping  Rule_Identifier="51" Family="MISRA-C3" Result_Name="8.7"/>
   </Mapping>
</Annotations>
```

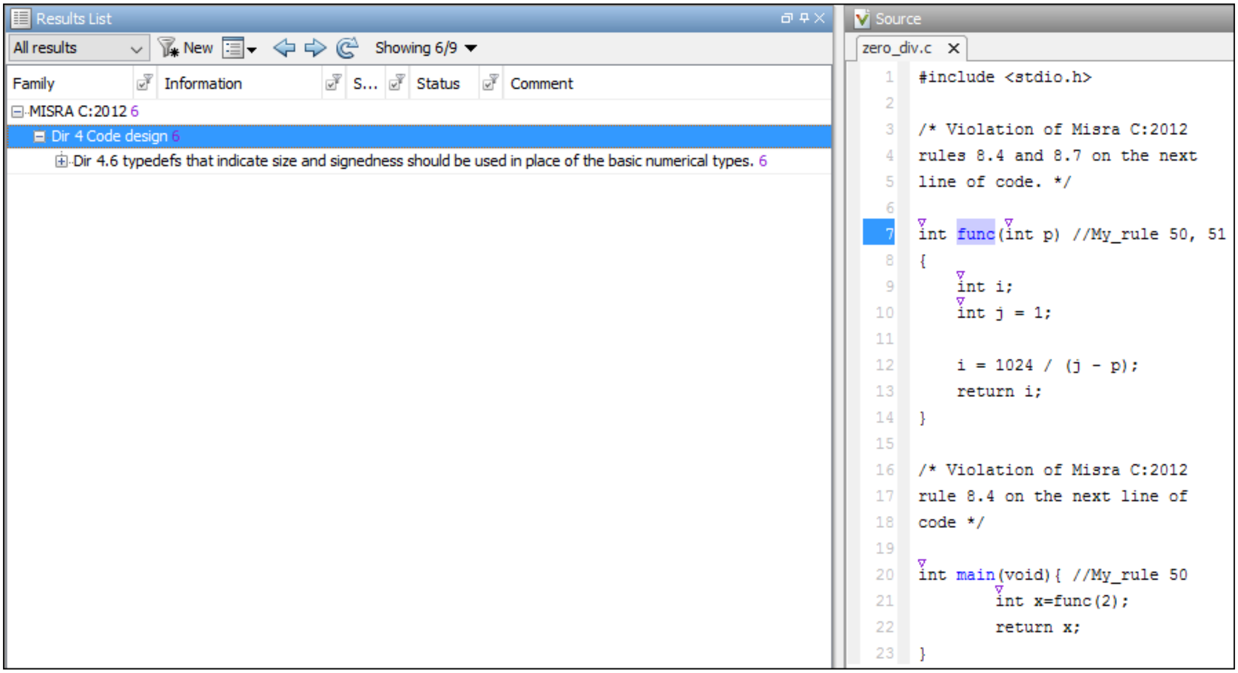
To import the existing annotations and apply them to the corresponding Polyspace results:

1 Copy the preceding code example to a text editor and save it on your machine as `annotations_description.xml`, for instance in `C:\Polyspace_workspace\annotations\`.

2 Rerun the analysis on `zero_div.c` by using the command:

```
polyspace-bug-finder-nodesktop -sources source_path -misra3 all ^
-xml-annotations-desriptions ^
C:\Polyspace_workspace\annotations\annotations_description.xml
```

Polyspace considers the annotated results justified and hides them in the **Results List** pane.



| Family | Information | S... | Status | Comment |
|---|---|---|---|---|
| MISRA C:2012 6 | | | | |
| Dir 4 Code design 6 | | | | |
| Dir 4.6 typedefs that indicate size and signedness should be used in place of the basic numerical types. 6 | | | | |

```
#include <stdio.h>

/* Violation of Misra C:2012
rules 8.4 and 8.7 on the next
line of code. */

int func(int p) //My_rule 50, 51
{
    int i;
    int j = 1;

    i = 1024 / (j - p);
    return i;
}

/* Violation of Misra C:2012
rule 8.4 on the next line of
code */

int main(void){ //My_rule 50
        int x=func(2);
        return x;
}
```

## See Also

### Topics

"Define Custom Annotation Format"
"Annotate and Hide Known or Acceptable Results"

Introduced in R2017b

3

# Defects

# *this not returned in copy assignment operator

`operator=` method does not return a pointer to the current object

## Description

**`*this` not returned from copy assignment operator** occurs when assignment operators such as `operator=` and `operator+=` do not return a reference to `*this`, where `this` is a pointer to the current object. If the `operator=` method does not return `*this`, it means that `a=b` or `a.operator=(b)` is not returning the assignee `a` following the assignment.

For instance:

- The operator returns its parameter instead of a reference to the current object.

  That is, the operator has a form `MyClass & operator=(const MyClass & rhs) { ... return rhs; }` instead of `MyClass & operator=(const MyClass & rhs) { ... return *this; }`.
- The operator returns by value and not reference.

  That is, the operator has a form `MyClass operator=(const MyClass & rhs) { ... return *this; }` instead of `MyClass & operator=(const MyClass & rhs) { ... return *this; }`.

## Risk

Users typically expect object assignments to behave like assignments between built-in types and expect an assignment to return the assignee. For instance, a right-associative chained assignment `a=b=c` requires that `b=c` return the assignee `b` following the assignment. If your assignment operator behaves differently, users of your class can face unexpected consequences.

The unexpected consequences occur when the assignment is part of another statement. For instance:

- If the operator= returns its parameter instead of a reference to the current object, the assignment a=b returns b instead of a. If the operator= performs a partial assignment of data members, following an assignment a=b, the data members of a and b are different. If you or another user of your class read the data members of the return value and expect the data members of a, you might have unexpected results. For an example, see “Return Value of operator= Same as Argument” on page 3-3.
- If the operator= method returns *this by value and not reference, a copy of *this is returned. If you expect to modify the result of the assignment using a statement such as (a=b).modifyValue(), you modify a copy of a instead of a itself.

### Fix

Return *this from your assignment operators.

## Examples

### Return Value of **operator=** Same as Argument

```
class MyClass {
    public:
        MyClass(bool b, int i): m_b(b), m_i(i) {}
        const MyClass& operator=(const MyClass& obj) {
            if (&obj!=this) {
                /* Note: Only m_i is copied. m_b retains its original value. */
                m_i = obj.m_i;
            }
            return obj;
        }
        bool isOk() const { return m_b;}
        int getI() const { return m_i;}
    private:
        bool m_b;
        int m_i;
};

void main() {
        MyClass r0(true, 0), r1(false, 1);
        /* Object calling isOk is r0 and the if block executes. */
        if ( (r1 = r0).isOk()) {
            /* Do something */
        }
}
```

In this example, the operator `operator=` returns its current argument instead of a reference to `*this`.

Therefore, in `main`, the assignment `r1 = r0` returns `r0` and not `r1`. Because the `operator=` does not copy the data member `m_b`, the value of `r0.m_b` and `r1.m_b` are different. The following unexpected behavior occurs.

| What You Might Expect | What Actually Happens |
|---|---|
| • The statement `(r1 = r0).isOk()` returns `r1.m_b` which has value `false`<br>• The `if` block does not execute. | • The statement `(r1 = r0).isOk()` returns `r0.m_b` which has value `true`<br>• The `if` block executes. |

One possible correction is to return `*this` from `operator=`.

```
class MyClass {
    public:
        MyClass(bool b, int i): m_b(b), m_i(i) {}
        const MyClass& operator=(const MyClass& obj) {
            if (&obj!=this) {
                /* Note: Only m_i is copied. m_b retains its original value. */
                m_i = obj.m_i;
            }
            return *this;
        }
        bool isOk() const { return m_b;}
        int getI() const { return m_i;}
    private:
        bool m_b;
        int m_i;
};

void main() {
        MyClass r0(true, 0), r1(false, 1);
        /* Object calling isOk is r0 and the if block executes. */
        if ( (r1 = r0).isOk()) {
            /* Do something */
        }
}
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** Off
**Command-Line Syntax:** `RETURN_NOT_REF_TO_THIS`
**Impact:** Low

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Abnormal termination of exit handler

Exit handler function interrupts the normal execution of a program

## Description

**Abnormal termination of exit handler** looks for registered exit handlers. Exit handlers are registered with specific functions such as `atexit`, (WinAPI) `_onexit`, or `at_quick_exit()`. If the exit handler calls a function that interrupts the program's expected termination sequence, Polyspace raises a defect. Some functions that can cause abnormal exits are `exit`, `abort`, `longjmp`, or (WinAPI) `_onexit`.

### Risk

If your exit handler terminates your program, you can have undefined behavior. Abnormal program termination means other exit handlers are not invoked. These additional exit handlers may do additional clean up or other required termination steps.

### Fix

In inside exit handlers, remove calls to functions that prevent the exit handler from terminating normally.

## Examples

### Exit Handler With Call to `exit`

```
#include <stdlib.h>

volatile int some_condition = 1;
void demo_exit1(void)
{
    /* ... Cleanup code ... */
    return;
}
```

```
void exitabnormalhandler(void)
{
    if (some_condition)
    {
        /* Clean up */
        exit(0);
    }
    return;
}

int demo_install_exitabnormalhandler(void)
{

    if (atexit(demo_exit1) != 0) /* demo_exit1() performs additional cleanup */
    {
        /* Handle error */
    }
    if (atexit(exitabnormalhandler) != 0)
    {
        /* Handle error */
    }
    /* ... Program code ... */
    return 0;
}
```

In this example, demo_install_exitabnormalhandler registers two exit handlers, demo_exit1 and exitabnormalhandler. Exit handlers are invoked in the reverse order of which they are registered. When the program ends, exitabnormalhandler runs, then demo_exit1. However, exitabnormalhandler calls exit interrupting the program exit process. Having this exit inside an exit handler causes undefined behavior because the program is not finished cleaning up safely.

One possible correction is to let your exit handlers terminate normally. For this example, exit is removed from exitabnormalhandler, allowing the exit termination process to complete as expected.

```
#include <stdlib.h>

volatile int some_condition = 1;
void demo_exit1(void)
{
    /* ... Cleanup code ... */
    return;
}
void exitabnormalhandler(void)
{
    if (some_condition)
    {
        /* Clean up */
        /* Return normally */
    }
    return;
}

int demo_install_exitabnormalhandler(void)
{

    if (atexit(demo_exit1) != 0) /* demo_exit1() continues clean up */
    {
        /* Handle error */
    }
    if (atexit(exitabnormalhandler) != 0)
    {
        /* Handle error */
    }
    /* ... Program code ... */
    return 0;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `EXIT_ABNORMAL_HANDLER`
**Impact:** Medium
**CWE ID:** 705
**CERT C ID:** ENV32-C

Introduced in R2016b

# Absorption of float operand

One addition or subtraction operand is absorbed by the other operand

## Description

**Absorption of float operand** occurs when one operand of an addition or subtraction operation is *always* negligibly small compared to the other operand. Therefore, the result of the operation is always equal to the value of the larger operand, making the operation redundant.

### Risk

Redundant operations waste execution cycles of your processor.

The absorption of a float operand can indicate design issues elsewhere in the code. It is possible that the developer expected a different range for one of the operands and did not expect the redundancy of the operation. However, the operand range is different from what the developer expects because of issues elsewhere in the code.

### Fix

See if the operand ranges are what you expect. To see the ranges, place your cursor on the operation.

- If the ranges are what you expect, justify why you have the redundant operation in place. For instance, the code is only partially written and you anticipate other values for one or both of the operands from future unwritten code.

  If you cannot justify the redundant operation, remove it.
- If the ranges are not what you expect, in your code, trace back to see where the ranges come from. To begin your traceback, search for instances of the operand in your code. Browse through previous instances of the operand and determine where the unexpected range originates.

To determine when one operand is negligible compared to the other operand, the defect uses rules based on IEEE 754 standards. To fix the defect, instead of using the actual rules, you can use this heuristic: the ratio of the larger to the smaller operand must be less than $2^{p-1}$ at least for some values. Here, `p` is equal to 24 for 32-bit precision and 53 for 64-bit precision. To determine the precision, the defect uses your specification for `Target processor type (-target)`.

This defect appears only if one operand is *always* negligibly smaller than the other operand. To see instances of subnormal operands or results, use the check **Subnormal Float** in Polyspace Code Prover.

# Examples

## One Addition Operand Negligibly Smaller Than The Other Operand

```
#include <stdlib.h>

float get_signal(void);
void do_operation(float);

float input_signal1(void) {
    float temp = get_signal();
    if(temp > 0. && temp < 1e-30)
        return temp;
    else {
       /* Reject value */
       exit(EXIT_FAILURE);
    }
}

float input_signal2(void) {
    float temp = get_signal();
    if(temp > 1.)
        return temp;
    else {
       /* Reject value */
       exit(EXIT_FAILURE);
    }
}

void main() {
    float signal1 = input_signal1();
    float signal2 = input_signal2();
    float super_signal = signal1 + signal2;
    do_operation(super_signal);
}
```

In this example, the defect appears on the addition because the operand `signal1` is in the range `(0,1e-30)` but `signal2` is greater than `1`.

One possible correction is to remove the redundant addition operation. In the following corrected code, the operand `signal2` and its associated code is also removed from consideration.

```
#include <stdlib.h>

float get_signal(void);
void do_operation(float);

float input_signal1(void) {
    float temp = get_signal();
    if(temp > 0. && temp < 1e-30)
        return temp;
    else {
       /* Reject value */
       exit(EXIT_FAILURE);
    }
}

void main() {
    float signal1 = input_signal1();
    do_operation(signal1);
}
```

Another possible correction is to see if the operand ranges are what you expect. For instance, if one of the operand range is not supposed to be negligibly small, fix the issue causing the small range. In the following corrected code, the range `(0,1e-2)` is imposed on `signal2` so that it is not *always* negligibly small as compared to `signal1`.

```
#include <stdlib.h>

float get_signal(void);
void do_operation(float);

float input_signal1(void) {
    float temp = get_signal();
    if(temp > 0. && temp < 1e-2)
        return temp;
    else {
       /* Reject value */
       exit(EXIT_FAILURE);
    }
}

float input_signal2(void) {
    float temp = get_signal();
    if(temp > 1.)
        return temp;
    else {
       /* Reject value */
       exit(EXIT_FAILURE);
    }
}

void main() {
    float signal1 = input_signal1();
    float signal2 = input_signal2();
    float super_signal = signal1 + signal2;
    do_operation(super_signal);
}
```

## Result Information

**Group:** Numerical
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `FLOAT_ABSORPTION`
**Impact:** High
**CWE ID:** 682, 873
**CERT C ID:** FLP00-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2016b

# Alignment changed after memory reallocation

Memory reallocation changes the originally stricter alignment of an object

## Description

**Alignment changed after memory reallocation** occurs when you use `realloc()` to modify the size of objects with strict memory alignment requirements.

### Risk

The pointer returned by `realloc()` can be suitably assigned to objects with less strict alignment requirements. A misaligned memory allocation can lead to buffer underflow or overflow, an illegally dereferenced pointer, or access to arbitrary memory locations. In processors that support misaligned memory, the allocation impacts the performance of the system.

### Fix

To reallocate memory:

1. Resize the memory block.
    - In Windows, use `_aligned_realloc()` with the alignment argument used in `_aligned_malloc()` to allocate the original memory block.
    - In UNIX/Linux, use the same function with the same alignment argument used to allocate the original memory block.
2. Copy the original content to the new memory block.
3. Free the original memory block.

**Note** This fix has implementation-defined behavior. The implementation might not support the requested memory alignment and can have additional constraints for the size of the new memory.

# Examples

## Memory Reallocated Without Preserving the Original Alignment

```
#include <stdio.h>
#include <stdlib.h>

#define SIZE1024 1024

void func(void)
{
    size_t resize = SIZE1024;
    size_t alignment = 1 << 12; /* 4096 bytes alignment */
    int *ptr = NULL;
    int *ptr1;

    /* Allocate memory with 4096 bytes alignment */

    if (posix_memalign((void **)&ptr, alignment, sizeof(int)) != 0)
    {
        /* Handle error */
      }

    /*Reallocate memory without using the original alignment.
    ptr1 may not be 4096 bytes aligned. */

    ptr1 = (int *)realloc(ptr, sizeof(int) * resize);

    if (ptr1 == NULL)
    {
        /* Handle error */
    }

    /* Processing using ptr1 */

    /* Free before exit */
    free(ptr1);
}
```

In this example, the allocated memory is 4096-bytes aligned. realloc() then resizes the allocated memory. The new pointer ptr1 might not be 4096-bytes aligned.

When you reallocate the memory, use posix_memalign() and pass the alignment argument that you used to allocate the original memory.

```
#include <stdio.h>
#include <stdlib.h>

#define SIZE1024 1024

void func(void)
{
    size_t resize = SIZE1024;
    size_t alignment = 1 << 12; /* 4096 bytes alignment */
    int *ptr = NULL;

    /* Allocate memory with 4096 bytes alignment */
    if (posix_memalign((void **)&ptr, alignment, sizeof(int)) != 0)
    {
        /* Handle error */
    }

    /* Reallocate memory using the original alignment. */
    if (posix_memalign((void **)&ptr, alignment, sizeof(int) * resize) != 0)
    {
        /* Handle error */
        free(ptr);
        ptr = NULL;
    }

    /* Processing using ptr */

    /* Free before exit */
    free(ptr);
}
```

## Result Information

**Group:** Dynamic memory
**Language:** C | C++
**Default:** On

**Command-Line Syntax:** `ALIGNMENT_CHANGE`
**Impact:** Low
**CERT C ID:** MEM36-C

## See Also

Introduced in R2017b

# Alternating input and output from a stream without flush or positioning call

Undefined behavior for input or output stream operations

## Description

**Alternating input and output from a stream without flush or positioning call** occurs when:

- You do not perform a flush or function positioning call between an output operation and a following input operation on a file stream in update mode.
- You do not perform a function positioning call between an input operation and a following output operation on a file stream in update mode.

### Risk

Alternating input and output operations on a stream without an intervening flush or positioning call is undefined behavior.

### Fix

Call `fflush()` or a file positioning function such as `fseek()` or `fsetpos()` between output and input operations on an update stream.

Call a file positioning function between input and output operations on an update stream.

## Examples

### Read After Write Without Intervening Flush

```
#include <stdio.h>
#define SIZE20 20
```

```
void initialize_data(char* data, size_t s) {};
const char *temp_filename = "/tmp/demo.txt";

void func()
{
    char data[SIZE20];
    char append_data[SIZE20];
    FILE *file;

    file = fopen(temp_filename, "a+");
    if (file == NULL)
      {
        /* Handle error. */;
      }

    initialize_data(append_data, SIZE20);

    if (fwrite(append_data, 1, SIZE20, file) != SIZE20)
      {
        (void)fclose(file);
        /* Handle error. */;
      }
    /* Read operation after write without
    intervening flush. */
    if (fread(data, 1, SIZE20, file) < SIZE20)
      {
          (void)fclose(file);
          /* Handle error. */;
      }

    if (fclose(file) == EOF)
      {
        /* Handle error. */;
      }
}
```

In this example, the file `demo.txt` is opened for reading and appending. After the call to `fwrite()`, a call to `fread()` without an intervening flush operation is undefined behavior.

After writing data to the file, before calling `fread()`, perform a flush call.

```
#include <stdio.h>
#define SIZE20 20

void initialize_data(char* data, size_t s) {};
const char *temp_filename = "/tmp/demo.txt";


void func()
{
    char data[SIZE20];
    char append_data[SIZE20];
    FILE *file;

    file = fopen(temp_filename, "a+");
    if (file == NULL)
      {
        /* Handle error. */;
      }

    initialize_data(append_data, SIZE20);

    if (fwrite(append_data, 1, SIZE20, file) != SIZE20)
      {
        (void)fclose(file);
        /* Handle error. */;
      }
    /* Buffer flush after write and before read */
    if (fflush(file) != 0)
      {
        (void)fclose(file);
        /* Handle error. */;
      }
    if (fread(data, 1, SIZE20, file) < SIZE20)
      {
        (void)fclose(file);
        /* Handle error. */;
      }

    if (fclose(file) == EOF)
      {
        /* Handle error. */;
        }
}
```

## Result Information

**Group:**Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `IO_INTERLEAVING`
**Impact:** Low
**CERT C ID:** FIO39-C
**ISO/IEC TS 17961 ID:** `ioileave`

## See Also

Introduced in R2017b

# Arithmetic operation with NULL pointer

Arithmetic operation performed on `NULL` pointer

## Description

**Arithmetic operation with NULL pointer** occurs when an arithmetic operation involves a pointer whose value is `NULL`.

## Examples

### Arithmetic Operation with NULL Pointer Error

```
#include<stdlib.h>

int Check_Next_Value(int *loc, int val)
 {
  int *ptr = loc, found = 0;

  if (ptr==NULL)
   {
      ptr++;
      /* Defect: NULL pointer shifted */

      if (*ptr==val) found=1;
   }

  return(found);
 }
```

When `ptr` is a `NULL` pointer, the code enters the `if` statement body. Therefore, a `NULL` pointer is shifted in the statement `ptr++`.

One possible correction is to perform the arithmetic operation when `ptr` is not `NULL`.

```
#include<stdlib.h>
```

```
int Check_Next_Value(int *loc, int val)
 {
  int *ptr = loc, found = 0;

  /* Fix: Perform operation when ptr is not NULL */
  if (ptr!=NULL)
   {
     ptr++;

     if (*ptr==val) found=1;
   }

  return(found);
 }
```

## Check Information

**Group:** Static memory
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `NULL_PTR_ARITH`
**Impact:** Low
**CERT C ID:** EXP34-C
**ISO/IEC TS 17961 ID:** `nullref`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Null pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

#### Introduced in R2013b

# Array access out of bounds

Array index outside bounds during array access

## Description

**Array access out of bounds** occurs when an array index falls outside the range `[0...array_size-1]` during array access.

## Examples

### Array Access Out of Bounds Error

```
#include <stdio.h>

void fibonacci(void)
{
    int i;
    int fib[10];

    for (i = 0; i < 10; i++)
       {
        if (i < 2)
            fib[i] = 1;
         else
            fib[i] = fib[i-1] + fib[i-2];
       }

    printf("The 10-th Fibonacci number is %i .\n", fib[i]);
    /* Defect: Value of i is greater than allowed value of 9 */
}
```

The array `fib` is assigned a size of 10. An array index for `fib` has allowed values of `[0,1,2,...,9]`. The variable `i` has a value 10 when it comes out of the `for`-loop. Therefore, the `printf` statement attempts to access `fib[10]` through `i`.

One possible correction is to print `fib[i-1]` instead of `fib[i]` after the `for`-loop.

```
#include <stdio.h>

void fibonacci(void)
{
   int i;
   int fib[10];

   for (i = 0; i < 10; i++)
    {
        if (i < 2)
            fib[i] = 1;
        else
            fib[i] = fib[i-1] + fib[i-2];
    }

    /* Fix: Print fib[9] instead of fib[10] */
    printf("The 10-th Fibonacci number is %i .\n", fib[i-1]);
}
```

The `printf` statement accesses `fib[9]` instead of `fib[10]`.

## Check Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `OUT_BOUND_ARRAY`
**Impact:** High
**CWE ID:** 119, 466
**CERT C ID:** API02-C, ARR00-C, ARR30-C, ARR33-C, ARR38-C, MSC15-C, STR31-C
**ISO/IEC TS 17961 ID:** `invptr`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Pointer access out of bounds`

## Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2013b

# Array access with tainted index

Array index from unsecure source possibly outside array bounds

## Description

**Array access with tainted index** detects reading or writing to an array by using a tainted index that has not been validated.

### Risk

The index might be outside the valid array range. If the tainted index is outside the array range, it can cause:

- Buffer underflow/underwrite — writing to memory before the beginning of the buffer.
- Buffer overflow — writing to memory after the end of a buffer.
- Over-reading a buffer — accessing memory after the end of the targeted buffer.
- Under-reading a buffer, or accessing memory before the beginning of the targeted buffer.

An attacker can use an invalid read or write operation create to problems in your program.

### Fix

Before using the index to access the array, validate the index value to make sure that it is inside the array range.

## Examples

### Use Index to Return Buffer Value

```
#define SIZE100 100
extern int tab[SIZE100];
```

```
int taintedarrayindex(int num) {
    return tab[num];
}
```

In this example, the index `num` accesses the array `tab`. The function does not check to see if `num` is inside the range of `tab`.

One possible correction is to check that `num` is in range before using it.

```
#define SIZE100 100
extern int tab[SIZE100];

int taintedarrayindex(int num) {
    if (num >= 0 && num < SIZE100) {
           return tab[num];
    } else {
        return -9999;
    }
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_ARRAY_INDEX`
**Impact:** Medium
**CWE ID:** 121, 124, 125, 129
**CERT C ID:** INT04-C, ARR30-C, API00-C, API02-C
**ISO/IEC TS 17961 ID:** `invptr`

## See Also

`Loop bounded with tainted value` | `Pointer dereference with tainted offset` | `Tainted size of variable length array`

### Topics

"Navigate to Root Cause of Defect"

"Review and Fix Results"

Introduced in R2015b

# Assertion

Failed assertion statement

## Description

**Assertion** occurs when you use an assert, and the asserted expression is or could be false.

**Note** Polyspace does not flag assert(0) as an assertion defect because these statements are commonly used to disable certain sections of code.

## Examples

### Check Assertion on Unsigned Integer

```
#include <assert.h>

void asserting_x(unsigned int theta) {
    theta =+ 5;
    assert(theta < 0);
}
```

In this example, the assert function checks if the input variable, theta, is less than or equal to zero. The assertion fails because theta is an unsigned integer, so the value at the beginning of the function is at least zero. The += statement increases this positive value by five. Therefore, the range of theta is [5..MAX_INT]. theta is always greater than zero.

One possible correction is to change the assertion expression. By changing the *less-than-or-equal-to* sign to a *greater-than-or-equal-to* sign, the assertion does not fail.

```
#include <assert.h>

void asserting_x(unsigned int theta) {
    theta =+ 5;
    assert(theta > 0);
}
```

One possible correction is to fix the code related to the assertion expression. If the assertion expression is true, fix your code so the assertion passes.

```
#include <assert.h>
#include <stdlib.h>

void asserting_x(int theta) {
    theta = -abs(theta);
    assert(theta < 0);
}
```

### Asserting Zero

```
#include <assert.h>

#define FLAG 0

int main(void){
    int i_test_z = 0;
    float f_test_z = (float)i_test_z;

    assert(i_test_z);
    assert(f_test_z);
    assert(FLAG);

    return 0;
}
```

In this example, Polyspace does not flag `assert(FLAG)` as a violation because a macro defines `FLAG` as `0`. The Polyspace Bug Finder assertion checker does not flag assertions with a constant zero parameter, `assert(0)`. These types of assertions are commonly used as dynamic checks during runtime. By inserting `assert(0)`, you indicate that the program must not reach this statement during run time, otherwise the program crashes.

However, the assertion checker does flag failed assertions caused by a variable value equal to zero, as seen in the example with `assert(i_test_z)` and `assert(f_test_z)`.

## Check Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `ASSERT`
**Impact:** High

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Bad file access mode or status

Access mode argument of function in fopen or open group is invalid

## Description

**Bad file access mode or status** occurs when you use functions in the fopen or open group with invalid or incompatible file access modes, file creation flags, or file status flags as arguments. For instance, for the open function, examples of valid:

- Access modes include O_RDONLY, O_WRONLY, and O_RDWR
- File creation flags include O_CREAT, O_EXCL, O_NOCTTY, and O_TRUNC.
- File status flags include O_APPEND, O_ASYNC, O_CLOEXEC, O_DIRECT, O_DIRECTORY, O_LARGEFILE, O_NOATIME, O_NOFOLLOW, O_NONBLOCK, O_NDELAY, O_SHLOCK, O_EXLOCK, O_FSYNC, O_SYNC and so on.

The defect can occur in the following situations.

| Situation | Risk | Fix |
|---|---|---|
| You pass an empty or invalid access mode to the fopen function.<br>According to the ANSI C standard, the valid access modes for fopen are:<br>• r,r+<br>• w,w+<br>• a,a+<br>• rb, wb, ab<br>• r+b, w+b, a+b<br>• rb+, wb+, ab+ | fopen has undefined behavior for invalid access modes.<br>Some implementations allow extension of the access mode such as:<br>• GNU: rb +cmxe,ccs=utf<br>• Visual C++: a+t, where t specifies a text mode.<br>However, your access mode string must begin with one of the valid sequences. | Pass a valid access mode to fopen. |

| Situation | Risk | Fix |
|---|---|---|
| You pass the status flag O_APPEND to the open function without combining it with either O_WRONLY or O_RDWR. | O_APPEND indicates that you intend to add new content at the end of a file. However, without O_WRONLY or O_RDWR, you cannot write to the file.<br>The open function does not return -1 for this logical error. | Pass either O_APPEND\|O_WRONLY or O_APPEND\|O_RDWR as access mode. |
| You pass the status flags O_APPEND and O_TRUNC together to the open function. | O_APPEND indicates that you intend to add new content at the end of a file. However, O_TRUNC indicates that you intend to truncate the file to zero. Therefore, the two modes cannot operate together.<br>The open function does not return -1 for this logical error. | Depending on what you intend to do, pass one of the two modes. |
| You pass the status flag O_ASYNC to the open function. | On certain implementations, the mode O_ASYNC does not enable signal-driven I/O operations. | Use the fcntl(pathname, F_SETFL, O_ASYNC); instead. |

## Examples

### Invalid Access Mode with **fopen**

```
#include <stdio.h>

void func(void) {
    FILE *file = fopen("data.txt", "rw");
    if(file!=NULL) {
        fputs("new data",file);
        fclose(file);
    }
}
```

In this example, the access mode `rw` is invalid. Because `r` indicates that you open the file for reading and `w` indicates that you create a new file for writing, the two access modes are incompatible.

One possible correction is to use the access mode corresponding to what you intend to do.

```
#include <stdio.h>

void func(void) {
    FILE *file = fopen("data.txt", "w");
    if(file!=NULL) {
        fputs("new data",file);
        fclose(file);
    }
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BAD_FILE_ACCESS_MODE_STATUS`
**Impact:** Medium
**CWE ID:** 628, 686
**CERT C ID:** EXP37-C, FIO11-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Bad order of dropping privileges

Dropped higher elevated privileges before dropping lower elevated privileges

## Description

**Bad order of dropping privileges** checks the order of privilege drops. If you drop higher elevated privileges before dropping lower elevated privileges, Polyspace raises a defect. For example dropping elevated primary group privileges before dropping elevated ancillary group privileges.

### Risk

If you drop privileges in the wrong order, you can potentially drop higher privileges that you need to drop lower privileges. The incorrect order can mean, privileges are not dropped, compromising the security of your program.

### Fix

Respect this order of dropping elevated privileges:

- Drop (elevated) ancillary group privileges, then drop (elevated) primary group privileges.
- Drop (elevated) primary group privileges, then drop (elevated) user privileges.

## Examples

### Dropping User Privileges First

```
#define _BSD_SOURCE
#include <sys/types.h>
#include <unistd.h>
#include <grp.h>
#include <stdlib.h>
#define fatal_error() abort()
```

```
static void sanitize_privilege_drop_check(uid_t olduid, gid_t oldgid)
{
    if (seteuid(olduid) != -1)
    {
        /* Privileges can be restored, handle error */
        fatal_error();
    }
    if (setegid(oldgid) != -1)
    {
        /* Privileges can be restored, handle error */
        fatal_error();
    }
}
void badprivilegedroporder(void) {
    uid_t
        newuid = getuid(),
        olduid = geteuid();
    gid_t
        newgid = getgid(),
        oldgid = getegid();

    if (setuid(newuid) == -1) {
        /* handle error condition */
        fatal_error();
    }
    if (setgid(newgid) == -1)  {
        /* handle error condition */
        fatal_error();
    }
    if (olduid == 0) {
        /* drop ancillary groups IDs only possible for root */
        if (setgroups(1, &newgid) == -1) {
            /* handle error condition */
            fatal_error();
        }
    }

    sanitize_privilege_drop_check(olduid, oldgid);
}
```

In this example, there are two privilege drops made in the incorrect order. `setgid` attempts to drop group privileges. However, `setgid` requires the user privileges, which were dropped previously using `setuid`, to perform this function. After dropping group privileges, this function attempts to drop ancillary groups privileges by using setgroups. This task requires the higher primary group privileges that were dropped with setgid. At the end of this function, it is possible to regain group privileges because the order of dropping privileges was incorrect.

One possible correction is to drop the lowest level privileges first. In this correction, ancillary group privileges are dropped, then primary group privileges are dropped, and finally user privileges are dropped.

```
#define _BSD_SOURCE
#include <sys/types.h>
#include <unistd.h>
#include <grp.h>
#include <stdlib.h>
#define fatal_error() abort()

static void sanitize_privilege_drop_check(uid_t olduid, gid_t oldgid)
{
    if (seteuid(olduid) != -1)
    {
        /* Privileges can be restored, handle error */
        fatal_error();
    }
    if (setegid(oldgid) != -1)
    {
        /* Privileges can be restored, handle error */
        fatal_error();
    }
}
void badprivilegedroporder(void) {
    uid_t
        newuid = getuid(),
        olduid = geteuid();
    gid_t
        newgid = getgid(),
        oldgid = getegid();

    if (olduid == 0) {
        /* drop ancillary groups IDs only possible for root */
        if (setgroups(1, &newgid) == -1) {
            /* handle error condition */
            fatal_error();
        }
    }
    if (setgid(getgid()) == -1)  {
        /* handle error condition */
        fatal_error();
    }
    if (setuid(getuid()) == -1) {
        /* handle error condition */
        fatal_error();
    }

    sanitize_privilege_drop_check(olduid, oldgid);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BAD_PRIVILEGE_DROP_ORDER`
**Impact:** High
**CWE ID:** 250, 696
**CERT C ID:** POS36-C

Introduced in R2016b

# Base class assignment operator not called

Copy assignment operator does not call copy assignment operators of base subobjects

## Description

**Base class assignment operator not called** occurs when a derived class copy assignment operator does not call the copy assignment operator of its base class.

### Risk

If this defect occurs, unless you are initializing the base class data members explicitly in the derived class assignment operator, the operator initializes the members implicitly by using the default constructor of the base class. Therefore, it is possible that the base class data members do not get assigned the right values.

If users of your class expect your assignment operator to perform a complete assignment between two objects, they can face unintended consequences.

### Fix

Call the base class copy assignment operator from the derived class copy assignment operator.

Even if the base class data members are not `private`, and you explicitly initialize the base class data members in the derived class copy assignment operator, replace this explicit initialization with a call to the base class copy assignment operator. Otherwise, determine why you retain the explicit initialization.

## Examples

### Base Class Copy Assignment Operator Not Called

```
class Base0 {
public:
    Base0();
    virtual ~Base0();
    Base0& operator=(const Base0&);
private:
    int _i;
};

class Base1 {
public:
    Base1();
    virtual ~Base1();
    Base1& operator=(const Base1&);
private:
    int _i;
};

class Derived: public Base0, Base1 {
public:
    Derived();
    ~Derived();
    Derived& operator=(const Derived& d) {
        if (&d == this) return *this;
        Base0::operator=(d);
        _j = d._j;
        return *this;
    }
private:
    int _j;
};
```

In this example, the class `Derived` is derived from two classes `Base0` and `Base1`. In the copy assignment operator of `Derived`, only the copy assignment operator of `Base0` is called. The copy assignment operator of `Base1` is not called.

The defect appears on the copy assignment operator of the derived class. Following are some tips for navigating in the source code:

- To find the derived class definition, right-click the derived class name and select **Go To Definition**.
- To find the base class definition, first navigate to the derived class definition. In the derived class definition, right-click the base class name and select **Go To Definition**.

- To find the definition of the base class copy assignment operator, first navigate to the base class definition. In the base class definition, right-click the operator name and select **Go To Definition**.

If you want your copy assignment operator to perform a complete assignment, one possible correction is to call the copy assignment operator of class `Base1`.

```
class Base0 {
public:
    Base0();
    virtual ~Base0();
    Base0& operator=(const Base0&);
private:
    int _i;
};

class Base1 {
public:
    Base1();
    virtual ~Base1();
    Base1& operator=(const Base1&);
private:
    int _i;
};

class Derived: public Base0, Base1 {
public:
    Derived();
    ~Derived();
    Derived& operator=(const Derived& d) {
        if (&d == this) return *this;
        Base0::operator=(d);
        Base1::operator=(d);
        _j = d._j;
        return *this;
    }
private:
    int _j;
};
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** On
**Command-Line Syntax:** `MISSING_BASE_ASSIGN_OP_CALL`
**Impact:** High

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Copy constructor not called in initialization list`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Base class destructor not virtual

Class cannot behave polymorphically for deletion of derived class objects

## Description

**Base class destructor not virtual** occurs when a class has `virtual` functions but not a `virtual` destructor.

### Risk

The presence of `virtual` functions indicates that the class is intended for use as a base class. However, if the class does not have a `virtual` destructor, it cannot behave polymorphically for deletion of derived class objects.

If a pointer to this class refers to a derived class object, and you use the pointer to delete the object, only the base class destructor is called. Additional resources allocated in the derived class are not released and can cause a resource leak.

### Fix

One possible fix is to always use a `virtual` destructor in a class that contains `virtual` functions.

## Examples

### Base Class Destructor Not Virtual

```
class Base {
        public:
                Base(): _b(0) {};
                virtual void update() {_b += 1;};
        private:
                int _b;
};
```

```
class Derived: public Base {
        public:
                Derived(): _d(0) {};
                ~Derived() {_d = 0;};
                virtual void update() {_d += 1;};
        private:
                int _d;
};
```

In this example, the class `Base` does not have a `virtual` destructor. Therefore, if a `Base*` pointer points to a `Derived` object that is allocated memory dynamically, and the `delete` operation is performed on that `Base*` pointer, the `Base` destructor is called. The memory allocated for the additional member `_d` is not released.

The defect appears on the base class definition. Following are some tips for navigating in the source code:

- To find classes derived from the base class, right-click the base class name and select **Search For All References**. Browse through each search result to find derived class definitions.
- To find if you are using a pointer or reference to a base class to point to a derived class object, right-click the base class name and select **Search For All References**. Browse through search results that start with `Base*` or `Base&` to locate pointers or references to the base class. You can then see if you are using a pointer or reference to point to a derived class object.

One possible correction is to declare a `virtual` destructor for the class `Base`.

```
class Base {
        public:
                Base(): _b(0) {};
                virtual ~Base() {_b = 0;};
                virtual void update() {_b += 1;};
        private:
                int _b;
};

class Derived: public Base {
        public:
                Derived(): _d(0) {};
                ~Derived() {_d = 0;};
                virtual void update() {_d += 1;};
        private:
                int _d;
};
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** On
**Command-Line Syntax:** `DTOR_NOT_VIRTUAL`
**Impact:** Medium

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### External Websites

CERT C++ OOP52-CPP

Introduced in R2015b

# Bitwise and arithmetic operation on the same data

Statement with mixed bitwise and arithmetic operations

## Description

**Bitwise and arithmetic operation on a same data** detects statements with bitwise and arithmetic operations on the same variable or expression.

### Risk

Mixed bitwise and arithmetic operations *do* compile. However, the size of integer types affects the result of these mixed operations. Mixed operations also reduce readability and maintainability.

### Fix

Separate bitwise and arithmetic operations, or use only one type of operation per statement.

## Examples

### Shift and Addition

```
unsigned int bitwisearithmix()
{
    unsigned int var = 50;
    var += (var << 2) + 1;
    return var;
}
```

This example shows bitwise and arithmetic operations on the variable `var`. `var` is shifted by two (bitwise), then increased by 1 and added to itself (arithmetic).

You can reduce this expression to arithmetic-only operations: `var + (var << 2)` is equivalent to `var * 5`.

```
unsigned int bitwisearithmix()
{
    unsigned int var = 50;
    var = var * 5 +1;
    return var;
}
```

## Result Information

**Group:** Good Practice
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BITWISE_ARITH_MIX`
**Impact:** Low
**CWE ID:** 710
**CERT C ID:** INT14-C

Introduced in R2016b

# Bitwise operation on negative value

Undefined behavior for bitwise operations on negative values

## Description

**Bitwise operation on negative value** detects bitwise operators (`>>`, `^`, `|`, `~`, `but`, `not`, `&`) used on signed integer variables with negative values.

### Risk

If the value of the signed integer is negative, bitwise operation results can be unexpected because:

- Bitwise operations on negative values are compiler-specific.
- Unexpected calculations can lead to additional vulnerabilities, such as buffer overflow.

### Fix

When performing bitwise operations, use `unsigned` integers to avoid unexpected results.

## Examples

### Right-Shift of Negative Integer

```
#include <stdio.h>
#include <stdarg.h>

static void demo_sprintf(const char *format, ...)
{
    int rc;
    va_list ap;
    char buf[sizeof("256")];
    va_start(ap, format);
    rc = vsprintf(buf, format, ap);
    if (rc == -1 || rc >= sizeof(buf)) {
        /* Handle error */
    }
    va_end(ap);
}

void bug_bitwiseneg()
{
    int stringify = 0x80000000;
    demo_sprintf("%u", stringify >> 24);
}
```

In this example, the statement `demo_sprintf("%u", stringify >> 24)` stops the program unexpectedly. You expect the result of `stringify >> 24` to be `0x80`. However, the actual result is `0xffffff80` because `stringify` is signed and negative. The sign bit is also shifted.

By adding the `unsigned` keyword, `stringify` is not negative and the right-shift operation gives the expected result of `0x80`.

```
#include <stdio.h>
#include <stdarg.h>

static void demo_sprintf(const char *format, ...)
{
    int rc;
    va_list ap;
    char buf[sizeof("256")];

    va_start(ap, format);
    rc = vsprintf(buf, format, ap);
    if (rc == -1 || rc >= sizeof(buf)) {
        /* Handle error */
    }
    va_end(ap);
}

void corrected_bitwiseneg()
{
    unsigned int stringify = 0x80000000;
    demo_sprintf("%u", stringify >> 24);
}
```

## Result Information

**Group:** Numerical
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BITWISE_NEG`
**Impact:** Medium
**CWE ID:** 682, 758
**CERT C ID:** INT13-C

Introduced in R2016b

# Buffer overflow from incorrect string format specifier

String format specifier causes buffer argument of standard library functions to overflow

## Description

**Buffer overflow from incorrect string format specifier** occurs when the format specifier argument for functions such as `sscanf` leads to an overflow or underflow in the memory buffer argument.

### Risk

If the format specifier specifies a precision that is greater than the memory buffer size, an overflow occurs. Overflows can cause unexpected behavior such as memory corruption.

### Fix

Use a format specifier that is compatible with the memory buffer size.

## Examples

### Memory Buffer Overflow

```
#include <stdio.h>

void func (char *str[]) {
    char buf[32];
    sscanf(str[1], "%33c", buf);
}
```

In this example, `buf` can contain 32 `char` elements. Therefore, the format specifier `%33c` causes a buffer overflow.

One possible correction is to use a smaller precision in the format specifier.

```
#include <stdio.h>

void func (char *str[]) {
    char buf[32];
    sscanf(str[1], "%32c", buf);
}
```

## Result Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `STR_FORMAT_BUFFER_OVERFLOW`
**Impact:** High
**CWE ID:** 124, 125, 126, 127
**CERT C ID:** ARR33-C, ARR38-C, STR03-C, STR31-C, STR35-C
**ISO/IEC TS 17961 ID:** `taintformatio`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

#### Introduced in R2015b

# Call through non-prototyped function pointer

Function pointer declared without its type or number of parameters causes unexpected behavior

## Description

**Call through non-prototyped function pointer** detects a call to a function through a pointer without a prototype. A function prototype specifies the type and number of parameters.

### Risk

Arguments passed to a function without a prototype might not match the number and type of parameters of the function definition, which can cause undefined behavior. If the parameters are restricted to a subset of their type domain, arguments from untrusted sources can trigger vulnerabilities in the called function.

### Fix

Before calling the function through a pointer, provide a function prototype.

## Examples

### Argument Does Not Match Parameter Restriction

```
#include <stdio.h>
#include <limits.h>
#define SIZE2 2

typedef void (*func_ptr)();
extern int getchar_wrapper(void);
extern void restricted_int_sink(int i);
/* Integer value restricted to
range [-1, 255] */
extern void restricted_float_sink(double i);
```

```
/* Double value restricted to > 0.0 */



func_ptr generic_callback[SIZE2] =
{
    (func_ptr)restricted_int_sink,
    (func_ptr)restricted_float_sink
};

void func(void)
{
    int ic;
    ic = getchar_wrapper();
    /* Wrong index used for generic_callback.
    Negative 'int' passed to restricted_float_sink. */
    (*generic_callback[1])(ic);
}
```

In this example, a call through `func_ptr` passes `ic` as an argument to function `generic_callback[1]`. The type of `ic` can have negative values, while the parameter of `generic_callback[1]` is restricted to float values greater than `0.0`. Typically, compilers and static analysis tools cannot perform type checking when you do not provide a pointer prototype.

Pass the argument `ic` to a function with a parameter of type `int`, by using a properly prototyped pointer.

```
#include <stdio.h>
#include <limits.h>
#define SIZE2 2

typedef void (*func_ptr_proto)(int);
extern int getchar_wrapper(void);
extern void restricted_int_sink(int i);
/* Integer value restricted to
range [-1, 255] */
extern void restricted_float_sink(double i);
/* Double value restricted to > 0.0 */

func_ptr_proto generic_callback[SIZE2] =
{
    (func_ptr_proto)restricted_int_sink,
    (func_ptr_proto)restricted_float_sink
};

void func(void)
{
    int ic;
    ic = getchar_wrapper();
    /* ic passed to function through
properly prototyped pointer. */
    (*generic_callback[0])(ic);
}
```

## Result Information

**Group:** Programming
**Language:** C
**Default:** On
**Command-Line Syntax:** `UNPROTOTYPED_FUNC_CALL`
**Impact:** Medium
**ISO/IEC TS 17961 ID:** `taintnoproto`

## See Also

`Declaration mismatch` | `Unreliable cast of function pointer`

### Introduced in R2017b

# Call to memset with unintended value

`memset` or `wmemset` used with possibly incorrect arguments

## Description

**Call to memset with unintended value** occurs when Polyspace Bug Finder detects a use of the `memset` or `wmemset` function with possibly incorrect arguments.

`void *memset (void *ptr, int value, size_t num)` fills the first `num` bytes of the memory block that `ptr` points to with the specified `value`. If the argument `value` is incorrect, the memory block is initialized with an unintended value.

The unintended initialization can occur in the following cases.

| Issue | Risk | Possible Fix |
|---|---|---|
| The second argument is `'0'` instead of `0` or `'\0'`. | The ASCII value of character `'0'` is `48` (decimal), `0x30` (hexadecimal), `069` (octal) but not `0` (or `'\0'`) . | If you want to initialize with `'0'`, use one of the ASCII values. Otherwise, use `0` or `'\0'`. |
| The second and third arguments are probably reversed. For instance, the third argument is a literal and the second argument is not a literal. | If the order is reversed, a memory block of unintended size is initialized with incorrect arguments. | Reverse the order of the arguments. |

| Issue | Risk | Possible Fix |
|---|---|---|
| The second argument cannot be represented in a byte. | If the second argument cannot be represented in a byte, and you expect each byte of a memory block to be filled with that argument, the initialization does not occur as intended. | Apply a bit mask to the argument to produce a wrapped or truncated result that can be represented in a byte. When you apply a bit mask, make sure that it produces an expected result.<br>For instance, replace `memset(a, -13, sizeof(a))` with `memset(a, (-13) & 0xFF, sizeof(a))`. |

# Examples

## Value Cannot Be Represented in a Byte

```
#include <string.h>

#define SIZE 32
void func(void) {
    char buf[SIZE];
    int c = -2;
    memset(buf, (char)c, sizeof(buf));
}
```

In this example, `(char)c` cannot be represented in a byte.

One possible correction is to apply a cast so that the result can be represented in a byte. However, check that the result of the cast is an acceptable initialization value.

```
#include <string.h>

#define SIZE 32
void func(void) {
    char buf[SIZE   ];
    int c = -2;
    memset(buf, (unsigned char)c, sizeof(buf));
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `MEMSET_INVALID_VALUE`
**Impact:** Low
**CWE ID:** 665
**CERT C ID:** INT31-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Use of memset with size argument zero`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2015b**

# Character value absorbed into EOF

Data type conversion makes a valid character value same as End-of-File (EOF)

## Description

**Character value absorbed into EOF** occurs when you perform a data type conversion that makes a valid character value indistinguishable from `EOF` (End-of-File). Bug Finder flags the defect in one of the following situations:

- *End-of-File*: You perform a data type conversion such as from `int` to `char` that converts a non-EOF character value into `EOF`.

  ```
  char ch = (char)getchar()
  ```

  You then compare the result with EOF.

  ```
  if((int)ch == EOF)
  ```

  The conversion can be explicit or implicit.
- *Wide End-of-File*: You perform a data type conversion that can convert a non-WEOF wide character value into WEOF, and then compare the result with WEOF.

### Risk

The data type `char` cannot hold the value `EOF` that indicates the end of a file. Functions such as `getchar` have return type `int` to accommodate `EOF`. If you convert from `int` to `char`, the values `UCHAR_MAX` (a valid character value) and `EOF` get converted to the same value -1 and become indistinguishable from each other. When you compare the result of this conversion with `EOF`, the comparison can lead to false detection of `EOF`. This rationale also applies to wide character values and `WEOF`.

### Fix

Perform the comparison with `EOF` or `WEOF` before conversion.

# Examples

## Return Value of getchar Converted to char

```
#include <stdio.h>
#include <stdlib.h>
#define fatal_error() abort()

char func(void)
{
    char ch;
    ch = getchar();
    if (EOF == (int)ch) {
        fatal_error();
    }
    return ch;
}
```

In this example, the return value of `getchar` is implicitly converted to `char`. If `getchar` returns `UCHAR_MAX`, it is converted to -1, which is indistinguishable from EOF. When you compare with EOF later, it can lead to a false positive.

One possible correction is to first perform the comparison with EOF, and then convert from `int` to `char`.

```
#include <stdio.h>
#include <stdlib.h>
#define fatal_error() abort()

char func(void)
{
    int i;
    i = getchar();
    if (EOF == i) {
        fatal_error();
    }
    else {
        return (char)i;
    }
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `CHAR_EOF_CONFUSED`
**Impact:** High
**CWE ID:** 704
**CERT C ID:** FIO34-C
**ISO/IEC TS 17961 ID:** `chreof`

## See Also

### Polyspace Results

`Errno not checked` | `Invalid use of standard library integer routine` | `Misuse of sign-extended character value` | `Returned value of a sensitive function not checked`

### Introduced in R2017a

# Closing a previously closed resource

Function closes a previously closed stream

## Description

**Closing a previously closed resource** occurs when a function attempts to close a stream that was closed earlier in your code and not reopened later.

### Risk

The standard states that the value of a `FILE*` pointer is indeterminate after you close the stream associated with it. Performing the close operation on the `FILE*` pointer again can cause unwanted behavior.

### Fix

Remove the redundant close operation.

## Examples

### Closing Previously Closed Resource

```
#include <stdio.h>

void func(char* data) {
    FILE* fp = fopen("file.txt", "w");
    if(fp!=NULL) {
        if(data)
            fputc(*data,fp);
        else
            fclose(fp);
    }
    fclose(fp);
}
```

In this example, if fp is not NULL and data is NULL, the fclose operation occurs on fp twice in succession.

One possible correction is to remove the last fclose operation. To avoid a resource leak, you must also place an fclose operation in the if(data) block.

```
#include <stdio.h>

void func(char* data) {
    FILE* fp = fopen("file.txt", "w");
    if(fp!=NULL) {
        if(data) {
            fputc(*data,fp);
            fclose(fp);
        }
        else
            fclose(fp);
    }
}
```

## Result Information

**Group:** Resource management
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** DOUBLE_RESOURCE_CLOSE
**Impact:** High
**CWE ID:** 672
**CERT C ID:** FIO46-C

## See Also

Find defects (-checkers)

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Code deactivated by constant false condition

Code segment deactivated by `#if 0` directive or `if(0)` condition

## Description

**Code deactivated by constant false condition** occurs when a block of code is deactivated using a `#if 0` directive or `if(0)` condition.

## Examples

### Code Deactivated by Constant False Condition Error

```
#include<stdio.h>
int Trim_Value(int* Arr,int Size,int Cutoff)
{
    int Count=0;

    for(int i=0;i < Size;i++){
        if(Arr[i]>Cutoff){
            Arr[i]=Cutoff;
            Count++;
        }
    }

    #if 0
    /* Defect: Code Segment Deactivated */

    if(Count==0){
        printf("Values less than cutoff.");
    }
     #endif

    return Count;
}
```

In the preceding code, the `printf` statement is placed within a `#if #endif` directive. The software treats the portion within the directive as code comments and not compiled.

Unless you intended to deactivate the `printf` statement, one possible correction is to reactivate the block of code in the `#if #endif` directive. To reactivate the block, change `#if 0` to `#if 1`.

```
#include<stdio.h>
int Trim_Value(int* Arr,int Size,int Cutoff)
{
 int Count=0;

 for(int i=0;i < Size;i++)
     {
      if(Arr[i]>Cutoff)
             {
              Arr[i]=Cutoff;
              Count++;
             }
     }


 /* Fix: Replace #if 0 by #if 1 */
 #if 1
      if(Count==0)
            {
             printf("Values less than cutoff.");
            }
 #endif

 return Count;
}
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** off
**Command-Line Syntax:** `DEACTIVATED_CODE`
**Impact:** Low

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Dead code` | `Unreachable code` | `Useless if`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Command executed from externally controlled path

Path argument from an unsecure source

## Description

**Command executed from externally controlled path** checks the path of commands that the application controls. If the path of a command is from or constructed from external sources, Bug Finder flags the command function.

### Risk

An attacker can:

- Change the command that the program executes, possibly to a command that only the attack can control.
- Change the environment in which the command executes, by which the attacker controls what the command means and does.

### Fix

Before calling the command, validate the path to make sure that it is the intended location.

## Examples

### Executing Path from Environment Variable

```
#include <stdlib.h>
#include <stdio.h>
#include <string.h>

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

void bug_taintedpathcmd() {
    char cmd[SIZE128] = "";
    char* userpath = getenv("MYAPP_PATH");

    strncpy(cmd, userpath, SIZE100);
    strcat(cmd, "/ls *");
    /* Launching command */
    system(cmd);
}
```

This example obtains a path from an environment variable `MYAPP_PATH`. `system` runs a command from that path without checking the value of the path. If the path is not the intended path, your program executes in the wrong location.

One possible correction is to use a list of allowed paths to match against the environment variable path.

```
#include <stdlib.h>
#include <stdio.h>
#include <string.h>

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

/* Function to sanitize a string */
int sanitize_str(char* s, size_t n) {
    int res = 0;
    /* String is ok if */
    if (s && n>0 && n<SIZE128) {
        /* - string is not null                     */
        /* - string has a positive and limited size */
        s[n-1] = '\0';  /* Add a security \0 char at end of string */
        /* Tainted pointer detected above, used as "firewall" */
        res = 1;
    }
    return res;
}
```

```
/* Authorized path ids */
enum { PATH0=1, PATH1, PATH2 };

void taintedpathcmd() {
    char cmd[SIZE128] = "";

    char* userpathid = getenv("MYAPP_PATH_ID");
    if (sanitize_str(userpathid, SIZE100)) {
        int pathid = atoi(userpathid);


        char path[SIZE128] = "";
        switch(pathid) {
            case PATH0:
                strcpy(path, "/usr/local/my_app0");
                break;
            case PATH1:
                strcpy(path, "/usr/local/my_app1");
                break;
            case PATH2:
                strcpy(path, "/usr/local/my_app2");
                break;
            default:
                /* do nothing */
        break;
        }
        if (strlen(path)>0) {
            strncpy(cmd, path, SIZE100);
            strcat(cmd, "/ls *");
            system(cmd);
        }
    }
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_PATH_CMD`
**Impact:** Medium
**CWE ID:** 114, 426

**CERT C ID:** API00-C, ENV33-C, STR02-C
**ISO/IEC TS 17961 ID:** `syscall`

## See Also

`Execution of externally controlled command` | `Use of externally controlled environment variable` | `Host change using externally controlled elements` | `Library loaded from externally controlled path`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

#### Introduced in R2015b

# Constant block cipher initialization vector

Initialization vector is constant instead of randomized

## Description

**Constant block cipher initialization vector** occurs when you use a constant for the initialization vector (IV) during encryption.

### Risk

Using a constant IV is equivalent to not using an IV. Your encrypted data is vulnerable to dictionary attacks.

Block ciphers break your data into blocks of fixed size. Block cipher modes such as CBC (Cipher Block Chaining) protect against dictionary attacks by XOR-ing each block with the encrypted output from the previous block. To protect the first block, these modes use a random initialization vector (IV). If you use a constant IV to encrypt multiple data streams that have a common beginning, your data becomes vulnerable to dictionary attacks.

### Fix

Produce a random IV by using a strong random number generator.

For a list of random number generators that are cryptographically weak, see `Vulnerable pseudo-random number generator`.

## Examples

### Constants Used for Initialization Vector

```
#include <openssl/evp.h>
```

```
#include <stdlib.h>
#define SIZE16 16

/* Using the cryptographic routines */

int func(EVP_CIPHER_CTX *ctx, unsigned char *key){
    unsigned char iv[SIZE16] = {'1', '2', '3', '4','5','6','b','8','9',
                                 '1','2','3','4','5','6','7'};
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

In this example, the initialization vector `iv` has constants only. The constant initialization vector makes your cipher vulnerable to dictionary attacks.

One possible correction is to use a strong random number generator to produce the initialization vector. The corrected code here uses the function `RAND_bytes` declared in `openssl/rand.h`.

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define SIZE16 16

/* Using the cryptographic routines */

int func(EVP_CIPHER_CTX *ctx, unsigned char *key){
    unsigned char iv[SIZE16];
    RAND_bytes(iv, 16);
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_CONSTANT_IV`
**Impact:** Medium
**CWE ID:** 310, 326, 329

**CERT C ID:** MSC18-C

Introduced in R2017a

# Constant cipher key

Encryption or decryption key is constant instead of randomized

## Description

**Constant cipher key** occurs when you use a constant for the encryption or decryption key.

### Risk

If you use a constant for the encryption or decryption key, an attacker can retrieve your key easily.

You use a key to encrypt and later decrypt your data. If a key is easily retrieved, data encrypted using that key is not secure.

### Fix

Produce a random key by using a strong random number generator.

For a list of random number generators that are cryptographically weak, see `Vulnerable pseudo-random number generator`.

## Examples

### Constants Used for Key

```
#include <openssl/evp.h>
#include <stdlib.h>
#define SIZE16 16

int func(EVP_CIPHER_CTX *ctx, unsigned char *iv){
    unsigned char key[SIZE16] = {'1', '2', '3', '4','5','6','b','8','9',
                                 '1','2','3','4','5','6','7'};
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

In this example, the cipher key, `key`, has constants only. An attacker can easily retrieve a constant key.

Use a strong random number generator to produce the cipher key. The corrected code here uses the function `RAND_bytes` declared in `openssl/rand.h`.

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define SIZE16 16

int func(EVP_CIPHER_CTX *ctx, unsigned char *iv){
    unsigned char key[SIZE16];
    RAND_bytes(key, 16);
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_CONSTANT_KEY`
**Impact:** Medium
**CWE ID:** 310, 320, 321, 326
**CERT C ID:** MSC18-C

Introduced in R2017a

# Copy constructor not called in initialization list

Copy constructor does not call copy constructors of some members or base classes

## Description

**Copy constructor not called in initialization list** occurs when the copy constructor of a class does not call the *copy constructor* of the following in its initialization list:

- One or more of its members.
- Its base classes when applicable.

  The defect occurs even when a base class constructor is called instead of the base class copy constructor.

### Risk

The calls to the copy constructors can be done only from the initialization list. If the calls are missing, it is possible that an object is only partially copied.

- If the copy constructor of a member is not called, it is possible that the member is not copied.
- If the copy constructor of a base class is not called, it is possible that the base class members are not copied.

### Fix

If you want your copy constructor to perform a complete copy, call the copy constructor of all members and all base classes in its initialization list.

## Examples

### Base Class Copy Constructor Not Called

```
class Base {
public:
    Base();
    Base(int);
    Base(const Base&);
    virtual ~Base();
private:
    int ib;
};

class Derived:public Base {
public:
    Derived();
    ~Derived();
    Derived(const Derived& d): Base(), i(d.i) { }
private:
    int i;
};
```

In this example, the copy constructor of class `Derived` calls the default constructor, but not the copy constructor of class `Base`.

The defect appears on the **:** symbol in the copy constructor definition. Following are some tips for navigating in the source code:

- To navigate to the class definition, right-click a member that is initialized in the constructor. Select **Go To Definition**. In the class definition, you see the class members, including those members whose copy constructors are not called.
- To navigate to a base class definition, first navigate to the derived class definition. In the derived class definition, where the derived class inherits from a base class, right-click the base class name and select **Go To Definition**.

One possible correction is to call the copy constructor of class `Base` from the initialization list of the `Derived` class copy constructor.

```
class Base {
public:
    Base();
    Base(int);
    Base(const Base&);
    virtual ~Base();
private:
    int ib;
};
```

```
class Derived:public Base {
public:
    Derived();
    ~Derived();
    Derived(const Derived& d): Base(d), i(d.i) { }
private:
    int i;
};
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** On
**Command-Line Syntax:** `MISSING_COPY_CTOR_CALL`
**Impact:** High

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Base class assignment operator not called`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2015b

# Copy of overlapping memory

Source and destination arguments of a copy function have overlapping memory

## Description

**Copy of overlapping memory** occurs when there is a memory overlap between the source and destination argument of a copy function such as `memcpy` or `strcpy`. For instance, the source and destination arguments of `strcpy` are pointers to different elements in the same string.

### Risk

If there is memory overlap between the source and destination arguments of copy functions, according to C standards, the behavior is undefined.

### Fix

Determine if the memory overlap is what you want. If so, find an alternative function. For instance:

- If you are using `memcpy` to copy values from one memory location to another, use `memmove` instead of `memcpy`.
- If you are using `strcpy` to copy one string to another, use `memmove` instead of `strcpy`, as follows:

  ```
  s = strlen(source);
  memmove(destination, source, s + 1);
  ```

  `strlen` determines the string length without the null terminator. Therefore, you must move `s+1` bytes instead of `s` bytes.

# Examples

## Overlapping Copy

```
#include <string.h>

char str[] = {"ABCDEFGH"};

void my_copy() {
    strcpy(&str[0],(const char*)&str[2]);
}
```

In this example, because the source and destination argument are pointers to the same string `str`, there is memory overlap between their allowed buffers.

# Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `OVERLAPPING_COPY`
**Impact:** Medium
**CWE ID:** 475, 628, 687
**CERT C ID:** EXP43-C, MSC15-C
**ISO/IEC TS 17961 ID:** `restrict`

# See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Overlapping assignment`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Data race

Multiple tasks perform unprotected non-atomic operations on shared variable

## Description

Data race occurs when:

1. Multiple tasks perform unprotected operations on a shared variable.
2. At least one task performs a read operation and another task performs a write operation.
3. At least one operation is non-atomic. For data race on both atomic and non-atomic operations, see `Data race including atomic operations`.

A non-atomic operation can translate into more than one machine instruction. For instance:

- The operation can involve both a read and write operation. For example, `var++` involves reading the value of `var`, increasing the value by one and writing the increased value back to `var`.
- The operation can involve a 64-bit variable on a 32-bit target. For example, the operation

  ```
  long long var1, var2;
  var1=var2;
  ```

  involves two steps in copying the content of `var2` to `var1` on certain targets.

  Polyspace uses the **Pointer** size for your **Target processor type** as the threshold to compute atomicity. For instance, if you use `i386` as your **Target processor type**, the **Pointer** size is 32 bits, and **Long long** and **Double** sizes are both 64 bits. Therefore, Polyspace considers copying one `long long` or `double` variable to another as non-atomic.
- The operation can involve writing the return value of a function call to a shared variable. For example, the operation `x=func()` involves calling `func` and writing the return value of `func` to `x`.

To find this defect, you must specify the multitasking options before analysis. To specify these options, on the **Configuration** pane, select **Multitasking**. For more information, see “Set Up Multitasking Analysis Manually”.

## Risk

Data race can result in unpredictable values of the shared variable because you do not control the order of the operations in different tasks.

## Fix

To fix this defect, protect the operations on the shared variable using critical sections or temporal exclusion. See `Critical section details (-critical-section-begin -critical-section-end)` and `Temporally exclusive tasks (-temporal-exclusions-file)`.

To identify existing protections that you can reuse, see the table and graphs associated with the result. The table shows each pair of conflicting calls. The **Access Protections** column shows existing protections on the calls. To see the function call sequence leading to the conflicts, click the icon. For an example, see below.

# Examples

## Unprotected Operation on Global Variable from Multiple Tasks

```
int var;
void begin_critical_section(void);
void end_critical_section(void);

void increment(void) {
    var++;
}

void task1(void)  {
      increment();
}

void task2(void)  {
      increment();
}

void task3(void)  {
     begin_critical_section();
     increment();
     end_critical_section();
}
```

In this example, to emulate multitasking behavior, specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | task1<br>task2<br>task3 | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | begin_critical_section | end_critical_section |

On the command-line, you can use the following:

```
 polyspace-bug-finder-nodesktop
   -entry-points task1,task2,task3
   -critical-section-begin begin_critical_section:cs1
   -critical-section-end end_critical_section:cs1
```

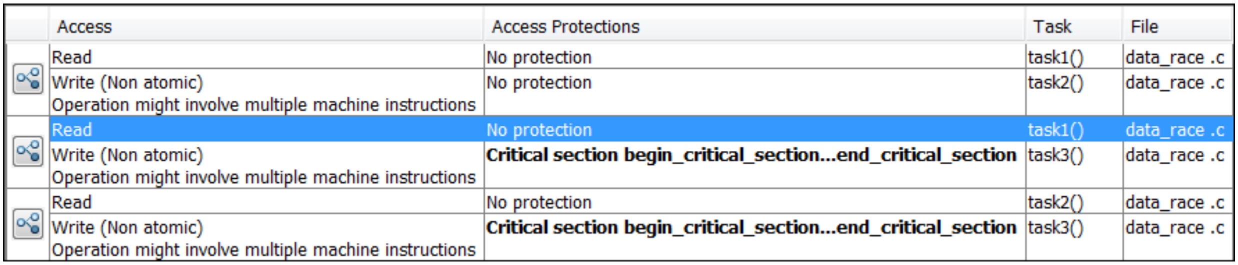
In this example, the tasks `task1`, `task2`, and `task3` call the function `increment`. `increment` contains the operation `var++` that can involve multiple machine instructions including:

- Reading `var`.
- Writing an increased value to `var`.

These machine instructions, when executed from `task1` and `task2`, can occur concurrently in an unpredictable sequence. For example, reading `var` from `task1` can occur either before or after writing to `var` from `task2`. Therefore the value of `var` can be unpredictable.

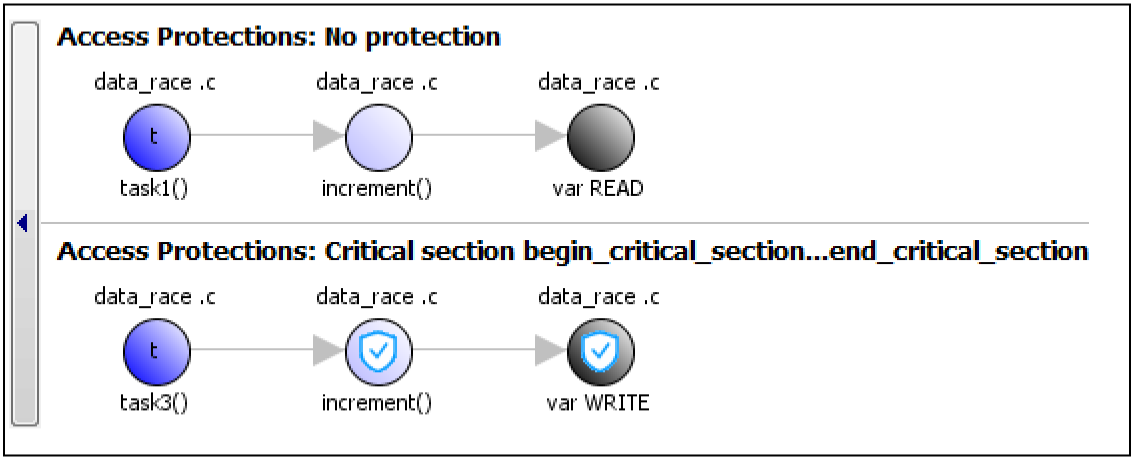
Though task3 calls increment inside a critical section, other tasks do not use the same critical section. The operations in the critical section of task3 are not mutually exclusive with operations in other tasks.

Therefore, the three tasks are operating on a shared variable without common protection. In your result details, you see each pair of conflicting function calls.



| | Access | Access Protections | Task | File |
|---|---|---|---|---|
| | Read | No protection | task1() | data_race .c |
| | Write (Non atomic)<br>Operation might involve multiple machine instructions | No protection | task2() | data_race .c |
| | Read | No protection | task1() | data_race .c |
| | Write (Non atomic)<br>Operation might involve multiple machine instructions | **Critical section begin_critical_section...end_critical_section** | task3() | data_race .c |
| | Read | No protection | task2() | data_race .c |
| | Write (Non atomic)<br>Operation might involve multiple machine instructions | **Critical section begin_critical_section...end_critical_section** | task3() | data_race .c |

If you click the icon, you see the function call sequence starting from the entry point to the read or write operation. You also see that the operation starting from task3 is in a critical section. The **Access Protections** entry shows the lock and unlock function that begin and end the critical section. In this example, you see the functions begin_critical_section and end_critical_section.



**Access Protections: No protection**

**Access Protections: Critical section begin_critical_section...end_critical_section**

One possible correction is to place the operation in critical section. You can implement the critical section in multiple ways. For instance:

- You can place var++ in a critical section. When task1 enters its critical section, the other tasks cannot enter their critical sections until task1 leaves its critical section. The operation var++ from the three tasks cannot interfere with each other.

  To implement the critical section, in the function increment, place the operation var++ between calls to begin_critical_section and end_critical_section.

  ```
  int var;

  void begin_critical_section(void);
  void end_critical_section(void);

  void increment(void) {
        begin_critical_section();
        var++;
        end_critical_section();
  }

  void task1(void)  {
        increment();
  }

  void task2(void)  {
        increment();
  }

  void task3(void)  {
        increment();
  }
  ```
- You can place the call to increment in the same critical section in the three tasks. When task1 enters its critical section, the other tasks cannot enter their critical sections until task1 leaves its critical section. The calls to increment from the three tasks cannot interfere with each other.

  To implement the critical section, in each of the three tasks, call increment between calls to begin_critical_section and end_critical_section.

```
int var;

void begin_critical_section(void);
void end_critical_section(void);

void increment(void) {
      var++;
}

void task1(void)  {
     begin_critical_section();
     increment();
     end_critical_section();
}

void task2(void)  {
     begin_critical_section();
     increment();
     end_critical_section();
}

void task3(void)  {
     begin_critical_section();
     increment();
     end_critical_section();
}
```

Another possible correction is to make the tasks, `task1`, `task2` and `task3`, temporally exclusive. Temporally exclusive tasks cannot execute concurrently.

On the **Configuration** pane, specify the following additional options:

| Option | Value |
|---|---|
| **Temporally exclusive tasks** on page 1-127 | `task1 task2 task3` |

On the command-line, you can use the following:

```
 polyspace-code-prover-nodesktop
     -temporal-exclusions-file "C:\exclusions_file.txt"
```

where the file `C:\exclusions_file.txt` has the following line:

```
task1 task2 task3
```

## Check Information

**Group:** Concurrency
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DATA_RACE`
**Impact:** High
**CWE ID:** 366
**CERT C ID:** CON00-C, CON09-C, CON32-C, CON43-C, POS49-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Target processor type (-target)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)` | `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`

### Polyspace Results

`Data race including atomic operations` | `Data race through standard library function call` | `Deadlock` | `Destruction of locked mutex` | `Double lock` | `Double unlock` | `Missing lock` | `Missing unlock`

### Topics

"Set Up Multitasking Analysis Manually"

Introduced in R2014b

# Data race including atomic operations

Multiple tasks perform unprotected operations on shared variable

## Description

Data race occurs when:

1. Multiple tasks perform unprotected operations on a shared variable.
2. At least one task performs a read operation and another task performs a write operation.

If you check for this defect, you can see data races on both atomic and non-atomic operations. To see data races on non-atomic operations alone, select `Data race`.

To find this defect, you must specify the multitasking options before analysis. To specify these options, on the **Configuration** pane, select **Multitasking**.

## Examples

### Unprotected Atomic Operation on Global Variable from Multiple Tasks

```
#include<stdio.h>

int var;

void begin_critical_section(void);
void end_critical_section(void);

void task1(void) {
    var = 1;
}

void task2(void) {
    int local_var;
    local_var = var;
    printf("%d", local_var);
}

void task3(void) {
    begin_critical_section();
    /* Operations in task3 */
    end_critical_section();
}
```

In this example, to emulate multitasking behavior, specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | `task1`<br>`task2`<br>`task3` | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | `begin_critical_section` | `end_critical_section` |

On the command-line, you can use the following:

```
 polyspace-bug-finder-nodesktop
   -entry-points task1,task2,task3
   -critical-section-begin begin_critical_section:cs1
   -critical-section-end end_critical_section:cs1
```

In this example, the write operation `var=1;` in task `task1` executes concurrently with the read operation `local_var=var;` in task `task2`.

`task3` uses a critical section that can be reused for the other tasks.

One possible correction is to place these operations in the same critical section:

- `var=1;` in `task1`
- `local_var=var;` in `task2`

When task1 enters its critical section, the other tasks cannot enter their critical sections until task1 leaves its critical section. Therefore, the two operations cannot execute concurrently.

To implement the critical section, reuse the already existing critical section in task3. Place the two operations between calls to begin_critical_section and end_critical_section.

```
#include<stdio.h>

int var;

void begin_critical_section();
void end_critical_section();

void task1(void) {
    begin_critical_section();
    var = 1;
    end_critical_section();
}

void task2(void) {
    int local_var;
    begin_critical_section();
    local_var = var;
    end_critical_section();
    printf("%d", local_var);
}

void task3(void) {
    begin_critical_section();
    /* Operations in task3 */
    end_critical_section();
}
```

Another possible correction is to make the tasks task1 and task2 temporally exclusive. Temporally exclusive tasks cannot execute concurrently.

On the **Configuration** pane, specify the following additional options:

| Option | Value |
|---|---|
| **Temporally exclusive tasks** on page 1-127 | `task1 task2` |

On the command-line, use the following:

```
 polyspace-code-prover-nodesktop
     -temporal-exclusions-file "C:\exclusions_file.txt"
```

where the file `C:\exclusions_file.txt` has the following line:

```
task1 task2
```

## Check Information

**Group:** Concurrency
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `DATA_RACE_ALL`
**Impact:** Medium
**CWE ID:** 366
**CERT C ID:** CON00-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)` | `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`

### Polyspace Results

`Data race` | `Data race through standard library function call` | `Deadlock` | `Destruction of locked mutex` | `Double lock` | `Double unlock` | `Missing lock` | `Missing unlock`

### Topics

“Set Up Multitasking Analysis Manually”

Introduced in R2014b

# Data race through standard library function call

Multiple tasks make unprotected calls to thread-unsafe standard library function

## Description

**Data race through standard library function call** occurs when:

1. Multiple tasks call the same standard library function.

   For instance, multiple tasks call the `strerror` function.
2. The calls are not protected using a common protection.

   For instance, the calls are not protected by the same critical section.

Functions flagged by this defect are not guaranteed to be reentrant. A function is reentrant if it can be interrupted and safely called again before its previous invocation completes execution. If a function is not reentrant, multiple tasks calling the function without protection can cause concurrency issues. For the list of functions that are flagged, see CON33-C: Avoid race conditions when using library functions.

To find this defect, you must specify the multitasking options before analysis. To specify these options, on the **Configuration** pane, select **Multitasking**. For more information, see “Set Up Multitasking Analysis Manually”.

### Risk

The functions flagged by this defect are nonreentrant because their implementations can use global or static variables. When multiple tasks call the function without protection, the function call from one task can interfere with the call from another task. The two invocations of the function can concurrently access the global or static variables and cause unpredictable results.

The calls can also cause more serious security vulnerabilities, such as abnormal termination, denial-of-service attack, and data integrity violations.

## Fix

To fix this defect, do one of the following:

- Use a reentrant version of the standard library function if it exists.

  For instance, instead of `strerror()`, use `strerror_r()` or `strerror_s()`. For alternatives to functions flagged by this defect, see the documentation for CON33-C.
- Protect the function calls using common critical sections or temporal exclusion.

  See `Critical section details (-critical-section-begin -critical-section-end)` and `Temporally exclusive tasks (-temporal-exclusions-file)`.

  To identify existing protections that you can reuse, see the table and graphs associated with the result. The table shows each pair of conflicting calls. The **Access Protections** column shows existing protections on the calls. To see the function call sequence leading to the conflicts, click the icon. For an example, see below.

# Examples

## Unprotected Call to Standard Library Function from Multiple Tasks

```
#include <errno.h>
#include <stdio.h>
#include <string.h>

void begin_critical_section(void);
void end_critical_section(void);

FILE *getFilePointer(void);

void func(FILE *fp) {
  fpos_t pos;
  errno = 0;
  if (0 != fgetpos(fp, &pos)) {
    char *errmsg = strerror(errno);
    printf("Could not get the file position: %s\n", errmsg);
  }
}

void task1(void) {
    FILE* fptr1 = getFilePointer();
    func(fptr1);
}

void task2(void) {
     FILE* fptr2 = getFilePointer();
     func(fptr2);
}

void task3(void) {
     FILE* fptr3 = getFilePointer();
     begin_critical_section();
     func(fptr3);
     end_critical_section();
}
```

In this example, to emulate multitasking behavior, specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | task1<br>task2<br>task3 | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | begin_critical_section | end_critical_section |

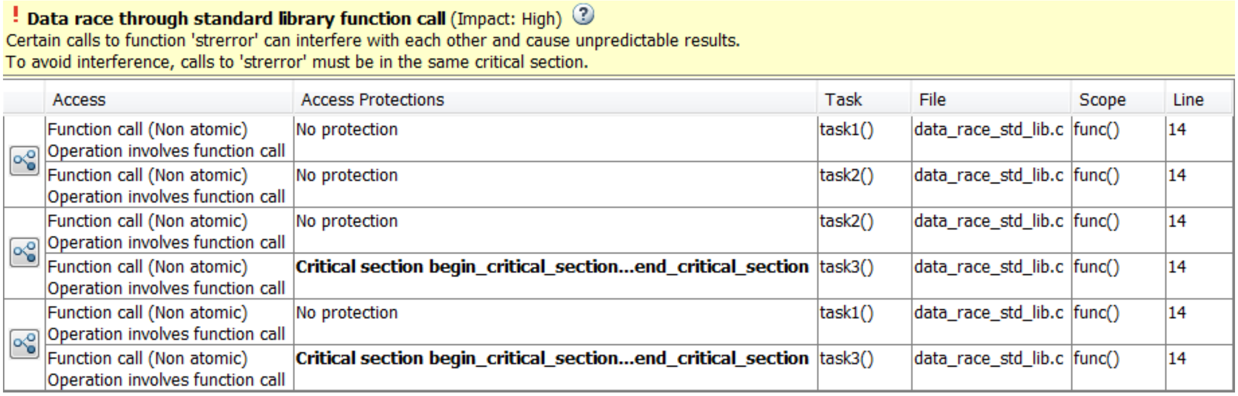
On the command-line, you can use the following:

```
 polyspace-bug-finder-nodesktop
   -entry-points task1,task2,task3
   -critical-section-begin begin_critical_section:cs1
   -critical-section-end end_critical_section:cs1
```

In this example, the tasks, `task1`, `task2` and `task3`, call the function `func`. `func` calls the nonreentrant standard library function, `strerror`.

Though task3 calls func inside a critical section, other tasks do not use the same critical section. Operations in the critical section of task3 are not mutually exclusive with operations in other tasks.

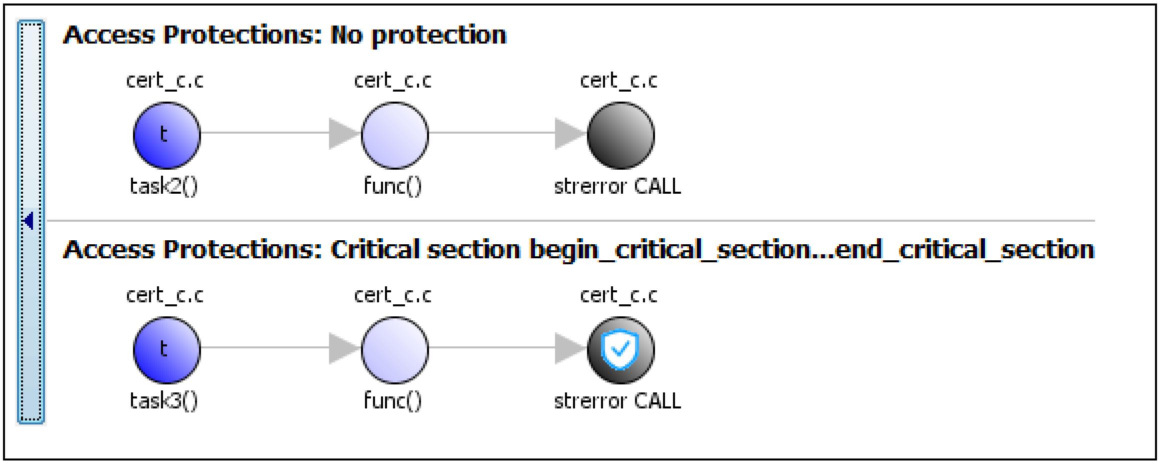
These three tasks are calling a nonreentrant standard library function without common protection. In your result details, you see each pair of conflicting function calls.



! **Data race through standard library function call** (Impact: High) ?
Certain calls to function 'strerror' can interfere with each other and cause unpredictable results.
To avoid interference, calls to 'strerror' must be in the same critical section.

| | Access | Access Protections | Task | File | Scope | Line |
|---|---|---|---|---|---|---|
| | Function call (Non atomic)<br>Operation involves function call | No protection | task1() | data_race_std_lib.c | func() | 14 |
| | Function call (Non atomic)<br>Operation involves function call | No protection | task2() | data_race_std_lib.c | func() | 14 |
| | Function call (Non atomic)<br>Operation involves function call | No protection | task2() | data_race_std_lib.c | func() | 14 |
| | Function call (Non atomic)<br>Operation involves function call | **Critical section begin_critical_section...end_critical_section** | task3() | data_race_std_lib.c | func() | 14 |
| | Function call (Non atomic)<br>Operation involves function call | No protection | task1() | data_race_std_lib.c | func() | 14 |
| | Function call (Non atomic)<br>Operation involves function call | **Critical section begin_critical_section...end_critical_section** | task3() | data_race_std_lib.c | func() | 14 |

If you click the icon, you see the function call sequence starting from the entry point to the standard library function call. You also see that the call starting from task3 is in a critical section. The **Access Protections** entry shows the lock and unlock function that begin and end the critical section. In this example, you see the functions begin_critical_section and end_critical_section.



**Access Protections: No protection**

**Access Protections: Critical section begin_critical_section...end_critical_section**

One possible correction is to use a reentrant version of the standard library function `strerror`. You can use the POSIX version `strerror_r` which has the same functionality but also guarantees thread-safety.

```
#include <errno.h>
#include <stdio.h>
#include <string.h>

void begin_critical_section(void);
void end_critical_section(void);

FILE *getFilePointer(void);
enum { BUFFERSIZE = 64 };

void func(FILE *fp) {
  fpos_t pos;
  errno = 0;
  if (0 != fgetpos(fp, &pos)) {
    char errmsg[BUFFERSIZE];
    if (strerror_r(errno, errmsg, BUFFERSIZE) != 0) {
      /* Handle error */
    }
    printf("Could not get the file position: %s\n", errmsg);
  }
}

void task1(void) {
    FILE* fptr1 = getFilePointer();
    func(fptr1);
}

void task2(void) {
     FILE* fptr2 = getFilePointer();
     func(fptr2);
}

void task3(void) {
     FILE* fptr3 = getFilePointer();
     begin_critical_section();
     func(fptr3);
     end_critical_section();
}
```

One possible correction is to place the call to strerror in critical section. You can implement the critical section in multiple ways.

For instance, you can place the call to the intermediate function func in the same critical section in the three tasks. When task1 enters its critical section, the other tasks cannot enter their critical sections until task1 leaves its critical section. The calls to func and therefore the calls to strerror from the three tasks cannot interfere with each other.

To implement the critical section, in each of the three tasks, call func between calls to begin_critical_section and end_critical_section.

```
#include <errno.h>
#include <stdio.h>
#include <string.h>

void begin_critical_section(void);
void end_critical_section(void);

FILE *getFilePointer(void);

void func(FILE *fp) {
  fpos_t pos;
  errno = 0;
  if (0 != fgetpos(fp, &pos)) {
    char *errmsg = strerror(errno);
    printf("Could not get the file position: %s\n", errmsg);
  }
}

void task1(void) {
    FILE* fptr1 = getFilePointer();
    begin_critical_section();
    func(fptr1);
    end_critical_section();
}

void task2(void) {
     FILE* fptr2 = getFilePointer();
     begin_critical_section();
     func(fptr2);
     end_critical_section();
}
```

```
void task3(void) {
     FILE* fptr3 = getFilePointer();
     begin_critical_section();
     func(fptr3);
     end_critical_section();
}
```

Another possible correction is to make the tasks, `task1`, `task2` and `task3`, temporally exclusive. Temporally exclusive tasks cannot execute concurrently.

On the **Configuration** pane, specify the following additional options:

| Option | Value |
|---|---|
| **Temporally exclusive tasks** on page 1-127 | `task1 task2 task3` |

On the command-line, you can use the following:

```
 polyspace-code-prover-nodesktop
     -temporal-exclusions-file "C:\exclusions_file.txt"
```

where the file `C:\exclusions_file.txt` has the following line:

```
task1 task2 task3
```

## Result Information

**Group:** Concurrency
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DATA_RACE_STD_LIB`
**Impact:** High
**CWE ID:** 366
**CERT C ID:** CON33-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-`

begin -critical-section-end) | Temporally exclusive tasks (-temporal-exclusions-file)

### Polyspace Results

Data race including atomic operations | Data race | Destruction of locked mutex | Double lock | Double unlock | Missing lock | Missing unlock

## Topics

"Set Up Multitasking Analysis Manually"

### Introduced in R2016b

# Deadlock

Call sequence to lock functions cause two tasks to block each other

## Description

**Deadlock** occurs when multiple tasks are stuck in their critical sections (CS) because:

- Each CS waits for another CS to end.
- The critical sections (CS) form a closed cycle. For example:
  - CS #1 waits for CS #2 to end, and CS #2 waits for CS #1 to end.
  - CS #1 waits for CS #2 to end, CS #2 waits for CS #3 to end and CS #3 waits for CS #1 to end.

Polyspace expects critical sections of code to follow a specific format. A critical section lies between a call to a lock function and a call to an unlock function. When a task `my_task` calls a lock function `my_lock`, other tasks calling `my_lock` must wait until `my_task` calls the corresponding unlock function. Both lock and unlock functions must have the form `void func(void)`.

To find this defect, you must specify the multitasking options before analysis. To specify these options, on the **Configuration** pane, select **Multitasking**.

## Examples

### Deadlock with Two Tasks

```
void task1(void);
void task2(void);

int var;
void perform_task_cycle(void) {
 var++;
}

void begin_critical_section_1(void);
void end_critical_section_1(void);

void begin_critical_section_2(void);
void end_critical_section_2(void);

void task1() {
 while(1) {
    begin_critical_section_1();
    begin_critical_section_2();
    perform_task_cycle();
    end_critical_section_2();
    end_critical_section_1();
 }
}

void task2() {
 while(1) {
    begin_critical_section_2();
    begin_critical_section_1();
    perform_task_cycle();
    end_critical_section_1();
    end_critical_section_2();
 }
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** | ☑ | |
| **Entry points** | task1<br>task2 | |
| **Critical section details** | **Starting routine** | **Ending routine** |
| | begin_critical_section_1 | end_critical_section_1 |
| | begin_critical_section_2 | end_critical_section_2 |

A **Deadlock** occurs because the instructions can execute in the following sequence:

1. task1 calls begin_critical_section_1.
2. task2 calls begin_critical_section_2.
3. task1 reaches the instruction begin_critical_section_2();. Since task2 has already called begin_critical_section_2, task1 waits for task2 to call end_critical_section_2.
4. task2 reaches the instruction begin_critical_section_1();. Since task1 has already called begin_critical_section_1, task2 waits for task1 to call end_critical_section_1.

One possible correction is to follow the same sequence of calls to lock and unlock functions in both task1 and task2.

```
void task1(void);
void task2(void);
void perform_task_cycle(void);

void begin_critical_section_1(void);
void end_critical_section_1(void);

void begin_critical_section_2(void);
void end_critical_section_2(void);

void task1() {
 while(1) {
    begin_critical_section_1();
    begin_critical_section_2();
    perform_task_cycle();
    end_critical_section_2();
    end_critical_section_1();
 }
}

void task2() {
 while(1) {
    begin_critical_section_1();
    begin_critical_section_2();
    perform_task_cycle();
    end_critical_section_2();
    end_critical_section_1();
 }
}
```

## Deadlock with More Than Two Tasks

```
int var;
void performTaskCycle() {
 var++;
}

void lock1(void);
void lock2(void);
void lock3(void);


void unlock1(void);
void unlock2(void);
void unlock3(void);

void task1() {
 while(1) {
    lock1();
    lock2();
    performTaskCycle();
    unlock2();
    unlock1();
 }
}

void task2() {
 while(1) {
    lock2();
    lock3();
    performTaskCycle();
    unlock3();
    unlock2();
 }
}
```

```
void task3() {
 while(1) {
    lock3();
    lock1();
    performTaskCycle();
    unlock1();
    unlock3();
 }
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** | ☑ | |
| **Entry points** | `task1`<br>`task2`<br>`task3` | |
| **Critical section details** | **Starting routine** | **Ending routine** |
| | `lock1` | `unlock1` |
| | `lock2` | `unlock2` |
| | `lock3` | `unlock3` |

A **Deadlock** occurs because the instructions can execute in the following sequence:

1 `task1` calls `lock1`.

2 `task2` calls `lock2`.

3 `task3` calls `lock3`.

4 `task1` reaches the instruction `lock2();`. Since `task2` has already called `lock2`, `task1` waits for call to `unlock2`.

5 `task2` reaches the instruction `lock3();`. Since `task3` has already called `lock3`, `task2` waits for call to `unlock3`.

6 `task3` reaches the instruction `lock1();`. Since `task1` has already called `lock1`, `task3` waits for call to `unlock1`.

To break the cyclic order between critical sections, note every lock function in your code in a certain sequence, for example:

1. `lock1`
2. `lock2`
3. `lock3`

If you use more than one lock function in a task, use them in the order in which they appear in the sequence. For example, you can use `lock1` followed by `lock2` but not `lock2` followed by `lock1`.

```
int var;
void performTaskCycle() {
 var++;
}

void lock1(void);
void lock2(void);
void lock3(void);

void unlock1(void);
void unlock2(void);
void unlock3(void);

void task1() {
 while(1) {
    lock1();
    lock2();
    performTaskCycle();
    unlock2();
    unlock1();
 }
}

void task2() {
 while(1) {
    lock2();
    lock3();
    performTaskCycle();
    unlock3();
    unlock2();
 }
}

void task3() {
 while(1) {
    lock1();
    lock3();
    performTaskCycle();
    unlock3();
    unlock1();
 }
}
```

## Check Information

**Group:** Concurrency
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DEADLOCK`
**Impact:** High
**CWE ID:** 833
**CERT C ID:** CON35-C, POS51-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Polyspace Results

`Data race including atomic operations` | `Data race` | `Data race through standard library function call` | `Destruction of locked mutex` | `Double lock` | `Double unlock` | `Missing lock` | `Missing unlock`

## Topics

"Set Up Multitasking Analysis Manually"

Introduced in R2014b

# Dead code

Code does not execute

## Description

**Dead code** occurs when a block of code cannot be reached via any execution path. This defect excludes:

- `Code deactivated by constant false condition`, which checks for directives such as `#if 0`.
- `Unreachable code`, which checks for code after a control escape such as `goto`, `break`, or `return`.
- `Useless if`, which checks for if statements that are always true.

## Examples

### Dead Code from `if`-Statement

```
#include <stdio.h>

int Return_From_Table(int ch){

    int table[5];

    /* Create a table */
    for(int i=0;i<=4;i++){
        table[i]=i^2+i+1;
    }

    if(table[ch]>100){ /* Defect: Condition always false */
         return 0;
    }
    return table[ch];
}
```

The maximum value in the array table is 4^2+4+1=21, so the test expression table[ch]>100 always evaluates to false. The return 0 in the if statement is not executed.

One possible correction is to remove the if condition from the code.

```
#include <stdio.h>

int Return_From_Table(int ch){

    int table[5];

    /* Create a table */
    for(int i=0;i<=4;i++){
        table[i]=i^2+i+1;
    }

    return table[ch];
}
```

## Dead Code for if with Enumerated Type

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void do_something(suit s);

void bridge(void)
{
    suit card = nextcard();
    if ((card < SPADES) || (card > CLUBS))
        card = UNKNOWN_SUIT;

    if (card > 7) {
        do_something(card);
    }
}
```

The type suit is enumerated with five options. However, the conditional expression card > 7 always evaluates to false because card can be at most 5. The content in the if statement is not executed.

One possible correction is to change the if-condition in the code. In this correction, the 7 is changed to `HEART` to relate directly to the type of `card`.

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void do_something(suit s);

void bridge(void)
{
    suit card = nextcard();
    if ((card < SPADES) || (card > CLUBS))
        card = UNKNOWN_SUIT;

    if (card > HEARTS) {
        do_something(card);
    }
}
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DEAD_CODE`
**Impact:** Low
**CWE ID:** 561
**CERT C ID:** MSC01-C, MSC07-C, MSC12-C
**ISO/IEC TS 17961 ID:** `swtchdflt`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Code deactivated by constant false condition` | `Unreachable code` | `Useless if`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Deallocation of previously deallocated pointer

Memory freed more than once without allocation

## Description

**Deallocation of previously deallocated pointer** occurs when a block of memory is freed more than once using the `free` function without an intermediate allocation.

## Examples

### Deallocation of Previously Deallocated Pointer Error

```
#include <stdlib.h>

void allocate_and_free(void)
{

    int* pi = (int*)malloc(sizeof(int));
    if (pi == NULL) return;

    *pi = 2;
    free(pi);
    free (pi);
    /* Defect: pi has already been freed */
}
```

The first `free` statement releases the block of memory that `pi` refers to. The second `free` statement on `pi` releases a block of memory that has been freed already.

One possible correction is to remove the second `free` statement.

```
#include <stdlib.h>

void allocate_and_free(void)
{
    int* pi = (int*)malloc(sizeof(int));
    if (pi == NULL) return;

    *pi = 2;
    free(pi);
    /* Fix: remove second deallocation */
}
```

## Check Information

**Group:** Dynamic memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DOUBLE_DEALLOCATION`
**Impact:** High
**CWE ID:** 415
**CERT C ID:** MEM00-C, MEM30-C
**ISO/IEC TS 17961 ID:** `accfree`, `dblfree`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Use of previously freed pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

#### Introduced in R2013b

# Declaration mismatch

Mismatch between function or variable declarations

## Description

**Declaration mismatch** occurs when a function or variable declaration does not match other instances of the function or variable.

## Examples

### Inconsistent Declarations in Two Files

*file1.c*

```
int foo(void) {
    return 1;
}
```

*file2.c*

```
double foo(void);

int bar(void) {
    return (int)foo();
}
```

In this example, *file1.c* declares `foo()` as returning an integer. In *file2.c*, `foo()` is declared as returning a double. This difference raises a defect on the second instance of `foo` in *file2*.

One possible correction is to change the function declarations so that they match. In this example, by changing the declaration of `foo` in *file2.c* to match *file1.c*, the defect is fixed.

*file1.c*

```
int foo(void) {
    return 1;
}
```

*file2.c*

```
int foo(void);

int bar(void) {
    return foo();
}
```

## Inconsistent Structure Alignment

*test1.c*

```
#include "square.h"
#include "circle.h"
struct aCircle circle;
struct aSquare square;

int main(){
    square.side=1;
    circle.radius=1;
    return 0;
}
```

*test2.c*

```
#include "circle.h"
#include "square.h"
struct aCircle circle;
struct aSquare square;

int main(){
    square.side=1;
    circle.radius=1;
    return 0;
}
```

*circle.h*

```
#pragma pack(1)

extern struct aCircle{
    int radius;
} circle;
```

*square.h*

```
extern struct aSquare {
    unsigned int side:1;
} square;
```

In this example, a declaration mismatch defect is raised on `square` in *square.h* because Polyspace infers that *square.h* does not have the same alignment as `square` in *test2.c*. This error occurs because the `#pragma pack(1)` statement in *circle.h* declares specific alignment. In *test2.c*, *circle.h* is included before *square.h*. Therefore, the `#pragma pack(1)` statement from *circle.h* is not reset to the default alignment after the `aCircle` structure. Because of this omission, *test2.c* infers that the `aSquare square` structure also has an alignment of `1` byte.

One possible correction is to reset the structure alignment after the `aCircle` struct declaration. For the GNU or Microsoft Visual compilers, fix the defect by adding a `#pragma pack()` statement at the end of *circle.h*.

*test1.c*

```
#include "square.h"
#include "circle.h"
struct aCircle circle;
struct aSquare square;

int main(){
    square.side=1;
    circle.radius=1;
    return 0;
}
```

*test2.c*

```
#include "circle.h"
#include "square.h"
struct aCircle circle;
struct aSquare square;

int main(){
    square.side=1;
    circle.radius=1;
    return 0;
}
```

*circle.h*

```
#pragma pack(1)

extern struct aCircle{
    int radius;
} circle;

#pragma pack()
```

*square.h*

```
extern struct aSquare {
    unsigned int side:1;
} square;
```

Other compilers require different `#pragma pack` syntax. For your syntax, see the documentation for your compiler.

One possible correction is to add the `Ignore pragma pack directives` option to your Bug Finder analysis. If you want the structure alignment to change for each structure, and you do not want to see this **Declaration mismatch** defect, use this correction.

1 On the Configuration pane, select the **Advanced Settings** pane.

2 In the **Other** box, enter `-ignore-pragma-pack`.

3 Rerun your analysis.

   The **Declaration mismatch** defect is resolved.

## Check Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DECL_MISMATCH`
**Impact:** High
**CWE ID:** 685, 686
**CERT C ID:** ARR31-C, DCL40-C, EXP37-C, MSC15-C
**ISO/IEC TS 17961 ID:** `argcomp`, `funcdecl`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Ignore pragma pack directives (-ignore-pragma-pack)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2013b**

# Delete of void pointer

`delete` operates on a `void*` pointer pointing to an object

## Description

**Delete of void pointer** occurs when the `delete` operator operates on a `void*` pointer.

### Risk

Deleting a `void*` pointer is undefined according to the C++ Standard.

If the object is of type `MyClass` and the `delete` operator operates on a `void*` pointer pointing to the object, the `MyClass` destructor is not called.

If the destructor contains cleanup operations such as release of resources or decreasing a counter value, the operations do not take place.

### Fix

Cast the `void*` pointer to the appropriate type. Perform the `delete` operation on the result of the cast.

For instance, if the `void*` pointer points to a `MyClass` object, cast the pointer to `MyClass*`.

## Examples

### Delete of `void*` Pointer

```
#include <iostream>

class MyClass {
public:
    explicit MyClass(int i):m_i(i) {}
    ~MyClass() {
        std::cout << "Delete MyClass(" << m_i << ")" << std::endl;
    }
private:
    int m_i;
};

void my_delete(void* ptr) {
    delete ptr;
}


int main() {
    MyClass* pt = new MyClass(0);
    my_delete(pt);
    return 0;
}
```

In this example, the function `my_delete` is designed to perform the `delete` operation on any type. However, in the function body, the `delete` operation acts on a `void*` pointer, `ptr`. Therefore, when you call `my_delete` with an argument of type `MyClass`, the `MyClass` destructor is not called.

One possible solution is to use a function template instead of a function for `my_delete`.

```
#include <iostream>

class MyClass {
public:
    explicit MyClass(int i):m_i(i) {}
    ~MyClass() {
        std::cout << "Delete MyClass(" << m_i << ")" << std::endl;
    }
private:
    int m_i;
};


template<typename T> void safe_delete(T*& ptr) {
    delete ptr;
    ptr = NULL;
}
```

```
int main() {
    MyClass* pt = new MyClass(0);
    safe_delete(pt);
    return 0;
}
```

## Result Information

**Group:** Good practice
**Language:** C++
**Default:** Off
**Command-Line Syntax:** `DELETE_OF_VOID_PTR`
**Impact:** Low

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Destination buffer overflow in string manipulation

Function writes to buffer at offset greater than buffer size

## Description

**Destination buffer overflow in string manipulation** occurs when certain string manipulation functions write to their destination buffer argument at an offset greater than the buffer size.

For instance, when calling the function `sprintf(char* buffer, const char* format)`, you use a constant string `format` of greater size than `buffer`.

### Risk

Buffer overflow can cause unexpected behavior such as memory corruption or stopping your system. Buffer overflow also introduces the risk of code injection.

### Fix

One possible solution is to use alternative functions to constrain the number of characters written. For instance:

- If you use `sprintf` to write formatted data to a string, use `snprintf`, `_snprintf` or `sprintf_s` instead to enforce length control. Alternatively, use `asprintf` to automatically allocate the memory required for the destination buffer.
- If you use `vsprintf` to write formatted data from a variable argument list to a string, use `vsnprintf` or `vsprintf_s` instead to enforce length control.
- If you use `wcscpy` to copy a wide string, use `wcsncpy`, `wcslcpy`, or `wcscpy_s` instead to enforce length control.

Another possible solution is to increase the buffer size.

# Examples

## Buffer Overflow in **sprintf** Use

```
#include <stdio.h>

void func(void) {
    char buffer[20];
    char *fmt_string = "This is a very long string, it does not fit in the buffer";

    sprintf(buffer, fmt_string);
}
```

In this example, `buffer` can contain 20 `char` elements but `fmt_string` has a greater size.

One possible correction is to use the `snprintf` function to enforce length control.

```
#include <stdio.h>

void func(void) {
    char buffer[20];
    char *fmt_string = "This is a very long string, it does not fit in the buffer";

    snprintf(buffer, 20, fmt_string);
}
```

# Result Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `STRLIB_BUFFER_OVERFLOW`
**Impact:** High
**CWE ID:** 121, 125, 251, 787
**CERT C ID:** ARR33-C, ARR38-C, ENV01-C, STR07-C, STR08-C, STR31-C, STR38-C
**ISO/IEC TS 17961 ID:** `libptr`, `taintformatio`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Destination buffer underflow in string manipulation`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2015b**

# Destination buffer underflow in string manipulation

Function writes to buffer at a negative offset from beginning of buffer

## Description

**Destination buffer underflow in string manipulation** occurs when certain string manipulation functions write to their destination buffer argument at a negative offset from the beginning of the buffer.

For instance, for the function `sprintf(char* buffer, const char* format)`, you obtain the `buffer` from an operation `buffer = (char*)arr; ... buffer += offset;`. `arr` is an array and `offset` is a negative value.

### Risk

Buffer underflow can cause unexpected behavior such as memory corruption or stopping your system. Buffer underflow also introduces the risk of code injection.

### Fix

If the destination buffer argument results from pointer arithmetic, see if you are decrementing a pointer. Fix the pointer decrement by modifying either the original value before decrement or the decrement value.

## Examples

### Buffer Underflow in `sprintf` Use

```
#include <stdio.h>
#define offset -2

void func(void) {
    char buffer[20];
    char *fmt_string ="Text";
    sprintf(&buffer[offset], fmt_string);
}
```

In this example, `&buffer[offset]` is at a negative offset from the memory allocated to `buffer`.

One possible correction is to change the value of `offset`.

```
#include <stdio.h>
#define offset 2

void func(void) {
    char buffer[20];
    char *fmt_string ="Text";

    sprintf(&buffer[offset], fmt_string);
}
```

## Result Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `STRLIB_BUFFER_UNDERFLOW`
**Impact:** High
**CWE ID:** 124, 786, 787
**CERT C ID:** ARR38-C, STR35-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Destination buffer overflow in string manipulation`

### Topics

"Navigate to Root Cause of Defect"

“Review and Fix Results”

Introduced in R2015b

# Destruction of locked mutex

Task tries to destroy a mutex in the locked state

## Description

**Destruction of locked mutex** occurs when a task destroys a mutex after it is locked (and before it is unlocked). The locking and destruction can happen in the same task or different tasks.

### Risk

A mutex is locked to protect shared variables from concurrent access. If a mutex is destroyed in the locked state, the protection does not apply.

### Fix

To fix this defect, destroy the mutex only after you unlock it. It is a good design practice to:

- Initialize a mutex *before* creating the threads where you use the mutex.
- Destroy a mutex *after* joining the threads that you created.

On the **Result Details** pane, you see two events, the locking and destruction of the mutex, and the tasks that initiated the events. To navigate to the corresponding line in your source code, click the event.

## Examples

### Locking and Destruction in Different Tasks

```
#include <pthread.h>
```

```
pthread_mutex_t lock1;
pthread_mutex_t lock2;
pthread_mutex_t lock3;

void t0 (void) {
  pthread_mutex_lock (&lock1);
  pthread_mutex_lock (&lock2);
  pthread_mutex_lock (&lock3);
  pthread_mutex_unlock (&lock2);
  pthread_mutex_unlock (&lock1);
  pthread_mutex_unlock (&lock3);
}

void t1 (void) {
  pthread_mutex_lock (&lock1);
  pthread_mutex_lock (&lock2);
  pthread_mutex_destroy (&lock3);
  pthread_mutex_unlock (&lock2);
  pthread_mutex_unlock (&lock1);
}
```

In this example, after task `t0` locks the mutex `lock3`, task `t1` can destroy it. The destruction occurs if the following events happen in sequence:

1. `t0` acquires `lock3`.
2. `t0` releases `lock2`.
3. `t0` releases `lock1`.
4. `t1` acquires the lock `lock1` released by `t0`.
5. `t1` acquires the lock `lock2` released by `t0`.
6. `t1` destroys `lock3`.

For simplicity, this example uses a mix of automatic and manual concurrency detection. The tasks `t0` and `t1` are manually specified as entry points by using the option `Entry points (-entry-points)`. The critical sections are implemented through primitives `pthread_mutex_lock` and `pthread_mutex_unlock` that the software detects automatically. In practice, for entry point specification (thread creation), you will use primitives such as `pthread_create`. The next example shows how the defect can appear when you use `pthread_create`.

The locking and destruction of `lock3` occurs inside the critical section imposed by `lock1` and `lock2`, but the unlocking occurs outside. One possible correction is to place the lock-unlock pair in the same critical section as the destruction of the mutex. Use one of these critical sections:

- Critical section imposed by `lock1` alone.
- Critical section imposed by `lock1` and `lock2`.

In this corrected code, the lock-unlock pair and the destruction is placed in the critical section imposed by `lock1` and `lock2`. When `t0` acquires `lock1` and `lock2`, `t1` has to wait for their release before it executes the instruction `pthread_mutex_destroy (&lock3);`. Therefore, `t1` cannot destroy mutex `lock3` in the locked state.

```
#include <pthread.h>

pthread_mutex_t lock1;
pthread_mutex_t lock2;
pthread_mutex_t lock3;

void t0 (void) {
  pthread_mutex_lock (&lock1);
  pthread_mutex_lock (&lock2);

  pthread_mutex_lock (&lock3);
  pthread_mutex_unlock (&lock3);

  pthread_mutex_unlock (&lock2);
  pthread_mutex_unlock (&lock1);
}

void t1 (void) {
  pthread_mutex_lock (&lock1);
  pthread_mutex_lock (&lock2);

  pthread_mutex_destroy (&lock3);

  pthread_mutex_unlock (&lock2);
  pthread_mutex_unlock (&lock1);
}
```

## Locking and Destruction in Start Routine of Thread

```
#include <pthread.h>

/* Define globally accessible variables and a mutex */
#define NUMTHREADS 4
pthread_t callThd[NUMTHREADS];
pthread_mutex_t lock;
void atomic_operation(void);

void *do_create(void *arg) {
    /* Creation thread */
    pthread_mutex_init(&lock, NULL);
    pthread_exit((void*) 0);
}

void *do_work(void *arg) {
    /* Worker thread */
    pthread_mutex_lock (&lock);
    atomic_operation();
    pthread_mutex_unlock (&lock);
    pthread_exit((void*) 0);
}

void *do_destroy(void *arg) {
    /* Destruction thread */
    pthread_mutex_destroy(&lock);
    pthread_exit((void*) 0);
}

int main (int argc, char *argv[]) {
   int i;
   void *status;
   pthread_attr_t attr;


   /* Create threads */
   pthread_attr_init(&attr);
   pthread_attr_setdetachstate(&attr, PTHREAD_CREATE_JOINABLE);

   /* Thread that initializes mutex */
   pthread_create(&callThd[0], &attr, do_create, NULL);

   /* Threads that use mutex for atomic operation*/
   for(i=0; i<NUMTHREADS-1; i++) {
      pthread_create(&callThd[i], &attr, do_work, (void *)i);
   }

   /* Thread that destroys mutex */
   pthread_create(&callThd[NUMTHREADS -1], &attr, do_destroy, NULL);

   pthread_attr_destroy(&attr);

   /* Join threads */
   for(i=0; i<NUMTHREADS; i++) {
      pthread_join(callThd[i], &status);
   }

   pthread_exit(NULL);
}
```

In this example, four threads are created. The threads are assigned different actions.

- The first thread `callThd[0]` initializes the mutex `lock`.
- The second and third threads, `callThd[1]` and `callThd[2]`, perform an atomic operation protected by the mutex `lock`.
- The fourth thread `callThd[3]` destroys the mutex `lock`.

The threads can interrupt each other. Therefore, immediately after the second or third thread locks the mutex, the fourth thread can destroy it.

One possible correction is to initialize and destroy the mutex in the `main` function outside the start routine of the threads. The threads perform only the atomic operation. You need two fewer threads because the mutex initialization and destruction threads are not required.

```
#include <pthread.h>

/* Define globally accessible variables and a mutex */
#define NUMTHREADS 2
pthread_t callThd[NUMTHREADS];
pthread_mutex_t lock;
void atomic_operation(void);

void *do_work(void *arg) {
   pthread_mutex_lock (&lock);
   atomic_operation();
   pthread_mutex_unlock (&lock);
   pthread_exit((void*) 0);
}

int main (int argc, char *argv[]) {
   int i;
   void *status;
   pthread_attr_t attr;


   /* Create threads */
   pthread_attr_init(&attr);
   pthread_attr_setdetachstate(&attr, PTHREAD_CREATE_JOINABLE);

   /* Initialize mutex */
   pthread_mutex_init(&lock, NULL);

   for(i=0; i<NUMTHREADS; i++) {
      pthread_create(&callThd[i], &attr, do_work, (void *)i);
   }

   pthread_attr_destroy(&attr);

   /* Join threads */
   for(i=0; i<NUMTHREADS; i++) {
      pthread_join(callThd[i], &status);
   }

   /* Destroy mutex */
   pthread_mutex_destroy(&lock);

   pthread_exit(NULL);
}
```

Another possible correction is to use a second mutex and protect the lock-unlock pair from the destruction. This corrected code uses the mutex `lock2` to achieve this protection. The second mutex is initialized in the `main` function outside the start routine of the threads.

```
#include <pthread.h>

/* Define globally accessible variables and a mutex */
```

```
#define NUMTHREADS 4
pthread_t callThd[NUMTHREADS];
pthread_mutex_t lock;
pthread_mutex_t lock2;
void atomic_operation(void);

void *do_create(void *arg) {
    /* Creation thread */
    pthread_mutex_init(&lock, NULL);
    pthread_exit((void*) 0);
}

void *do_work(void *arg) {
    /* Worker thread */
    pthread_mutex_lock (&lock2);
    pthread_mutex_lock (&lock);
    atomic_operation();
    pthread_mutex_unlock (&lock);
    pthread_mutex_unlock (&lock2);
    pthread_exit((void*) 0);
}

void *do_destroy(void *arg) {
    /* Destruction thread */
    pthread_mutex_lock (&lock2);
    pthread_mutex_destroy(&lock);
    pthread_mutex_unlock (&lock2);
    pthread_exit((void*) 0);
}


int main (int argc, char *argv[]) {
   int i;
   void *status;
   pthread_attr_t attr;


   /* Create threads */
   pthread_attr_init(&attr);
   pthread_attr_setdetachstate(&attr, PTHREAD_CREATE_JOINABLE);

   /* Initialize second mutex */
   pthread_mutex_init(&lock2, NULL);
   /* Thread that initializes first mutex */
   pthread_create(&callThd[0], &attr, do_create, NULL);

   /* Threads that use first mutex for atomic operation */
   /* The threads use second mutex to protect first from destruction in locked state*/
   for(i=0; i<NUMTHREADS-1; i++) {
      pthread_create(&callThd[i], &attr, do_work, (void *)i);
   }

   /* Thread that destroys first mutex */
   /* The thread uses the second mutex to prevent destruction of locked mutex */
   pthread_create(&callThd[NUMTHREADS -1], &attr, do_destroy, NULL);


   pthread_attr_destroy(&attr);

   /* Join threads */
   for(i=0; i<NUMTHREADS; i++) {
      pthread_join(callThd[i], &status);
   }

   /* Destroy second mutex */
   pthread_mutex_destroy(&lock2);

   pthread_exit(NULL);
}
```

## Result Information

**Group:** Concurrency
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `DESTROY_LOCKED`
**Impact:** Medium
**CWE ID:** 667, 826
**CERT C ID:** CON31-C, POS48-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Target processor type (-target)` | `Configure multitasking manually` | `Entry points (-entry-points)`

### Polyspace Results

`Data race including atomic operations` | `Data race` | `Data race through standard library function call` | `Deadlock` | `Double lock` | `Double unlock` | `Missing lock` | `Missing unlock`

## Topics

"Set Up Multitasking Analysis Manually"

**Introduced in R2016b**

# Deterministic random output from constant seed

Seeding routine uses a constant seed making the output deterministic

## Description

**Deterministic random output from constant seed** detects random standard functions that when given a constant seed, have deterministic output.

### Risk

When some random functions, such as `srand`, `srandom`, and `initstate`, have constant seeds, the results produce the same output every time that your program is run. A hacker can disrupt your program if they know how your program behaves.

### Fix

Use a different random standard function or use a nonconstant seed.

Some standard random routines are inherently cryptographically weak on page 3-630, and should not be used for security purposes.

## Examples

### Random Number Generator Initialization

```
#include <stdlib.h>

void random_num(void)
{
    srand(12345U);
    /* ... */
}
```

This example initializes a random number generator using srand with a constant seed. The random number generation is deterministic, making this function cryptographically weak.

One possible correction is to use a random number generator that does not require a seed. This example uses rand_s.

```
#define _CRT_RAND_S
#include <stdlib.h>
#include <stdio.h>

unsigned int random_num_time(void)
{

    unsigned int number;
    errno_t err;
    err = rand_s(&number);

    if(err != 0)
    {
        return number;
    }
    else
    {
        return err;
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** RAND_SEED_CONSTANT
**Impact:** Medium
**CWE ID:** 330, 336
**CERT C ID:** MSC32-C

## See Also

`Predictable random output from predictable seed` | `Unsafe standard encryption function` | `Vulnerable pseudo-random number generator`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Double lock

Lock function is called twice in a task without an intermediate call to unlock function

## Description

**Double lock** occurs when:

- A task calls a lock function `my_lock`.
- The task calls `my_lock` again before calling the corresponding unlock function.

In multitasking code, a lock function begins a critical section of code and an unlock function ends it. When a task `task1` calls a lock function `lock`, other tasks calling `lock` must wait until `task` calls the corresponding unlock function. Polyspace requires that both lock and unlock functions must have the form `void func(void)`.

To find this defect, you must specify the multitasking options before analysis. To specify these options, on the **Configuration** pane, select **Multitasking**.

## Examples

### Double Lock

```
int global_var;

void lock(void);
void unlock(void);

void task1(void)
{
    lock();
    global_var += 1;
    lock();
    global_var += 1;
    unlock();
}

void task2(void)
{
    lock();
    global_var += 1;
    unlock();
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

| Option | Value | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | task1<br>task2 | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | lock | unlock |

On the command-line, you can use the following:

```
 polyspace-bug-finder-nodesktop
   -entry-points task1,task2
   -critical-section-begin lock:cs1
   -critical-section-end unlock:cs1
```

task1 enters a critical section through the call lock();. task1 calls lock again before it leaves the critical section through the call unlock();.

If you want the first global_var+=1; to be outside the critical section, one possible correction is to remove the first call to lock. However, if other tasks are using global_var, this code can produce a Data race error.

```
int global_var;

void lock(void);
void unlock(void);

void task1(void)
{
    global_var += 1;
    lock();
    global_var += 1;
    unlock();
}

void task2(void)
{
    lock();
    global_var += 1;
    unlock();
}
```

If you want the first `global_var+=1;` to be inside the critical section, one possible correction is to remove the second call to `lock`.

```
int global_var;

void lock(void);
void unlock(void);

void task1(void)
{
    lock();
    global_var += 1;
    global_var += 1;
    unlock();
}

void task2(void)
{
    lock();
    global_var += 1;
    unlock();
}
```

If you want the second global_var+=1; to be inside a critical section, another possible correction is to add another call to unlock.

```
int global_var;

void lock(void);
void unlock(void);

void task1(void)
{
    lock();
    global_var += 1;
    unlock();
    lock();
    global_var += 1;
    unlock();
}

void task2(void)
{
    lock();
    global_var += 1;
    unlock();
}
```

## Double Lock with Function Call

```
int global_var;

void lock(void);
void unlock(void);

void performOperation(void) {
  lock();
  global_var++;
}
```

```
void task1(void)
{
    lock();
    global_var += 1;
    performOperation();
    unlock();
}

void task2(void)
{
    lock();
    global_var += 1;
    unlock();
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | `task1`<br>`task2` | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | `lock` | `unlock` |

On the command-line, you can use the following:

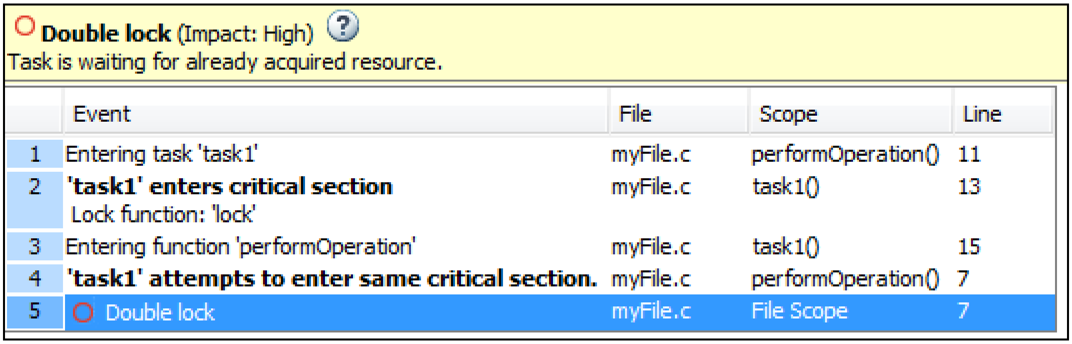
```
 polyspace-bug-finder-nodesktop
   -entry-points task1,task2
   -critical-section-begin lock:cs1
   -critical-section-end unlock:cs1
```

`task1` enters a critical section through the call `lock();`. `task1` calls the function `performOperation`. In `performOperation`, `lock` is called again even though `task1` has not left the critical section through the call `unlock();`.

In the result details for the defect, you see the sequence of instructions leading to the defect. For instance, you see that following the first entry into the critical section, the execution path:

- Enters function `performOperation`.

- Inside `performOperation`, attempts to enter the same critical section once again.



○ **Double lock** (Impact: High) ?
Task is waiting for already acquired resource.

| | Event | File | Scope | Line |
|---|---|---|---|---|
| 1 | Entering task 'task1' | myFile.c | performOperation() | 11 |
| 2 | **'task1' enters critical section**<br>Lock function: 'lock' | myFile.c | task1() | 13 |
| 3 | Entering function 'performOperation' | myFile.c | task1() | 15 |
| 4 | **'task1' attempts to enter same critical section.** | myFile.c | performOperation() | 7 |
| 5 | ○ Double lock | myFile.c | File Scope | 7 |

You can click each event to navigate to the corresponding line in the source code.

One possible correction is to remove the call to `lock` in `task1`.

```
int global_var;

void lock(void);
void unlock(void);

void performOperation(void) {
  global_var++;
}

void task1(void)
{
    lock();
    global_var += 1;
    performOperation();
    unlock();
}

void task2(void)
{
    lock();
    global_var += 1;
    unlock();
}
```

## Check Information

**Group:** Concurrency
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DOUBLE_LOCK`
**Impact:** High
**CWE ID:** 764
**CERT C ID:** CON01-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Polyspace Results

`Data race including atomic operations` | `Data race` | `Data race through standard library function call` | `Deadlock` | `Destruction of locked mutex` | `Double unlock` | `Missing lock` | `Missing unlock`

## Topics

"Set Up Multitasking Analysis Manually"

Introduced in R2014b

# Double unlock

Unlock function is called twice in a task without an intermediate call to lock function

## Description

**Double unlock** occurs when:

- A task calls a lock function `my_lock`.
- The task calls the corresponding unlock function `my_unlock`.
- The task calls `my_unlock` again. The task does not call `my_lock` a second time between the two calls to `my_unlock`.

In multitasking code, a lock function begins a critical section of code and an unlock function ends it. When a task `task1` calls a lock function `my_lock`, other tasks calling `my_lock` must wait until `task1` calls the corresponding unlock function. Polyspace requires that both lock and unlock functions must have the form `void func(void)`.

To find this defect, you must specify the multitasking options before analysis. To specify these options, on the **Configuration** pane, select **Multitasking**.

## Examples

### Double Unlock

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void task1(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}

void task2(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

| Option | Value | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | `task1`<br>`task2` | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | `BEGIN_CRITICAL_SECTION` | `END_CRITICAL_SECTION` |

On the command-line, you can use the following:

```
 polyspace-bug-finder-nodesktop
   -entry-points task1,task2
   -critical-section-begin BEGIN_CRITICAL_SECTION:cs1
   -critical-section-end END_CRITICAL_SECTION:cs1
```

`task1` enters a critical section through the call `BEGIN_CRITICAL_SECTION();`. `task1` leaves the critical section through the call `END_CRITICAL_SECTION();`. `task1` calls `END_CRITICAL_SECTION` again without an intermediate call to `BEGIN_CRITICAL_SECTION`.

If you want the second `global_var+=1;` to be outside the critical section, one possible correction is to remove the second call to `END_CRITICAL_SECTION`. However, if other tasks are using `global_var`, this code can produce a `Data race` error.

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void task1(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
    global_var += 1;
}

void task2(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

If you want the second `global_var+=1;` to be inside the critical section, one possible correction is to remove the first call to `END_CRITICAL_SECTION`.

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void task1(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    global_var += 1;
    END_CRITICAL_SECTION();
}

void task2(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

If you want the second `global_var+=1;` to be inside a critical section, another possible correction is to add another call to `BEGIN_CRITICAL_SECTION`.

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void task1(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}

void task2(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

## Check Information

**Group:** Concurrency
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DOUBLE_UNLOCK`
**Impact:** High
**CWE ID:** 765
**CERT C ID:** CON01-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Polyspace Results

`Data race including atomic operations` | `Data race` | `Data race through standard library function call` | `Deadlock` | `Destruction of locked mutex` | `Double lock` | `Missing lock` | `Missing unlock`

## Topics

"Set Up Multitasking Analysis Manually"

**Introduced in R2014b**

# Errno not checked

errno is not checked for error conditions following function call

## Description

**Errno not checked** occurs when you call a function that sets errno to indicate error conditions, but do not check errno after the call. For these functions, checking errno is the only reliable way to determine if an error occurred.

Functions that set errno on errors include:

- fgetwc, strtol, and wcstol.

  For a comprehensive list of functions, see documentation about errno.
- POSIX errno-setting functions such as encrypt and setkey.

### Risk

To see if the function call completed without errors, check errno for error values.

The return values of these errno-setting functions do not indicate errors. The return value can be one of the following:

- void
- Even if an error occurs, the return value can be the same as the value from a successful call. Such return values are called in-band error indicators.

You can determine if an error occurred only by checking errno.

For instance, strtol converts a string to a long integer and returns the integer. If the result of conversion overflows, the function returns LONG_MAX and sets errno to ERANGE. However, the function can also return LONG_MAX from a successful conversion. Only by checking errno can you distinguish between an error and a successful conversion.

## Fix

Before calling the function, set errno to zero.

After the function call, to see if an error occurred, compare errno to zero. Alternatively, compare errno to known error indicator values. For instance, strtol sets errno to ERANGE to indicate errors.

The error message in the Polyspace result shows the error indicator value that you can compare to.

# Examples

### errno Not Checked After Call to strtol

```
#include<stdio.h>
#include<stdlib.h>
#include<errno.h>

int main(int argc, char *argv[]) {
    char *str, *endptr;
    int base;

    str = argv[1];
    base = 10;

    long val = strtol(str, &endptr, base);
    printf("Return value of strtol() = %ld\n", val);
}
```

You are using the return value of strtol without checking errno.

Before calling strtol, set errno to zero . After a call to strtol, check the return value for LONG_MIN or LONG_MAX and errno for ERANGE.

```
#include<stdlib.h>
#include<stdio.h>
#include<errno.h>
#include<limits.h>
```

```
int main(int argc, char *argv[]) {
    char *str, *endptr;
    int base;

    str = argv[1];
    base = 10;

    errno = 0;
    long val = strtol(str, &endptr, base);
    if((val == LONG_MIN || val == LONG_MAX) && errno == ERANGE) {
         printf("strtol error");
         exit(EXIT_FAILURE);
    }
    printf("Return value of strtol() = %ld\n", val);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `ERRNO_NOT_CHECKED`
**Impact:** Medium
**CWE ID:** 391
**CERT C ID:** ERR33-C
**ISO/IEC TS 17961 ID:** `inverrno`

## See Also

### Polyspace Results

`Errno not reset` | `Misuse of errno` | `Returned value of a sensitive function not checked`

### Introduced in R2017a

# Errno not reset

errno not reset before calling a function that sets errno

## Description

**Errno not reset** occurs when you do not reset errno before calling a function that sets errno to indicate error conditions. However, you check errno for those error conditions after the function call.

### Risk

The errno is not clean and can contain values from a previous call. Checking errno for errors can give the false impression that an error occurred.

errno is set to zero at program startup but subsequently, errno is not reset by a C standard library function. You must explicitly set errno to zero when required.

### Fix

Before calling a function that sets errno to indicate error conditions, reset errno to zero explicitly.

## Examples

### errno Not Reset Before Call to strtod

```
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <float.h>

#define fatal_error() abort()

double func(const char *s1, const char *s2)
```

```
{
    double f1;
    f1 = strtod (s1, NULL);
    if (0 == errno) {
      double f2 = strtod (s2, NULL);
        if (0 == errno) {
            long double result = (long double)f1 + f2;
            if ((result <= (long double)DBL_MAX) && (result >= (long double)-DBL_MAX))
                  {
                return (double)result;
            }
        }
    }
    fatal_error();
    return 0.0;
}
```

In this example, `errno` is not reset to 0 before the first call to `strtod`. Checking `errno` for 0 later can lead to a false positive.

One possible correction is to reset `errno` to 0 before calling `strtod`.

```
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <float.h>

#define fatal_error() abort()

double func(const char *s1, const char *s2)
{
    double f1;
    errno = 0;
    f1 = strtod (s1, NULL);
    if (0 == errno) {
      double f2 = strtod (s2, NULL);
        if (0 == errno) {
            long double result = (long double)f1 + f2;
            if ((result <= (long double)DBL_MAX) && (result >= (long double)-DBL_MAX))
              {
                return (double)result;
            }
        }
    }
    fatal_error();
    return 0.0;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `MISSING_ERRNO_RESET`
**Impact:** High
**CWE ID:** 456, 703
**CERT C ID:** ERR30-C
**ISO/IEC TS 17961 ID:** `inverrno`

## See Also

### Polyspace Results

`Errno not reset` | `Errno not checked` | `Returned value of a sensitive function not checked`

### Introduced in R2017a

# Exception caught by value

catch statement accepts an object by value

## Description

**Exception caught by value** occurs when a catch statement accepts an object by value.

### Risk

If a throw statement passes an object and the corresponding catch statement accepts the exception by value, the object is copied to the catch statement parameter. This copy can lead to unexpected behavior such as:

- Object slicing, if the throw statement passes a derived class object.
- Undefined behavior of the exception, if the copy fails.

### Fix

Catch the exception by reference or by pointer. Catching an exception by reference is recommended.

## Examples

### Standard Exception Caught by Value

```
#include <exception>

extern void print_str(const char* p);
extern void throw_exception();

void func() {
    try {
        throw_exception();
    }
    catch(std::exception exc) {
        print_str(exc.what());
    }
}
```

In this example, the `catch` statement takes a `std::exception` object by value. Catching an exception by value causes copying of the object. It can cause undefined behavior of the exception if the copy fails.

One possible solution is to catch the exception by reference.

```
#include <exception>

extern void print_str(const char* p);
extern void throw_exception();

void corrected_excpcaughtbyvalue() {
    try {
        throw_exception();
    }
    catch(std::exception& exc) {
        print_str(exc.what());
    }
}
```

## Derived Class Exception Caught by Value

```
#include <exception>
#include <string>
#include <typeinfo>
#include <iostream>

// Class declarations
class BaseExc {
public:
    explicit BaseExc();
    virtual ~BaseExc() {};
protected:
    BaseExc(const std::string& type);
private:
    std::string _id;
};
```

```
class IOExc: public BaseExc {
public:
    explicit IOExc();
};

//Class method declarations
BaseExc::BaseExc():_id(typeid(this).name()) {
}
BaseExc::BaseExc(const std::string& type): _id(type) {
}
IOExc::IOExc(): BaseExc(typeid(this).name()) {
}

int input(void);

int main(void) {
    int rnd = input();
    try {
        if (rnd==0) {
            throw IOExc();
        } else {
            throw BaseExc();
        }
    }


    catch(BaseExc exc) {
        std::cout << "Intercept BaseExc" << std::endl;
    }
    return 0;
}
```

In this example, the `catch` statement takes a `BaseExc` object by value. Catching exceptions by value causes copying of the object. The copying can cause:

- Undefined behavior of the exception if it fails.
- Object slicing if an exception of the derived class `IOExc` is caught.

One possible correction is to catch exceptions by reference.

```
#include <exception>
#include <string>
```

```
#include <typeinfo>
#include <iostream>

// Class declarations
class BaseExc {
public:
    explicit BaseExc();
    virtual ~BaseExc() {};
protected:
    BaseExc(const std::string& type);
private:
    std::string _id;
};

class IOExc: public BaseExc {
public:
    explicit IOExc();
};

//Class method declarations
BaseExc::BaseExc():_id(typeid(this).name()) {
}
BaseExc::BaseExc(const std::string& type): _id(type) {
}
IOExc::IOExc(): BaseExc(typeid(this).name()) {
}

int input(void);

int main(void) {
    int rnd = input();
    try {
        if (rnd==0) {
            throw IOExc();
        } else {
            throw BaseExc();
        }
    }



    catch(BaseExc& exc) {
        std::cout << "Intercept BaseExc" << std::endl;
    }
    return 0;
}
```

## Result Information

**Group:** Programming
**Language:** C++
**Default:** On
**Command-Line Syntax:** `EXCP_CAUGHT_BY_VALUE`
**Impact:** Medium

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Exception handler hidden by previous handler

`catch` statement is not reached because of an earlier `catch` statement for the same exception

## Description

**Exception handler hidden by previous handler** occurs when a `catch` statement is not reached because a previous `catch` statement handles the exception.

For instance, a `catch` statement accepts an object of a class `my_exception` and a later `catch` statement accepts one of the following:

- An object of the `my_exception` class.
- An object of a class derived from the `my_exception` class.

### Risk

Because the `catch` statement is not reached, it is effectively dead code.

### Fix

One possible fix is to remove the redundant `catch` statement.

Another possible fix is to reverse the order of `catch` statements. Place the `catch` statement that accepts the derived class exception before the `catch` statement that accepts the base class exception.

## Examples

### `catch` Statement Hidden by Previous Statement

```
#include <new>
```

```
extern void print_str(const char* p);
extern void throw_exception();

void func() {
    try {
        throw_exception();
    }
    catch(std::exception& exc) {
        print_str(exc.what());
    }

    catch(std::bad_alloc& exc) {
        print_str(exc.what());
    }
}
```

In this example, the second `catch` statement accepts a `std::bad_alloc` object. Because the `std::bad_alloc` class is derived from a `std::exception` class, the second `catch` statement is hidden by the previous `catch` statement that accepts a `std::exception` object.

The defect appears on the parameter type of the `catch` statement. To find which `catch` statement hides the current `catch` statement:

1. On the **Source** pane, right-click the keyword `catch` and select **Search For** `"catch"`**in Current Source File**.
2. On the **Search** pane, click each search result, proceeding backwards from the current `catch` statement. Continue until you find the `catch` statement that hides the `catch` statement with the defect.

One possible correction is to place the `catch` statement with the derived class parameter first.

```
#include <new>

extern void print_str(const char* p);
extern void throw_exception();

void corrected_excphandlerhidden() {
    try {
        throw_exception();
    }
    catch(std::bad_alloc& exc) {
        print_str(exc.what());
    }
    catch(std::exception& exc) {
        print_str(exc.what());
    }
}
```

## Result Information

**Group:** Programming
**Language:** C++
**Default:** On
**Command-Line Syntax:** `EXCP_HANDLER_HIDDEN`
**Impact:** Medium
**CWE ID:** 755

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2015b**

# Execution of a binary from a relative path can be controlled by an external actor

Command with relative path is vulnerable to malicious attack

## Description

**Execution of a binary from a relative path can be controlled by an external actor** detects calls to an external command. If the call uses a relative path or no path to call the external command, Bug Finder flags the call as a defect.

This defect also finds results that the **Execution of externally controlled command** defect checker finds.

### Risk

By using a relative path or no path to call an external command, your program uses an unsafe search process to find the command. An attacker can control the search process and replace the intended command with a command of their own.

### Fix

When you call an external command, specify the full path.

## Examples

### Call Command with Relative Path

```
# define _GNU_SOURCE
# include <sys/types.h>
# include <sys/socket.h>
# include <unistd.h>
# include <stdio.h>
# include <stdlib.h>
# include <wchar.h>
# include <string.h>
# define MAX_BUFFER 100

void rel_path()
{
    char * data;
    char data_buf[MAX_BUFFER] = "";
    data = data_buf;

    strcpy(data, "ls -la");
    FILE *pipe;
    pipe = popen(data, "wb");
    if (pipe != NULL) pclose(pipe);
}
```

In this example, Bug Finder flags `popen` because it tries to call `ls -la` using a relative path. An attacker can manipulate the command to use a malicious version.

One possible correction is to use the full path when calling the command.

```
# define _GNU_SOURCE
# include <sys/types.h>
# include <sys/socket.h>
# include <unistd.h>
# include <stdio.h>
# include <stdlib.h>
# include <wchar.h>
# include <string.h>
# define MAX_BUFFER 100

void rel_path()
{
    char * data;
    char data_buf[MAX_BUFFER] = "";
    data = data_buf;

    strcpy(data, "/usr/bin/ls -la");
    FILE *pipe;
    pipe = popen(data, "wb");
    if (pipe != NULL) pclose(pipe);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `RELATIVE_PATH_CMD`
**Impact:** Medium
**CWE ID:** 114, 427

## See Also

`Load of library from a relative path can be controlled by an external actor` | `Vulnerable path manipulation` | `Execution of externally controlled command` | `Command executed from externally controlled path`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Execution of externally controlled command

Command argument from an unsecure source vulnerable to operating system command injection

## Description

**Execution of externally controlled command** checks for commands that are fully or partially constructed from externally controlled input.

### Risk

Attackers can use the externally controlled input as operating system commands, or arguments to the application. An attacker could read or modify sensitive data can be read or modified, execute unintended code, or gain access to other aspects of the program.

### Fix

Validate the inputs to allow only intended input values. For example, create a whitelist of acceptable inputs and compare the input against this list.

## Examples

### Call Argument Command

```
#define _XOPEN_SOURCE
#define _GNU_SOURCE

#include "stdlib.h"
#include "stdio.h"
#include "string.h"
#include "unistd.h"
#include "dlfcn.h"
#include "limits.h"

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

void taintedexternalcmd(char* usercmd)
{
    char cmd[SIZE128] = "/usr/bin/cat ";
    strcat(cmd, usercmd);
    system(cmd);
}
```

This example function calls a command from a user argument without checking the command variable.

One possible correction is to use a `switch` statement to run a predefined command, using the user input as the switch variable.

```
#define _XOPEN_SOURCE
#define _GNU_SOURCE

#include "stdlib.h"
#include "stdio.h"
#include "string.h"
#include "unistd.h"
#include "dlfcn.h"
#include "limits.h"

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};
enum { CMD0 = 1, CMD1, CMD2 };

void taintedexternalcmd(int usercmd)
{
    char cmd[SIZE128] = "/usr/bin/cat ";

    switch(usercmd) {
        case CMD0:
            strcat(cmd, "*.c");
            break;
        case CMD1:
            strcat(cmd, "*.h");
            break;
        case CMD2:
            strcat(cmd, "*.cpp");
            break;
        default:
            strcat(cmd, "*.c");
    }
    system(cmd);
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** TAINTED_EXTERNAL_CMD
**Impact:** Medium
**CWE ID:** 77, 78, 88, 114
**CERT C ID:** API00-C, ENV33-C, STR02-C
**ISO/IEC TS 17961 ID:** syscall

## See Also

Use of externally controlled environment variable | Host change using externally controlled elements | Command executed from externally controlled path | Library loaded from externally controlled path | Execution of a binary from a relative path can be controlled by an external actor

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# File access between time of check and use (TOCTOU)

File or folder might change state due to access race

## Description

**File access between time of check and use (TOCTOU)** detects race condition issues between checking the existence of a file or folder, and using a file or folder.

### Risk

An attacker can access and manipulate your file between your check for the file and your use of a file. Symbolic links are particularly risky because an attacker can change where your symbolic link points.

### Fix

Before using a file, do not check its status. Instead, use the file and check the results afterward.

## Examples

### Check File Before Using

```
#include <stdio.h>
#include <fcntl.h>
#include <unistd.h>

extern void print_tofile(FILE* f);

void toctou(char * log_path) {
    if (access(log_path, W_OK)==0) {
        FILE* f = fopen(log_path, "w");
        if (f) {
            print_tofile(f);
            fclose(f);
        }
    }
}
```

In this example, before opening and using the file, the function checks if the file exists. However, an attacker can change the file between the first and second lines of the function.

One possible correction is to open the file, and then check the existence and contents afterward.

```
#include <stdio.h>
#include <fcntl.h>
#include <unistd.h>

extern void print_tofile(FILE* f);

void toctou(char * log_path) {
    int fd = open(log_path, O_WRONLY);
    if (fd!=-1) {
        FILE *f = fdopen(fd, "w");
        if (f) {
            print_tofile(f);
            fclose(f);
        }
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TOCTOU`
**Impact:** Medium
**CWE ID:** 367
**CERT C ID:** FIO01-C, FIO45-C, POS35-C

## See Also

`Data race` | `Bad file access mode or status`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2015b**

# File descriptor exposure to child process

Copied file descriptor used in multiple processes

## Description

**File descriptor exposure to child process** occurs when a process is forked and the child process uses file descriptors inherited from the parent process.

### Risk

When you fork a child process, file descriptors are copied from the parent process, which means that you can have concurrent operations on the same file. Use of the same file descriptor in the parent and child processes can lead to race conditions that may not be caught during standard debugging. If you do not properly manage the file descriptor permissions and privileges, the file content is vulnerable to attacks targeting the child process.

### Fix

Check that the file has not been modified before forking the process. Close all inherited file descriptors and reopen them with stricter permissions and privileges, such as read-only permission.

## Examples

### File Descriptor Accessed from Forked Process

```
# include <stdio.h>
# include <stdlib.h>
# include <string.h>
# include <unistd.h>
# include <fcntl.h>
# include <sys/types.h>
# include <sys/stat.h>
```

```
const char *test_file="/home/user/test.txt";

void func(void)
{
    char c;
    pid_t pid;
    /* create file descriptor in read and write mode */
    int fd = open(test_file, O_RDWR);
    if (fd == -1)
    {
        /* Handle error */
        abort();
    }
    /* fork process */
    pid = fork();
    if (pid == -1)
    {
        /* Handle error */
        abort();
    }
    else if (pid == 0)
    {   /* Child process accesses file descriptor inherited
        from parent process */
        (void)read(fd, &c, 1);
    }
    else
    {   /* Parent process access same file descriptor as
        child process */
        (void)read(fd, &c, 1);
    }
}
```

In this example, a file descriptor `fd` is created in read and write mode. The process is then forked. The child process inherits and accesses `fd` with the same permissions as the parent process. A race condition exists between the parent and child processes. The contents of the file is vulnerable to attacks through the child process.

After you create the file descriptor, check the file for tampering. Then, close the inherited file descriptor in the child process and reopen it in read-only mode.

```
# include <stdio.h>
# include <stdlib.h>
# include <string.h>
# include <unistd.h>
# include <fcntl.h>
# include <sys/types.h>
# include <sys/stat.h>

void func(void)
{
    char c;
    pid_t pid;

    /* Get the state of file for further file tampering checking */

    /* create file descriptor in read and write mode */
    int fd = open(test_file, O_RDWR);
    if (fd == -1)
    {
        /* Handle error */
        abort();
    }

    /* Be sure the file was not tampered with while opening */

    /* fork process */

    pid = fork();
    if (pid == -1)
    {
        /* Handle error */
        (void)close(fd);
        abort();
    }
    else if (pid == 0)
    {  /* Close file descriptor in child process and repoen
        it in read only mode */

        (void)close(fd);
        fd = open(test_file, O_RDONLY);
        if (fd == -1)
        {
            /* Handle error */
            abort();
        }


        (void)read(fd, &c, 1);
        (void)close(fd);
    }
    else
    {  /* Parent acceses original file descriptor */
        (void)read(fd, &c, 1);
        (void)close(fd);
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `FILE_EXPOSURE_TO_CHILD`
**Impact:** Medium
**CWE ID:** 362,
**CERT C ID:** POS38-C

## See Also

Introduced in R2017b

# File manipulation after **chroot()** without **chdir("/")**

Path-related vulnerabilities for file manipulated after call to chroot

## Description

**File manipulation after chroot() without chdir("/")** detects access to the file system outside of the jail created by chroot. By calling chroot, you create a file system jail that confines access to a specific file subsystem. However, this jail is ineffective if you do not call chdir("/").

### Risk

If you do not call chdir("/") after creating a chroot jail, file manipulation functions that takes a path as an argument can access files outside of the jail. An attacker can still manipulate files outside the subsystem that you specified, making the chroot jail ineffective.

### Fix

After calling chroot, call chdir("/") to make your chroot jail more secure.

## Examples

### Open File in **chroot**-jail

```
#include <unistd.h>
#include <stdio.h>

const char root_path[] = "/var/ftproot";
const char log_path[] = "file.log";
FILE* chrootmisuse() {
    FILE* res;
    chroot(root_path);
    chdir("base");
    res = fopen(log_path, "r");
    return res;
}
```

This example uses `chroot` to create a chroot-jail. However, to use the `chroot` jail securely, you must call `chdir("\")` afterward. This example calls `chdir("base")`, which is not equivalent. Bug Finder also flags `fopen` because `fopen` opens a file in the vulnerable `chroot`-jail.

Before opening files, call `chdir("/")`.

```
#include <unistd.h>
#include <stdio.h>

const char root_path[] = "/var/ftproot";
const char log_path[] = "file.log";
FILE* chrootmisuse() {
    FILE* res;
    chroot(root_path);
    chdir("/");
    res = fopen(log_path, "r");
    return res;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CHROOT_MISUSE`
**Impact:** Medium
**CWE ID:** 243
**CERT C ID:** POS05-C

## See Also

`Umask used with chmod-style arguments` | `Vulnerable path manipulation`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Float conversion overflow

Overflow when converting between floating point data types

## Description

**Float conversion overflow** occurs when converting a floating point number to a smaller floating point data type. If the variable does not have enough memory to represent the original number, the conversion overflows.

The exact storage allocation for different floating point types depends on your processor. See `Target processor type (-target)`.

## Examples

### Converting from `double` to `float`

```
float convert(void) {

    double diam = 1e100;
    return (float)diam;
}
```

In the return statement, the variable `diam` of type double (64 bits) is converted to a variable of type float (32 bits). However, the value 1^100 requires more than 32 bits to be precisely represented.

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `FLOAT_CONV_OVFL`
**Impact:** High
**CWE ID:** 197, 681

**CERT C ID:** FLP03-C, FLP34-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Integer conversion overflow` | `Unsigned integer conversion overflow` | `Sign change integer conversion overflow`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Float division by zero

Dividing floating point number by zero

## Description

**Float division by zero** occurs when the denominator of a division operation is a zero and a floating point number.

## Examples

### Dividing a Floating Point Number by Zero

```
float fraction(float num)
{
    float denom = 0.0;
    float result = 0.0;

    result = num/denom;

    return result;
}
```

A division by zero error occurs at `num/denom` because `denom` is zero.

```
float fraction(float num)
{
    float denom = 0.0;
    float result = 0.0;

    if( ((int)denom) != 0)
        result = num/denom;

    return result;
}
```

Before dividing, add a test to see if the denominator is zero, checking before division occurs. If `denom` is always zero, this correction can produce a dead code defect in your Polyspace results.

One possible correction is to change the denominator value so that `denom` is not zero.

```
float fraction(float num)
{
    float denom = 2.0;
    float result = 0.0;

    result = num/denom;

    return result;
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `FLOAT_ZERO_DIV`
**Impact:** High
**CWE ID:** 369
**CERT C ID:** FLP03-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Integer division by zero`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Float overflow

Overflow from operation between floating points

## Description

**Float overflow** occurs when an operation on floating point variables exceeds the space available to represent the resulting value.

The exact storage allocation for different floating point types depends on your processor. See `Target processor type (-target)`.

## Examples

### Multiplication of Floats

```
#include <float.h>

float square(void) {

   float val = FLT_MAX;
   return val * val;
}
```

In the return statement, the variable `val` is multiplied by itself. The square of the maximum float value cannot be represented by a float (the return type for this function) because the value of `val` is the maximum float value.

One possible correction is to store the result of the operation in a larger data type. In this example, by returning a `double` instead of a `float`, the overflow defect is fixed.

```
#include <float.h>

double square(void) {
    float val = FLT_MAX;
    return (double)val * (double)val;
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `FLOAT_OVFL`
**Impact:** Low
**CWE ID:** 682, 873
**CERT C ID:** FLP03-C, FLP06-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Integer overflow` | `Unsigned integer overflow`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Format string specifiers and arguments mismatch

String specifiers do not match corresponding arguments

## Description

**Format string specifiers and arguments mismatch** occurs when the parameters in the format specification do not match their corresponding arguments. For example, an argument of type `unsigned long` must have a format specification of `%lu`.

## Examples

### Printing a Float

```
#include <stdio.h>

void string_format(void) {

    unsigned long fst = 1;

    printf("%d\n", fst);
}
```

In the `printf` statement, the format specifier, `%d`, does not match the data type of `fst`.

One possible correction is to use the `%lu` format specifier. This specifier matches the `unsigned` integer type and `long` size of `fst`.

```
#include <stdio.h>

void string_format(void) {

    unsigned long fst = 1;

    printf("%lu\n", fst);
}
```

One possible correction is to change the argument to match the format specifier. Convert `fst` to an integer to match the format specifier and print the value `1`.

```
#include <stdio.h>

void string_format(void) {

    unsigned long fst = 1;

    printf("%d\n", (int)fst);
}
```

## Check Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `STRING_FORMAT`
**Impact:** Low
**CWE ID:** 685, 686
**CERT C ID:** DCL10-C, DCL11-C, EXP37-C, FIO47-C, INT00-C, MSC15-C
**ISO/IEC TS 17961 ID:** `argcomp`, `invfmtstr`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Invalid use of standard library string routine`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### External Websites

Standard library output functions

Introduced in R2013b

# Function called from signal handler not asynchronous-safe

Call to interrupted function causes undefined program behavior

## Description

**Function called from signal handler not asynchronous-safe** occurs when a signal handler calls a function that is not asynchronous-safe according to the POSIX standard. An asynchronous-safe function can be interrupted at any point in its execution, then called again without causing an inconsistent state. It can also correctly handle global data that might be in an inconsistent state.

### Risk

When a signal handler is invoked, the execution of the program is interrupted. After the handler is finished, program execution resumes at the point of interruption. If a function is executing at the time of the interruption, calling it from within the signal handler is undefined behavior, unless it is asynchronous-safe.

### Fix

The POSIX standard defines these functions as asynchronous-safe. You can call these functions from a signal handler.

| | | |
|---|---|---|
| `_exit()` | `getpgrp()` | `setsockopt()` |
| `_Exit()` | `getpid()` | `setuid()` |
| `abort()` | `getppid()` | `shutdown()` |
| `accept()` | `getsockname()` | `sigaction()` |
| `access()` | `getsockopt()` | `sigaddset()` |
| `aio_error()` | `getuid()` | `sigdelset()` |
| `aio_return()` | `kill()` | `sigemptyset()` |
| `aio_suspend()` | `link()` | `sigfillset()` |

| | | |
|---|---|---|
| alarm() | linkat() | sigismember() |
| bind() | listen() | signal() |
| cfgetispeed() | lseek() | sigpause() |
| cfgetospeed() | lstat() | sigpending() |
| cfsetispeed() | mkdir() | sigprocmask() |
| cfsetospeed() | mkdirat() | sigqueue() |
| chdir() | mkfifo() | sigset() |
| chmod() | mkfifoat() | sigsuspend() |
| chown() | mknod() | sleep() |
| clock_gettime() | mknodat() | sockatmark() |
| close() | open() | socket() |
| connect() | openat() | socketpair() |
| creat() | pathconf() | stat() |
| dup() | pause() | symlink() |
| dup2() | pipe() | symlinkat() |
| execl() | poll() | sysconf() |
| execle() | posix_trace_event() | tcdrain() |
| execv() | pselect() | tcflow() |
| execve() | pthread_kill() | tcflush() |
| faccessat() | pthread_self() | tcgetattr() |
| fchdir() | pthread_sigmask() | tcgetpgrp() |
| fchmod() | quick_exit() | tcsendbreak() |
| fchmodat() | raise() | tcsetattr() |
| fchown() | read() | tcsetpgrp() |
| fchownat() | readlink() | time() |
| fcntl() | readlinkat() | timer_getoverrun() |
| fdatasync() | recv() | timer_gettime() |
| fexecve() | recvfrom() | timer_settime() |
| fork() | recvmsg() | times() |

| | | |
|---|---|---|
| fpathconf() | rename() | umask() |
| fstat() | renameat() | uname() |
| fstatat() | rmdir() | unlink() |
| fsync() | select() | unlinkat() |
| ftruncate() | sem_post() | utime() |
| futimens() | send() | utimensat() |
| getegid() | sendmsg() | utimes() |
| geteuid() | sendto() | wait() |
| getgid() | setgid() | waitpid() |
| getgroups() | setpgid() | write() |
| getpeername() | setsid() | |

Functions not in the previous table are not asynchronous-safe, and should not be called from a signal hander.

## Examples

### Call to `printf()` Inside Signal Handler

```
#include <signal.h>
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <setjmp.h>
#include <syslog.h>
#include <unistd.h>

#define SIZE20 20

extern volatile sig_atomic_t e_flag;

void display_info(const char *info)
{
    if (info)
    {
        (void)fputs(info, stderr);
    }
}

void sig_handler(int signum)
{
    /* Call function printf() that is not
    asynchronous-safe */
    printf("signal %d received.", signum);
    e_flag = 1;
}

int main(void)
{
    e_flag = 0;
    if (signal(SIGINT, sig_handler) == SIG_ERR)
    {
        /* Handle error */
    }
    char *info = (char *)calloc(SIZE20, sizeof(char));
    if (info == NULL)
    {
        /* Handle Error */
    }
    while (!e_flag)
    {
        /* Main loop program code */
        display_info(info);
        /* More program code */
    }
    free(info);
    info = NULL;
    return 0;
}
```

In this example, `sig_handler` calls `printf()` when catching a signal. If the handler catches another signal while `printf()` is executing, the behavior of the program is undefined.

Use your signal handler to set only the value of a flag. `e_flag` is of type volatile `sig_atomic_t`. `sig_handler` can safely access it asynchronously.

```
#include <signal.h>
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <setjmp.h>
#include <syslog.h>
#include <unistd.h>

#define SIZE20 20

extern volatile sig_atomic_t e_flag;

void display_info(const char *info)
{
    if (info)
    {
        (void)fputs(info, stderr);
    }
}

void sig_handler1(int signum)
{
    int s0 = signum;
    e_flag = 1;
}

int func(void)
{
    e_flag = 0;
    if (signal(SIGINT, sig_handler1) == SIG_ERR)
    {
        /* Handle error */
    }
    char *info = (char *)calloc(SIZE20, 1);
    if (info == NULL)
    {
        /* Handle error */
    }
    while (!e_flag)
    {
        /* Main loop program code */
        display_info(info);
        /* More program code */
    }
    free(info);
    info = NULL;
    return 0;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** SIG_HANDLER_ASYNC_UNSAFE
**Impact:** Medium
**CWE ID:** 387, 479, 663, 828
**CERT C ID:** SIG30-C ERR32-C
**ISO/IEC TS 17961 ID:** asyncsig

## See Also

Function called from signal handler not asynchronous-safe (strict) | Return from computational exception signal handler | Shared data access within signal handler | Signal call from within signal handler

Introduced in R2017b

# Function called from signal handler not asynchronous-safe (strict)

Call to interrupted function causes undefined program behavior

## Description

**Function called from signal handler not asynchronous-safe (strict)** occurs when a signal handler calls a function that is not asynchronous-safe according to the C standard. An asynchronous-safe function can be interrupted at any point in its execution, then called again without causing an inconsistent state. It can also correctly handle global data that might be in an inconsistent state.

When you select the checker **Function called from signal handler not asynchronous-safe**, the checker detects calls to functions that are not asynchronous-safe according to the POSIX standard. **Function called from signal handler not asynchronous-safe (strict)** does not raise a defect for these cases. **Function called from signal handler not asynchronous-safe (strict)** raises a defect for functions that are asynchronous-safe according to the POSIX standard but not according to the C standard.

### Risk

When a signal handler is invoked, the execution of the program is interrupted. After the handler is finished, program execution resumes at the point of interruption. If a function is executing at the time of the interruption, calling it from within the signal handler is undefined behavior, unless it is asynchronous-safe.

### Fix

The C standard defines the following functions as asynchronous-safe. You can call these functions from a signal handler:

- `abort()`
- `_Exit()`

- `quick_exit()`
- `signal()`

## Examples

### Call to `raise()` Inside Signal Handler

```
#include <signal.h>
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <setjmp.h>
#include <syslog.h>
#include <unistd.h>

void SIG_ERR_handler(int signum)
{
    int s0 = signum;
    /* SIGTERM specific handling */
}

void sig_handler(int signum)
{
    int s0 = signum;
    /* Call raise() */
    if (raise(SIGTERM) != 0) {
        /* Handle error */
    }
}

int finc(void)
{
    if (signal(SIGTERM, SIG_ERR_handler) == SIG_ERR)
    {
        /* Handle error */
    }
    if (signal(SIGINT, sig_handler) == SIG_ERR)
    {
        /* Handle error */
    }
    /* Program code */
    if (raise(SIGINT) != 0)
    {
        /* Handle error */
    }
    /* More code */
    return 0;
}
```

In this example, `sig_handler` calls `raise()` when catching a signal. If the handler catches another signal while `raise()` is executing, the behavior of the program is undefined.

According to the C standard, the only functions that you can safely call from a signal handler are `abort()`, `_Exit()`, `quick_exit()`, and `signal()`.

```
#include <signal.h>
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <setjmp.h>
#include <syslog.h>
#include <unistd.h>

void SIG_ERR_handler(int signum)
{
    int s0 = signum;
    /* SIGTERM specific handling */
}
void sig_handler(int signum)
{
    int s0 = signum;


}

int func(void)
{
    if (signal(SIGTERM, SIG_ERR_handler) == SIG_ERR)
    {
        /* Handle error */
    }
    if (signal(SIGINT, sig_handler) == SIG_ERR)
    {
        /* Handle error */
    }
    /* Program code */
    if (raise(SIGINT) != 0)
    {
        /* Handle error */
    }
    /* More code */
    return 0;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `SIG_HANDLER_ASYNC_UNSAFE_STRICT`
**Impact:** Medium
**CWE ID:** 387, 479, 663, 828
**CERT C ID:** SIG30-C, ERR32-C
**ISO/IEC TS 17961 ID:** `asyncsig`

## See Also

`Function called from signal handler not asynchronous-safe` | `Shared data access within signal handler` | `Signal call from within signal handler`

### Introduced in R2017b

# Function pointer assigned with absolute address

Constant expression is used as function address is vulnerable to code injection

## Description

**Function pointer assigned with absolute address** looks for assignments to function pointers. If the function pointer is assigned an absolute address, Bug Finder raises a defect.

Bug Finder considers expressions with any combination of literal constants as an absolute address. The one exception is when the value of the expression is zero.

### Risk

Using a fixed address is not portable because it is possible the address is invalid on other platforms.

An attacker can inject code at the absolute address, causing your program to execute arbitrary, possibly malicious, code.

### Fix

Do not use an absolute address with function pointers.

## Examples

### Function Pointer Address Assignment

```
extern int func0(int i, char c);
typedef int (*FuncPtr) (int, char);

FuncPtr funcptrabsoluteaddr() {
    return (FuncPtr)0x08040000;
}
```

In this example, the function returns a function pointer to the address `0x08040000`. If an attacker knows this absolute address, an attacker can compromise your program.

One possible correction is to use the address of an existing function instead.

```
extern int func0(int i, char c);
typedef int (*FuncPtr) (int, char);

FuncPtr funcptrabsoluteaddr() {
    return &func0;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `FUNC_PTR_ABSOLUTE_ADDR`
**Impact:** Low
**CWE ID:** 587

## See Also

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

#### Introduced in R2015b

# Hard-coded buffer size

Size of memory buffer is a numerical value instead of symbolic constant

## Description

**Hard-coded buffer size** occurs when you use a numerical value instead of a symbolic constant when declaring a memory buffer such as an array.

### Risk

Hard-coded buffer size causes the following issues:

- Hard-coded buffer size increases the likelihood of mistakes and therefore maintenance costs. If a policy change requires developers to change the buffer size, they must change every occurrence of the buffer size in the code.
- Hard-constant constants can be exposed to attack if the code is disclosed.

### Fix

Use a symbolic name instead of a hard-coded constant for buffer size. Symbolic names include `const`-qualified variables, `enum` constants, or macros.

`enum` constants are recommended.

- Macros are replaced by their constant values after preprocessing. Therefore, they can expose the loop boundary.
- `enum` constants are known at compilation time. Therefore, compilers can optimize the loops more efficiently.

  `const`-qualified variables are usually known at run time.

# Examples

## Hard-Coded Buffer Size

```
int table[100];

void read(int);

void func(void) {
    for (int i=0; i<100; i++)
        read(table[i]);
}
```

In this example, the size of the array `table` is hard-coded.

One possible correction is to replace the hard-coded size with a symbolic name.

```
const int MAX_1 = 100;
#define MAX_2 100
enum { MAX_3 = 100 };

int table_1[MAX_1];
int table_2[MAX_2];
int table_3[MAX_3];

void read(int);

void func(void) {
    for (int i=0; i < MAX_1; i++)
        read(table_1[i]);
    for (int i=0; i < MAX_2; i++)
        read(table_2[i]);
    for (int i=0; i < MAX_3; i++)
        read(table_3[i]);
}
```

# Result Information

**Group:** Good practice
**Language:** C | C++
**Default:** Off

**Command-Line Syntax:** `HARD_CODED_BUFFER_SIZE`
**Impact:** Low
**CWE ID:** 547
**CERT C ID:** DCL06-C

## See Also

`Find defects (-checkers)`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Hard-coded loop boundary

Loop boundary is a numerical value instead of symbolic constant

## Description

**Hard-coded loop boundary** occurs when you use a numerical value instead of symbolic constant for the boundary of a `for`, `while` or `do-while` loop.

### Risk

Hard-coded loop boundary causes the following issues:

- Hard-coded loop boundary makes the code vulnerable to denial of service attacks when the loop involves time-consuming computation or resource allocation.
- Hard-coded loop boundary increases the likelihood of mistakes and maintenance costs. If a policy change requires developers to change the loop boundary, they must change every occurrence of the boundary in the code.

  For instance, the loop boundary is 10000 and represents the maximum number of client connections supported in a network server application. If the server supports more clients, you must change all instances of the loop boundary in your code. Even if the loop boundary occurs once, you have to search for a numerical value of `10000` in your code. The numerical value can occur in places other than the loop boundary. You must browse through those places before you find the loop boundary.

### Fix

Use a symbolic name instead of a hard-coded constant for loop boundary. Symbolic names include `const`-qualified variables, `enum` constants or macros.`enum` constants are recommended because:

- Macros are replaced by their constant values after preprocessing. Therefore, they can expose the buffer size.
- `enum` constants are known at compilation time. Therefore, compilers can allocate storage for them more efficiently.

const-qualified variables are usually known at run time.

# Examples

## Hard-Coded Loop Boundary

```
void performOperation(int);

void func(void) {
    for (int i=0; i<100; i++)
        performOperation(i);
}
```

In this example, the boundary of the for loop is hard-coded.

One possible correction is to replace the hard-coded loop boundary with a symbolic name.

```
const int MAX_1 = 100;
#define MAX_2 100
enum { MAX_3 = 100 };

void performOperation_1(int);
void performOperation_2(int);
void performOperation_3(int);

void func(void) {
    for (int i=0; i<MAX_1; i++)
        performOperation_1(i);
    for (int i=0; i<MAX_2; i++)
        performOperation_2(i);
    for (int i=0; i<MAX_3; i++)
        performOperation_3(i);
}
```

# Result Information

**Group:** Good practice
**Language:** C | C++
**Default:** Off

**Command-Line Syntax:** `HARD_CODED_LOOP_BOUNDARY`
**Impact:** Low
**CWE ID:** 547
**CERT C ID:** DCL06-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Hard-coded object size used to manipulate memory

Memory manipulation with hard-coded size instead of `sizeof`

## Description

**Hard-coded object size used to manipulate memory** occurs on constants that are memory size arguments for memory functions such as `malloc` or `memset`.

### Risk

If you hard code object size, your code is not portable to architectures with different type sizes. If the constant value is not the same as the object size, the buffer might or might not overflow.

### Fix

For the size argument of memory functions, use `sizeof(`*`object`*`)`.

## Examples

### Assume 4-Byte Integer Pointers

```
#include <stddef.h>
#include <stdlib.h>
enum {
    SIZE3   = 3,
    SIZE20  = 20
};
extern void fill_ints(int **matrix, size_t nb, size_t s);

void bug_hardcodedmemsize()
{
    size_t i, s;

    s = 4;
    int **matrix = (int **)calloc(SIZE20, s);
    if (matrix == NULL) {
        return; /* Indicate calloc() failure */
    }
    fill_ints(matrix, SIZE20, s);
    free(matrix);
}
```

In this example, the memory allocation function `calloc` is called with a memory size of 4. The memory is allocated for an integer pointer, which can be a more or less than 4 bytes depending on your target. If the integer pointer is not 4 bytes, your program can fail.

When calling `calloc`, replace the hard-coded size with a call to `sizeof`. This change makes your code more portable.

```
#include <stddef.h>
#include <stdlib.h>
enum {
    SIZE3   = 3,
    SIZE20  = 20
};
extern void fill_ints(int **matrix, size_t nb, size_t s);

void corrected_hardcodedmemsize()
{
    size_t i, s;

    s = sizeof(int *);
    int **matrix = (int **)calloc(SIZE20, s);
    if (matrix == NULL) {
        return; /* Indicate calloc() failure */
    }
    fill_ints(matrix, SIZE20, s);
    free(matrix);
}
```

## Result Information

**Group:** Good Practice
**Language:** C | C++
**Default:** Off

**Command-Line Syntax:** `HARD_CODED_MEM_SIZE`
**Impact:** Low
**CWE ID:** 805
**CERT C ID:** EXP09-C

Introduced in R2016b

# Host change using externally controlled elements

Changing host ID from an unsecure source

## Description

**Host change using externally controlled elements** detects uncontrolled arguments in calls to routines that change the host ID, such as `sethostid` (Linux) or `SetComputerName` (Windows).

### Risk

The tainted host ID value can allow external control of system settings. This control can disrupt services, cause unexpected application behavior, or cause other malicious intrusions.

### Fix

Use caution when changing or editing the host ID. Do not allow user-provided values to control sensitive data.

## Examples

### Change Host ID from Function Argument

```
#include <unistd.h>

void bug_taintedhostid(long userhid) {
    sethostid(userhid);
}
```

This example sets a new host ID using the argument passed to the function. Before using the host ID, check the value passed in.

One possible correction is to change the host ID to a predefined ID. This example uses the host argument as a switch variable to choose between the different, predefined host IDs.

```
#include <unistd.h>

extern long called_taintedhostid_sanitize(long);
enum { HI0 = 1, HI1, HI2, HI3 };

void taintedhostid(int host) {

    long hid = 0;
    switch(host) {
        case HI0:
            hid = 0x7f0100;
            break;
        case HI1:
            hid = 0x7f0101;
            break;
        case HI2:
            hid = 0x7f0102;
            break;
        case HI3:
            hid = 0x7f0103;
            break;
        default:
            /* do nothing */
        break;
    }
    if (hid > 0) {
        sethostid(hid);
    }
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_HOSTID`
**Impact:** Medium

**CWE ID:** 15
**CERT C ID:** API00-C

## See Also

`Execution of externally controlled command` | `Use of externally controlled environment variable` | `Host change using externally controlled elements` | `Command executed from externally controlled path` | `Library loaded from externally controlled path`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Improper array initialization

Incorrect array initialization when using initializers

## Description

**Improper array initialization** occurs when Polyspace Bug Finder considers that an array initialization using initializers is incorrect.

This defect applies to normal and designated initializers. In C99, with designated initializers, you can place the elements of an array initializer in any order and implicitly initialize some array elements. The designated initializers use the array index to establish correspondence between an array element and an array initializer element. For instance, the statement `int arr[6] = { [4] = 29, [2] = 15 }` is equivalent to `int arr[6] = { 0, 0, 15, 0, 29, 0 }`.

You can use initializers incorrectly in one of the following ways.

| Issue | Risk | Possible Fix |
|---|---|---|
| In your initializer for a one-dimensional array, you have more elements than the array size. | Unused array initializer elements indicate a possible coding error. | Increase the array size or remove excess elements. |
| You place the braces enclosing initializer values incorrectly. | Because of the incorrect placement of braces, some array initializer elements are not used.<br>Unused array initializer elements indicate a possible coding error. | Place braces correctly. |

| Issue | Risk | Possible Fix |
|---|---|---|
| In your designated initializer, you do not initialize the first element of the array explicitly. | The implicit initialization of the first array element indicates a possible coding error. You possibly overlooked the fact that array indexing starts from 0. | Initialize all elements explicitly. |
| In your designated initializer, you initialize an element twice. | The first initialization is overridden.<br>The redundant first initialization indicates a possible coding error. | Remove the redundant initialization. |
| You use designated and nondesignated initializers in the same initialization. | You or another reviewer of your code cannot determine the size of the array by inspection. | Use either designated or nondesignated initializers. |

# Examples

## Incorrectly Placed Braces (C Only)

```
int arr[2][3]
= {{1, 2},
    {3, 4},
    {5, 6}
};
```

In this example, the array `arr` is initialized as `{1,2,0,3,4,0}`. Because the initializer contains `{5,6}`, you might expect the array to be initialized `{1,2,3,4,5,6}`.

One possible correction is to place the braces correctly so that all elements are explicitly initialized.

```
int a1[2][3]
= {{1, 2, 3},
    {4, 5, 6}
};
```

## First Element Not Explicitly Initialized

```
int arr[5]
= {
    [1] = 2,
    [2] = 3,
    [3] = 4,
    [4] = 5
};
```

In this example, `arr[0]` is not explicitly initialized. It is possible that the programmer did not consider that the array indexing starts from 0.

One possible correction is to initialize all elements explicitly.

```
int arr[5]
= {
    [0] = 1,
    [1] = 2,
    [2] = 3,
    [3] = 4,
    [4] = 5
};
```

## Element Initialized Twice

```
int arr[5]
= {
    [0] = 1,
    [1] = 2,
    [2] = 3,
    [2] = 4,
    [4] = 5
};
```

In this example, arr[2] is initialized twice. The first initialization is overridden. In this case, because arr[3] was not explicitly initialized, it is possible that the programmer intended to initialize arr[3] when arr[2] was initialized a second time.

One possible correction is to eliminate the redundant initialization.

```
int arr[5]
= {
    [0] = 1,
    [1] = 2,
    [2] = 3,
    [3] = 4,
    [4] = 5
};
```

## Mix of Designated and Nondesignated Initializers

```
int arr[]
= {
    [0] = 1,
    [3] = 3,
    4,
    [5] = 5,
    6
    };
```

In this example, because a mix of designated and nondesignated initializers are used, it is difficult to determine the size of arr by inspection.

One possible correction is to use only designated initializers for array initialization.

```
int arr[]
= {
    [0] = 1,
    [3] = 3,
    [4] = 4,
    [5] = 5,
    [6] = 6
};
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `IMPROPER_ARRAY_INIT`
**Impact:** Medium
**CWE ID:** 665
**CERT C ID:** ARR00-C, ARR02-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Incompatible types prevent overriding

Derived class method hides a `virtual` base class method instead of overriding it

## Description

**Incompatible types prevent overriding** occurs when a derived class method has the same name and number of parameters as a `virtual` base class method but:

- Differ in at least one parameter type.
- Differ in the presence or absence of qualifiers such as `const`.

The derived class method hides the `virtual` base class method instead of overriding it.

### Risk

Risks include the following:

- If you intend that the derived class method must override the base class method, the overriding does not occur.
- Because the base class method is hidden, you cannot use a derived class object to call the method. If you use a derived class object to call the method with the base class parameters, the derived class method is called instead. For the parameters whose types do not match the arguments that you pass, a cast takes place if possible. Otherwise, a compilation failure occurs.

### Fix

Possible solutions include the following:

- If you want the derived class method to override the base class method, change the interface of the derived class method.

  For instance, change the parameter type or add a `const` qualifier if required.
- Otherwise, add the line `using` *`Base_class_name`*`::`*`method_name`* to the derived class declaration. In this way, you can access the base class method using an object of the derived class.

## Examples

### `typedef` Causing Virtual Function Hiding in Derived Class

```
class Base {
public:
    Base();
    virtual ~Base();
    virtual void func(float i);
    virtual void funcp(float* i);
    virtual void funcr(float& i);
};

typedef double Float;

class Derived: public Base {
public:
    Derived();
    ~Derived();
    void func(Float i);
    void funcp(Float* i);
    void funcr(Float& i);
};
```

In this example, because of the statement `typedef double Float;`, the `Derived` class methods `func`, `funcp` and `funcr` have `double` arguments while the `Base` class methods with the same name have `float` arguments.

Therefore, you cannot access the `Base` class methods using a `Derived` class object.

The defect appears on the method that hides a base class method. To find which base class method is hidden:

1. Navigate to the base class definition. On the **Source** pane, right-click the base class name and select **Go To Definition**.
2. In the base class definition, identify the `virtual` method that has the same name as the derived class method name.

One possible correction is to use the same argument type for the base and derived class methods to enable overriding. Otherwise, if you want to call the `Base` class methods with the `float` arguments using a `Derived` class object, add the line `using Base::`*`method_name`* to the `Derived` class declaration.

```
class Base {
public:
    Base();
    virtual ~Base();
    virtual void func(float i);
    virtual void funcp(float* i);
    virtual void funcr(float& i);
};

typedef double Float;

class Derived: public Base {
public:
    Derived();
    ~Derived();
    using Base::func;
    using Base::funcp;
    using Base::funcr;
    void func(Float i);
    void funcp(Float* i);
    void funcr(Float& i);
};
```

## `const` Qualifier Missing in Derived Class Method

```
namespace Missing_Const {
class Base {
public:
    virtual void func(int) const ;
    virtual ~Base() ;
} ;

class Derived : public Base {
public:
    virtual void func(int) ;

} ;
}
```

In this example, `Derived::func` does not have a `const` qualifier but `Base::func` does. Therefore, `Derived::func` does not override `Base::func`.

To enable overriding, add the `const` qualifier to the derived class method declaration.

```
namespace Missing_Const {
class Base {
public:
    virtual void func(int) const ;
    virtual ~Base() ;
} ;

class Derived : public Base {
public:
    virtual void func(int) const;

} ;
}
```

### Value Instead of Reference in Derived Class Method

```
namespace Missing_Ref {

class Obj {
    int data;
};

class Base {
public:
    virtual void func(Obj& o);
    virtual ~Base() ;
} ;

class Derived : public Base {
public:
    virtual void func(Obj o) ;

} ;
}
```

In this example, `Derived::func` accepts an `Obj` parameter by value but `Base::func` accepts an `Obj` parameter by reference. Therefore, `Derived::func` does not override `Base::func`.

To enable overriding, pass the derived class method parameter by reference.

```
namespace Missing_Ref {

class Obj {
    int data;
};

class Base {
public:
    virtual void func(Obj& o);
    virtual ~Base() ;
} ;

class Derived : public Base {
public:
    virtual void func(Obj& o) ;

} ;
}
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** On
**Command-Line Syntax:** `VIRTUAL_FUNC_HIDING`
**Impact:** Medium

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Inconsistent cipher operations

Encryption and decryption steps occur in succession with the same cipher context without a reinitialization in between

## Description

**Inconsistent cipher operations** occurs when you perform an encryption and decryption step with the same cipher context. You do not reinitalize the context in between those steps.

For instance, you set up a cipher context for decryption using `EVP_DecryptInit_ex`.

```
EVP_DecryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);
```

However, you use the context for encryption using `EVP_EncryptUpdate`.

```
EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
```

### Risk

Mixing up encryption and decryption steps can lead to obscure code. It is difficult to determine at a glance whether the current cipher context is used for encryption or decryption. The mixup can also lead to race conditions, failed encryption, and unexpected ciphertext.

### Fix

After you set up a cipher context for a certain family of operations, use the context for only that family of operations.

For instance, if you set up a cipher context for decryption using `EVP_DecryptInit_ex`, use the context afterward for decryption only.

# Examples

## Encryption Step Following Decryption Step

```
#include <openssl/evp.h>
#include <stdlib.h>

/* Using the cryptographic routines */

unsigned char *out_buf;
int out_len;
unsigned char g_key[16];
unsigned char g_iv[16];
void func(unsigned char* src, int len) {

    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);

    /* Cipher context set up for decryption*/
    EVP_DecryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, g_key, g_iv);

    /* Update step for encryption */
    EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
}
```

In this example, the cipher context `ctx` is set up for decryption using `EVP_DecryptInit_ex`. However, immediately afterward, the context is used for encryption using `EVP_EncryptUpdate`.

One possible correction is to change the setup step. If you want to use the cipher context for encryption, set it up using `EVP_EncryptInit_ex`.

```
#include <openssl/evp.h>
#include <stdlib.h>

unsigned char *out_buf;
int out_len;
```

```
unsigned char g_key[16];
unsigned char g_iv[16];

void func(unsigned char* src, int len) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);

    /* Cipher context set up for encryption*/
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, g_key, g_iv);

    /* Update step for encryption */
    EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_BAD_FUNCTION`
**Impact:** Medium
**CWE ID:** 372, 664

Introduced in R2017a

# Incorrect order of network connection operations

Socket is not correctly established due to bad order of connection steps or missing steps

## Description

**Incorrect order of network connection operations** occurs when you perform operations on a network connection at the wrong point of the connection lifecycle.

### Risk

Sending or receiving data to an incorrectly connected socket can cause unexpected behavior or disclosure of sensitive information.

If you do not connect your socket correctly or change the connection by mistake, you can send sensitive data to an unexpected port. You can also get unexpected data from an incorrect socket.

### Fix

During socket connection and communication, check the return of each call and the length of the data.

Before reading, writing, sending, or receiving information, create sockets in this order:

- For a connection-oriented server socket (`SOCK_STREAM` or `SOCK_SEQPACKET`):

  ```
  socket(...);
  bind(...);
  listen(...);
  accept(...);
  ```

- For a connectionless server socket (`SOCK_DGRAM`):

  ```
  socket(...);
  bind(...);
  ```

- For a client socket (connection-oriented or connectionless):

```
socket(...);
connect(...);
```

## Examples

### Connecting a Connection-Oriented Server Socket

```
# include <stdio.h>
# include <string.h>
# include <time.h>
# include <arpa/inet.h>
# include <unistd.h>

enum { BUF_SIZE=1025 };

volatile int rd;

int stream_socket_server(int argc, char *argv[])
{
    int listenfd = 0, connfd = 0;
    struct sockaddr_in serv_addr;

    char sendBuff[BUF_SIZE];
    time_t ticks;
    struct tm * timeinfo;

    listenfd = socket(AF_INET, SOCK_STREAM, 0);
    memset(&serv_addr, 48, sizeof(serv_addr));
    memset(sendBuff, 48, sizeof(sendBuff));

    serv_addr.sin_family = AF_INET;
    serv_addr.sin_addr.s_addr = htonl(INADDR_ANY);
    serv_addr.sin_port = htons(5000);

    bind(listenfd, (struct sockaddr*)&serv_addr, sizeof(serv_addr));

    listen(listenfd, 10);

    while(1)
    {
        connfd = accept(listenfd, (struct sockaddr*)NULL, NULL);
        ticks = time(NULL);
        timeinfo = localtime(&ticks);
        strftime (sendBuff,BUF_SIZE,"%I:%M%p.",timeinfo);

        write(listenfd, sendBuff, strlen(sendBuff));

        close(connfd);
        sleep(1);
    }
}
```

This example creates a connection-oriented network connection. The function calls the correct functions in the correct order: `socket`, `bind`, `listen`, `accept`. However, the program should write to the `connfd` socket instead of the `listenfd` socket.

One possible correction is to write to the `connfd` function instead of the `listenfd` socket.

```
# include <stdio.h>
# include <string.h>
# include <time.h>
# include <arpa/inet.h>
# include <unistd.h>

enum { BUF_SIZE=1025 };

volatile int rd;

int stream_socket_server_good(int argc, char *argv[])
{
    int listenfd = 0, connfd = 0;
    struct sockaddr_in serv_addr;

    char sendBuff[BUF_SIZE];
    time_t ticks;
    struct tm * timeinfo;

    listenfd = socket(AF_INET, SOCK_STREAM, 0);
    memset(&serv_addr, 48, sizeof(serv_addr));
    memset(sendBuff, 48, sizeof(sendBuff));

    serv_addr.sin_family = AF_INET;
    serv_addr.sin_addr.s_addr = htonl(INADDR_ANY);
    serv_addr.sin_port = htons(5000);

    bind(listenfd, (struct sockaddr*)&serv_addr, sizeof(serv_addr));
    listen(listenfd, 10);

    while(1)
    {
        connfd = accept(listenfd, (struct sockaddr*)NULL, NULL);
        ticks = time(NULL);
        timeinfo = localtime(&ticks);
        strftime (sendBuff,BUF_SIZE,"%I:%M%p.",timeinfo);
        write(connfd, sendBuff, strlen(sendBuff));
        close(connfd);
        sleep(1);
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BAD_NETWORK_CONNECT_ORDER`
**Impact:** Medium
**CWE ID:** 666

## See Also

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Incorrect pointer scaling

Implicit scaling in pointer arithmetic might be ignored

## Description

**Incorrect pointer scaling** occurs when Polyspace Bug Finder considers that you are ignoring the implicit scaling in pointer arithmetic.

For instance, the defect can occur in the following situations.

| Situation | Risk | Possible Fix |
|---|---|---|
| You use the `sizeof` operator in arithmetic operations on a pointer. | The `sizeof` operator returns the size of a data type in number of bytes.<br>Pointer arithmetic is already implicitly scaled by the size of the data type of the pointed variable. Therefore, the use of `sizeof` in pointer arithmetic produces unintended results. | Do not use `sizeof` operator in pointer arithmetic. |
| You perform arithmetic operations on a pointer, and then apply a cast. | Pointer arithmetic is implicitly scaled. If you do not consider this implicit scaling, casting the result of a pointer arithmetic produces unintended results. | Apply the cast before the pointer arithmetic. |

# Examples

## Use of sizeof Operator

```
void func(void) {
    int arr[5] = {1,2,3,4,5};
    int *ptr = arr;

    int value_in_position_2 = *(ptr + 2*(sizeof(int)));
}
```

In this example, the operation `2*(sizeof(int))` returns twice the size of an `int` variable in bytes. However, because pointer arithmetic is implicitly scaled, the number of bytes by which `ptr` is offset is `2*(sizeof(int))*(sizeof(int))`.

In this example, the incorrect scaling shifts `ptr` outside the bounds of the array. Therefore, a **Pointer access out of bounds** error appears on the `*` operation.

One possible correction is to remove the `sizeof` operator.

```
void func(void) {
    int arr[5] = {1,2,3,4,5};
    int *ptr = arr;

    int value_in_position_2 = *(ptr + 2);
}
```

## Cast Following Pointer Arithmetic

```
int func(void) {
    int x = 0;
    char r = *(char *)(&x + 1);
    return r;
}
```

In this example, the operation `&x + 1` offsets `&x` by `sizeof(int)`. Following the operation, the resulting pointer points outside the allowed buffer. When you dereference the pointer, a **Pointer access out of bounds** error appears on the `*` operation.

If you want to access the second byte of x, first cast &x to a char* pointer and then perform the pointer arithmetic. The resulting pointer is offset by sizeof(char) bytes and still points within the allowed buffer, whose size is sizeof(int) bytes.

```
int func(void) {
    int x = 0;
    char r = *((char *)(&x )+ 1);
    return r;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** BAD_PTR_SCALING
**Impact:** Medium
**CWE ID:** 468
**CERT C ID:** ARR39-C, EXP08-C
**ISO/IEC TS 17961 ID:** libptr

## See Also

Find defects (-checkers)

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Integer conversion overflow

Overflow when converting between integer types

## Description

**Integer conversion overflow** occurs when converting an integer to a smaller integer type. If the variable does not have enough bytes to represent the original constant, the conversion overflows.

The exact storage allocation for different integer types depends on your processor. See `Target processor type (-target)`.

## Examples

### Converting from `int` to `char`

```
char convert(void) {

    int num = 1000000;

    return (char)num;
}
```

In the return statement, the integer variable `num` is converted to a `char`. However, an 8-bit or 16-bit character cannot represent 1000000 because it requires at least 20 bits. So the conversion operation overflows.

One possible correction is to convert to a different integer type that can represent the entire number.

```
long convert(void) {

    int num = 1000000;

    return (long)num;
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `INT_CONV_OVFL`
**Impact:** High
**CWE ID:** 190, 191, 197
**CERT C ID:** FLP34-C, INT02-C, INT12-C, INT18-C, INT31-C

## See Also

`Float conversion overflow` | `Unsigned integer conversion overflow` | `Sign change integer conversion overflow` | `Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Integer division by zero

Dividing integer number by zero

## Description

**Integer division by zero** occurs when the denominator of a division or modulo operation is zero.

## Examples

### Dividing an Integer by Zero

```
int fraction(int num)
{
    int denom = 0;
    int result = 0;

    result = num/denom;

    return result;
}
```

A division by zero error occurs at `num/denom` because `denom` is zero.

```
int fraction(int num)
{
    int denom = 0;
    int result = 0;

    if (denom != 0)
        result = num/denom;

    return result;
}
```

Before dividing, add a test to see if the denominator is zero, checking before division occurs. If `denom` is always zero, this correction can produce a dead code defect in your Polyspace results.

One possible correction is to change the denominator value so that `denom` is not zero.

```
int fraction(int num)
{
    int denom = 2;
    int result = 0;

    result = num/denom;

    return result;
}
```

## Modulo Operation with Zero

```
int mod_arr(int input)
{
    int arr[5];
    for(int i = 0; i < 5; i++)
    {
        arr[i] = input % i;
    }

    return arr[0]+arr[1]+arr[2]+arr[3]+arr[4];
}
```

In this example, Polyspace flags the modulo operation as a division by zero. Because modulo is inherently a division operation, the divisor (right hand argument) cannot be zero. The modulo operation uses the `for` loop index as the divisor. However, the `for` loop starts at zero, which cannot be an iterator.

One possible correction is checking the divisor before the modulo operation. In this example, see if the index `i` is zero before the modulo operation.

```
int mod_arr(int input)
{
    int arr[5];
    for(int i = 0; i < 5; i++)
    {
        if(i != 0)
        {
             arr[i] = input % i;
        }
        else
        {
             arr[i] = input;
        }
    }

    return arr[0]+arr[1]+arr[2]+arr[3]+arr[4];
}
```

Another possible correction is changing the divisor to a nonzero integer. In this example, add one to the index before the `%` operation to avoid dividing by zero.

```
int mod_arr(int input)
{
    int arr[5];
    for(int i = 0; i < 5; i++)
    {
         arr[i] = input % (i+1);
    }

    return arr[0]+arr[1]+arr[2]+arr[3]+arr[4];
}
```

## Check Information

**Group:** Numerical  
**Language:** C | C++  
**Default:** On  
**Command-Line Syntax:** `INT_ZERO_DIV`  
**Impact:** High  
**CWE ID:** 369  
**CERT C ID:** INT33-C  
**ISO/IEC TS 17961 ID:** `diverr`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

Float division by zero on page 3-188

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2013b**

# Integer overflow

Overflow from operation between integers

## Description

**Integer overflow** occurs when an operation on integer variables exceeds the space available to represent the resulting value.

The exact storage allocation for different integer types depends on your processor. See `Target processor type (-target)`.

## Examples

### Addition of Maximum Integer

```
#include <limits.h>

int plusplus(void) {

    int var = INT_MAX;
    var++;
    return var;
}
```

In the third statement of this function, the variable `var` is increased by one. But the value of `var` is the maximum integer value, so an `int` cannot represent one plus the maximum integer value.

One possible correction is to change data types. Store the result of the operation in a larger data type (Note that on a 32-bit machine, `int` and `long` has the same size). In this example, on a 32-bit machine, by returning a `long long` instead of an `int`, the overflow error is fixed.

```
#include <limits.h>
```

```
long long plusplus(void) {

    long long lvar = INT_MAX;
    lvar++;
    return lvar;
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `INT_OVFL`
**Impact:** Medium
**CWE ID:** 190, 191
**CERT C ID:** INT00-C, INT08-C, INT18-C, INT32-C, MSC15-C
**ISO/IEC TS 17961 ID:** `intoflow`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Unsigned integer overflow` | `Float overflow`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Invalid assumptions about memory organization

Address is computed by adding or subtracting from address of a variable

## Description

**Invalid assumptions about memory organization** occurs when you compute the address of a variable in the stack by adding or subtracting from the address of another non-array variable.

### Risk

When you compute the address of a variable in the stack by adding or subtracting from the address of another variable, you assume a certain memory organization. If your assumption is incorrect, accessing the computed address can be invalid.

### Fix

Do not perform an access that relies on assumptions about memory organization.

## Examples

### Reliance on Memory Organization

```
void func(void) {
    int var1 = 0x00000011, var2;
    *(&var1 + 1) = 0;
}
```

In this example, the programmer relies on the assumption that `&var1 + 1` provides the address of `var2`. Therefore, an **Invalid assumptions about memory organization** appears on the + operation. In addition, a **Pointer access out of bounds** error also appears on the dereference.

One possible correction is not perform direct computation on addresses to access separately declared variables.

## Result Information

**Group:** Programming  
**Language:** C | C++  
**Default:** On  
**Command-Line Syntax:** `INVALID_MEMORY_ASSUMPTION`  
**Impact:** Medium  
**CWE ID:** 188  
**CERT C ID:** ARR37-C

## See Also

`Find defects (-checkers)`

### Topics

“Navigate to Root Cause of Defect”  
“Review and Fix Results”

Introduced in R2015b

# Invalid deletion of pointer

Pointer deallocation using `delete` without corresponding allocation using `new`

## Description

**Invalid deletion of pointer** occurs when a block of memory released using the `delete` operator was not previously allocated with the `new` operator.

This defect applies only to C++ source files.

## Examples

### Deleting Static Memory

```
void assign_ones(void)
{
    int ptr[10];

    for(int i=0;i<10;i++)
        *(ptr+i)=1;

    delete[] ptr;
}
```

The pointer `ptr` is released using the `delete` operator. However, `ptr` points to a memory location that was not dynamically allocated.

If the number of elements of the array `ptr` is known at compile time, one possible correction is to remove the deallocation of the pointer `ptr`.

```
void assign_ones(void)
{
    int ptr[10];

    for(int i=0;i<10;i++)
```

```
        *(ptr+i)=1;
}
```

If the number of array elements is not known at compile time, one possible correction is to dynamically allocate memory to the array `ptr` using the `new` operator.

```
void assign_ones(int num)
{
    int *ptr = new int[num];

    for(int i=0; i < num; i++)
        *(ptr+i) = 1;

    delete[] ptr;
   }
```

## Mismatched `new` and `delete`

```
int main (void)
{
    int *p_scale = new int[5];

    //more code using scal

    delete p_scale;
}
```

In this example, `p_scale` is initialized to an array of size 5 using `new int[5]`. However, `p_scale` is deleted with `delete` instead of `delete[]`. The `new-delete` pair does not match. Do not use `delete` without the brackets when deleting arrays.

One possible correction is to add brackets so the `delete` matches the `new []` declaration.

```
int main (void)
{
    int *p_scale = new int[5];

    //more code using p_scale

    delete[] p_scale;
}
```

Another possible correction is to change the declaration of p_scale. If you meant to initialize p_scale as 5 itself instead of an array of size 5, you must use different syntax. For this correction, change the square brackets in the initialization to parentheses. Leave the delete statement as it is.

```
int main (void)
{
    int *p_scale = new int(5);

    //more code using p_scale

    delete p_scale;
}
```

## Check Information

**Group:** Dynamic memory
**Language:** C++
**Default:** Off
**Command-Line Syntax:** BAD_DELETE
**Impact:** High
**CWE ID:** 404

## See Also

### Polyspace Analysis Options

Find defects (-checkers)

### Polyspace Results

Invalid free of pointer | Memory leak

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Invalid file position

`fsetpos()` is invoked with a file position argument not obtained from `fgetpos()`

## Description

**Invalid file position** occurs when the file position argument of `fsetpos()` uses a value that is not obtained from `fgetpos()`.

### Risk

The function `fgetpos(FILE *stream, fpos_t *pos)` gets the current file position of the stream. When you use any other value as the file position argument of `fsetpos(FILE *stream, const fpos_t *pos)`, you might access an unintended location in the stream.

### Fix

Use the value returned from a successful call to `fgetpos()` as the file position argument of `fsetpos()`.

## Examples

### `memset()` Sets File Position Argument

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>


FILE *func(FILE *file)
{
    fpos_t offset;
    if (file == NULL)
    {
        /* Handle error */
    }
    /* Store initial position in variable 'offset' */
    (void)memset(&offset, 0, sizeof(offset));

    /* Read data from file */

    /* Return to the initial position. offset was not
    returned from a call to fgetpos()    */
    if (fsetpos(file, &offset) != 0)
    {
        /* Handle error */
    }
    return file;
}
```

In this example, `fsetpos()` uses `offset` as its file position argument. However, the value of `offset` is set by `memset()`. The preceding code might access the wrong location in the stream.

Call `fgetpos()`, and if it returns successfully, use the position argument in your call to `fsetpos()`.

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>

FILE *func(FILE *file)
{
    fpos_t offset;
    if (file == NULL)
    {
        /* Handle error */
    }
    /* Store initial position in variable 'offset'
    using fgetpos() */
    if (fgetpos(file, &offset) != 0)
    {
        /* Handle error */
    }
    /* Read data from file */

    /* Back to the initial position */
    if (fsetpos(file, &offset) != 0)
    {
        /* Handle error */
    }
    return file;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `INVALID_FILE_POS`
**Impact:** Medium
**CERT C ID:** FIO44-C
**ISO/IEC TS 17961 ID:** `xfilepos`

## See Also

Introduced in R2017b

# Invalid free of pointer

Pointer deallocation without a corresponding dynamic allocation

## Description

**Invalid free of pointer** occurs when a block of memory released using the `free` function was not previously allocated using `malloc`, `calloc`, or `realloc`.

## Examples

### Invalid Free of Pointer Error

```
#include <stdlib.h>

void Assign_Ones(void)
{
  int p[10];
  for(int i=0;i<10;i++)
     *(p+i)=1;

  free(p);
  /* Defect: p does not point to dynamically allocated memory */
}
```

The pointer `p` is deallocated using the `free` function. However, `p` points to a memory location that was not dynamically allocated.

If the number of elements of the array `p` is known at compile time, one possible correction is to remove the deallocation of the pointer `p`.

```
#include <stdlib.h>

void Assign_Ones(void)
 {
  int p[10];
  for(int i=0;i<10;i++)
```

```
     *(p+i)=1;
  /* Fix: Remove deallocation of p */
 }
```

If the number of elements of the array p is not known at compile time, one possible correction is to dynamically allocate memory to the array p.

```
#include <stdlib.h>

void Assign_Ones(int num)
{
  int *p;
  /* Fix: Allocate memory dynamically to p */
  p=(int*) calloc(10,sizeof(int));
  for(int i=0;i<10;i++)
     *(p+i)=1;
  free(p);
}
```

## Check Information

**Group:** Dynamic Memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** BAD_FREE
**Impact:** High
**CWE ID:** 404, 590, 762
**CERT C ID:** MEM00-C, MEM34-C
**ISO/IEC TS 17961 ID:** xfree

## See Also

### Polyspace Analysis Options

Find defects (-checkers)

### Polyspace Results

Invalid deletion of pointer

## Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2013b

# Invalid use of == operator

Equality operation in assignment statement

## Description

**Invalid use of == operator** occurs when an equality operator instead of an assignment operator is used in a simple statement. A common correction is removing one of the equal signs (=).

## Examples

### Equality Evaluation in `for`-Loop

```
void populate_array(void)
{
    int i = 0;
    int j = 0;
    int array[4];

    for (j == 5; j < 9; j++) {
        array[i] = j;
        i++;
    }
}
```

Inside the `for`-loop, the statement `j == 5` tests whether `j` is equal to 5 instead of setting `j` to 5. The `for`-loop iterates from 0 to 8 because `j` starts with a value of 0, not 5. A by-product of the invalid equality operator is an out-of-bounds array access in the next line.

One possible correction is to change the == operator to a single equal sign (=). Changing the == sign resolves both defects because the `for`-loop iterates the intended number of times.

```
void populate_array(void)
{
    int i = 0;
    int j = 0;
    int array[4];

    for (j = 5; j < 9; j++) {
        array[i] = j;
        i++;
    }
}
```

## Check Information

**Group:** Programming
**Language:** C | C++
**Default:** On for handwritten code, off for generated code
**Command-Line Syntax:** `BAD_EQUAL_EQUAL_USE`
**Impact:** High
**CWE ID:** 482

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Invalid use of = operator`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Invalid use of = operator

Assignment in conditional statement

## Description

**Invalid use of = operator** occurs when an assignment is made inside the predicate of a conditional, such as `if` or `while`.

In C and C++, a single equal sign is an assignment not a comparison. Using a single equal sign in a conditional statement can indicate a typo or a mistake.

### Risk

- Conditional statement tests the wrong values— The single equal sign operation assigns the value of the right operand to the left operand. Then, because this assignment is inside the predicate of a conditional, the program checks whether the new value of the left operand is nonzero or not NULL.
- Maintenance and readability issues — Even if the assignment is intended, someone reading or updating the code can misinterpret the assignment as an equality comparison instead of an assignment.

### Fix

- If the assignment is a bug, to check for equality, add a second equal sign (==).
- If the assignment inside the conditional statement was intentional, to improve readability, separate the assignment and the test. Move the assignment outside the control statement. In the control statement, simply test the result of the assignment.

## Examples

### Single Equal Sign Inside an `if` Condition

```
#include <stdio.h>
```

```
void bad_equals_ex(int alpha, int beta)
{
    if(alpha = beta)
    {
        printf("Equal\n");
    }
}
```

The equal sign is flagged as a defect because the assignment operator is used within the predicate of the if-statement. The predicate assigns the value `beta` to `alpha`, then implicitly tests whether `alpha` is true or false.

One possible correction is adding an additional equal sign. This correction changes the assignment to a comparison. The if condition compares whether `alpha` and `beta` are equal.

```
#include <stdio.h>

void equality_test(int alpha, int beta)
{
    if(alpha == beta)
    {
        printf("Equal\n");
    }
}
```

If an assignment must be made inside the predicate, a possible correction is adding an explicit comparison. This correction assigns the value of `beta` to `alpha`, then explicitly checks whether `alpha` is nonzero. The code is clearer.

```
#include <stdio.h>

int assignment_not_zero(int alpha, int beta)
{
    if((alpha = beta) != 0)
    {
        return alpha;
    }
    else
    {
        return 0;
    }
}
```

If the assignment can be made outside the control statement, one possible correction is to separate the assignment and comparison. This correction assigns the value of `beta` to `alpha` before the if. Inside the if-condition, only `alpha` is given to test if `alpha` is nonzero or not NULL.

```
#include <stdio.h>

void assign_and_print(int alpha, int beta)
{
    alpha = beta;
    if(alpha)
    {
        printf("%d", alpha);
    }
}
```

## Check Information

**Group:** Programming
**Language:** C | C++
**Default:** On for handwritten code, off for generated code
**Command-Line Syntax:** `BAD_EQUAL_USE`
**Impact:** Medium
**CWE ID:** 481
**CERT C ID:** EXP45-C
**ISO/IEC TS 17961 ID:** `boolasgn`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Invalid use of == operator`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Floating point comparison with equality operators

Imprecise comparison of floating-point variables

## Description

**Floating point comparison with equality operators** occurs when you use an equality (==) or inequality (!=) operation with floating-point numbers. It is possible that the equality or inequality of two floating-point values is not exact because floating-point representation can be imprecise.

Polyspace does not raise a defect for an equality or inequality operation with floating-point numbers when:

- The comparison is between two float constants.

  ```
      float flt = 1.0;
      if (flt == 1.1)
  ```

- The comparison is between a constant and a variable that can take a finite, reasonably small number of values.

  ```
  float x;

  int rand = random();
  switch(rand) {
  case 1: x = 0.0; break;
  case 2: x = 1.3; break;
  case 3: x = 1.7; break;
  case 4: x = 2.0; break;
  default: x = 3.5; break; }
  …
  if (x==1.3)
  ```

- The comparison is between floating-point expressions that contain only integer values.

  ```
  float x = 0.0;
  for (x=0.0;x!=100.0;x+=1.0) {
  …
  if (random) break;
  ```

```
}

if (3*x+4==2*x-1)
…
if (3*x+4 == 1.3)
```

- One of the operands is `0.0`, unless you use the option flag `-detect-bad-float-op-on-zero`.

  ```
  /* Defect detected when
  you use the option flag */

  if (x==0.0f)
  ```

  If you are running an analysis through the user interface, you can enter this option in the **Other** field, under the **Advanced Settings** node on the **Configuration** pane. See `Other`.

  At the command line, add the flag to your analysis command.

  ```
  polyspace-bug-finder-nodesktop -sources filename ^
  -checkers BAD_FLOAT_OP -detect-bad-float-op-on-zero
  ```

## Examples

### Floats Inequality in `for`-loop

```
#include <math.h>
#include <float.h>

void func(void)
{
    float f;
    for (f = 1.0; f != 2.0; f = f + 0.1)
        (void)printf("Value: %f\n", f);
}
```

In this function, the `for`-loop tests the inequality of `f` and the number 2.0 as a stopping mechanism. The number of iterations is difficult to determine, or might be infinite, because of the imprecision in floating-point representation.

One possible correction is to use a different operator that is not as strict. For example, an inequality like >= or <=.

```
#include <math.h>
#include <float.h>

void func(void)
{
    float f;
    for (f = 1.0; f <= 2.0; f = f + 0.1)
        (void)printf("Value: %f\n", f);
}
```

## Check Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BAD_FLOAT_OP`
**Impact:** Medium
**CWE ID:** 873
**CERT C ID:** FLP02-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2013b**

# Invalid use of standard library floating point routine

Wrong arguments to standard library function

## Description

**Invalid use of standard library floating point routine** occurs when you use invalid arguments with a floating point function from the standard library. This defect picks up:

- Rounding and absolute value routines

  `ceil, fabs, floor, fmod`
- Fractions and division routines

  `fmod, modf`
- Exponents and log routines

  `frexp, ldexp, sqrt, pow, exp, log, log10`
- Trigonometry function routines

  `cos, sin, tan, acos, asin, atan, atan2, cosh, sinh, tanh, acosh, asinh, atanh`

## Examples

### Arc Cosine Operation

```
#include <math.h>

double arccosine(void) {
    double degree = 5.0;
    return acos(degree);
}
```

The input value to `acos` must be in the interval `[-1,1]`. This input argument, `degree`, is outside this range.

One possible correction is to change the input value to fit the specified range. In this example, change the input value from degrees to radians to fix this defect.

```
#include <math.h>

double arccosine(void) {
    double degree = 5.0;
    double radian = degree * 3.14159 / 180.;
    return acos(radian);
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `FLOAT_STD_LIB`
**Impact:** High
**CWE ID:** 227, 369, 682, 873
**CERT C ID:** FLP03-C, FLP32-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Invalid use of standard library integer routine` | `Invalid use of standard library memory routine` | `Invalid use of standard library string routine` | `Invalid use of standard library routine`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Invalid use of standard library integer routine

Wrong arguments to standard library function

## Description

**Invalid use of standard library integer routine** occurs when you use invalid arguments with an integer function from the standard library. This defect picks up:

- Character Conversion

  `toupper, tolower`
- Character Checks

  `isalnum, isalpha, iscntrl, isdigit, isgraph, islower, isprint, ispunct, isspace, isupper, isxdigit`
- Integer Division

  `div, ldiv`
- Absolute Values

  `abs, labs`

## Examples

### Absolute Value of Large Negative

```
#include <limits.h>
#include <stdlib.h>

int absoluteValue(void) {

    int neg = INT_MIN;
    return abs(neg);
}
```

The input value to abs is INT_MIN. The absolute value of INT_MIN is INT_MAX+1. This number cannot be represented by the type int.

One possible correction is to change the input value to fit returned data type. In this example, change the input value to INT_MIN+1.

```
#include <limits.h>
#include <stdlib.h>

int absoluteValue(void) {

    int neg = INT_MIN+1;
    return abs(neg);
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** INT_STD_LIB
**Impact:** High
**CWE ID:** 227, 369, 682, 872
**ISO/IEC TS 17961 ID:** chrsgnext

## See Also

### Polyspace Analysis Options

Find defects (-checkers)

### Polyspace Results

Invalid use of standard library floating point routine | Invalid use of standard library memory routine | Invalid use of standard library string routine | Invalid use of standard library routine

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Invalid use of standard library memory routine

Standard library memory function called with invalid arguments

## Description

**Invalid use of standard library memory routine** occurs when a memory library function is called with invalid arguments.

## Examples

### Invalid Use of Standard Library Memory Routine Error

```
#include <string.h>
#include <stdio.h>

char* Copy_First_Six_Letters(void)
 {
  char str1[10],str2[5];

  printf("Enter string:\n");
  scanf("%s",str1);

  memcpy(str2,str1,6);
  /* Defect: Arguments of memcpy invalid: str2 has size < 6 */

  return str2;
 }
```

The size of string `str2` is 5, but six characters of string `str1` are copied into `str2` using the `memcpy` function.

One possible correction is to adjust the size of `str2` so that it accommodates the characters copied with the `memcpy` function.

```
#include <string.h>
#include <stdio.h>
```

```
char* Copy_First_Six_Letters(void)
 {
  /* Fix: Declare str2 with size 6 */
  char str1[10],str2[6];

  printf("Enter string:\n");
  scanf("%s",str1);

  memcpy(str2,str1,6);
  return str2;
 }
```

## Check Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `MEM_STD_LIB`
**Impact:** High
**CWE ID:** 120, 227
**CERT C ID:** API00-C, ARR38-C, ARR39-C, EXP08-C, EXP34-C, MSC15-C
**ISO/IEC TS 17961 ID:** `nullref`, `libptr`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Invalid use of standard library string routine`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Invalid use of standard library routine

Wrong arguments to standard library function

## Description

**Invalid use of standard library routine** occurs when you use invalid arguments with a function from the standard library. This defect picks up errors related to other functions not covered by float, integer, memory, or string standard library routines.

## Examples

### Calling `printf` Without a String

```
#include <stdio.h>
#include <stdlib.h>

void print_null(void) {

  printf(NULL);
}
```

The function `printf` takes only string input arguments or format specifiers. In this function, the input value is NULL, which is not a valid string.

One possible correction is to change the input arguments to fit the requirements of the standard library routine. In this example, the input argument was changed to a character.

```
#include <stdio.h>

void print_null(void) {
    char zero_val = '0';
    printf((const char*)zero_val);
}
```

## Check Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `OTHER_STD_LIB`
**Impact:** High
**CWE ID:** 227
**CERT C ID:** API00-C, MSC15-C
**ISO/IEC TS 17961 ID:** `strmod`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Invalid use of standard library integer routine` | `Invalid use of standard library floating point routine` | `Invalid use of standard library memory routine` | `Invalid use of standard library string routine`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Invalid use of standard library string routine

Standard library string function called with invalid arguments

## Description

**Invalid use of standard library string routine** occurs when a string library function is called with invalid arguments.

## Examples

### Invalid Use of Standard Library String Routine Error

```
 #include <string.h>
 #include <stdio.h>

 char* Copy_String(void)
 {
  char *res;
  char gbuffer[5],text[20]="ABCDEFGHIJKL";

  res=strcpy(gbuffer,text);
  /* Error: Size of text is less than gbuffer */

  return(res);
 }
```

The string `text` is larger in size than `gbuffer`. Therefore, the function `strcpy` cannot copy `text` into `gbuffer`.

One possible correction is to declare the destination string `gbuffer` with equal or larger size than the source string `text`.

```
#include <string.h>
 #include <stdio.h>

 char* Copy_String(void)
```

```
{
 char *res;
 /*Fix: gbuffer has equal or larger size than text */
 char gbuffer[20],text[20]="ABCDEFGHIJKL";

 res=strcpy(gbuffer,text);

 return(res);
}
```

## Check Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `STR_STD_LIB`
**Impact:** High
**CWE ID:** 120, 227
**CERT C ID:** API00-C, ARR33-C, ARR38-C, MEM30-C, MSC15-C, STR31-C, STR32-C, STR35-C
**ISO/IEC TS 17961 ID:** `accfree`, `nullref`, `libptr`, `nonnullcs`, `taintformatio`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Invalid use of standard library memory routine`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Invalid va_list argument

Variable argument list used after invalidation with `va_end` or not initialized with `va_start` or `va_copy`

## Description

**Invalid va_list argument** occurs when you use a `va_list` variable as an argument to a function in the `vprintf` group but:

- You do not initialize the variable previously using `va_start` or `va_copy`.
- You invalidate the variable previously using `va_end` and do not reinitialize it.

For instance, you call the function `vsprintf` as `vsprintf (buffer,format, args)`. However, before the function call, you do not initialize the `va_list` variable `args` using either of the following:

- `va_start(args, paramName)`. `paramName` is the last named argument of a variable-argument function. For instance, for the function definition `void func(int n, char c, ...) {}`, `c` is the last named argument.
- `va_copy(args, anotherList)`. `anotherList` is another valid `va_list` variable.

### Risk

The behavior of an uninitialized `va_list` argument is undefined. Calling a function with an uninitialized `va_list` argument can cause stack overflows.

### Fix

Before using a `va_list` variable as function argument, initialize it with `va_start` or `va_copy`.

Clean up the variable using `va_end` only after all uses of the variable.

## Examples

### va_list Variable Used Following Call to va_end

```
#include <stdarg.h>
#include <stdio.h>

int call_vfprintf(int line, const char *format, ...) {
    va_list ap;
    int r=0;

    va_start(ap, format);
    r = vfprintf(stderr, format, ap);
    va_end(ap);

    r += vfprintf(stderr, format, ap);
    return r;
}
```

In this example, the va_list variable ap is used in the vfprintf function, after the va_end macro is called.

One possible correction is to call va_end only after all uses of the va_list variable.

```
#include <stdarg.h>
#include <stdio.h>

int call_vfprintf(int line, const char *format, ...) {
    va_list ap;
    int r=0;

    va_start(ap, format);
    r = vfprintf(stderr, format, ap);
    r += vfprintf(stderr, format, ap);
    va_end(ap);

    return r;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `INVALID_VA_LIST_ARG`
**Impact:** High
**CWE ID:** 628
**CERT C ID:** MSC39-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Large pass-by-value argument

Large argument passed by value between functions

## Description

**Large pass-by-value argument** occurs when a large input argument or return value is passed between functions by its value. For variables larger than 64 bytes, pass the value by pointer or by reference to save stack space and copy time.

In C code, when a function returns by value, the return value is copied to the caller. Therefore, this defect appears on functions that have large return values. In C++ code, if a function return value is of class type, under certain conditions, the standard allows compilers to avoid copying the return value (C++98: Section 12.8, Item 15; C++11: Section 12.8, Item 31). Most compilers do not perform a copy in such cases. This behavior is called return value optimization. In such cases, Polyspace Bug Finder does not produce this defect if a large object is returned by value.

## Examples

### Large Function Argument

```
typedef struct s_userid {
    char name[2];
    int idnumber[100];
} userid;

char username(userid first) {
    return first.name[0];
}
```

The large structure, `userid`, is passed to the function `username`. Because `userid` is larger than 64 bytes, this function produces a large pass-by-value defect.

One possible correction is to pass the argument by reference instead of by value. In this corrected example, the pointer to a userid structure is passed instead of the actual structure.

```
typedef struct s_userid {
    char name[2];
    int idnumber[100];
} userid;

char username(userid *first) {
    return (*first).name[0];
}
```

## Large Function Return Value

```
#include <stdlib.h>

#define initialSize 4
#define idSize 100

typedef struct {
    char initials[initialSize];
    int id[idSize];
} userId;

userId* getAddress(void);
assignValues(char*, int*);

userId username(void) {
    userId * newId = getAddress();
    assignValues((*newId).initials, (*newId).id);
    return *newId;
}
```

In this example, the function username returns a large structure *newId by value. When a function calls username, the value in *newId is copied to the caller.

One possible correction is to return the large structure by reference. In this corrected example, the pointer to structure newId is returned from the function username.

```
#include <stdlib.h>
```

```
#define initialSize 4
#define idSize 100

typedef struct {
    char initials[initialSize];
    int id[idSize];
} userId;

userId* getAddress(void);
assignValues(char*, int*);

userId * username(void) {
    userId * newId = getAddress();
    assignValues((*newId).initials, (*newId).id);
    return newId;
}
```

## Check Information

**Group:** Good practice
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `PASS_BY_VALUE`
**Impact:** Low

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2013b**

# Library loaded from externally controlled path

Using a library argument from an externally controlled path

## Description

**Library loaded from externally controlled path** looks for libraries loaded from fixed or controlled paths. If unintended actors can control one or more locations on this fixed path, Bug Finder raises a defect.

### Risk

If an attacker knows or controls the path that you use to load a library, the attacker can change:

- The library that the program loads, replacing the intended library and commands.
- The environment in which the library executes, giving unintended permissions and capabilities to the attacker.

### Fix

When possible, use hard-coded or fully qualified path names to load libraries. It is possible the hard-coded paths do not work on other systems. Use a centralized location for hard-coded paths, so that you can easily modify the path within the source code.

Another solution is to use functions that require explicit paths. For example, `system()` does not require a full path because it can use the `PATH` environment variable. However, `execl()` and `execv()` do require the full path.

## Examples

### Call Custom Library

```
#include <stdlib.h>
#include <stdio.h>
```

```
#include <string.h>
#include <unistd.h>
#include <dlfcn.h>
#include <limits.h>

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

void* taintedpathlib() {
    void* libhandle = NULL;
    char lib[SIZE128] = "";
    char* userpath = getenv("LD_LIBRARY_PATH");
    strncpy(lib, userpath, SIZE128);
    strcat(lib, "/libX.so");
    libhandle = dlopen(lib, 0x00001);
    return libhandle;
}
```

This example loads the library `libX.so` from an environment variable `LD_LIBRARY_PATH`. An attacker can change the library path in this environment variable. The actual library you load could be a different library from the one that you intend.

One possible correction is to change how you get the library path and check the path of the library before opening the library. This example receives the path as an input argument. Then the path is checked to make sure the library is not under `/usr/`.

```
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <unistd.h>
#include <dlfcn.h>
#include <limits.h>

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};
```

```
/* Function to sanitize a string */
int sanitize_str(char* s, size_t n) {
    /* strlen is used here as a kind of firewall for tainted string errors */
    int res = (strlen(s) > 0 && strlen(s) < n);
    return res;
}
void* taintedpathlib(char* userpath) {
    void* libhandle = NULL;
    if (sanitize_str(userpath, SIZE128)) {
        char lib[SIZE128] = "";

        if (strncmp(userpath, "/usr", 4)!=0) {
            strncpy(lib, userpath, SIZE128);
            strcat(lib, "/libX.so");
            libhandle = dlopen(lib, RTLD_LAZY);
        }
    }
    return libhandle;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_PATH_LIB`
**Impact:** Medium
**CWE ID:** 114, 426
**CERT C ID:** API00-C, STR02-C, WIN00-C

## See Also

`Execution of externally controlled command` | `Use of externally controlled environment variable` | `Command executed from externally controlled path`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Line with more than one statement

Multiple statements on a line

## Description

Before preprocessing starts, **Line with more than one statement** checks for additional text after the semicolon (`;`) on a line. A defect is not raised for comments, `for`-loop definitions, braces, or backslashes.

## Examples

### Single-Line Initialization

```
int multi_init(void){
_    int abc = 4; int efg = 0; //defect

    return abc*efg;
}
```

In this example, `abc` and `efg` are initialized on the second line of the function as separate statements.

One possible correction is to use a comma instead of a semicolon to declare multiple variables on the same line.

```
int multi_init(void){
    int a = 4, b = 0;

    return a*b;
}
```

One possible correction is to separate each initialization. By putting the initialization of `b` on the next line, the code longer raises a defect.

```
int multi_init(void){
    int a = 4;
    int b = 0;

    return a*b;
}
```

## Single-Line Loops

```
int multi_loop(void){
    int a, b = 0;
    int index = 1;
    int tab[9] = {1,1,2,3,5,8,13,21};

    for(a=0; a < 3; a++) {b+=a;} // no defect

_   for(b=0; b < 3; b++) {a+=b; index=b;} //defect

_   while (index < 7) {index++; tab[index] = index * index;} //defect
    return a*b;
}
```

In this example, there are three loops coded on single lines, each with multiple semicolons.

- The first `for` loop has multiple semicolons. Polyspace does not raise a defect for multiple statements within a `for` loop declaration.
- Polyspace does raise a defect on the second `for` loop because there are multiple statements after the `for` loop declaration.
- The `while` loop also has multiple statements after the loop declaration. Polyspace raises a defect on this line.

One possible correction is to use a new line for each statement after the loop declaration.

```
int multi_loop(void){
    int a, b = 0;
    int index = 1;
    int tab[9] = {1,1,2,3,5,8,13,21};

    for(a=0; a < 3; a++) {b+=a;}

    for(b=0; b < 3; b++){
      a+=b;
      index=b;
    }

    while (index < 7){
      index++;
      tab[index] = index * index;
    }
    return a*b;
}
```

### Single-line Conditionals

```
int multi_if(void){

    int a, b = 1;
    if(a == 0) { a++;} // no defect
_    else if(b == 1) {b++; a *= b;} //defect
}
```

In this example, there are two conditional statements an: `if` and an `else if`. The `if` line does not raise a defect because only one statement follows the condition. The `else if` statement does raise a defect because two statements follow the condition.

One possible correction is to use a new line for conditions with multiple statements.

```
int multi_if(void){
    int a, b = 1;

    if(a == 0) a++;
    else if(b == 1){
      b++;
      a *= b;
    }
}
```

## Check Information

**Group:** Good practice
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `MORE_THAN_ONE_STATEMENT`

**Impact:** Low

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Load of library from a relative path can be controlled by an external actor

Library loaded with relative path is vulnerable to malicious attacks

## Description

**Load of library from a relative path can be controlled by an external actor** detects library loading routines that load an external library. If you load the library using a relative path or no path, Bug Finder flags the loading routine as a defect.

### Risk

By using a relative path or no path to load an external library, your program uses an unsafe search process to find the library. An attacker can control the search process and replace the intended library with a library of their own.

### Fix

When you load an external library, specify the full path.

## Examples

### Open Library with Library Name

```
#include <dlfcn.h>
#include <stdlib.h>
#include <string.h>
#include <malloc.h>
#include <stdio.h>

void relative_path()
{
    dlopen("liberty.dll",RTLD_LAZY);
}
```

In this example, `dlopen` opens the `liberty` library by calling only the name of the library. However, this call to the library uses a relative path to find the library, which is unsafe.

One possible correction is to use the full path to the library when you load it into your program.

```
#include <dlfcn.h>
#include <stdlib.h>
#include <string.h>
#include <malloc.h>
#include <stdio.h>

void relative_path()
{
    dlopen("/home/my_libs/library/liberty.dll",RTLD_LAZY);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `RELATIVE_PATH_LIB`
**Impact:** Medium
**CWE ID:** 114, 427
**CERT C ID:** WIN00-C

## See Also

`Execution of a binary from a relative path can be controlled by an external actor` | `Vulnerable path manipulation` | `Library loaded from externally controlled path`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Loop bounded with tainted value

Loop controlled by a value from an unsecure source

## Description

**Loop bounded with tainted value** detects loops that are bounded by values from an unsecure source.

### Risk

A tainted value can cause over looping or infinite loops. Attackers can use this vulnerability to crash your program or cause other unintended behavior.

### Fix

Before starting the loop, validate unknown boundary and iterator values.

## Examples

### Loop Boundary From Input Argument

```
enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

int taintedloopboundary(int count) {
    int res = 0;
    for (int i=0 ; i < count; ++i) {
        res += i;
    }
    return res;
}
```

In this example, the function uses the input argument to loop `count` times. `count` could be any number because the value is not checked before starting the for-loop.

One possible correction is to check the value of the variable controlling the loop before starting the for-loop. This example checks if `count` is greater than zero and less than the maximum size.

```
enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

int taintedloopboundary(int count) {
    int res = 0;

    if (count>0 && count<SIZE128) {
        for (int i=0 ; i<count ; ++i) {
            res += i;
        }
    }
    return res;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_LOOP_BOUNDARY`
**Impact:** Medium
**CWE ID:** 606
**CERT C ID:** INT04-C, MSC21-C
**ISO/IEC TS 17961 ID:** `taintsink`

## See Also

`Array access with tainted index` | `Pointer dereference with tainted offset`

## Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Member not initialized in constructor

Constructor does not initialize some members of a class

## Description

**Non-initialized member** occurs when a class constructor has at least one execution path on which it does not initialize some data members of the class.

The defect does not appear in the following cases:

- Empty constructors.
- The non-initialized member is not used in the code.

### Risk

The members that the constructor does not initialize can have unintended values when you read them later.

Initializing all members in the constructor makes it easier to use your class. If you call a separate method to initialize your members and then read them, you can avoid uninitialized values. However, someone else using your class can read a class member *before* calling your initialization method. Because a constructor is called when you create an object of the class, if you initialize all members in the constructor, they cannot have uninitialized values later on.

### Fix

The best practice is to initialize all members in your constructor, preferably in an initialization list.

# Examples

## Non-Initialized Member

```
class MyClass {
public:
    explicit MyClass(int);
private:
    int _i;
    char _c;
};

MyClass::MyClass(int flag) {
    if(flag == 0) {
        _i = 0;
        _c = 'a';
    }
    else {
        _i = 1;
    }
}
```

In this example, if `flag` is not 0, the member `_c` is not initialized.

The defect appears on the closing brace of the constructor. Following are some tips for navigating in the source code:

- On the **Result Details** pane, see which members are not initialized.
- To navigate to the class definition, right-click a member that is initialized in the constructor. Select **Go To Definition**. In the class definition, you can see all the members, including those members that are not initialized in the constructor.

One possible correction is to initialize all members of the class `MyClass` for all values of `flag`.

```
class MyClass {
public:
    explicit MyClass(int);
private:
    int _i;
    char _c;
};

MyClass::MyClass(int flag) {
    if(flag == 0) {
        _i = 0;
        _c = 'a';
    }
    else {
        _i = 1;
        _c = 'b';
    }
}
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** Off
**Command-Line Syntax:** `NON_INIT_MEMBER`
**Impact:** Medium
**CWE ID:** 456, 457, 908
**ISO/IEC TS 17961 ID:** `uninitref`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Copy constructor not called in initialization list`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Memory allocation with tainted size

Size argument to memory function is from an unsecure source

## Description

**Memory allocation with tainted size** checks memory allocation functions, such as `calloc` or `malloc`, for size arguments from unsecured sources.

### Risk

Uncontrolled memory allocation can cause your program to request too much system memory. This consequence can lead to a crash due to an out-of-memory condition, or assigning too many resources.

### Fix

Before allocating memory, check the value of your arguments to check that they do not exceed the bounds.

## Examples

### Allocate Memory Using Input Argument

```
#include "stdlib.h"

int* bug_taintedmemoryallocsize(size_t size) {
    int* p = (int*)malloc(size);
    return p;
}
```

In this example, `malloc` allocates `size` amount of memory for the pointer `p`. `size` is an outside variable, so could be any size value. If the size is larger than the amount of memory you have available, your program could crash.

One possible correction is to check the size of the memory that you want to allocate before performing the `malloc` operation. This example checks to see if the size is positive and less than the maximum size.

```
#include "stdlib.h"

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

int* corrected_taintedmemoryallocsize(int size) {
    int* p = NULL;
    if (size>0 && size<SIZE128) {          /* Fix: Check entry range before use */
        p = (int*)malloc((unsigned int)size);
    }
    return p;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_MEMORY_ALLOC_SIZE`
**Impact:** Medium
**CWE ID:** 789
**CERT C ID:** API00-C, ARR32-C, INT04-C, MEM07-C, MEM10-C, MEM11-C, MEM35-C
**ISO/IEC TS 17961 ID:** `taintsink`

## See Also

`Unprotected dynamic memory allocation`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Memory comparison of padding data

memcmp compares data stored in structure padding

## Description

**Memory comparison of padding data** occurs when you use the memcmp function to compare two structures as a whole. In the process, you compare meaningless data stored in the structure padding.

For instance:

```
struct structType {
    char member1;
    int member2;
    .
    .
};

structType var1;
structType var2;
.
.
if(memcmp(&var1,&var2,sizeof(var1)))
{...}
```

### Risk

If members of a structure have different data types, your compiler introduces additional padding for data alignment in memory. For an example of padding, see Higher Estimate of Local Variable Size.

The content of these extra padding bytes is meaningless. The C Standard allows the content of these bytes to be indeterminate, giving different compilers latitude to implement their own padding. If you perform a byte-by-byte comparison of structures with memcmp, you compare even the meaningless data stored in the padding. You might reach the false conclusion that two data structures are not equal, even if their corresponding members have the same value.

## Fix

Instead of comparing two structures in one attempt, compare the structures member by member.

For efficient code, write a function that does the comparison member by member. Use this function for comparing two structures.

You can use `memcmp` for byte-by-byte comparison of structures only if you know that the structures do not contain padding. Typically, to prevent padding, you use specific attributes or pragmas such as `#pragma pack`. However, these attributes or pragmas are not supported by all compilers and make your code implementation-dependent. If your structures contain bit-fields, using these attributes or pragmas cannot prevent padding.

# Examples

### Structures Compared with memcmp

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define fatal_error() abort()

typedef struct s_padding
{
    char c;
    int i;
    unsigned int bf1:1;
    unsigned int bf2:2;
    unsigned char buffer[20];
} S_Padding ;

/* Function that guarantees safe access to the input memory */
extern int trusted_memory_zone(void *ptr, size_t sz);

int func(const S_Padding *left, const S_Padding *right)
{

    if (!trusted_memory_zone((void *)left, sizeof(S_Padding)) ||
        !trusted_memory_zone((void *)right, sizeof(S_Padding))) {
```

```
        fatal_error();
    }

    if (0 == memcmp(left, right, sizeof(S_Padding)))
    {
        return 1;
    }
    else
        return 0;
}
```

In this example, `memcmp` compares byte-by-byte the two structures that `left` and `right` point to. Even if the values stored in the structure members are the same, the comparison can show an inequality if the meaningless values in the padding bytes are not the same.

One possible correction is to compare individual structure members.

**Note** You can compare entire arrays by using `memcmp`. All members of an array have the same data type. Padding bytes are not required to store arrays.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define fatal_error() abort()

typedef struct s_padding
{
    char c;
    int i;
    unsigned int bf1:1;
    unsigned int bf2:2;
    unsigned char buffer[20];
} S_Padding ;

/* Function that guarantees safe access to the input memory */
extern int trusted_memory_zone(void *ptr, size_t sz);

int func(const S_Padding *left, const S_Padding *right)
{
    if (!trusted_memory_zone((void *)left, sizeof(S_Padding)) ||
        !trusted_memory_zone((void *)right, sizeof(S_Padding))) {
        fatal_error();
    }

    return ((left->c == right->c) &&
            (left->i == right->i) &&
            (left->bf1 == right->bf1) &&
            (left->bf2 == right->bf2) &&
            (memcmp(left->buffer, right->buffer, 20) == 0));
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `MEMCMP_PADDING_DATA`
**Impact:** Medium
**CWE ID:** 188
**CERT C ID:** EXP42-C
**ISO/IEC TS 17961 ID:** `padcomp`

## See Also

### Polyspace Results

Memory comparison of strings

### Introduced in R2017a

# Memory comparison of strings

`memcmp` compares data stored in strings after the null terminator

## Description

**Memory comparison of strings** occurs when:

- You compare two strings byte-by-byte with the `memcmp` function.
- The number of bytes compared is such that you compare meaningless data stored after the null terminator.

For instance:

```
memcmp(string1, string2, sizeof(string1))
```

can compare bytes in the string after the null terminator.

### Risk

The null terminator signifies the end of a string. Comparison of bytes after the null terminator is meaningless. You might reach the false conclusion that two strings are not equal, even if the bytes before the null terminator store the same value.

### Fix

Use `strcmp` for string comparison. The function compares strings only up to the null terminator.

If you use `memcmp` for a byte-by-byte comparison of two strings, avoid comparison of bytes after the null terminator. Determine the number of bytes to compare by using the `strlen` function.

# Examples

## Strings Compared with **`memcmp`**

```
#include <stdio.h>
#include <string.h>

#define SIZE20 20

int func()
{
    char s1[SIZE20] =  "abc";
    char s2[SIZE20] =  "abc";

    return memcmp(s1, s2, sizeof(s1));
}
```

In this example, `sizeof` returns the length of the entire array `s1`, which is 20. However, only the first three bytes of the string are relevant.

Even though `s1` and `s2` hold the same value, the comparison with `memcmp` can show a false inequality.

One possible correction is to determine the number of bytes to compare using the `strlen` function. `strlen` returns the number of bytes *before* the null terminator (and excluding the null terminator itself).

```
#include <stdio.h>
#include <string.h>

#define SIZE20 20

int func()
{
    char s1[SIZE20] =  "abc";
    char s2[SIZE20] =  "abc";

    return memcmp(s1, s2, strlen(s1));
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `MEMCMP_STRINGS`
**Impact:** Medium
**CWE ID:** 188

## See Also

### Polyspace Results

`Memory comparison of padding data`

### Introduced in R2017a

# Memory leak

Memory allocated dynamically not freed

## Description

**Memory leak** occurs when you do not free a block of memory allocated through malloc, calloc, realloc, or new. If the memory is allocated in a function, the defect does not occur if:

- Within the function, you free the memory using free or delete.
- The function returns the pointer assigned by malloc, calloc, realloc, or new.
- The function stores the pointer in a global variable or in a parameter.

## Examples

### Pointer with Dynamic Memory

```
#include<stdlib.h>
#include<stdio.h>

void assign_memory(void)
{
    int* pi = (int*)malloc(sizeof(int));
    if (pi == NULL)
        {
         printf("Memory allocation failed");
         return;
        }


    *pi = 42;
    /* Defect: pi is not freed */
}
```

In this example, pi is dynamically allocated by malloc. The function assign_memory does not free the memory, nor does it return pi.

One possible correction is to free the memory referenced by pi using the free function. The free function must be called before the function assign_memory terminates

```
#include<stdlib.h>
#include<stdio.h>

void assign_memory(void)
{
    int* pi = (int*)malloc(sizeof(int));
    if (pi == NULL)
        {
         printf("Memory allocation failed");
         return;
        }
    *pi = 42;

    /* Fix: Free the pointer pi*/
    free(pi);
}
```

Another possible correction is to return the pointer pi. Returning pi allows the function calling assign_memory to free the memory block using pi.

```
#include<stdlib.h>
#include<stdio.h>

int* assign_memory(void)
{
    int* pi = (int*)malloc(sizeof(int));
    if (pi == NULL)
        {
            printf("Memory allocation failed");
            return(pi);
        }
    *pi = 42;

    /* Fix: Return the pointer pi*/
    return(pi);
}
```

### Memory Leak with New/Delete

```
#define NULL '\0'

void initialize_arr1(void)
{
    int *p_scalar = new int(5);
}

void initialize_arr2(void)
{
    int *p_array = new int[5];
}
```

In this example, the functions create two variables, `p_scalar` and `p_array`, using the `new` keyword. However, the functions end without cleaning up the memory for these pointers. Because the functions used `new` to create these variables, you must clean up their memory by calling `delete` at the end of each function.

To correct this error, add a `delete` statement for every `new` initialization. If you used brackets `[]` to instantiate a variable, you must call delete with brackets as well.

```
#define NULL '\0'

void initialize_arrs(void)
{
    int *p_scalar = new int(5);
    int *p_array = new int[5];

    delete p_scalar;
    p_scalar = NULL;

    delete[] p_array;
    p_scalar = NULL;
}
```

## Check Information

**Group:** Dynamic memory

**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `MEM_LEAK`
**Impact:** Medium
**CWE ID:** 401, 404
**CERT C ID:** MEM11-C, MEM12-C, MEM31-C
**ISO/IEC TS 17961 ID:** `fileclose`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Mismatched alloc/dealloc functions on Windows

Improper deallocation function causes memory corruption issues

## Description

**Mismatched alloc/dealloc functions on Windows** occurs when you use a Windows deallocation function that is not properly paired to its corresponding allocation function.

### Risk

Deallocating memory with a function that does not match the allocation function can cause memory corruption or undefined behavior. If you are using an older version of Windows, the improper function can also cause compatibility issues with newer versions.

### Fix

Properly pair your allocation and deallocation functions according to the functions listed in this table.

| Allocation Function | Deallocation Function |
|---|---|
| `malloc()` | `free()` |
| `realloc()` | `free()` |
| `calloc()` | `free()` |
| `_aligned_malloc()` | `_aligned_free()` |
| `_aligned_offset_malloc()` | `_aligned_free()` |
| `_aligned_realloc()` | `_aligned_free()` |
| `_aligned_offset_realloc()` | `_aligned_free()` |
| `_aligned_recalloc()` | `_aligned_free()` |
| `_aligned_offset_recalloc()` | `_aligned_free()` |
| `_malloca()` | `_freea()` |
| `LocalAlloc()` | `LocalFree()` |

| Allocation Function | Deallocation Function |
|---|---|
| `LocalReAlloc()` | `LocalFree()` |
| `GlobalAlloc()` | `GlobalFree()` |
| `GlobalReAlloc()` | `GlobalFree()` |
| `VirtualAlloc()` | `VirtualFree()` |
| `VirtualAllocEx()` | `VirtualFreeEx()` |
| `VirtualAllocExNuma()` | `VirtualFreeEx()` |
| `HeapAlloc()` | `HeapFree()` |
| `HeapReAlloc()` | `HeapFree()` |

## Examples

### Memory Deallocated with Incorrect Function

```
#ifdef _WIN32_
#include <windows.h>
#else
#define _WIN32_
typedef void *HANDLE;
typedef HANDLE HGLOBAL;
typedef HANDLE HLOCAL;
typedef unsigned int UINT;
extern HLOCAL LocalAlloc(UINT uFlags, UINT uBytes);
extern HLOCAL LocalFree(HLOCAL hMem);
extern HGLOBAL GlobalFree(HGLOBAL hMem);
#endif

#define SIZE9 9


void func(void)
{
    /* Memory allocation */
    HLOCAL p = LocalAlloc(0x0000, SIZE9);

    if (p) {
        /* Memory deallocation. */
        GlobalFree(p);

    }
}
```

In this example, memory is allocated with `LocallAlloc()`. The program then erroneously uses `GlobalFree()` to deallocate the memory.

When you allocate memory with `LocalAllocate()`, use `LocalFree()` to deallocate the memory.

```
#ifdef _WIN32_
#include <windows.h>
#else
#define _WIN32_
typedef void *HANDLE;
typedef HANDLE HGLOBAL;
typedef HANDLE HLOCAL;
typedef unsigned int UINT;
extern HLOCAL LocalAlloc(UINT uFlags, UINT uBytes);
extern HLOCAL LocalFree(HLOCAL hMem);
extern HGLOBAL GlobalFree(HGLOBAL hMem);
#endif

#define SIZE9 9
void func(void)
{
    /* Memory allocation */
    HLOCAL p = LocalAlloc(0x0000, SIZE9);
    if (p) {
        /* Memory deallocation. */
        LocalFree(p);
    }
}
```

## Result Information

**Group:** Dynamic memory
**Language:** C | C++
**Default:** Off

**Command-Line Syntax:** `WIN_MISMATCH_DEALLOC`
**Impact:** Low
**CWE ID:** 404, 762
**CERT C ID:** WIN30-C

## See Also

`Invalid deletion of pointer` | `Invalid free of pointer`

Introduced in R2017b

# Mismatch between data length and size

Data size argument is not computed from actual data length

## Description

**Mismatch between data length and size** looks for memory copying functions such as `memcpy`, `memset`, or `memmove`. If you do not control the length argument and data buffer argument properly, Bug Finder raises a defect.

### Risk

If an attacker can manipulate the data buffer or length argument, the attacker can cause buffer overflow by making the actual data size smaller than the length.

This mismatch in length allows the attacker to copy memory past the data buffer to a new location. If the extra memory contains sensitive information, the attacker can now access that data.

This defect is similar to the SSL Heartbleed bug.

### Fix

When copying or manipulating memory, compute the length argument directly from the data so that the sizes match.

## Examples

### Copy Buffer of Data

```
#include <stdlib.h>
#include <string.h>

typedef struct buf_mem_st {
    char *data;
    size_t max;     /* size of buffer */
} BUF_MEM;

extern BUF_MEM beta;

int cpy_data(BUF_MEM *alpha)
{
    BUF_MEM *os = alpha;
    int num, length;

    if (alpha == 0x0) return 0;
    num = 0;

    length = *(unsigned short *)os->data;
    memcpy(&(beta.data[num]), os->data + 2, length);

    return(1);
}
```

This function copies the buffer `alpha` into a buffer `beta`. However, the `length` variable is not related to `data+2`.

One possible correction is to check the length of your buffer against the maximum value minus 2. This check ensures that you have enough space to copy the data to the `beta` structure.

```
#include <stdlib.h>
#include <string.h>

typedef struct buf_mem_st {
    char *data;
    size_t max;     /* size of buffer */
} BUF_MEM;

extern BUF_MEM beta;

int cpy_data(BUF_MEM *alpha)
{
    BUF_MEM *os = alpha;
    int num, length;

    if (alpha == 0x0) return 0;
    num = 0;
    length = *(unsigned short *)os->data;
    if (length<(os->max -2)) {
        memcpy(&(beta.data[num]), os->data + 2, length);
    }

    return(1);

}
```

## Result Information

**Group:** Security<br>
**Language:** C | C++<br>
**Default:** Off<br>
**Command-Line Syntax:** `DATA_LENGTH_MISMATCH`<br>
**Impact:** Medium<br>
**CWE ID:** 130, 240<br>
**CERT C ID:** ARR38-C

## See Also

`Copy of overlapping memory`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

#### Introduced in R2015b

# Missing block cipher initialization vector

Non-NULL initialization vector is not associated with the cipher context for encryption or decryption

## Description

**Missing block cipher initialization vector** occurs when you encrypt or decrypt data using a NULL initialization vector (IV).

**Note** You can initialize your cipher context with a NULL initialization vector (IV). However, if your algorithm requires an IV, before the encryption or decryption step, you must associate the cipher context with a non-NULL IV.

### Risk

Many block cipher modes use an initialization vector (IV) to prevent dictionary attacks. If you use a NULL IV, your encrypted data is vulnerable to such attacks.

Block ciphers break your data into blocks of fixed size. Block cipher modes such as CBC (Cipher Block Chaining) protect against dictionary attacks by XOR-ing each block with the encrypted output from the previous block. To protect the first block, these modes use a random initialization vector (IV). If you use a NULL IV, you get the same ciphertext when encrypting the same plaintext. Your data becomes vulnerable to dictionary attacks.

### Fix

Before your encryption or decryption steps

```
 ret = EVP_EncryptUpdate(&ctx, out_buf, &out_len, src, len)
```

associate your cipher context `ctx` with a non-NULL initialization vector.

```
ret = EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv)
```

## Examples

### NULL Initialization Vector Used for Encryption

```
#include <openssl/evp.h>
#include <stdlib.h>
#define fatal_error() abort()

unsigned char *out_buf;
int out_len;

int func(EVP_CIPHER_CTX *ctx, unsigned char *key, unsigned char *src, int len){
    if (key == NULL)
        fatal_error();

    /* Last argument is initialization vector */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, NULL);

    /* Update step with NULL initialization vector */
    return EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
}
```

In this example, the initialization vector associated with the cipher context `ctx` is NULL. If you use this context to encrypt your data, your data is vulnerable to dictionary attacks.

Use a strong random number generator to produce the initialization vector. The corrected code here uses the function `RAND_bytes` declared in `openssl/rand.h`.

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define fatal_error() abort()
#define SIZE16 16

unsigned char *out_buf;
int out_len;

int func(EVP_CIPHER_CTX *ctx, unsigned char *key, unsigned char *src, int len){
    if (key == NULL)
        fatal_error();
    unsigned char iv[SIZE16];
    RAND_bytes(iv, 16);

    /* Last argument is initialization vector */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);

    /* Update step with non-NULL initialization vector */
    return EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_NO_IV`
**Impact:** Medium
**CWE ID:** 310, 326, 329

Introduced in R2017a

# Missing break of switch case

No comments at the end of switch case without a break statement

## Description

**Missing break of switch case** looks for switch cases that do not end in a `break` statement. If the case does not have a code comment after it, Polyspace assumes the missing break is not intentional and raises a defect.

### Risk

Switch cases without break statements fall through to the next switch case. If this fall-through is not intended, the switch case can unintentionally execute code and end the switch with unexpected results.

### Fix

If you do not want a break for the highlighted switch case, add a comment to your code to document why this case falls through to the next case. This comment removes the defect from your results and makes your code more maintainable.

If you forgot the break, add it before the end of the switch case.

## Examples

### Switch Without Break Statements

```
enum WidgetEnum { WE_W, WE_X, WE_Y, WE_Z } widget_type;

extern void demo_do_something_for_WE_W(void);
extern void demo_do_something_for_WE_X(void);
extern void demo_report_error(void);

void bug_missingswitchbreak(enum WidgetEnum wt)
```

```
{
    /*
      In this non-compliant code example, the case where widget_type is WE_W lacks a
      break statement. Consequently, statements that should be executed only when
      widget_type is WE_X are executed even when widget_type is WE_W.
    */
    switch (wt)
    {
      case WE_W:
        demo_do_something_for_WE_W();
      case WE_X:
        demo_do_something_for_WE_X();
      default:
        /* Handle error condition */
        demo_report_error();
    }
}
```

In this example, there are two cases without `break` statements. When `wt` is `WE_W`, the statements for `WE_W`, `WE_X`, and the `default` case execute because the program falls through the two cases without a break. No defect is raised on the `default` case or last case because it does not need a break statement.

To fix this example, either add a comment to mark and document the acceptable fall-through or add a break statement to avoid fall-through. In this example, case `WE_W` is supposed to fall through, so a comment is added to explicitly state this action. For the second case, a break statement is added to avoid falling through to the `default` case.

```
enum WidgetEnum { WE_W, WE_X, WE_Y, WE_Z } widget_type;

extern void demo_do_something_for_WE_W(void);
extern void demo_do_something_for_WE_X(void);
extern void demo_report_error(void);

void corrected_missingswitchbreak(enum WidgetEnum wt)
{
    switch (wt)
    {
      case WE_W:
        demo_do_something_for_WE_W();
        /* fall through to WE_X*/
      case WE_X:
        demo_do_something_for_WE_X();
        break;
      default:
        /* Handle error condition */
        demo_report_error();
    }
}
```

## Result Information

**Group:** Good Practice
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** MISSING_SWITCH_BREAK
**Impact:** Low
**CWE ID:** 484
**CERT C ID:** MSC17-C

## See Also

Missing case for switch condition

Introduced in R2016b

# Missing byte reordering when transferring data

Different endianness of host and network

## Description

**Missing byte reordering when transferring data** occurs when you do not use a byte ordering function:

- Before sending data to a network socket.
- After receiving data from a network socket.

### Risk

Some system architectures implement little endian byte ordering (least significant byte first), and other systems implement big endian (most significant byte first). If the endianness of the sent data does not match the endianness of the receiving system, the value returned when reading the data is incorrect.

### Fix

After receiving data from a socket, use a byte ordering function such as `ntohl()`. Before sending data to a socket, use a byte ordering function such as `htonl()` .

## Examples

### Data Transferred Without Byte Reordering

```
#include <stdio.h>
#include <stdlib.h>
#include <stdint.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <byteswap.h>
```

```
#include <unistd.h>
#include <string.h>


unsigned int func(int sock, int server)
{
    unsigned int num;   /* assume int is 32-bits */
    if (server)
    {
        /* Server side */
        num = 0x17;
        /* Endianness of server host may not match endianness of network. */
        if (send(sock, (void *)&num, sizeof(num), 0) < (int)sizeof(num))
        {
            /* Handle error */
        }
        return 0;
    }
    else {
        /* Endianness of client host may not match endianness of network. */
        if (recv (sock, (void *)&num, sizeof(num), 0) < (int) sizeof(num))
        {
            /* Handle error */
        }

        /* Comparison may be inaccurate */
        if (num> 255)
        {
            return 255;
        }
        else
        {
            return num;
        }
    }
}
```

In this example, variable `num` is assigned hexadecimal value `0x17` and is sent over a network to the client from the server. If the server host is little endian and the network is big endian, `num` is transferred as `0x17000000`. The client then reads an incorrect value for `num` and compares it to a local numeric value.

Before sending num from the server host, use htonl() to convert from host to network byte ordering. Similarly, before reading num on the client host, use ntohl() to convert from network to host byte ordering.

```
#include <stdio.h>
#include <stdlib.h>
#include <stdint.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <arpa/inet.h>
#include <byteswap.h>
#include <unistd.h>
#include <string.h>

unsigned int func(int sock, int server)
{
    unsigned int num;   /* assume int is 32-bits */
    if (server)
    {
        /* Server side */
        num = 0x17;

        /* Convert to network byte order. */
        num = htonl(num);
        if (send(sock, (void *)&num, sizeof(num), 0) < (int)sizeof(num))
        {
            /* Handle error */
        }
        return 0;
    }
    else {
        if (recv (sock, (void *)&num, sizeof(num), 0) < (int) sizeof(num))
        {
            /* Handle error */
        }

        /* Convert to host byte order. */
        num = ntohl(num);
        if (num > 255)
        {
            return 255;
        }
        else
        {
            return num;
        }
    }
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `MISSING_BYTESWAP`
**Impact:** Medium
**CWE ID:** 188, 198
**CERT C ID:** POS39-C

## See Also

Introduced in R2017b

# Missing case for switch condition

`switch` variable not covered by cases and default case is missing

## Description

**Missing case for switch condition** occurs when the `switch` variable can take values that are not covered by a `case` statement.

**Note** Bug Finder only raises a defect if the switch variable is not full range.

### Risk

If the `switch` variable takes a value that is not covered by a `case` statement, your program can have unintended behavior.

A switch-statement that makes a security decision is particularly vulnerable when all possible values are not explicitly handled. An attacker can use this situation to deviate the normal execution flow.

### Fix

It is good practice to use a `default` statement as a catch-all for values that are not covered by a `case` statement. Even if the `switch` variable takes an unintended value, the resulting behavior can be anticipated.

## Examples

### Missing Default Condition

```
#include <stdio.h>
#include <string.h>

typedef enum E
```

```
{
    ADMIN=1,
    GUEST,
    UNKNOWN = 0
} LOGIN;

static LOGIN system_access(const char *username) {
  LOGIN user = UNKNOWN;

  if ( strcmp(username, "root") == 0 )
    user = ADMIN;

  if ( strcmp(username, "friend") == 0 )
    user = GUEST;

  return user;
}

int identify_bad_user(const char * username)
{
    int r=0;

    switch( system_access(username) )
    {
    case ADMIN:
        r = 1;
        break;
    case GUEST:
        r = 2;
    }

    printf("Welcome!\n");
    return r;
}
```

In this example, the `enum` parameter `User` can take a value `UNKNOWN` that is not covered by a `case` statement.

One possible correction is to add a default condition for possible values that are not covered by a `case` statement.

```
#include <stdio.h>
#include <string.h>
```

```
typedef enum E
{
    ADMIN=1,
    GUEST,
    UNKNOWN = 0
} LOGIN;

static LOGIN system_access(const char *username) {
  LOGIN user = UNKNOWN;

  if ( strcmp(username, "root") == 0 )
    user = ADMIN;

  if ( strcmp(username, "friend") == 0 )
    user = GUEST;

  return user;
}

int identify_bad_user(const char * username)
{
    int r=0;

    switch( system_access(username) )
    {
    case ADMIN:
        r = 1;
        break;
    case GUEST:
        r = 2;
    break;
    default:
        printf("Invalid login credentials!\n");
    }

    printf("Welcome!\n");
    return r;
}
```

## Result Information

**Group:** Security

**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `MISSING_SWITCH_CASE`
**Impact:** Low
**CWE ID:** 478
**CERT C ID:** MSC01-C, MSC07-C
**ISO/IEC TS 17961 ID:** `swtchdflt`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Missing cipher algorithm

An encryption or decryption algorithm is not associated with the cipher context

## Description

**Missing cipher algorithm** occurs when you do not assign a cipher algorithm when setting up your cipher context.

You can initialize your cipher context without an algorithm. However, before you encrypt or decrypt your data, you must associate the cipher context with a cipher algorithm.

### Risk

A missing cipher algorithm can lead to run-time errors or at least, non-secure ciphertext.

Before encryption or decryption, you set up a cipher context that has the information required for encryption: the cipher algorithm and mode, an encryption or decryption key and an initialization vector (for modes that require initialization vectors).

```
ret = EVP_EncryptInit(&ctx, EVP_aes_128_cbc(), key, iv)
```

The function `EVP_aes_128_cbc()` specifies that the Advanced Encryption Standard (AES) algorithm must be used for encryption. The function also specifies a block size of 128 bits and the Cipher Bloch Chaining (CBC) mode.

Instead of specifying the algorithm, you can use NULL in the initialization step. However, before using the cipher context for encryption or decryption, you must perform an additional initialization that associates an algorithm with the context. Otherwise, the update steps for encryption or decryption can lead to run-time errors.

### Fix

Before your encryption or decryption steps

```
 ret = EVP_EncryptUpdate(&ctx, out_buf, &out_len, src, len)
```

associate your cipher context `ctx` with an algorithm.

```
ret = EVP_EncryptInit(ctx, EVP_aes_128_cbc(), key, iv)
```

# Examples

## Algorithm Missing During Context Initialization

```
#include <openssl/evp.h>
#include <stdlib.h>
#define SIZE16 16

unsigned char key[SIZE16];
unsigned char iv[SIZE16];
void func(void) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);
    EVP_EncryptInit_ex(ctx, NULL, NULL, key, iv);
}
```

In this example, an algorithm is not provided when the cipher context `ctx` is initialized.

Before you encrypt or decrypt your data, you have to provide a cipher algorithm. If you perform a second initialization to provide the algorithm, the cipher context is completely re-initialized. Therefore, the current initialization statement using `EVP_EncryptInit_ex` is redundant.

One possible correction is to provide an algorithm when you initialize the cipher context. In the corrected code below, the routine `EVP_aes_128_cbc` invokes the Advanced Encryption Standard (AES) algorithm. The routine also specifies a block size of 128 bits and the Cipher Block Chaining (CBC) mode for encryption.

```
#include <openssl/evp.h>
#include <stdlib.h>
#define SIZE16 16

unsigned char key[SIZE16];
unsigned char iv[SIZE16];
```

```
void func(unsigned char *src, int len, unsigned char *out_buf, int out_len) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);

    /* Initialization of cipher context */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);

    /* Update steps for encryption */
    EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_NO_ALGORITHM`
**Impact:** Medium
**CWE ID:** 310, 573

Introduced in R2017a

# Missing cipher data to process

Final encryption or decryption step is performed without previous update steps

## Description

**Missing cipher data to process** occurs when you perform the final step of a block cipher encryption or decryption incorrectly.

For instance, you do one of the following:

- You do not perform update steps for encrypting or decrypting the data before performing a final step.

  ```
  /* Initialization of cipher context */
  ret = EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);
  ...
  /* Missing update step */
  ...
  /* Final step */
  ret = EVP_EncryptFinal_ex(ctx, out_buf, &out_len);
  ```
- You perform consecutive final steps without intermediate initialization and update steps.

  ```
  /* Initialization of cipher context */
  ret = EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);
  ...
  /* Update step(s) */
  ret = EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
  ...
  /* Final step */
  ret = EVP_EncryptFinal_ex(ctx, out_buf, &out_len);
  ...
  /* Missing initialization and update */
  ...
  /* Second final step */
  ret = EVP_EncryptFinal_ex(ctx, out_buf, &out_len);
  ```
- You perform a cleanup of the cipher context and then perform a final step.

  ```
  /* Initialization of cipher context */
  ret = EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);
  ```

```
   ...
   /* Update step(s) */
   ret = EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
   ...
   /* Cleanup of cipher context */
   EVP_CIPHER_CTX_cleanup(ctx);
   ...
   /* Second final step */
   ret = EVP_EncryptFinal_ex(ctx, out_buf, &out_len);
```

### Risk

Block ciphers break your data into blocks of fixed size. During encryption or decryption, the update step encrypts or decrypts your data in blocks. Any leftover data is encrypted or decrypted by the final step. The final step adds padding to the leftover data so that it occupies one block, and then encrypts or decrypts the padded data.

If you perform the final step before performing the update steps, or perform the final step when there is no data to process, the behavior is undefined. You can also encounter run-time errors.

### Fix

Perform encryption or decryption in this sequence:

- Initialization of cipher context
- Update steps
- Final step
- Cleanup of context

## Examples

### Missing Update Steps for Encryption Before Final Step

```
#include <openssl/evp.h>
#include <stdlib.h>
```

```
#define SIZE16 16

unsigned char *out_buf;
int out_len;
unsigned char key[SIZE16];
unsigned char iv[SIZE16];

void func(void) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);

    /* Initialization of cipher context */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);

    /* Missing update steps for encryption */

    /* Final encryption step */
    EVP_EncryptFinal_ex(ctx, out_buf, &out_len);
}
```

In this example, after the cipher context is initialized, there are no update steps for encrypting the data. The update steps are supposed to encrypt one or more blocks of data, leaving the final step to encrypt data that is left over in a partial block. If you perform the final step without previous update steps, the behavior is undefined.

Perform update steps for encryption before the final step. In the corrected code below, the routine `EVP_EncryptUpdate` performs the update steps.

```
#include <openssl/evp.h>
#include <stdlib.h>
#define SIZE16 16

unsigned char *out_buf;
int out_len;
unsigned char key[SIZE16];
unsigned char iv[SIZE16];

void func(unsigned char *src, int len) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);
    /* Initialization of cipher context */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);

    /* Update steps for encryption */
    EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);

    /* Final encryption step */
    EVP_EncryptFinal_ex(ctx, out_buf, &out_len);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_NO_DATA`
**Impact:** Medium
**CWE ID:** 311, 325, 372, 664

Introduced in R2017a

# Missing cipher final step

You do not perform a final step after update steps for encrypting or decrypting data

## Description

**Missing cipher final step** occurs when you do not perform a final step after your update steps for encrypting or decrypting data.

For instance, you do the following:

```
/* Initialization of cipher context */
ret = EVP_EncryptInit_ex(&ctx, EVP_aes_128_cbc(), NULL, key, iv);
...
/* Update step */
ret = EVP_EncryptUpdate(&ctx, out_buf, &out_len, src, len);
...
/* Missing final step */
...
/* Cleanup of cipher context */
EVP_CIPHER_CTX_cleanup(ctx);
```

### Risk

Block ciphers break your data into blocks of fixed size. During encryption or decryption, the update step encrypts or decrypts your data in blocks. Any leftover data is encrypted or decrypted by the final step. The final step adds padding to the leftover data so that it occupies one block, and then encrypts or decrypts the padded data.

If you do not perform the final step, leftover data remaining in a partial block is not encrypted or decrypted. You can face incomplete or unexpected output.

### Fix

After your update steps for encryption or decryption, perform a final step to encrypt or decrypt leftover data.

```
/* Initialization of cipher context */
ret = EVP_EncryptInit_ex(&ctx, EVP_aes_128_cbc(), NULL, key, iv);
```

```
...
/* Update step(s) */
ret = EVP_EncryptUpdate(&ctx, out_buf, &out_len, src, len);
...
/* Final step */
ret = EVP_EncryptFinal_ex(&ctx, out_buf, &out_len);
...
/* Cleanup of cipher context */
EVP_CIPHER_CTX_cleanup(ctx);
```

# Examples

## Cleanup of Cipher Context Before Final Step

```
#include <openssl/evp.h>
#include <stdlib.h>
#define SIZE16 16

unsigned char *out_buf;
int out_len;
unsigned char key[SIZE16];
unsigned char iv[SIZE16];

void func(unsigned char *src, int len) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);

    /* Initialization of cipher context */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);

    /* Update steps for encryption */
    EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);

    /* Missing final encryption step */

    /* Cleanup of cipher context */
    EVP_CIPHER_CTX_cleanup(ctx);
}
```

In this example, the cipher context ctx is cleaned up before a final encryption step. The final step is supposed to encrypt leftover data. Without the final step, the encryption is incomplete.

After your update steps for encryption, perform a final encryption step to encrypt leftover data. In the corrected code below, the routine EVP_EncryptFinal_ex is used to perform this final step.

```
#include <openssl/evp.h>
#include <stdlib.h>
#define SIZE16 16

unsigned char *out_buf;
int out_len;
unsigned char key[SIZE16];
unsigned char iv[SIZE16];

void func(unsigned char *src, int len) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);

    /* Initialization of cipher context */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);

    /* Update steps for encryption */
    EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);

    /* Final encryption step */
    EVP_EncryptFinal_ex(ctx, out_buf, &out_len);

    /* Cleanup of cipher context */
    EVP_CIPHER_CTX_cleanup(ctx);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off

**Command-Line Syntax:** `CRYPTO_CIPHER_NO_FINAL`
**Impact:** Medium
**CWE ID:** 311, 325, 372, 664

Introduced in R2017a

# Missing cipher key

Non-NULL key is not associated with the cipher context for encryption or decryption

## Description

**Missing cipher key** occurs when you encrypt or decrypt data using a NULL encryption or decryption key.

**Note** You can initialize your cipher context with a NULL key. However, before you encrypt or decrypt your data, you must associate the cipher context with a non-NULL key.

### Risk

Encryption or decryption with a NULL key can lead to run-time errors or at least, non-secure ciphertext.

### Fix

Before your encryption or decryption steps

```
 ret = EVP_EncryptUpdate(&ctx, out_buf, &out_len, src, len)
```

associate your cipher context `ctx` with a non-NULL key.

```
ret = EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv)
```

Sometimes, you initialize your cipher context with a non-NULL key

```
ret = EVP_EncryptInit_ex(&ctx, cipher_algo_1, NULL, key, iv)
```

but change the cipher algorithm later. When you change the cipher algorithm, you use a NULL key.

```
 ret = EVP_EncryptInit_ex(&ctx, cipher_algo_2, NULL, NULL, NULL)
```

The second statement reinitializes the cipher context completely but with a NULL key. To avoid this issue, every time you initialize a cipher context with an algorithm, associate it with a key.

# Examples

## NULL Key Used for Encryption

```
#include <openssl/evp.h>
#include <stdlib.h>
#define fatal_error() abort()

unsigned char *out_buf;
int out_len;

int func(EVP_CIPHER_CTX *ctx, unsigned char *iv, unsigned char *src, int len){
    if (iv == NULL)
        fatal_error();

    /* Fourth argument is cipher key */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, NULL, iv);

    /* Update step with NULL key */
    return EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
}
```

In this example, the cipher key associated with the context `ctx` is NULL. When you use this context to encrypt your data, you can encounter run-time errors.

Use a strong random number generator to produce the cipher key. The corrected code here uses the function `RAND_bytes` declared in `openssl/rand.h`.

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define fatal_error() abort()
#define SIZE16 16
```

```
unsigned char *out_buf;
int out_len;

int func(EVP_CIPHER_CTX *ctx, unsigned char *iv, unsigned char *src, int len){
    if (iv == NULL)
        fatal_error();
    unsigned char key[SIZE16];
    RAND_bytes(key, 16);

    /* Fourth argument is cipher key */
    EVP_EncryptInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv);

    /* Update step with non-NULL cipher key */
    return EVP_EncryptUpdate(ctx, out_buf, &out_len, src, len);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_NO_KEY`
**Impact:** Medium
**CWE ID:** 310, 320, 573, 664

### Introduced in R2017a

# Missing explicit keyword

Constructor missing the `explicit` specifier

## Description

**Missing `explicit` keyword** occurs when the declaration of a constructor does not use the `explicit` specifier. The `explicit` specifier prevents implicit conversion from a variable of another type to the current class type.

The defect applies to:

- One-parameter constructors.
- Constructors where all but one parameters have default values.

  For instance, `MyClass::MyClass(float f, bool b=true){}`.

### Risk

If you do not declare a constructor `explicit`, compilers can perform unexpected and often unintended type conversions to the class type using the constructor.

The implicit conversion can occur, for instance, when a function accepts a parameter of the class type, but you call the function with an argument of a different type.

### Fix

For better readability of your code and to prevent implicit conversions, in the constructor declaration, place the `explicit` keyword before the constructor name.

If you want to convert from a variable of another type, explicitly call the class constructor and pass the variable as argument.

# Examples

## Missing **explicit** Keyword

```
class MyClass {
public:
    MyClass(int val);
private:
    int val;
};

void func(MyClass);

void main() {
    MyClass MyClassObject(0);

    func(MyClassObject);   // No conversion
    func(MyClass(0));      // Explicit conversion
    func(0);               // Implicit conversion
}
```

In this example, the constructor of `MyClass` is not declared `explicit`. Therefore, the call `func(0)` can perform an implicit conversion from `int` to `MyClass`.

One possible correction is to declare the constructor of `MyClass` as `explicit`. If an operation in your code performs an implicit conversion, the compiler generates an error. Therefore, using the `explicit` keyword, you detect unintended type conversions in the compilation stage.

For instance, in function `main` below, if you add the statement `func(0);` that performs implicit conversion, the code does not compile.

```
class MyClass {
public:
    explicit MyClass(int val);
private:
    int val;
};

void func(MyClass);
void main() {
    MyClass MyClassObject(0);

    func(MyClassObject);   // No conversion
    func(MyClass(0));      // Explicit conversion
}
```

## Incorrect Argument Order Preventable Through `explicit` Keyword

```
class Month {
    int val;
public:
    Month(int m): val(m) {}
    ~Month() {}
};

class Day {
    int val;
public:
    Day(int d): val(d) {}
    ~Day() {}
};

class Year {
    int val;
public:
    Year(int y): val(y) {}
    ~Year() {}
};

class Date {
    Month mm;
    Day dd;
    Year yyyy;
public:
    Date(const Month & m, const Day & d, const Year & y):mm(m), dd(d), yyyy(y) {}
};

void main() {
    Date(20,1,2000); //Implicit conversion, wrong argument order undetected
}
```

In this example, the constructors for classes Month, Day and Year do not have an explicit keyword. They allow implicit conversion from int variables to Month, Day and Year variables.

When you create a Date variable and use an incorrect argument order for the Date constructor, because of the implicit conversion, your code compiles. You might not detect that you have switched the month value and the day value.

If you use the explicit keyword for the constructors of classes Month, Day and Year, you cannot call the Date constructor with an incorrect argument order.

- If you call the Date constructor with int variables, your code does not compile because the explicit keyword prevents implicit conversion from int variables.
- If you call the Date constructor with the arguments explicitly converted to Month, Day and Year, and have the wrong argument order, your code does not compile because of the argument type mismatch.

```
class Month {
    int val;
public:
    explicit Month(int m): val(m) {}
    ~Month() {}
};

class Day {
    int val;
public:
    explicit Day(int d): val(d) {}
    ~Day() {}
};

class Year {
    int val;
public:
    explicit Year(int y): val(y) {}
    ~Year() {}
};

class Date {
    Month mm;
    Day dd;
    Year yyyy;
public:
    Date(const Month & m, const Day & d, const Year & y):mm(m), dd(d), yyyy(y) {}
};

void main() {
    Date(Month(1),Day(20),Year(2000));
    // Date(20,1,2000); - Does not compile
    // Date(Day(20), Month(1), Year(2000)); - Does not compile
}
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** Off
**Command-Line Syntax:** `MISSING_EXPLICIT_KEYWORD`
**Impact:** Low

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Missing lock

Unlock function without lock function

## Description

**Missing lock** occurs when a task calls an unlock function before calling the corresponding lock function.

In multitasking code, a lock function begins a critical section of code and an unlock function ends it. When a task `my_task` calls a lock function `my_lock`, other tasks calling `my_lock` must wait till `my_task` calls the corresponding unlock function. Polyspace requires that both lock and unlock functions must have the form `void func(void)`.

To find this defect, you must specify the multitasking options before analysis. To specify these options, on the **Configuration** pane, select **Multitasking**.

## Examples

### Missing lock

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset(void)
{
  begin_critical_section();
  global_var = 0;
  end_critical_section();
}

void my_task(void)
```

```
{
  global_var += 1;
  end_critical_section();
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | `my_task`, `reset` | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | `begin_critical_section` | `end_critical_section` |

On the command-line, you can use the following:

```
polyspace-bug-finder-nodesktop
   -entry-points my_task,reset
   -critical-section-begin begin_critical_section:cs1
   -critical-section-end end_critical_section:cs1
```

The example has two entry points, `my_task` and `reset`. `my_task` calls `end_critical_section` before calling `begin_critical_section`.

One possible correction is to call the lock function `begin_critical_section` before the instructions in the critical section.

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset(void)
{
  begin_critical_section();
  global_var = 0;
  end_critical_section();
}

void my_task(void)
{
    begin_critical_section();
    global_var += 1;
    end_critical_section();
}
```

## Lock in Condition

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset() {
    begin_critical_section();
    global_var=0;
    end_critical_section();
}

void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      if(index%10==0) {
        begin_critical_section();
        global_var ++;
      }
      end_critical_section();
      index++;
    }
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | `my_task, reset` | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | `begin_critical_section` | `end_critical_section` |

On the command-line, you can use the following:

```
polyspace-bug-finder-nodesktop
   -entry-points my_task,reset
   -critical-section-begin begin_critical_section:cs1
   -critical-section-end end_critical_section:cs1
```

The example has two entry points, `my_task` and `reset`.

In the `while` loop, `my_task` leaves a critical section through the call `end_critical_section();`. In an iteration of the `while` loop:

- If `my_task` enters the `if` condition branch, the critical section begins through a call to `begin_critical_section`.
- If `my_task` does not enter the `if` condition branch and leaves the `while` loop, the critical section does not begin. Therefore, a **Missing lock** defect occurs.
- If `my_task` does not enter the `if` condition branch and continues to the next iteration of the `while` loop, the unlock function `end_critical_section` is called again. A **Double unlock** defect occurs.

Because `numCycles` is a `volatile` variable, it can take any value. Any of the cases above are possible. Therefore, a **Missing lock** defect and a **Double unlock** defect appear on the call `end_critical_section`.

## Check Information

**Group:** Concurrency
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `BAD_UNLOCK`

**Impact:** Medium
**CWE ID:** 832
**CERT C ID:** CON01-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Polyspace Results

`Data race including atomic operations` | `Data race` | `Data race through standard library function call` | `Deadlock` | `Destruction of locked mutex` | `Double lock` | `Double unlock` | `Missing unlock`

## Topics

"Set Up Multitasking Analysis Manually"

### Introduced in R2014b

# Missing null in string array

String does not terminate with null character

## Description

**Missing null in string array** occurs when a string does not have enough space to terminate with a null character '\0'. This defect can cause various memory errors in your code, so is important to fix it.

This defect applies only for projects in C.

## Examples

### Array size is too small

```
void countdown(int i)
{
    static char one[5]   = "ONE";
    static char two[5]   = "TWO";
    static char three[5] = "THREE";
}
```

The character array three has a size of 5 and 5 characters 'T', 'H', 'R', 'E', and 'E'. There is no room for the null character at the end because three is only five bytes large.

One possible correction is to change the array size to allow for the five characters plus a null character.

```
void countdown(int i)
{
    static char one[5]   = "ONE";
    static char two[5]   = "TWO";
    static char three[6] = "THREE";
}
```

One possible correction is to initialize the string by leaving the array size blank. This initialization method allocates enough memory for the five characters and a terminating-null character.

```
void countdown(int i)
{
    static char one[5]   = "ONE";
    static char two[5]   = "TWO";
    static char three[]  = "THREE";
}
```

## Check Information

**Group:** Programming
**Language:** C
**Default:** On for handwritten code, off for generated code
**Command-Line Syntax:** `MISSING_NULL_CHAR`
**Impact:** Low
**CWE ID:** 170
**CERT C ID:** ARR33-C, STR11-C, STR31-C
**ISO/IEC TS 17961 ID:** `NONNULLCS`, `TAINTFORMATIO`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Missing reset of a freed pointer

Pointer `free` not followed by a reset statement to clear leftover data

## Description

**Missing reset of a freed pointer** detects pointers that have been freed and not reassigned another value. After freeing a pointer, the memory data is still accessible. To clear this data, the pointer must also be set to NULL or another value.

### Risk

Not resetting pointers can cause dangling pointers. Dangling pointers can cause:

- Freeing already freed memory.
- Reading from or writing to already freed memory.
- Hackers executing code stored in freed pointers or with vulnerable permissions.

### Fix

After freeing a pointer, if it is not immediately assigned to another valid address, set the pointer to NULL.

## Examples

### Free Without Reset

```
#include <stdlib.h>
enum {
    SIZE3   = 3,
    SIZE20  = 20
};

void missingfreedptrreset()
{
    static char *str = NULL;

    if (str == NULL)
        str = (char *)malloc(SIZE20);

    if (str != NULL)
        free(str);
}
```

In this example, the pointer `str` is freed at the end of the program. The next call to `bug_missingfreedptrrese` can fail because `str` is not NULL and the initialization to NULL can be invalid.

One possible correction is to customize `free` so that when you free a pointer, it is automatically reset.

```
#include <stdlib.h>
enum {
    SIZE3   = 3,
    SIZE20  = 20
};

static void sanitize_free(void **p)
{
    if ((p != NULL) && (*p != NULL))
    {
        free(*p);
        *p = NULL;
    }
}

#define free(X) sanitize_free((void **)&X)

void missingfreedptrreset()
{
    static char *str = NULL;

    if (str == NULL)
        str = (char *)malloc(SIZE20);

    if (str != ((void *)0))
    {
        free(str);
    }
}
```

## Result Information

**Group:** Good Practice
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `MISSING_FREED_PTR_RESET`
**Impact:** Low
**CWE ID:** 415, 416
**CERT C ID:** MEM01-C

## See Also

`Use of previously freed pointer` | `Invalid free of pointer`

**Introduced in R2016b**

# Missing return statement

Function does not return value though return type is not `void`

## Description

**Missing return statement** occurs when a function does not return a value along at least one execution path. If the return type of the function is `void`, this error does not occur.

## Examples

### Missing or invalid return statement error

```
int AddSquares(int n)
 {
   int i=0;
   int sum=0;

   if(n!=0)
    {
     for(i=1;i<=n;i++)
        {
         sum+=i^2;
        }
     return(sum);
    }
 }
/* Defect: No return value if n is not 0*/
```

If `n` is equal to 0, the code does not enter the `if` statement. Therefore, the function `AddSquares` does not return a value if `n` is 0.

One possible correction is to return a value in every branch of the `if...else` statement.

```
 int AddSquares(int n)
 {
    int i=0;
    int sum=0;

    if(n!=0)
     {
      for(i=1;i<=n;i++)
          {
           sum+=i^2;
          }
      return(sum);
     }

    /*Fix: Place a return statement on branches of if-else */
    else
      return 0;
  }
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `MISSING_RETURN`
**Impact:** Low
**CERT C ID:** MSC37-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Missing unlock

Lock function without unlock function

## Description

**Missing unlock** occurs when:

- A task calls a lock function.
- The task ends without a call to an unlock function.

In multitasking code, a lock function begins a critical section of code and an unlock function ends it. When a task, `my_task`, calls a lock function, `my_lock`, other tasks calling `my_lock` must wait until `my_task` calls the corresponding unlock function. Polyspace requires that both lock and unlock functions must have the form `void func(void)`.

To find this defect, before analysis, you must specify the multitasking options. On the **Configuration** pane, select **Multitasking**.

## Examples

### Missing Unlock

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset()
{
    begin_critical_section();
    global_var = 0;
    end_critical_section();
}

void my_task(void)
{
    begin_critical_section();
    global_var += 1;
}
```

In this example, to emulate multitasking behavior, specify the following options:

| Option | Value | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | `my_task`, `reset` | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | `begin_critical_section` | `end_critical_section` |

On the command-line, you can use the following:

```
polyspace-bug-finder-nodesktop
   -entry-points my_task,reset
   -critical-section-begin begin_critical_section:cs1
   -critical-section-end end_critical_section:cs1
```

The example has two entry points, `my_task` and `reset`. `my_task` enters a critical section through the call `begin_critical_section();`. `my_task` ends without calling `end_critical_section`.

One possible correction is to call the unlock function `end_critical_section` after the instructions in the critical section.

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset(void)
```

```
{
    begin_critical_section();
    global_var = 0;
    end_critical_section();
}

void my_task(void)
{
    begin_critical_section();
    global_var += 1;
    end_critical_section();
}
```

## Unlock in Condition

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset() {
    begin_critical_section();
    global_var=0;
    end_critical_section();
}

void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      begin_critical_section();
      global_var ++;
      if(index%10==0) {
        global_var = 0;
        end_critical_section();
      }
      index++;
    }
}
```

In this example, to emulate multitasking behavior, specify the following options.

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** on page 1-105 | ☑ | |
| **Entry points** on page 1-112 | `my_task, reset` | |
| **Critical section details** on page 1-124 | **Starting routine** | **Ending routine** |
| | `begin_critical_section` | `end_critical_section` |

On the command-line, you can use the following:

```
polyspace-bug-finder-nodesktop
   -entry-points my_task,reset
   -critical-section-begin begin_critical_section:cs1
   -critical-section-end end_critical_section:cs1
```

The example has two entry points, `my_task` and `reset`.

In the `while` loop, `my_task` enters a critical section through the call `begin_critical_section();`. In an iteration of the `while` loop:

- If `my_task` enters the `if` condition branch, the critical section ends through a call to `end_critical_section`.
- If `my_task` does not enter the `if` condition branch and leaves the `while` loop, the critical section does not end. Therefore, a **Missing unlock** defect occurs.
- If `my_task` does not enter the `if` condition branch and continues to the next iteration of the `while` loop, the lock function `begin_critical_section` is called again. A **Double lock** defect occurs.

Because `numCycles` is a `volatile` variable, it can take any value. Any of the cases above is possible. Therefore, a **Missing unlock** defect and a **Double lock** defect appear on the call `begin_critical_section`.

One possible correction is to call the unlock function `end_critical_section` outside the `if` condition.

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset() {
    begin_critical_section();
    global_var=0;
    end_critical_section();
}

void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      begin_critical_section();
      global_var ++;
      if(index%10==0) {
        global_var=0;
      }
      end_critical_section();
      index++;
    }
}
```

Another possible correction is to call the unlock function `end_critical_section` in every branches of the `if` condition.

```
void begin_critical_section(void);
void end_critical_section(void);

int global_var;

void reset() {
    begin_critical_section();
    global_var=0;
    end_critical_section();
}
```

```
void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      begin_critical_section();
      global_var ++;
      if(index%10==0) {
        global_var=0;
        end_critical_section();
      }
      else
        end_critical_section();
      index++;
    }
}
```

## Check Information

**Group:** Concurrency
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `BAD_LOCK`
**Impact:** High
**CWE ID:** 667
**CERT C ID:** MEM12-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)` | `Configure multitasking manually` | `Entry points (-entry-points)` | `Critical section details (-critical-section-begin -critical-section-end)` | `Temporally exclusive tasks (-temporal-exclusions-file)`

### Polyspace Results

`Data race including atomic operations` | `Data race` | `Data race through standard library function call` | `Deadlock` | `Destruction of locked mutex` | `Double lock` | `Double unlock` | `Missing lock`

## Topics

"Set Up Multitasking Analysis Manually"

Introduced in R2014b

# Missing virtual inheritance

A base class is inherited virtually and nonvirtually in the same hierarchy

## Description

**Missing virtual inheritance** occurs when:

- A class is derived from multiple base classes, and some of those base classes are themselves derived from a common base class.

  For instance, a class Final is derived from two classes, Intermediate_left and Intermediate_right. Both Intermediate_left and Intermediate_right are derived from a common class, Base.
- At least one of the inheritances from the common base class is virtual and at least one is not virtual.

  For instance, the inheritance of Intermediate_right from Base is virtual. The inheritance of Intermediate_left from Base is not virtual.

### Risk

If this defect appears, multiple copies of the base class data members appear in the final derived class object. To access the correct copy of the base class data member, you have to qualify the member and method name appropriately in the final derived class. The development is error-prone.

For instance, when the defect occurs, two copies of the base class data members appear in an object of class Final. If you do not qualify method names appropriately in the class Final, you can assign a value to a Base data member but not retrieve the same value.

- You assign the value using a Base method accessed through Intermediate_left. Therefore, you assign the value to one copy of the Base member.
- You retrieve the value using a Base method accessed through Intermediate_right. Therefore, you retrieve a different copy of the Base member.

### Fix

Declare all the intermediate inheritances as `virtual` when a class is derived from multiple base classes that are themselves derived from a common base class.

If you indeed want multiple copies of the `Base` data members as represented in the intermediate derived classes, use aggregation instead of inheritance. For instance, declare two objects of class `Intermediate_left` and `Intermediate_right` in the `Final` class.

## Examples

### Missing Virtual Inheritance

```
#include <stdio.h>
class Base {
public:
    explicit Base(int i): m_b(i) {};
    virtual ~Base() {};
    virtual int get() const {
        return m_b;
    }
    virtual void set(int b) {
        m_b = b;
    }
private:
    int m_b;
};

class Intermediate_left: virtual public Base {
public:
    Intermediate_left():Base(0), m_d1(0) {};
private:
    int m_d1;
};

class Intermediate_right: public Base {
public:
    Intermediate_right():Base(0), m_d2(0) {};
private:
    int m_d2;
};

class Final: public Intermediate_left, Intermediate_right {
public:
    Final(): Base(0), Intermediate_left(), Intermediate_right() {};
    int get() const {
        return Intermediate_left::get();
    }
    void set(int b) {
        Intermediate_right::set(b);
    }
    int get2() const {
        return Intermediate_right::get();
    }
};

int main(int argc, char* argv[]) {
    Final d;
    int val = 12;
    d.set(val);
    int res = d.get();
    printf("d.get=%d\n",res);             // Result: d.get=0
    printf("d.get2=%d\n",d.get2());       // Result: d.get2=12
    return res;
}
```

In this example, `Final` is derived from both `Intermediate_left` and `Intermediate_right`. `Intermediate_left` is derived from `Base` in a non-`virtual` manner and `Intermediate_right` is derived from `Base` in a `virtual` manner. Therefore, two copies of the base class and the data member `m_b` are present in the final derived class,

Both derived classes `Intermediate_left` and `Intermediate_right` do not override the `Base` class methods `get` and `set`. However, `Final` overrides both methods. In the overridden `get` method, it calls `Base::get` through `Intermediate_left`. In the overridden `set` method, it calls `Base::set` through `Intermediate_right`.

Following the statement `d.set(val)`, `Intermediate_right`'s copy of `m_b` is set to 12. However, `Intermediate_left`'s copy of `m_b` is still zero. Therefore, when you call `d.get()`, you obtain a value zero.

Using the `printf` statements, you can see that you retrieve a value that is different from the value that you set.

The defect appears in the final derived class definition and on the name of the class that are derived virtually from the common base class. Following are some tips for navigating in the source code:

- To find the definition of a class, on the **Source** pane, right-click the class name and select **Go To Definition**.
- To navigate up the class hierarchy, first navigate to the intermediate class definition. In the intermediate class definition, right-click a base class name and select **Go To Definition**.

One possible correction is to declare both the inheritances from `Base` as `virtual`.

Even though the overridden `get` and `set` methods in `Final` still call `Base::get` and `Base::set` through different classes, only one copy of `m_b` exists in `Final`.

```
#include <stdio.h>
class Base {
public:
    explicit Base(int i): m_b(i) {};
    virtual ~Base() {};
    virtual int get() const {
        return m_b;
    }
    virtual void set(int b) {
        m_b = b;
    }
private:
    int m_b;
};

class Intermediate_left: virtual public Base {
public:
    Intermediate_left():Base(0), m_d1(0) {};
private:
    int m_d1;
};

class Intermediate_right: virtual public Base {
public:
    Intermediate_right():Base(0), m_d2(0) {};
private:
    int m_d2;
};

class Final: public Intermediate_left, Intermediate_right {
public:
    Final(): Base(0), Intermediate_left(), Intermediate_right() {};
    int get() const {
        return Intermediate_left::get();
    }
    void set(int b) {
        Intermediate_right::set(b);
    }
    int get2() const {
        return Intermediate_right::get();
    }
};

int main(int argc, char* argv[]) {
    Final d;
    int val = 12;
    d.set(val);
    int res = d.get();
    printf("d.get=%d\n",res);             // Result: d.get=12
    printf("d.get2=%d\n",d.get2());       // Result: d.get2=12
    return res;
}
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** Off
**Command-Line Syntax:** `MISSING_VIRTUAL_INHERITANCE`
**Impact:** Medium

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Misuse of a FILE object

Use of copy of FILE object

## Description

**Misuse of a FILE object** occurs when:

- You dereference a pointer to a FILE object, including indirect dereference by using `memcmp()`.
- You modify an entire FILE object or one of its components through its pointer.
- You take the address of FILE object that was not returned from a call to an `fopen`-family function. No defect is raised if a macro defines the pointer as the address of a built-in FILE object, such as `#define ptr (&__stdout)`.

### Risk

In some implementations, the address of the pointer to a FILE object used to control a stream is significant. A pointer to a copy of a FILE object is interpreted differently than a pointer to the original object, and can potentially result in operations on the wrong stream. Therefore, the use of a copy of a FILE object can cause the software to stop responding, which an attacker might exploit in denial-of-service attacks.

### Fix

Do not make a copy of a FILE object. Do not use the address of a FILE object that was not returned from a successful call to an `fopen`-family function.

## Examples

### Copy of FILE Object Used in `fputs()`

```
#include <stdio.h>
#include <unistd.h>
```

```
#include <stdlib.h>
#include <string.h>
#include <strings.h>

int func(void)
{
    /*'stdout' dereferenced and contents
        copied to 'my_stdout'. */
    FILE my_stdout = *stdout;

    /* Address of 'my_stdout' may not point to correct stream. */
    if (fputs("Hello, World!\n", &my_stdout) == EOF)
    {
        /* Handler error */
        fatal_error();
    }
    return 0;
}
```

In this example, FILE object `stdout` is dereferenced and its contents are copied to `my_stdout`. The contents of `stdout` might not be significant. `fputs()` is then called with the address of `my_stdout` as an argument. Because no call to `fopen()` or a similar function was made, the address of `my_stdout` might not point to the correct stream.

Declare `my_stdout` to point to the same address as `stdout` to ensure that you write to the correct stream when you call `fputs()`.

```
#include <stdio.h>
#include <unistd.h>
#include <stdlib.h>
#include <string.h>
#include <strings.h>

int func(void)
{
    /* 'my_stdout' and 'stdout' point to the same object. */
    FILE *my_stdout = stdout;
    if (fputs("Hello, World!\n", my_stdout) == EOF)
    {
        /* Handler error */
        fatal_error();
    }
    return 0;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `FILE_OBJECT_MISUSE`
**Impact:** Low
**CERT C ID:** FIO38-C
**ISO/IEC TS 17961 ID:** `filecpy`

## See Also

Introduced in R2017b

# Misuse of structure with flexible array member

Memory allocation ignores flexible array member

## Description

**Misuse of structure with flexible array member** occurs when:

- You define an object with a flexible array member of unknown size at compilation time.
- You make an assignment between structures with a flexible array member without using `memcpy()` or a similar function.
- You use a structure with a flexible array member as an argument to a function and pass the argument by value.
- Your function returns a structure with a flexible array member.

A flexible array member has no array size specified and is the last element of a structure with at least two named members.

### Risk

If the size of the flexible array member is not defined, it is ignored when allocating memory for the containing structure. Accessing such a structure has undefined behavior.

### Fix

- Use `malloc()` or a similar function to allocate memory for a structure with a flexible array member.
- Use `memcpy()` or a similar function to copy a structure with a flexible array member.
- Pass a structure with a flexible array member as a function argument by pointer.

# Examples

## Structure Passed By Value to Function

```
#include <stddef.h>
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include <unistd.h>


struct example_struct
{
    size_t num;
    int data[];
};

extern void arg_by_value(struct example_struct s);

void func(void)
{
    struct example_struct *flex_struct;
    size_t i;
    size_t array_size = 4;
    /* Dynamically allocate memory for the struct */
    flex_struct = (struct example_struct *)
        malloc(sizeof(struct example_struct) + sizeof(int) * array_size);
    if (flex_struct == NULL)
    {
        /* Handle error */
    }
    /* Initialize structure */
    flex_struct->num = array_size;
    for (i = 0; i < array_size; ++i)
    {
        flex_struct->data[i] = 0;
    }
    /* Handle structure */

    /* Argument passed by value. 'data' not
    copied to passed value. */
    arg_by_value(*flex_struct);
    /* Free dynamically allocated memory */
    free(flex_struct);
}
```

In this example, `flex_struct` is passed by value as an argument to `arg_by_value`. As a result, the flexible array member data is not copied to the passed argument.

To ensure that all the members of the structure are copied to the passed argument, pass `flex_struct` to `arg_by_pointer` by pointer.

```
#include <stddef.h>
#include <stdlib.h>
#include <string.h>
#include <stdio.h>
#include <unistd.h>


struct example_struct
{
    size_t num;
    int data[];
};

extern void arg_by_pointer(struct example_struct *s);

void func(void)
{
    struct example_struct *flex_struct;
    size_t i;
    size_t array_size = 4;
    /* Dynamically allocate memory for the struct */
    flex_struct = (struct example_struct *)
        malloc(sizeof(struct example_struct) + sizeof(int) * array_size);
    if (flex_struct == NULL)
    {
        /* Handler error */
    }
    /* Initialize structure */
    flex_struct->num = array_size;
    for (i = 0; i < array_size; ++i)
    {
        flex_struct->data[i] = 0;
    }
    /* Handle structure */

    /* Structure passed by pointer */
    arg_by_pointer(flex_struct);

    /* Free dynamically allocated memory */
    free(flex_struct);
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `FLEXIBLE_ARRAY_MEMBER_STRUCT_MISUSE`
**Impact:** Low
**CERT C ID:** MEM33-C

## See Also

Introduced in R2017b

# Misuse of errno

errno incorrectly checked for error conditions

## Description

**Misuse of errno** occurs when you check errno for error conditions in situations where checking errno does not guarantee the absence of errors. In some cases, checking errno can lead to false positives.

For instance, you check errno following calls to the functions:

- fopen: If you follow the ISO Standard, the function might not set errno on errors.
- atof: If you follow the ISO Standard, the function does not set errno.
- signal: The errno value indicates an error only if the function returns the SIG_ERR error indicator.

### Risk

The ISO C Standard does not enforce that these functions set errno on errors. Whether the functions set errno or not is implementation-dependent.

To detect errors, if you check errno alone, the validity of this check also becomes implementation-dependent.

In some cases, the errno value indicates an error only if the function returns a specific error indicator. If you check errno before checking the function return value, you can see false positives.

### Fix

For information on how to detect errors, see the documentation for that specific function.

Typically, the functions return an out-of-band error indicator to indicate errors. For instance:

- `fopen` returns a null pointer if an error occurs.
- `signal` returns the `SIG_ERR` error indicator and sets `errno` to a positive value. Check `errno` only after you have checked the function return value.

# Examples

## Incorrectly Checking for **`errno`** After **`fopen`** Call

```
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

#define fatal_error() abort()

const char *temp_filename = "/tmp/demo.txt";

FILE *func()
{
    FILE *fileptr;
    errno = 0;
    fileptr = fopen(temp_filename, "w+b");
    if (errno != 0) {                                  if (fileptr != NULL) {
            (void)fclose(fileptr);
        }
        /* Handle error */
        fatal_error();
    }
    return fileptr;
}
```

In this example, `errno` is the first variable that is checked after a call to `fopen`. You might expect that `fopen` changes `errno` to a nonzero value if an error occurs. If you run this code with an implementation of `fopen` that does not set `errno` on errors, you might miss an error condition. In this situation, `fopen` can return a null pointer that escapes detection.

One possible correction is to only check the return value of `fopen` for a null pointer.

```
#include <stdio.h>
#include <stdlib.h>
```

```
#include <errno.h>

#define fatal_error() abort()

const char *temp_filename = "/tmp/demo.txt";

FILE *func()
{
    FILE *fileptr;
    fileptr = fopen(temp_filename, "w+b");
    if (fileptr == NULL) {
        fatal_error();
    }
    return fileptr;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** ERRNO_MISUSE
**Impact:** High
**CWE ID:** 703
**CERT C ID:** ERR30-C
**ISO/IEC TS 17961 ID:** inverrno

## See Also

### Polyspace Results

Errno not reset | Errno not checked | Returned value of a sensitive function not checked | Unsafe conversion from string to numerical value

### Introduced in R2017a

# Misuse of readlink()

Third argument of `readlink` does not leave space for null terminator in buffer

## Description

**Misuse of readlink()** occurs when you pass a buffer size argument to `readlink()` that does not leave space for a null terminator in the buffer.

For instance:

```
ssize_t len = readlink("/usr/bin/perl", buf, sizeof(buf));
```

The third argument is exactly equal to the size of the second argument. For large enough symbolic links, this use of `readlink()` does not leave space to enter a null terminator.

### Risk

The `readlink()` function copies the content of a symbolic link (first argument) to a buffer (second argument). However, the function does not append a null terminator to the copied content. After using `readlink()`, you must explicitly add a null terminator to the buffer.

If you fill the entire buffer when using `readlink`, you do not leave space for this null terminator.

### Fix

When using the `readlink()` function, make sure that the third argument is one less than the buffer size.

Then, append a null terminator to the buffer. To determine where to add the null terminator, check the return value of `readlink()`. If the return value is -1, an error has occurred. Otherwise, the return value is the number of characters (bytes) copied.

# Examples

## Incorrect Size Argument of **readlink**

```
#include <unistd.h>

#define SIZE1024 1024

extern void display_path(const char *);

void func() {
    char buf[SIZE1024];
    ssize_t len = readlink("/usr/bin/perl", buf, sizeof(buf));
    if (len > 0) {
        buf[len - 1] = '\0';
    }
    display_path(buf);
}
```

In this example, the third argument of `readlink` is exactly the size of the buffer (second argument). If the first argument is long enough, this use of `readlink` does not leave space for the null terminator.

Also, if no characters are copied, the return value of `readlink` is 0. The following statement leads to a buffer underflow when `len` is 0.

```
buf[len - 1] = '\0';
```

One possible correction is to make sure that the third argument of `readlink` is one less than size of the second argument.

The following corrected code also accounts for `readlink` returning 0.

```
#include <stdlib.h>
#include <unistd.h>

#define fatal_error() abort()
#define SIZE1024 1024

extern void display_path(const char *);

void func() {
    char buf[SIZE1024];
    ssize_t len = readlink("/usr/bin/perl", buf, sizeof(buf) - 1);
    if (len != -1) {
        buf[len] = '\0';
        display_path(buf);
    }
    else {
        /* Handle error */
        fatal_error();
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `READLINK_MISUSE`
**Impact:** Medium
**CWE ID:** 170
**CERT C ID:** POS30-C

## See Also

### Polyspace Results

`Array access out of bounds` | `File access between time of check and use (TOCTOU)` | `Invalid use of standard library string routine` | `Pointer access out of bounds` | `Returned value of a sensitive function not checked`

### Introduced in R2017a

# Misuse of return value from nonreentrant standard function

Pointer to static buffer from previous call is used despite a subsequent call that modifies the buffer

## Description

**Misuse of return value from nonreentrant standard function** occurs when these events happen in this sequence:

1 You point to the buffer returned from a nonreentrant standard function such as `getenv` or `setlocale`.

```
user = getenv("USER");
```

2 You call that nonreentrant standard function again.

```
user2 = getenv("USER2");
```

3 You use or dereference the pointer from the first step expecting the buffer to remain unmodified since that step. In the meantime, the call in the second step has modified the buffer.

For instance:

```
var=*user;
```

In some cases, the defect might appear even if you do not call the `getenv` function a second time but simply return the pointer. For instance:

```
char* func() {
     user=getenv("USER");
     .
     .
     return user;
}
```

For information on which functions are covered by this defect, see documentation on nonreentrant standard functions.

### Risk

The C Standard allows nonreentrant functions such as `getenv` to return a pointer to a *static* buffer. Because the buffer is static, a second call to `getenv` modifies the buffer. If you continue to use the pointer returned from the first call past the second call, you can see unexpected results. The buffer that it points to no longer has values from the first call.

The defect appears even if you do not call `getenv` a second time but simply return the pointer. The reason is that someone calling your function might use the returned pointer *after* a second call to `getenv`. By returning the pointer from your call to `getenv`, you make your function unsafe to use.

The same rationale is true for other nonreentrant functions covered by this defect.

### Fix

After the first call to `getenv`, make a copy of the buffer that the returned pointer points to. After the second call to `getenv`, use this copy. Even if the second call modifies the buffer, your copy is untouched.

## Examples

### Return from **`getenv`** Used After Second Call to **`getenv`**

```
#include <stdlib.h>
#include <string.h>

int func()
{
    int result = 0;

    char *home = getenv("HOME");   /* First call */
    if (home != NULL) {
        char *user = NULL;
        char *user_name_from_home = strrchr(home, '/');

        if (user_name_from_home != NULL) {
            user = getenv("USER");   /* Second call */
            if ((user != NULL) &&
                (strcmp(user, user_name_from_home) == 0))
            {
                result = 1;
            }
        }
    }
    return result;
}
```

In this example, the pointer `user_name_from_home` is derived from the pointer `home`. `home` points to the buffer returned from the first call to `getenv`. Therefore, `user_name_from_home` points to a location in the same buffer.

After the second call to `getenv`, the buffer is modified. If you continue to use `user_name_from_home`, you can get unexpected results.

If you want to access the buffer from the first call to `getenv` past the second call, make a copy of the buffer after the first call. One possible correction is to use the `strdup` function to make the copy.

```
#include <stdlib.h>
#include <string.h>

int func()
{
    int result = 0;

    char *home = getenv("HOME");
    if (home != NULL) {
        char *user = NULL;
        char *user_name_from_home = strrchr(home, '/');
        if (user_name_from_home != NULL) {
            /* Make copy before second call */
            char *saved_user_name_from_home = strdup(user_name_from_home);
            if (saved_user_name_from_home != NULL) {
                user = getenv("USER");
                if ((user != NULL) &&
                    (strcmp(user, saved_user_name_from_home) == 0))
                {
                    result = 1;
                }
                free(saved_user_name_from_home);
            }
        }
    }
    return result;
}
```

# Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `NON_REENTRANT_STD_RETURN`
**Impact:** High
**CERT C ID:** ENV34-C
**ISO/IEC TS 17961 ID:** `libuse`

# See Also

### Polyspace Results

`Modification of internal buffer returned from nonreentrant standard function` | `Use of obsolete standard function`

### Introduced in R2017a

# Misuse of sign-extended character value

Data type conversion with sign extension causes unexpected behavior

## Description

**Misuse of sign-extended character value** occurs when you convert a signed or plain `char` data type to a wider integer data type with sign extension. Then you use the resulting sign-extended value as array index or for comparison with EOF.

### Risk

*Comparison with EOF*: Suppose, your compiler implements the plain `char` type as signed. On this implementation, the character with the decimal form of 255 (–1 in two's complement form) is stored as a signed value. When you convert a `char` variable to the wider data type `int` for instance, the sign bit is preserved (sign extension). This sign extension results in the character with the decimal form 255 being converted to the integer –1, which cannot be distinguished from EOF.

*Use as array index*: By similar reasoning, sign-extended plain `char` variables cannot be used as array index. If the sign bit is preserved, the conversion from `char` to `int` can result in negative integers. You must use positive integer values for array index.

### Fix

Cast the signed or plain `char` value explicitly to `unsigned char` before conversion to a wider integer data type.

## Examples

### Sign-extended Character Value Compared with EOF

```
#include <stdio.h>
#include <stdlib.h>
#define fatal_error() abort()
```

```
extern char parsed_token_buffer[20];

static int parser(char *buf)
{
    int c = EOF;
    if (buf && *buf) {
        c = *buf++;
    }
    return c;
}

void func()
{
    if (parser(parsed_token_buffer) == EOF) {
        /* Handle error */
        fatal_error();
    }
}
```

In this example, the function `parser` can traverse a string input `buf`. If a character in the string has the decimal form 255, when converted to the `int` variable `c`, its value becomes –1, which is indistinguishable from `EOF`. The later comparison with `EOF` can lead to a false positive.

One possible correction is to cast the plain `char` value to `unsigned char` before conversion to the wider `int` type.

```
#include <stdio.h>
#include <stdlib.h>
#define fatal_error() abort()

extern char parsed_token_buffer[20];

static int parser(char *buf)
{
    int c = EOF;
    if (buf && *buf) {
        c = (unsigned char)*buf++;
    }
    return c;
}
```

```
void func()
{
    if (parser(parsed_token_buffer) == EOF) {
        /* Handle error */
        fatal_error();
    }
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `CHARACTER_MISUSE`
**Impact:** Medium
**CWE ID:** 704
**CERT C ID:** STR34-C
**ISO/IEC TS 17961 ID:** `signconv`

## See Also

### Polyspace Results

`Character value absorbed into EOF` | `Errno not checked` | `Invalid use of standard library integer routine` | `Returned value of a sensitive function not checked`

### Introduced in R2017a

# Modification of internal buffer returned from nonreentrant standard function

Function attempts to modify internal buffer returned from a nonreentrant standard function

## Description

**Modification of internal buffer returned from nonreentrant standard function** occurs when the following happens:

- A nonreentrant standard function returns a pointer.
- You attempt to write to the memory location that the pointer points to.

Nonreentrant standard functions that return a non `const`-qualified pointer to an internal buffer include `getenv`, `getlogin`, `crypt`, `setlocale`, `localeconv`, `strerror` and others.

### Risk

Modifying the internal buffer that a nonreentrant standard function returns can cause the following issues:

- It is possible that the modification does not succeed or alters other internal data.

  For instance, `getenv` returns a pointer to an environment variable value. If you modify this value, you alter the environment of the process and corrupt other internal data.
- Even if the modification succeeds, it is possible that a subsequent call to the same standard function does not return your modified value.

  For instance, you modify the environment variable value that `getenv` returns. If another process, thread, or signal handler calls `setenv`, the modified value is overwritten. Therefore, a subsequent call to `getenv` does not return your modified value.

### Fix

Avoid modifying the internal buffer using the pointer returned from the function.

## Examples

### Modification of getenv Return Value

```
#include <stdlib.h>
#include <string.h>

void printstr(const char*);

void func() {
    char* env = getenv("LANGUAGE");
    if (env != NULL) {
        strncpy(env, "C", 1);
        printstr(env);
    }
}
```

In this example, the first argument of `strncpy` is the return value from a nonreentrant standard function `getenv`. The behavior can be undefined because `strncpy` modifies this argument.

One possible solution is to copy the return value of `getenv` and pass the copy to the `strncpy` function.

```
#include <stdlib.h>
#include <string.h>
enum {
    SIZE20 = 20
};

void printstr(const char*);

void func() {
    char* env = getenv("LANGUAGE");
    if (env != NULL) {
        char env_cp[SIZE20];
        strncpy(env_cp, env, SIZE20);
        strncpy(env_cp, "C", 1);
        printstr(env_cp);
    }
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `WRITE_INTERNAL_BUFFER_RETURNED_FROM_STD_FUNC`
**Impact:** Low
**CWE ID:** 573, 628
**CERT C ID:** ENV30-C, STR06-C
**ISO/IEC TS 17961 ID:** `libmod`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Non-initialized pointer

Pointer not initialized before dereference

## Description

**Non-initialized pointer** occurs when a pointer is not assigned an address before dereference.

## Examples

### Non-initialized pointer error

```
#include <stdlib.h>

int* assign_pointer(int* prev)
{
    int j = 42;
    int* pi;

    if (prev == NULL)
      {
        pi = (int*)malloc(sizeof(int));
        if (pi == NULL) return NULL;
      }

    *pi = j;
    /* Defect: Writing to uninitialized pointer */

    return pi;
}
```

If `prev` is not `NULL`, the pointer `pi` is not assigned an address. However, `pi` is dereferenced on every execution paths, irrespective of whether `prev` is `NULL` or not.

One possible correction is to assign an address to `pi` when `prev` is not `NULL`.

```
#include <stdlib.h>

int* assign_pointer(int* prev)
{
    int j = 42;
    int* pi;

    if (prev == NULL)
       {
        pi = (int*)malloc(sizeof(int));
        if (pi == NULL) return NULL;
       }
    /* Fix: Initialize pi in branches of if statement  */
    else
        pi = prev;


    *pi = j;

    return pi;
}
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `NON_INIT_PTR`
**Impact:** High
**CWE ID:** 456, 457, 824, 908
**CERT C ID:** EXP33-C, MEM09-C, MSC15-C
**ISO/IEC TS 17961 ID:** `uninitref`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Non-initialized variable`

## Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2013b

# Non-initialized variable

Variable not initialized before use

## Description

**Non-initialized variable** occurs when a variable is not initialized before its value is read.

## Examples

### Non-initialized variable error

```
int get_sensor_value(void)
{
    extern int getsensor(void);
    int command;
    int val;

    command = getsensor();
    if (command == 2)
      {
        val = getsensor();
      }

    return val;
    /* Defect: val does not have a value if command is not 2 */
}
```

If `command` is not 2, the variable `val` is unassigned. In this case, the return value of function `get_sensor_value` is undetermined.

One possible correction is to initialize `val` during declaration so that the initialization is not bypassed on some execution paths.

```
int get_sensor_value(void)
{
    extern int getsensor(void);
    int command;
    /* Fix: Initialize val */
    int val=0;

    command = getsensor();
    if (command == 2)
      {
        val = getsensor();
      }

    return val;
 }
```

`val` is assigned an initial value of 0. When `command` is not equal to 2, the function `get_sensor_value` returns this value.

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `NON_INIT_VAR`
**Impact:** High
**CWE ID:** 456, 457, 908
**CERT C ID:** EXP33-C, MEM09-C, MSC15-C, MSC39-C
**ISO/IEC TS 17961 ID:** `uninitref`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Non-initialized pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Null pointer

NULL pointer dereferenced

## Description

**Null pointer** occurs when you use a pointer with a value of NULL as if it points to a valid memory location.

## Examples

### Null pointer error

```
#include <stdlib.h>

int FindMax(int *arr, int Size)
{
 int* p=NULL;

 *p=arr[0];
 /* Defect: Null pointer dereference */

 for(int i=0;i<Size;i++)
  {
   if(arr[i] > (*p))
     *p=arr[i];
  }

 return *p;
}
```

The pointer p is initialized with value of NULL. However, when the value arr[0] is written to *p, p is assumed to point to a valid memory location.

One possible correction is to initialize p with a valid memory address before dereference.

```
#include <stdlib.h>
```

```
int FindMax(int *arr, int Size)
{
 /* Fix: Assign address to null pointer */
 int* p=&arr[0];

 for(int i=0;i<Size;i++)
  {
   if(arr[i] > (*p))
     *p=arr[i];
  }

 return *p;
}
```

## Check Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `NULL_PTR`
**Impact:** High
**CWE ID:** 476
**CERT C ID:** EXP34-C, MSC15-C
**ISO/IEC TS 17961 ID:** `nullref`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Arithmetic operation with NULL pointer` | `Non-initialized pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Object slicing

Derived class object passed by value to function with base class parameter

## Description

**Object slicing** occurs when you pass a derived class object by value to a function, but the function expects a base class object as parameter.

### Risk

If you pass a derived class object *by value* to a function, you expect the derived class copy constructor to be called. If the function expects a base class object as parameter:

1. The base class copy constructor is called.
2. In the function body, the parameter is considered as a base class object.

In C++, `virtual` methods of a class are resolved at run time according to the actual type of the object. Because of object slicing, an incorrect implementation of a `virtual` method can be called. For instance, the base class contains a `virtual` method and the derived class contains an implementation of that method. When you call the `virtual` method from the function body, the base class method is called, even though you pass a derived class object to the function.

### Fix

One possible fix is to pass the object by reference or pointer. Passing by reference or pointer does not cause invocation of copy constructors. If you do not want the object to be modified, use a `const` qualifier with your function parameter.

Another possible fix is to overload the function with another function that accepts the derived class object as parameter.

# Examples

## Function Call Causing Object Slicing

```
#include <iostream>

class Base {
public:
    explicit Base(int b) {
        _b = b;
    }
    virtual ~Base() {}
    virtual int update() const;
protected:
    int _b;
};


class Derived: public Base {
public:
    explicit Derived(int b):Base(b) {}
    int update() const;
};

//Class methods definition

int Base::update() const {
    return (_b + 1);
}

int Derived::update() const {
    return (_b -1);
}


//Other function definitions
void funcPassByValue(const Base bObj) {
    std::cout << "Updated _b=" << bObj.update() << std::endl;
}

int main() {
    Derived dObj(0);
    funcPassByValue(dObj);       //Function call slices object
    return 0;
 }
```

In this example, the call `funcPassByValue(dObj)` results in the output `Updated _b=1` instead of the expected `Updated _b=-1`. Because `funcPassByValue` expects a `Base` object parameter, it calls the `Base` class copy constructor.

Therefore, even though you pass the `Derived` object `dObj`, the function `funcPassByValue` treats its parameter `b` as a `Base` object. It calls `Base::update()` instead of `Derived::update()`.

One possible correction is to pass the `Derived` object `dObj` by reference or by pointer. In the following, corrected example, `funcPassByReference` and `funcPassByPointer` have the same objective as `funcPassByValue` in the preceding example. However, `funcPassByReference` expects a reference to a `Base` object and `funcPassByPointer` expects a pointer to a `Base` object.

Passing the `Derived` object `d` by a pointer or by reference does not slice the object. The calls `funcPassByReference(dObj)` and `funcPassByPointer(&dObj)` produce the expected result `Updated _b=-1`.

```
#include <iostream>

class Base {
public:
    explicit Base(int b) {
        _b = b;
    }
    virtual ~Base() {}
    virtual int update() const;
protected:
    int _b;
};


class Derived: public Base {
public:
    explicit Derived(int b):Base(b) {}
    int update() const;
};

//Class methods definition
```

```
int Base::update() const {
    return (_b + 1);
}

int Derived::update() const {
    return (_b -1);
}


//Other function definitions
void funcPassByReference(const Base& bRef) {
    std::cout << "Updated _b=" << bRef.update() << std::endl;
}

void funcPassByPointer(const Base* bPtr) {
    std::cout << "Updated _b=" << bPtr->update() << std::endl;
}

int main() {
    Derived dObj(0);
    funcPassByReference(dObj);       //Function call does not slice object
    funcPassByPointer(&dObj);       //Function call does not slice object
    return 0;
 }
```

**Note** If you pass by value, because a copy of the object is made, the original object is not modified. Passing by reference or by pointer makes the object vulnerable to modification. If you are concerned about your original object being modified, add a `const` qualifier to your function parameter, as in the preceding example.

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** On
**Command-Line Syntax:** `OBJECT_SLICING`
**Impact:** High

## See Also

`Find defects (-checkers)`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

**Introduced in R2015b**

# Opening previously opened resource

Opening an already opened file

## Description

**Opening previously opened resource** checks for file opening functions that are opening an already opened file.

### Risk

If you open a resource multiple times, you can encounter:

- A race condition when accessing the file.
- Undefined or unexpected behavior for that file.
- Portability issues when you run your program on different targets.

### Fix

Once a resource is open, close the resource before reopening.

## Examples

### File Reopened With New Permissions

```
#include <stdio.h>
const char* logfile = "my_file.log";

void doubleresourceopen()
{
    FILE* fpa = fopen(logfile, "w");
    if (fpa == NULL) {
        return;
    }
    (void)fprintf(fpa, "Writing");
    FILE* fpb = fopen(logfile, "r");
    (void)fclose(fpa);
    (void)fclose(fpb);
}
```

In this example, a `logfile` is opened in the first line of this function with write privileges. Halfway through the function, the `logfile` is opened again with read privileges.

One possible correction is to close the file before reopening the file with different privileges.

```
#include <stdio.h>
const char* logfile = "my_file.log";

void doubleresourceopen()
{
    FILE* fpa = fopen(logfile, "w");
    if (fpa == NULL) {
        return;
    }
    (void)fprintf(fpa, "Writing");
    (void)fclose(fpa);
    FILE* fpb = fopen(logfile, "r");
    (void)fclose(fpb);
}
```

## Result Information

**Group:** Resources
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `DOUBLE_RESOURCE_OPEN`
**Impact:** Medium
**CWE ID:** 362, 675
**CERT C ID:** FIO24-C, FIO31-C

Introduced in R2016b

# Overlapping assignment

Memory overlap between left and right sides of an assignment

## Description

**Overlapping assignment** occurs when there is a memory overlap between the left and right sides of an assignment. For instance, a variable is assigned to itself or one member of a union is assigned to another.

### Risk

If the left and right sides of an assignment have memory overlap, the behavior is either redundant or undefined. For instance:

- Self-assignment such as `x=(int)(long)x;` is redundant unless `x` is `volatile`-qualified.
- Assignment of one union member to another causes undefined behavior.

  For instance, in the following code:

  - The result of the assignment `u1.a = u1.b` is undefined because `u1.b` is not initialized.
  - The result of the assignment `u2.b = u2.a` depends on the alignment and endianness of the implementation. It is not defined by C standards.

  ```
  union {
     char a;
     int b;
  }u1={'a'}, u2={'a'}; //'u1.a' and 'u2.a' are initialized

  u1.a = u1.b;
  u2.b = u2.a;
  ```

### Fix

Avoid assignment between two variables that have overlapping memory.

# Examples

## Assignment of Union Members

```
#include <string.h>

union Data {
    int i;
    float f;
};

int main( ) {
    union Data data;
    data.i = 0;
    data.f = data.i;

    return 0;
}
```

In this example, the variables `data.i` and `data.f` are part of the same `union` and are stored in the same location. Therefore, part of their memory storage overlaps.

# Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `OVERLAPPING_ASSIGN`
**Impact:** Low
**CWE ID:** 665
**CERT C ID:** MSC15-C

# See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Copy of overlapping memory`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Partial override of overloaded virtual functions

Class overrides fraction of inherited virtual functions with a given name

## Description

**Partial override of overloaded virtual functions** occurs when:

- A base class has multiple `virtual` methods with the same name but different signatures (overloading).
- A class derived from the base class overrides at least one of those `virtual` methods, but not all of them.

### Risk

The `virtual` methods that the derived class does not override are hidden. You cannot call those methods using an object of the derived class.

### Fix

See if the overloads in the base class are required. If they are needed, possible solutions include:

- In your derived class, if you override one `virtual` method, override all `virtual` methods from the base class with the same name as that method.
- Otherwise, add the line `using` *`Base_class_name`*`::`*`method_name`* to the derived class declaration. In this way, you can call the base class methods using an object of the derived class.

## Examples

### Partial Override

```
class Base {
public:
    explicit Base(int b);
    virtual ~Base() {};
    virtual void set()           {
        _b = (int)0;
    };
    virtual void set(short i)    {
        _b = (int)i;
    };
    virtual void set(int i)      {
        _b = (int)i;
    };
    virtual void set(long i)     {
        _b = (int)i;
    };
    virtual void set(float i)    {
        _b = (int)i;
    };
    virtual void set(double i)   {
        _b = (int)i;
    };
private:
    int _b;
};

class Derived: public Base {
        public:
                Derived(int b, int d): Base(b), _d(d) {};
                void set(int i)    { Base::set(i); _d = (int)i; };
        private:
                int _d;
};
```

In this example, the class `Derived` overrides the function `set` that takes an `int` argument. It does not override other functions that have the same name `set` but take arguments of other types.

The defect appears on the derived class name in the derived class definition. To find which base class method is overridden:

1. Navigate to the base class definition. On the **Source** pane, right-click the base class name and select **Go To Definition**.
2. In the base class definition, identify the method that has the same name and signature as a derived class method name.

One possible correction is add the line `using Base::set` to the `Derived` class declaration.

```
class Base {
public:
    explicit Base(int b);
    virtual ~Base() {};
    virtual void set()           {
        _b = (int)0;
    };
    virtual void set(short i)    {
        _b = (int)i;
    };
    virtual void set(int i)      {
        _b = (int)i;
    };
    virtual void set(long i)     {
        _b = (int)i;
    };
    virtual void set(float i)    {
        _b = (int)i;
    };
    virtual void set(double i)   {
        _b = (int)i;
    };
private:
    int _b;
};

class Derived: public Base {
        public:
                Derived(int b, int d): Base(b), _d(d) {};
                using Base::set;
                void set(int i)    { Base::set(i); _d = (int)i; };
        private:
                int _d;
};
```

## Result Information

**Group:** Object oriented
**Language:** C++

**Default:** On
**Command-Line Syntax:** `PARTIAL_OVERRIDE`
**Impact:** Medium

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Partially accessed array

Array partly read or written before end of scope

## Description

**Partially accessed array** occurs when an array is partially read or written before the end of array scope. For arrays local to a function, the end of scope occurs when the function ends.

## Examples

### Partially accessed array error

```
int Calc_Sum(void)
{
  int tab[5]={0,1,2,3,4},sum=0;
  /* Defect: tab[4] is not read */

  for (int i=0; i<4;i++) sum+=tab[i];

  return(sum);

 }
```

The array `tab` is only partially read before end of function `Calc_Sum`. While calculating `sum`, `tab[4]` is not included.

One possible correction is to read every element in the array `tab`.

```
int Calc_Sum(void)
{
  int tab[5]={0,1,2,3,4},sum=0;

  /* Fix: Include tab[4] in calculating sum */
  for (int i=0; i<5;i++) sum+=tab[i];

  return(sum);

 }
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On for handwritten code, off for generated code
**Command-Line Syntax:** `PARTIALLY_ACCESSED_ARRAY`
**Impact:** Low

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2013b**

# Pointer access out of bounds

Pointer dereferenced outside its bounds

## Description

**Pointer access out of bounds** occurs when a pointer is dereferenced outside its bounds.

When a pointer is assigned an address, a block of memory is associated with the pointer. You cannot access memory beyond that block using the pointer.

## Examples

### Pointer access out of bounds error

```
int* Initialize(void)
{
 int arr[10];
 int *ptr=arr;

 for (int i=0; i<=9;i++)
   {
    ptr++;
    *ptr=i;
    /* Defect: ptr out of bounds for i=9 */
   }

 return(arr);
}
```

`ptr` is assigned the address `arr` that points to a memory block of size `10*sizeof(int)`. In the `for`-loop, `ptr` is incremented 10 times. In the last iteration of the loop, `ptr` points outside the memory block assigned to it. Therefore, it cannot be dereferenced.

One possible correction is to reverse the order of increment and dereference of `ptr`.

```
int* Initialize(void)
{
 int arr[10];
 int *ptr=arr;

 for (int i=0; i<=9;i++)
     {
      /* Fix: Dereference pointer before increment */
      *ptr=i;
      ptr++;
     }

 return(arr);
}
```

After the last increment, even though `ptr` points outside the memory block assigned to it, it is not dereferenced more.

## Check Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `OUT_BOUND_PTR`
**Impact:** High
**CWE ID:** 119, 188, 466, 823
**CERT C ID:** API02-C, ARR30-C, ARR38-C, ARR39-C, EXP08-C, EXP39-C, MEM35-C, MSC15-CSTR31-C
**ISO/IEC TS 17961 ID:** `ptrcomp`, `insufmem`, `invptr`, `taintformatio`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Array access out of bounds`

### Topics

"Navigate to Root Cause of Defect"

“Review and Fix Results”

**Introduced in R2013b**

# Pointer dereference with tainted offset

Offset is from an unsecure source and dereference may be out of bounds

## Description

**Pointer dereference with tainted offset** detects pointer dereferencing, either reading or writing, using an offset variable from an unknown or unsecure source.

This check focuses on dynamically allocated buffers. For static buffer offsets, see `Array access with tainted index`.

### Risk

The index might be outside the valid array range. If the tainted index is outside the array range, it can cause:

- Buffer underflow/underwrite, or writing to memory before the beginning of the buffer.
- Buffer overflow, or writing to memory after the end of a buffer.
- Over reading a buffer, or accessing memory after the end of the targeted buffer.
- Under-reading a buffer, or accessing memory before the beginning of the targeted buffer.

An attacker can use an invalid read or write to compromise your program.

### Fix

Validate the index before you use the variable to access the pointer. Check to make sure that the variable is inside the valid range and does not overflow.

## Examples

### Dereference Pointer Array

```
#include <stdlib.h>
```

```
enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};
extern void read_pint(int*);

int taintedptroffset(int i) {
    int* pint = (int*)calloc(SIZE10, sizeof(int));
    int c = 0;
    if(pint) {
        /* Filling array */
        read_pint(pint);
        c = pint[i];
        free(pint);
    }
    return c;
}
```

In this example, the function initializes an integer pointer `pint`. The pointer is dereferenced using the input index `i`. The value of `i` could be outside the pointer range, causing an out-of-range error.

One possible correction is to validate the value of the index. If the index is inside the valid range, continue with the pointer dereferencing.

```
#include <stdlib.h>

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};
extern void read_pint(int*);

int taintedptroffset(int i) {
    int* pint = (int*)calloc(SIZE10, sizeof(int));
    int c = 0;
    if (pint) {
        /* Filling array */
        read_pint(pint);
        if (i>0 && i<SIZE10) {
            c = pint[i];
        }
        free(pint);
    }
    return c;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_PTR_OFFSET`
**Impact:** Low
**CWE ID:** 122, 124, 129, 823
**CERT C ID:** API00-C, API02-C, ARR30-C
**ISO/IEC TS 17961 ID:** `invptr`

## See Also

`Array access with tainted index` | `Use of tainted pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Pointer or reference to stack variable leaving scope

Pointer to local variable leaves the variable scope

## Description

**Pointer or reference to stack variable leaving scope** occurs when a pointer or reference to a local variable leaves the scope of the variable. For instance:

- A function returns a pointer to a local variable.
- A function performs the assignment `globPtr = &locVar`. `globPtr` is a global pointer variable and `locVar` is a local variable.
- A function performs the assignment `*paramPtr = &locVar`. `paramPtr` is a function parameter that is, for instance, an `int**` pointer and `locVar` is a local `int` variable.
- A C++ method performs the assignment `memPtr = &locVar`. `memPtr` is a pointer data member of the class the method belongs to. `locVar` is a variable local to the method.

The defect also applies to memory allocated using the `alloca` function. The defect does not apply to static, local variables.

### Risk

Local variables are allocated an address on the stack. Once the scope of a local variable ends, this address is available for reuse. Using this address to access the local variable value outside the variable scope can cause unexpected behavior.

If a pointer to a local variable leaves the scope of the variable, Polyspace Bug Finder highlights the defect. The defect appears even if you do not use the address stored in the pointer. For maintainable code, it is a good practice to not allow the pointer to leave the variable scope. Even if you do not use the address in the pointer now, someone else using your function can use the address, causing undefined behavior.

### Fix

Do not allow a pointer or reference to a local variable to leave the variable scope.

# Examples

## Pointer to Local Variable Returned from Function

```
void func2(int *ptr) {
    *ptr = 0;
}

int* func1(void) {
    int ret = 0;
    return &ret ;
}
void main(void) {
    int* ptr = func1() ;
    func2(ptr) ;
}
```

In this example, `func1` returns a pointer to local variable `ret`.

In `main`, `ptr` points to the address of the local variable. When `ptr` is accessed in `func2`, the access is illegal because the scope of `ret` is limited to `func1`,

# Result Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `LOCAL_ADDR_ESCAPE`
**Impact:** High
**CWE ID:** 562
**CERT C ID:** DCL30-C
**ISO/IEC TS 17961 ID:** `addrescape`

# See Also

`Find defects (-checkers)`

## Topics

"Navigate to Root Cause of Defect"

"Review and Fix Results"

Introduced in R2015b

# Pointer to non-initialized value converted to const pointer

Pointer to constant assigned address that does not contain a value

## Description

**Pointer to non initialized value converted to const pointer** occurs when a pointer to a constant is assigned an address that does not yet contain a value.

## Examples

### Pointer to non initialized value converted to const pointer error

```
#include<stdio.h>

void Display_Parity()
 {
  int num,parity;
  const int* num_ptr = &num;
  /* Defect: Address &num does not store a value */

  printf("Enter a number\n:");
  scanf("%d",&num);

  parity=((*num_ptr)%2);
  if(parity==0)
    printf("The number is even.");
  else
    printf("The number is odd.");

 }
```

`num_ptr` is declared as a pointer to a constant. However the variable `num` does not contain a value when `num_ptr` is assigned the address `&num`.

One possible correction is to obtain the value of num from the user before &num is assigned to num_ptr.

```
#include<stdio.h>

void Display_Parity()
 {
  int num,parity;
  const int* num_ptr;

  printf("Enter a number\n:");
  scanf("%d",&num);

 /* Fix: Assign &num to pointer after it receives a value */
  num_ptr=&num;
  parity=((*num_ptr)%2);
  if(parity==0)
    printf("The number is even.");
  else
    printf("The number is odd.");
 }
```

The scanf statement stores a value in &num. Once the value is stored, it is legitimate to assign &num to num_ptr.

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** NON_INIT_PTR_CONV
**Impact:** Medium
**ISO/IEC TS 17961 ID:** uninitref

## See Also

Find defects (-checkers)

## Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2013b

# Possible misuse of sizeof

Use of `sizeof` operator can cause unintended results

## Description

**Possible misuse of sizeof** occurs when Polyspace Bug Finder detects possibly unintended results from the use of `sizeof` operator. For instance:

- You use the `sizeof` operator on an array parameter name, expecting the array size. However, the array parameter name by itself is a pointer. The `sizeof` operator returns the size of that pointer.
- You use the `sizeof` operator on an array element, expecting the array size. However, the operator returns the size of the array element.
- The size argument of certain functions such as `strncmp` or `wcsncpy` is incorrect because you used the `sizeof` operator earlier with possibly incorrect expectations. For instance:
  - In a function call `strncmp(string1, string2, num)`, `num` is obtained from an incorrect use of the `sizeof` operator on a pointer.
  - In a function call `wcsncpy(destination, source, num)`, `num` is the not the number of wide characters but a size in bytes obtained by using the `sizeof` operator. For instance, you use `wcsncpy(destination, source, sizeof(destination) - 1)` instead of `wcsncpy(destination, source, (sizeof(desintation)/sizeof(wchar_t)) - 1)`.

### Risk

Incorrect use of the `sizeof` operator can cause the following issues:

- If you expect the `sizeof` operator to return array size and use the return value to constrain a loop, the number of loop runs are smaller than what you expect.
- If you use the return value of `sizeof` operator to allocate a buffer, the buffer size is smaller than what you require. Insufficient buffer can lead to resultant weaknesses such as buffer overflows.

- If you use the return value of sizeof operator incorrectly in a function call, the function does not behave as you expect.

## Fix

Possible fixes are:

- Do not use the sizeof operator on an array parameter name or array element to determine array size.

  The best practice is to pass the array size as a separate function parameter and use that parameter in the function body.
- Use the sizeof operator carefully to determine the number argument of functions such as strncmp or wcsncpy. For instance, for wide string functions such as wcsncpy, use the number of wide characters as argument instead of the number of bytes.

# Examples

## sizeof Used Incorrectly to Determine Array Size

```
#define MAX_SIZE 1024

void func(int a[MAX_SIZE]) {
    int i;

    for (i = 0; i < sizeof(a)/sizeof(int); i++)    {
        a[i] = i + 1;
    }
}
```

In this example, sizeof(a) returns the size of the pointer a and not the array size.

One possible correction is to use another means to determine the array size.

```
#define MAX_SIZE 1024

void func(int a[MAX_SIZE]) {
    int i;
    for (i = 0; i < MAX_SIZE; i++)    {
        a[i] = i + 1;
    }
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `SIZEOF_MISUSE`
**Impact:** High
**CWE ID:** 467
**CERT C ID:** ARR00-C, ARR01-C, ARR38-C, ARR39-C, EXP01-C
**ISO/IEC TS 17961 ID:** `libptr`, `insufmem`, `sizeofptr`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### External Websites

Linux man page for strncmp
Linux man page for wcsncpy

Introduced in R2015b

# Possibly unintended evaluation of expression because of operator precedence rules

Operator precedence rules cause unexpected evaluation order in arithmetic expression

## Description

**Possibly unintended evaluation of expression because of operator precedence rules** occurs when an arithmetic expression result is possibly unintended because operator precedence rules dictate an evaluation order that you do not expect.

The defect highlights expressions of the form `x` *`op_1`* `y` *`op_2`* `z`. Here, *`op_1`*-*`op_2`* are operator combinations that commonly induce this error. For instance, `(x == y | z)`.

### Risk

The defect can cause the following issues:

- If you or another code reviewer reviews the code, the intended order of evaluation is not immediately clear.
- It is possible that the result of the evaluation does not meet your expectations. For instance:

  - In the operation `*p++`, it is possible that you expect the dereferenced value to be incremented. However, the pointer `p` is incremented before the dereference.
  - In the operation `(x == y | z)`, it is possible that you expect `x` to be compared with `y | z`. However, the `==` operation happens before the `|` operation.

### Fix

See if the order of evaluation is what you intend. If not, apply parentheses to implement the evaluation order that you want.

For better readability of your code, it is good practice to apply parenthesis to implement an evaluation order even when operator precedence rules impose that order.

# Examples

## Expressions with Possibly Unintended Evaluation Order

```
int test(int a, int b, int c) {
    return(a & b == c);
}
```

In this example, the == operation happens first, followed by the `&` operation. If you intended the reverse order of operations, the result is not what you expect.

One possible correction is to apply parenthesis to implement the intended evaluation order.

```
int test(int a, int b, int c) {
    return((a & b) == c);
}
```

# Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `OPERATOR_PRECEDENCE`
**Impact:** High
**CWE ID:** 783
**CERT C ID:** EXP00-C, EXP13-C

# See Also

`Find defects (-checkers)`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

## External Websites

C++ Operator Precedence

Introduced in R2015b

# Predictable block cipher initialization vector

Initialization vector is generated from a weak random number generator

## Description

**Predictable block cipher initialization vector** occurs when you use a weak random number generator for the block cipher initialization vector.

### Risk

If you use a weak random number generator for the initiation vector, your data is vulnerable to dictionary attacks.

Block ciphers break your data into blocks of fixed size. Block cipher modes such as CBC (Cipher Block Chaining) protect against dictionary attacks by XOR-ing each block with the encrypted output from the previous block. To protect the first block, these modes use a random initialization vector (IV). If you use a weak random number generator for your IV, your data becomes vulnerable to dictionary attacks.

### Fix

Use a strong pseudo-random number generator (PRNG) for the initialization vector. For instance, use:

- OS-level PRNG such as `/dev/random` on UNIX or `CryptGenRandom()` on Windows
- Application-level PRNG such as Advanced Encryption Standard (AES) in Counter (CTR) mode, HMAC-SHA1, etc.

For a list of random number generators that are cryptographically weak, see `Vulnerable pseudo-random number generator`.

# Examples

## Predictable Initialization Vector

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define SIZE16 16

int func(EVP_CIPHER_CTX *ctx, unsigned char *key){
    unsigned char iv[SIZE16];
    RAND_pseudo_bytes(iv, 16);
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

In this example, the function `RAND_pseudo_bytes` declared in `openssl/rand.h` produces the initialization vector. The byte sequences that `RAND_pseudo_bytes` generates are not necessarily unpredictable.

Use a strong random number generator to produce the initialization vector. The corrected code here uses the function `RAND_bytes` declared in `openssl/rand.h`.

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define SIZE16 16

int func(EVP_CIPHER_CTX *ctx, unsigned char *key){
    unsigned char iv[SIZE16];
    RAND_bytes(iv, 16);
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

# Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off

**Command-Line Syntax:** `CRYPTO_CIPHER_PREDICTABLE_IV`
**Impact:** Medium
**CWE ID:** 310, 329, 330, 338
**CERT C ID:** MSC18-C

Introduced in R2017a

# Predictable cipher key

Encryption or decryption key is generated from a weak random number generator

## Description

**Predictable cipher key** occurs when you use a weak random number generator for the encryption or decryption key.

### Risk

If you use a weak random number generator for the encryption or decryption key, an attacker can retrieve your key easily.

You use a key to encrypt and later decrypt your data. If a key is easily retrieved, data encrypted using that key is not secure.

### Fix

Use a strong pseudo-random number generator (PRNG) for the key. For instance:

- Use an OS-level PRNG such as `/dev/random` on UNIX or `CryptGenRandom()` on Windows
- Use an application-level PRNG such as Advanced Encryption Standard (AES) in Counter (CTR) mode, HMAC-SHA1, etc.

For a list of random number generators that are cryptographically weak, see `Vulnerable pseudo-random number generator`.

## Examples

### Predictable Cipher Key

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define SIZE16 16

int func(EVP_CIPHER_CTX *ctx, unsigned char *iv){
    unsigned char key[SIZE16];
    RAND_pseudo_bytes(key, 16);
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

In this example, the function `RAND_pseudo_bytes` declared in `openssl/rand.h` produces the cipher key. However, the byte sequences that `RAND_pseudo_bytes` generates are not necessarily unpredictable.

One possible correction is to use a strong random number generator to produce the cipher key. The corrected code here uses the function `RAND_bytes` declared in `openssl/rand.h`.

```
#include <openssl/evp.h>
#include <openssl/rand.h>
#include <stdlib.h>
#define SIZE16 16

int func(EVP_CIPHER_CTX *ctx, unsigned char *iv){
    unsigned char key[SIZE16];
    RAND_bytes(key, 16);
    return EVP_CipherInit_ex(ctx, EVP_aes_128_cbc(), NULL, key, iv, 1);
}
```

# Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_PREDICTABLE_KEY`
**Impact:** Medium
**CWE ID:** 310, 326, 330, 338
**CERT C ID:** MSC18-C

Introduced in R2017a

# Predictable random output from predictable seed

Seeding routine uses a predictable seed making the output predictable

## Description

**Predictable random output from predictable seed** looks for random standard functions that use a nonconstant but predictable seed. Examples of predictable seed generators are `time`, `gettimeofday`, and `getpid`.

### Risk

When you use predictable seed values for random number generation, your random numbers are also predictable. A hacker can disrupt your program if they know how your program behaves.

### Fix

You can use a different function to generate less predictable seeds.

You can also use a different random number generator that does not require a seed. For example, the Windows API function `rand_s` seeds itself by default. It uses information from the entire system, for example, system time, thread ids, system counter, and memory clusters. This information is more random and a user cannot access this information.

Some standard random routines are inherently cryptographically weak on page 3-630, and should not be used for security purposes.

## Examples

### Seed as an Argument

```
#include <stdlib.h>
#include <time.h>
```

```
void seed_rng(int seed)
{
    srand(seed);
}

int generate_num(void)
{
    seed_rng(time(NULL) + 3);
    /* ... */
}
```

This example uses `srand` to start the random number generator with `seed` as the seed. However, `seed` is predictable because the function `time` generates it. So, an attacker can predict the random numbers generated by `srand`.

One possible correction is to use a random number generator that does not require a seed. This example uses `rand_s`.

```
#define _CRT_RAND_S

#include <stdlib.h>
#include <stdio.h>
#include <errno.h>

int generate_num(void)
{
    unsigned int number;
    errno_t err;
    err = rand_s(&number);

    if(err != 0)
    {
        return number;
    }
    else
    {
        return err;
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `RAND_SEED_PREDICTABLE`
**Impact:** Medium
**CWE ID:** 330, 337
**CERT C ID:** MSC32-C

## See Also

`Deterministic random output from constant seed` | `Unsafe standard encryption function` | `Vulnerable pseudo-random number generator`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Privilege drop not verified

Verify privilege relinquishment was successful

## Description

**Privilege drop not verified** detects calls to functions that relinquish privileges. If you do not verify that the privileges were dropped before the end of your function, a defect is raised.

### Risk

If privilege relinquishment fails, an attacker can regain elevated privileges and have more access to your program than intended. This security hole can cause unexpected behavior in your code if left open.

### Fix

Before the end of scope, verify that the privileges that you dropped were actually dropped.

## Examples

### Drop Privileges Within a Function

```
#define _BSD_SOURCE
#include <sys/types.h>
#include <unistd.h>
#include <grp.h>
#include <stdlib.h>
#define fatal_error() abort()
extern int need_more_privileges;

void missingprivilegedropcheck() {
    /* Code intended to run with elevated privileges */
    /* Temporarily drop elevated privileges */
    if (seteuid(getuid()) != 0) {
        /* Handle error */
        fatal_error();
    }

    /* Code intended to run with lower privileges */

    if (need_more_privileges) {
        /* Restore elevated privileges */
        if (seteuid(0) != 0) {
            /* Handle error */
            fatal_error();
        }
        /* Code intended to run with elevated privileges */
    }

    /* ... */

    /* Permanently drop elevated privileges */
    if (setuid(getuid()) != 0) {
        /* Handle error */
        fatal_error();
    }

    /* Code intended to run with lower privileges */
}
```

In this example, privileges are elevated and dropped to run code with the intended privilege level. When privileges are dropped, the privilege level before exiting the function body is not verified. A malicious attacker can regain their elevated privileges.

One possible correction is to use `setuid` to verify that the privileges were dropped.

```
#define _BSD_SOURCE
#include <sys/types.h>
#include <unistd.h>
#include <grp.h>
#include <stdlib.h>
#define fatal_error() abort()
extern int need_more_privileges;

void missingprivilegedropcheck() {
    /* Store the privileged ID for later verification */
```

```
uid_t privid = geteuid();

/* Code intended to run with elevated privileges   */

/* Temporarily drop elevated privileges */
if (seteuid(getuid()) != 0) {
    /* Handle error */
    fatal_error();
}

/* Code intended to run with lower privileges  */

if (need_more_privileges) {
    /* Restore elevated Privileges */
    if (seteuid(privid) != 0) {
        /* Handle error */
        fatal_error();
    }
    /* Code intended to run with elevated privileges   */
}

/* ... */

/* Restore privileges if needed */
if (geteuid() != privid) {
    if (seteuid(privid) != 0)
    {
        /* Handle error */
        fatal_error();
    }
}

/* Permanently drop privileges */
if (setuid(getuid()) != 0)
{
    /* Handle error */
    fatal_error();
}

if (setuid(0) != -1)
{
    /* Privileges can be restored, handle error */
    fatal_error();
}
```

```
    /* Code intended to run with lower privileges; */
}
```

## Result Information

**Group:** Security  
**Language:** C | C++  
**Default:** Off  
**Command-Line Syntax:** `MISSING_PRIVILEGE_DROP_CHECK`  
**Impact:** High  
**CWE ID:** 250, 273  
**CERT C ID:** POS37-C

Introduced in R2016b

# Qualifier removed in conversion

Variable qualifier is lost during conversion

## Description

**Qualifier removed in conversion** occurs during a conversion when one variable has a qualifier and the other does not. For example, when converting from a `const int` to an `int`, the conversion removes the `const` qualifier.

This defect applies only for projects in C.

## Examples

### Cast of Character Pointers

```
void implicit_cast(void) {
    const char  cc, *pcc = &cc;
    char * quo;

    quo = &cc;
    quo = pcc;

    read(quo);
}
```

During the assignment to the character `q`, the variables, `cc` and `pcc`, are converted from `const char` to `char`. The `const` qualifier is removed during the conversion causing a defect.

One possible correction is to add the same qualifiers to the new variables. In this example, changing `q` to a `const char` fixes the defect.

```
void implicit_cast(void) {
    const char  cc, *pcc = &cc;
    const char * quo;
    quo = &cc;
    quo = pcc;

    read(quo);
}
```

One possible correction is to remove the qualifiers in the converted variable. In this example, removing the `const` qualifier from the `cc` and `pcc` initialization fixes the defect.

```
void implicit_basic_cast(void) {
    char  cc, *pcc = &cc;
    char * quo;

    quo = &cc;
    quo = pcc;

    read(quo);
}
```

## Check Information

**Group:** Programming
**Language:** C
**Default:** Off
**Command-Line Syntax:** `QUALIFIER_MISMATCH`
**Impact:** Low
**CWE ID:** 704
**CERT C ID:** EXP05-C, EXP32-C, EXP37-C
**ISO/IEC TS 17961 ID:** `argcomp`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Resource leak

File stream not closed before FILE pointer scope ends or pointer is reassigned

## Description

**Resource leak** occurs when you open a file stream by using a FILE pointer but do not close it before:

- The end of the pointer's scope.
- Assigning the pointer to another stream.

### Risk

If you do not release file handles explicitly as soon as possible, a failure can occur due to exhaustion of resources.

### Fix

Close a FILE pointer before the end of its scope, or before you assign the pointer to another stream.

## Examples

### FILE Pointer Not Released Before End of Scope

```
#include <stdio.h>

void func1( void ) {
    FILE *fp1;
    fp1 = fopen ( "data1.txt", "w" );
    fprintf ( fp1, "*" );

    fp1 = fopen ( "data2.txt", "w" );
    fprintf ( fp1, "!" );
    fclose ( fp1 );
}
```

In this example, the file pointer `fp1` is pointing to a file `data1.txt`. Before `fp1` is explicitly dissociated from the file stream of `data1.txt`, it is used to access another file `data2.txt`.

One possible correction is to explicitly dissociate `fp1` from the file stream of `data1.txt`.

```
#include <stdio.h>

void func1( void ) {
    FILE *fp1;
    fp1 = fopen ( "data1.txt", "w" );
    fprintf ( fp1, "*" );
    fclose(fp1);

    fp1 = fopen ( "data2.txt", "w" );
    fprintf ( fp1, "!" );
    fclose ( fp1 );
}
```

## Result Information

**Group:** Resource management
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `RESOURCE_LEAK`
**Impact:** High
**CWE ID:** 772
**CERT C ID:** FIO42-C, MEM12-C
**ISO/IEC TS 17961 ID:** `fileclose`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"

“Review and Fix Results”

Introduced in R2015b

# Return from computational exception signal handler

Undefined behavior when signal handler returns normally from program error

## Description

**Return from computational exception signal handler** occurs when a signal handler returns after catching a computational exception signal SIGFPE, SIGILL, or SIGSEGV.

### Risk

A signal handler that returns normally from a computational exception is undefined behavior. Even if the handler attempts to fix the error that triggered the signal, the program can behave unexpectedly.

### Fix

Check the validity of the values of your variables before the computation to avoid using a signal handler to catch exceptions. If you cannot avoid a handler to catch computation exception signals, call abort(), quick_exit(), or _Exit() in the handler to stop the program.

## Examples

### Signal Handler Return from Division by Zero

```
#include <errno.h>
#include <limits.h>
#include <signal.h>
#include <stdlib.h>

static volatile sig_atomic_t denom;
/* Declare signal handler to catch division by zero
computation error. */
void sig_handler(int s)
```

```
{
    int s0 = s;
    if (denom == 0)
    {
        denom = 1;
    }
    /* Normal return from computation exception
    signal */
    return;
}


long func(int v)
{
    denom = (sig_atomic_t)v;

        if (signal(SIGFPE, sig_handler) == SIG_ERR)
        {
            /* Handle error */
        }

    long result = 100 / (long)denom;
    return result;
}
```

In this example, `sig_handler` is declared to handle a division by zero computation error. The handler changes the value of `denom` if it is zero and returns, which is undefined behavior.

After catching a computational exception, call `abort()` from `sig_handler` to exit the program without further error.

```
#include <errno.h>
#include <limits.h>
#include <signal.h>
#include <stdlib.h>

static volatile sig_atomic_t denom;
/* Declare signal handler to catch division by zero
computation error. */
```

```
void sig_handler(int s)
{
    int s0 = s;
    /* call to abort() to exit the program */
    abort();
}

long func(int v)
{
    denom = (sig_atomic_t)v;

        if (signal(SIGFPE, sig_handler) == SIG_ERR)
        {
            /* Handle error */
        }

    long result = 100 / (long)denom;
    return result;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** SIG_HANDLER_COMP_EXCP_RETURN
**Impact:** Low
**CWE ID:** 387,
**CERT C ID:** SIG35-C

## See Also

Function called from signal handler not asynchronous-safe | Function called from signal handler not asynchronous-safe (strict) | Signal call from within signal handler

### Introduced in R2017b

# Return of non const handle to encapsulated data member

Method returns pointer or reference to internal member of object

## Description

**Return of non-const handle to encapsulated data member** occurs when:

- A class method returns a handle to a data member. Handles include pointers and references.
- The method is more accessible than the data member. For instance, the method has access specifier `public`, but the data member is `private` or `protected`.

### Risk

The access specifier determines the accessibility of a class member. For instance, a class member declared with the `private` access specifier cannot be accessed outside a class. Therefore, nonmember, nonfriend functions cannot modify the member.

When a class method returns a handle to a less accessible data member, the member accessibility changes. For instance, if a `public` method returns a pointer to a `private` data member, the data member is effectively not `private` anymore. A nonmember, nonfriend function calling the `public` method can use the returned pointer to view and modify the data member.

Also, if you assign the pointer to a data member of an object to another pointer, when you delete the object, the second pointer can be left dangling. The second pointer points to the part of an object that does not exist anymore.

### Fix

One possible fix is to avoid returning a handle to a data member from a class method. Return a data member by value so that a copy of the member is returned. Modifying the copy does not change the data member.

If you must return a handle, use a const qualifier with the method return type so that the handle allows viewing, but not modifying, the data member.

# Examples

## Return of Pointer to private Data Member

```
#include <string>
#define NUM_RECORDS 100

struct Date {
    int dd;
    int mm;
    int yyyy;
};


struct Period {
    Date startDate;
    Date endDate;
};

class DataBaseEntry {
private:
    std::string employeeName;
    Period employmentPeriod;
public:
    Period* getPeriod(void);
};

Period* DataBaseEntry::getPeriod(void) {
    return &employmentPeriod;
}


void use(Period*);
void reset(Period*);

int main() {
    DataBaseEntry dataBase[NUM_RECORDS];
    Period* tempPeriod;
    for(int i=0;i < NUM_RECORDS;i++) {
        tempPeriod = dataBase[i].getPeriod();
        use(tempPeriod);
        reset(tempPeriod);
    }
    return 0;
}

void reset(Period* aPeriod) {
       aPeriod->startDate.dd = 1;
       aPeriod->startDate.mm = 1;
       aPeriod->startDate.yyyy = 2000;
}
```

In this example, `employmentPeriod` is `private` to the class `DataBaseEntry`. It is therefore immune from modification by nonmember, nonfriend functions. However, returning a pointer to `employmentPeriod` breaks this encapsulation. For instance, the nonmember function `reset` modifies the member `startDate` of `employmentPeriod`.

One possible correction is to return the data member `employmentPeriod` by value instead of pointer. Modifying the return value does not change the data member because the return value is a copy of the data member.

```
#include <string>
#define NUM_RECORDS 100

struct Date {
    int dd;
    int mm;
    int yyyy;
};


struct Period {
    Date startDate;
    Date endDate;
};

class DataBaseEntry {
private:
    std::string employeeName;
    Period employmentPeriod;
public:
    Period getPeriod(void);
};

Period DataBaseEntry::getPeriod(void) {
    return employmentPeriod;
}


void use(Period*);
void reset(Period*);

int main() {
    DataBaseEntry dataBase[NUM_RECORDS];
    Period tempPeriodVal;
    Period* tempPeriod;
    for(int i=0;i < NUM_RECORDS;i++) {
        tempPeriodVal = dataBase[i].getPeriod();
        tempPeriod = &tempPeriodVal;
        use(tempPeriod);
        reset(tempPeriod);
    }
    return 0;
}

void reset(Period* aPeriod) {
       aPeriod->startDate.dd = 1;
       aPeriod->startDate.mm = 1;
       aPeriod->startDate.yyyy = 2000;
}
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** Off
**Command-Line Syntax:** `BREAKING_DATA_ENCAPSULATION`
**Impact:** Medium
**CWE ID:** 767

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

**Introduced in R2015b**

# Returned value of a sensitive function not checked

Sensitive functions called without checking for unexpected return values and errors

## Description

**Returned value of a sensitive function not checked** occurs when you call sensitive standard functions, but you:

- Ignore the return value.
- Use an output or a return value without testing the validity of the return value.

For this defect, two type of functions are considered: ***sensitive*** and ***critical sensitive***.

A ***sensitive*** function is a standard function that can encounter:

- Exhausted system resources (for example, when allocating resources)
- Changed privileges or permissions
- Tainted sources when reading, writing, or converting data from external sources
- Unsupported features despite an existing API

A ***critical sensitive*** function is a sensitive function that performs one of these critical or vulnerable tasks:

- Set privileges (for example, `setuid`)
- Create a jail (for example, `chroot`)
- Create a process (for example, `fork`)
- Create a thread (for example, `pthread_create`)
- Lock or unlock mutex (for example, `pthread_mutex_lock`)
- Lock or unlock memory segments (for example, `mlock`)

## Risk

If you do not check the return value of functions that perform sensitive or critical sensitive tasks, your program can behave unexpectedly. Errors from these functions can propagate throughout the program causing incorrect output, security vulnerabilities, and possibly system failures.

## Fix

Before continuing with the program, test the return value of *critical sensitive* functions.

For *sensitive functions*, you can explicitly ignore a return value by casting the function to `void`. Polyspace does not raise this defect for sensitive functions cast to void. This resolution is not accepted for *critical sensitive functions* because they perform more vulnerable tasks.

# Examples

## Sensitive Function Return Ignored

```
#include <pthread.h>

void initialize() {
    pthread_attr_t attr;

    pthread_attr_init(&attr);
}
```

This example shows a call to the sensitive function `pthread_attr_init`. The return value of `pthread_attr_init` is ignored, causing a defect.

One possible correction is to cast the function to void. This fix informs Polyspace and any reviewers that you are explicitly ignoring the return value of the sensitive function.

```
#include <pthread.h>

void initialize() {
    pthread_attr_t attr;

    (void)pthread_attr_init(&attr);
}
```

One possible correction is to test the return value of pthread_attr_init to check for errors.

```
#include <pthread.h>
#include <stdlib.h>
#define fatal_error() abort()

void initialize() {
    pthread_attr_t attr;
    int result;

    result = pthread_attr_init(&attr);
    if (result != 0) {
        /* Handle error */
        fatal_error();
    }
}
```

## Critical Function Return Ignored

```
#include <pthread.h>
extern void *start_routine(void *);

void returnnotchecked() {
    pthread_t thread_id;
    pthread_attr_t attr;
    void *res;

    (void)pthread_attr_init(&attr);
    (void)pthread_create(&thread_id, &attr, &start_routine, ((void *)0));
    pthread_join(thread_id,  &res);
}
```

In this example, two critical functions are called: pthread_create and pthread_join. The return value of the pthread_create is ignored by casting to void, but because pthread_create is a critical function (not just a sensitive function), Polyspace does not ignore this *Return value of a sensitive function not checked* defect. The other critical function, pthread_join, returns value that is ignored implicitly. pthread_join uses the return value of pthread_create, which was not checked.

The correction for this defect is to check the return value of these critical functions to verify the function performed as expected.

```
#include <pthread.h>
#include <stdlib.h>
#define fatal_error() abort()

extern void *start_routine(void *);

void returnnotchecked() {
    pthread_t thread_id;
    pthread_attr_t attr;
    void *res;
    int result;

    (void)pthread_attr_init(&attr);
    result = pthread_create(&thread_id, &attr, &start_routine, NULL);
    if (result != 0) {
        /* Handle error */
        fatal_error();
    }

    result = pthread_join(thread_id,  &res);
    if (result != 0) {
        /* Handle error */
        fatal_error();
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `RETURN_NOT_CHECKED`
**Impact:** High
**CWE ID:** 252, 754
**CERT C ID:** ERR33-C, EXP12-C, FIO04-C, FIO33-C, POS54-C
**ISO/IEC TS 17961 ID:** `liberr`

Introduced in R2016b

# Self assignment not tested in operator

Copy assignment operator does not test for self-assignment

## Description

**Self assignment not tested in operator** occurs when you do not test if the argument to the copy assignment operator of an object is the object itself.

### Risk

Self-assignment causes unnecessary copying. Though it is unlikely that you assign an object to itself, because of aliasing, you or users of your class cannot always detect a self-assignment.

Self-assignment can cause subtle errors if a data member is a pointer and you allocate memory dynamically to the pointer. In your copy assignment operator, you typically perform these steps:

1. Deallocate the memory originally associated with the pointer.

   ```
   delete ptr;
   ```
2. Allocate new memory to the pointer. Initialize the new memory location with contents obtained from the operator argument.

   ```
    ptr = new ptrType(*(opArgument.ptr));
   ```

If the argument to the operator, `opArgument`, is the object itself, after your first step, the pointer data member in the operator argument, `opArgument.ptr`, is not associated with a memory location. `*opArgument.ptr` contains unpredictable values. Therefore, in the second step, you initialize the new memory location with unpredictable values.

### Fix

Test for self-assignment in the copy assignment operator of your class. Only after the test, perform the assignments in the copy assignment operator.

# Examples

## Missing Test for Self-Assignment

```
class MyClass1 { };
class MyClass2 {
public:
    MyClass2()                : p_(new MyClass1())      { }
    MyClass2(const MyClass2& f)    : p_(new MyClass1(*f.p_)) { }
    ~MyClass2()                {
        delete p_;
    }
    MyClass2& operator= (const MyClass2& f)
    {
        delete p_;
        p_ = new MyClass1(*f.p_);
        return *this;
    }
private:
    MyClass1* p_;
};
```

In this example, the copy assignment operator in `MyClass2` does not test for self-assignment. If the parameter `f` is the current object, after the statement `delete p_`, the memory allocated to pointer `f.p_` is also deallocated. Therefore, the statement `p_ = new MyClass1(*f.p_)` initializes the memory location that `p_` points to with unpredictable values.

One possible correction is to test for self-assignment in the copy assignment operator.

```
class MyClass1 { };
class MyClass2 {
public:
    MyClass2()                : p_(new MyClass1())      { }
    MyClass2(const MyClass2& f)    : p_(new MyClass1(*f.p_)) { }
    ~MyClass2()                {
        delete p_;
    }
    MyClass2& operator= (const MyClass2& f)
    {
        if(&f != this) {
           delete p_;
```

```
            p_ = new MyClass1(*f.p_);
        }
        return *this;
    }
private:
    MyClass1* p_;
};
```

## Result Information

**Group:** Object oriented
**Language:** C++
**Default:** Off
**Command-Line Syntax:** `MISSING_SELF_ASSIGN_TEST`
**Impact:** Medium

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2015b**

# Sensitive data printed out

Function prints sensitive data

## Description

**Sensitive data printed out** detects print functions, such as `stdout` or `stderr`, that print sensitive information.

The checker considers the following as sensitive information:

- Return values of password manipulation functions such as `getpw`, `getpwnam` or `getpwuid`.
- Input values of functions such as the Windows-specific function `LogonUser`.

### Risk

Printing sensitive information, such as passwords or user information, allows an attacker additional access to the information.

### Fix

One fix for this defect is to not print out sensitive information.

If you are saving your logfile to an external file, set the file permissions so that attackers cannot access the logfile information.

## Examples

### Printing Passwords

```
#include <sys/types.h>
#include <pwd.h>
#include <stdio.h>
#include <string.h>
```

```
#include <unistd.h>

extern void verify_null(const char* buf);
void bug_sensitivedataprint(const char * my_user) {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[1024] = "";
    getpwnam_r(my_user, &pwd, buf, bufsize, &result);
    puts("Name\n");
    puts(pwd.pw_name);
    puts("PassWord\n");
    puts(pwd.pw_passwd);
    memset(buf, 0, sizeof(buf));
    verify_null(buf);
}
```

In this example, Bug Finder flags `puts` for printing out the password `pwd.pw_passwd`.

One possible correction is to obfuscate the password information so that the information is not visible.

```
#include <sys/types.h>
#include <pwd.h>
#include <stdio.h>
#include <string.h>
#include <unistd.h>

extern void verify_null(const char* buf);

void sensitivedataprint(const char * my_user) {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[1024] = "";
    getpwnam_r(my_user, &pwd, buf, bufsize, &result);
    puts("Name\n");
    puts(pwd.pw_name);
    puts("PassWord\n");
    puts("XXXXXXXX\n");
    memset(buf, 0, sizeof(buf));
    verify_null(buf);
}
```

## Result Information

**Group:** Security<br>
**Language:** C | C++<br>
**Default:** Off<br>
**Command-Line Syntax:** `SENSITIVE_DATA_PRINT`<br>
**Impact:** Medium<br>
**CWE ID:** 532, 534, 535<br>
**CERT C ID:** MEM06-C

## See Also

`Sensitive heap memory not cleared before release` | `Uncleared sensitive data in stack`

### Topics

"Navigate to Root Cause of Defect"<br>
"Review and Fix Results"

Introduced in R2015b

# Sensitive heap memory not cleared before release

Sensitive data not cleared or released by memory routine

## Description

**Sensitive heap memory not cleared before release** detects dynamically allocated memory containing sensitive data. If you do not clear the sensitive data when you free the memory, Bug Finder raises a defect on the `free` function.

### Risk

If the memory zone is reallocated, an attacker can still inspect the sensitive data in the old memory zone.

### Fix

Before calling `free`, clear out the sensitive data using `memset` or `SecureZeroMemory`.

## Examples

### Sensitive Buffer Freed, Not Cleared

```
#include <unistd.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <pwd.h>

void sensitiveheapnotcleared(const char * my_user) {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char* buf = (char*) malloc(1024);
    getpwnam_r(my_user, &pwd, buf, bufsize, &result);
    free(buf);
}
```

In this example, the function uses a buffer of passwords and frees the memory before the end of the function. However, the data in the memory is not cleared by using the `free` command.

One possible correction is to write over the data to clear out the sensitive information. This example uses `memset` to write over the data with zeros.

```
#include <unistd.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <pwd.h>
#include <assert.h>

#define isNull(arr) for(int i=0; i<(sizeof(arr)/sizeof(arr[0])); i++) assert(arr[i]==0)

void sensitiveheapnotcleared(const char * my_user) {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char* buf = (char*) malloc(1024);

    if (buf) {
        getpwnam_r(my_user, &pwd, buf, bufsize, &result);
        memset(buf, 0, (size_t)1024);
        isNull(buf);
        free(buf);
    }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `SENSITIVE_HEAP_NOT_CLEARED`
**Impact:** Medium
**CWE ID:** 244
**CERT C ID:** MEM03-C, MSC18-C

## See Also

`Uncleared sensitive data in stack` | `Sensitive data printed out`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2015b**

# Shared data access within signal handler

Access or modification of shared data causes inconsistent state

## Description

**Shared data access within signal handler** occurs when you access or modify a shared object inside a signal handler.

### Risk

When you define a signal handler function to access or modify a shared object, the handler accesses or modifies the shared object when it receives a signal. If another function is already accessing the shared object, that function causes a race condition and can leave the data in an inconsistent state.

### Fix

To access or modify shared objects inside a signal handler, check that the objects are lock-free atomic, or, if they are integers, declare them as `volatile sig_atomic_t`.

## Examples

### `int` Variable Access in Signal Handler

```
#include <signal.h>
#include <stdlib.h>
#include <string.h>

/* declare global variable. */
int e_flag;

void sig_handler(int signum)
{
    /* Signal handler accesses variable that is not
    of type volatile sig_atomic_t. */
    e_flag = signum;
}

int func(void)
{
    if (signal(SIGINT, sig_handler) == SIG_ERR)
    {
        /* Handle error */
        abort();
    }
    /* Program code */
    if (raise(SIGINT) != 0)
    {
        /* Handle error */
        abort();
    }
    /* More code */
    return 0;
}
```

In this example, `sig_handler` accesses `e_flag`, a variable of type `int`. A concurrent access by another function can leave `e_flag` in an inconsistent state.

Before you access a shared variable from a signal handler, declare the variable with type `volatile sig_atomic_t` instead of `int`. You can safely access variables of this type asynchronously.

```
#include <signal.h>
#include <stdlib.h>
#include <string.h>

/* Declare variable of type volatile sig_atomic_t. */
volatile sig_atomic_t e_flag;
void sig_handler(int signum)
{
    /* Use variable of proper type inside signal handler. */
    e_flag = signum;

}

int func(void)
```

```
{
    if (signal(SIGINT, sig_handler) == SIG_ERR)
    {
        /* Handle error */
        abort();
    }
    /* Program code */
    if (raise(SIGINT) != 0)
    {
        /* Handle error */
        abort();
    }
    /* More code */
    return 0;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `SIG_HANDLER_SHARED_OBJECT`
**Impact:** Medium
**CERT C ID:** SIG31-C
**ISO/IEC TS 17961 ID:** `accsig`

## See Also

`Function called from signal handler not asynchronous-safe` | `Signal call from within signal handler`

### Introduced in R2017b

# Shift of a negative value

Shift operator on negative value

## Description

**Shift of a negative value** occurs when a bit-wise shift is used on a negative number. Shifts can overwrite the sign bit that identifies a number as negative.

## Examples

### Shifting a negative variable

```
int shifting(int val)
{
    int res = -1;
    return res << val;
}
```

In the return statement, the variable `res` is shifted a certain number of bits to the left. However, because `res` is negative, the shift might overwrite the sign bit.

One possible correction is to change the data type of the shifted variable to unsigned. This correction eliminates the sign bit, so left shifting does not change the sign of the variable.

```
int shifting(int val)
{
    unsigned int res = -1;
    return res << val;
}
```

## Check Information

**Group:** Numerical

**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `SHIFT_NEG`
**Impact:** Low
**CERT C ID:** INT34-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Shift operation overflow`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Shift operation overflow

Overflow from shifting operation

## Description

**Shift operation overflow** occurs when a shift operation exceeds the space available to represent the resulting value.

The exact storage allocation for different data types depends on your processor. See `Target processor type (-target)`.

## Examples

### Left Shift of Integer

```
int left_shift(void) {

    int foo = 33;
    return 1 << foo;
}
```

In the return statement of this function, bit-wise shift operation is performed shifting 1 `foo` bits to the left. However, an `int` has only 32 bits, so the range of the shift must be between 0 and 31. Therefore, this shift operation causes an overflow.

One possible correction is to store the shift operation result in a larger data type. In this example, by returning a `long long` instead of an `int`, the overflow defect is fixed.

```
long long left_shift(void) {

    int foo = 33;
    return 1LL << foo;
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `SHIFT_OVFL`
**Impact:** Low
**CWE ID:** 190
**CERT C ID:** INT34-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Sign change integer conversion overflow

Overflow when converting between signed and unsigned integers

## Description

**Sign change integer conversion overflow** occurs when converting an unsigned integer to a signed integer. If the variable does not have enough bytes to represent both the original constant and the sign bit, the conversion overflows.

The exact storage allocation for different integer types depends on your processor. See `Target processor type (-target)`.

## Examples

### Convert from `unsigned char` to `char`

```
char sign_change(void) {
    unsigned char count = 255;

    return (char)count;
}
```

In the return statement, the unsigned character variable `count` is converted to a signed character. However, `char` has 8 bits, 1 for the sign of the constant and 7 to represent the number. The conversion operation overflows because 255 uses 8 bits.

One possible correction is using a larger integer type. By using an `int`, there are enough bits to represent the sign and the number value.

```
int sign_change(void) {
    unsigned char count = 255;

    return (int)count;
}
```

## Check Information

**Group:** Numerical  
**Language:** C | C++  
**Default:** On  
**Command-Line Syntax:** `SIGN_CHANGE`  
**Impact:** Medium  
**CWE ID:** 194, 195, 196  
**CERT C ID:** INT31-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Float conversion overflow` | `Unsigned integer conversion overflow` | `Integer conversion overflow`

### Topics

"Navigate to Root Cause of Defect"  
"Review and Fix Results"

Introduced in R2013b

# Signal call from within signal handler

Nonpersistent signal handler calling `signal()` in Windows system causes race condition

## Description

**Signal call from within signal handler** occurs when you call `signal()` from a nonpersistent signal handler on a Windows platform.

### Risk

A nonpersistent signal handler is reset after catching a signal. The handler does not catch subsequent signals unless the handler is reestablished by calling `signal()`. A nonpersistent signal handler on a Windows platform is reset to `SIG_DFL`. If another signal interrupts the execution of the handler, that signal can cause a race condition between `SIG_DFL` and the existing signal handler. A call to `signal()` can also result in an infinite loop inside the handler.

### Fix

Do not call `signal()` from a signal handler on Windows platforms.

## Examples

### `signal()` Called from Signal Handler

```
#include <stdio.h>
#include <stdlib.h>
#include <signal.h>
#include <unistd.h>

volatile sig_atomic_t e_flag = 0;

void sig_handler(int signum)
{
    int s0 = signum;
    e_flag = 1;

    /* Call signal() to reestablish sig_handler
    upon receiving SIG_ERR. */

    if (signal(s0, sig_handler) == SIG_ERR)
    {
        /* Handle error */
    }
}

void func(void)
{
        if (signal(SIGINT, sig_handler) == SIG_ERR)
        {
            /* Handle error */

        }
  /* more code */
}
```

In this example, the definition of `sig_handler()` includes a call to `signal()` when the handler catches `SIG_ERR`. On Windows platforms, signal handlers are nonpersistent. This code can result in a race condition.

If your code requires the use of a persistent signal handler on a Windows platform, use a persistent signal handler after performing a thorough risk analysis.

```
#include <stdio.h>
#include <stdlib.h>
#include <signal.h>
#include <unistd.h>

volatile sig_atomic_t e_flag = 0;


void sig_handler(int signum)
{
    int s0 = signum;
    e_flag = 1;
    /* No call to signal() */
}

int main(void)
{

        if (signal(SIGINT, sig_handler) == SIG_ERR)
        {
            /* Handle error */

        }
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `SIG_HANDLER_CALLING_SIGNAL`
**Impact:** Medium
**CWE ID:** 387
**CERT C ID:** SIG34-C
**ISO/IEC TS 17961 ID:** `sigcall`

## See Also

### Topics

`Function called from signal handler not asynchronous-safe`
`Return from computational exception signal handler`
`Shared data access within signal handler`

#### Introduced in R2017b

# Standard function call with incorrect arguments

Argument to a standard function does not meet requirements for use in the function

## Description

**Standard function call with incorrect arguments** occurs when the arguments to certain standard functions do not meet the requirements for their use in the functions.

For instance, the arguments to these functions can be invalid in the following ways.

| Function Type | Situation | Risk | Fix |
|---|---|---|---|
| String manipulation functions such as `strlen` and `strcpy` | The pointer arguments do not point to a `NULL`-terminated string. | The behavior of the function is undefined. | Pass a `NULL`-terminated string to string manipulation functions. |
| File handling functions in `stdio.h` such as `fputc` and `fread` | The `FILE*` pointer argument can have the value `NULL`. | The behavior of the function is undefined. | Test the `FILE*` pointer for `NULL` before using it as function argument. |
| File handling functions in `unistd.h` such as `lseek` and `read` | The file descriptor argument can be -1. | The behavior of the function is undefined.<br>Most implementations of the `open` function return a file descriptor value of -1. In addition, they set `errno` to indicate that an error has occurred when opening a file. | Test the return value of the `open` function for -1 before using it as argument for `read` or `lseek`.<br>If the return value is -1, check the value of `errno` to see which error has occurred. |

| Function Type | Situation | Risk | Fix |
|---|---|---|---|
|  | The file descriptor argument represents a closed file descriptor. | The behavior of the function is undefined. | Close the file descriptor only after you have completely finished using it. Alternatively, reopen the file descriptor before using it as function argument. |
| Directory name generation functions such as `mkdtemp` and `mkstemps` | The last six characters of the string template are not `XXXXXX`. | The function replaces the last six characters with a string that makes the file name unique. If the last six characters are not `XXXXXX`, the function cannot generate a unique enough directory name. | Test if the last six characters of a string are `XXXXXX` before using the string as function argument. |
| Functions related to environment variables such as `getenv` and `setenv` | The string argument is `""`. | The behavior is implementation-defined. | Test the string argument for `""` before using it as `getenv` or `setenv` argument. |
|  | The string argument terminates with an equal sign, `=`. For instance, `"C="` instead of `"C"`. | The behavior is implementation-defined. | Do not terminate the string argument with `=`. |
| String handling functions such as `strtok` and `strstr` | • `strtok`: The delimiter argument is `""`.<br>• `strstr`: The search string argument is `""`. | Some implementations do not handle these edge cases. | Test the string for `""` before using it as function argument. |

# Examples

## `NULL` Pointer Passed as `strnlen` Argument

```
#include <string.h>
#include <stdlib.h>

enum {
    SIZE10 = 10,
    SIZE20 = 20
};

int func() {
    char* s = NULL;
    return strnlen(s, SIZE20);
}
```

In this example, a `NULL` pointer is passed as `strnlen` argument instead of a `NULL`-terminated string.

Before running analysis on the code, specify a GNU compiler. See `Compiler (-compiler)`.

Pass a `NULL`-terminated string as the first argument of `strnlen`.

```
#include <string.h>
#include <stdlib.h>

enum {
    SIZE10 = 10,
    SIZE20 = 20
};

int func() {
    char* s = "";
    return strnlen(s, SIZE20);
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `STD_FUNC_ARG_MISMATCH`
**Impact:** Medium
**CWE ID:** 628, 685, 686, 687
**CERT C ID:** API00-C, EXP37-C, FIO04-C, FIO33-C, FIO46-C, MSC15-C, STR32-C
**ISO/IEC TS 17961 ID:** `argcomp`, `liberr`, `nonnullcs`

## See Also

`Find defects (-checkers)`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Static uncalled function

Function with static scope not called in file

## Description

**Static uncalled function** occurs when a `static` function is not called in the same file where it is defined.

## Examples

### Uncalled function error

Save the following code in the file `Initialize_Value.c`

```
#include <stdlib.h>
#include <stdio.h>

static int Initialize(void)
/* Defect: Function not called */
  {
   int input;
   printf("Enter an integer:");
   scanf("%d",&input);
   return(input);
  }

 void main()
  {
   int num;

   num=0;

   printf("The value of num is %d",num);
  }
```

The `static` function `Initialize` is not called in the file `Initialize_Value.c`.

One possible correction is to call `Initialize` at least once in the file `Initialize_Value.c`.

```
#include <stdlib.h>
#include <stdio.h>

static int Initialize(void)
  {
   int input;
   printf("Enter an integer:");
   scanf("%d",&input);
   return(input);
  }

 void main()
  {
   int num;

   /* Fix: Call static function Initialize */
   num=Initialize();

   printf("The value of num is %d",num);
  }
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `UNCALLED_FUNC`
**Impact:** Low
**CWE ID:** 561

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Subtraction or comparison between pointers to different arrays

Subtraction or comparison between pointers causes undefined behavior

## Description

**Subtraction or comparison between pointers to different arrays** occurs when you subtract or compare pointers that are null or that point to elements in different arrays. The relational operators for the comparison are >, <, >=, and <=.

### Risk

When you subtract two pointers to elements in the same array, the result is the difference between the subscripts of the two array elements. Similarly, when you compare two pointers to array elements, the result is the positions of the pointers relative to each other. If the pointers are null or point to different arrays, a subtraction or comparison operation is undefined. If you use the subtraction result as a buffer index, it can cause a buffer overflow.

### Fix

Before you subtract or use relational operators to compare pointers to array elements, check that they are non-null and that they point to the same array.

## Examples

### Subtraction Between Pointers to Elements in Different Arrays

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define SIZE20 20
```

```
size_t func(void)
{
    int nums[SIZE20];
    int end;
    int *next_num_ptr = nums;
    size_t free_elements;
    /* Increment next_num_ptr as array fills */

    /* Subtraction operation is undefined unless array nums
    is adjacent to variable end in memory. */
    free_elements = &end - next_num_ptr;
    return free_elements;
}
```

In this example, the array `nums` is incrementally filled. Pointer subtraction is then used to determine how many free elements remain. Unless `end` points to a memory location one past the last element of `nums`, the subtraction operation is undefined.

Subtract the pointer to the last element that was filled from the pointer to the last element in the array.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define SIZE20 20

size_t func(void)
{
    int nums[SIZE20];
    int *next_num_ptr = nums;
    size_t free_elements;
    /* Increment next_num_ptr as array fills */

    /* Subtraction operation involves pointers to the same array. */
    free_elements = &(nums[SIZE20 - 1]) - next_num_ptr;

    return free_elements + 1;
}
```

## Result Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `PTR_TO_DIFF_ARRAY`
**Impact:** High
**CWE ID:** 469
**CERT C ID:** ARR36-C
**ISO/IEC TS 17961 ID:** `ptrobj`

## See Also

Introduced in R2017b

# Tainted division operand

Division / operands from an unsecure source

## Description

**Tainted division operand** detects division operations where one or both of the integer operands is from an unsecure source.

### Risk

- If the numerator is the minimum possible value and the denominator is `-1`, your division operation overflows because the result cannot be represented by the current variable size.
- If the denominator is zero, your division operation fails possibly causing your program to crash.

These risks can be used to execute arbitrary code. This code is usually outside the scope of a program's implicit security policy.

### Fix

Before performing the division, validate the values of the operands. Check for denominators of `0` or `-1`, and numerators of the minimum integer value.

## Examples

### Division of Function Arguments

```
extern void print_int(int);

int taintedintdivision(int usernum, int userden) {
    int r =  usernum/userden;
    print_int(r);
    return r;
}
```

This example function divides two argument variables, then prints and returns the result. The argument values are unknown and can cause division by zero or integer overflow.

One possible correction is to check the values of the numerator and denominator before performing the division.

```
#include "limits.h"

extern void print_int(int);

int taintedintdivision(int usernum, int userden) {
    int r = 0;
    if (userden!=0 && !(usernum=INT_MIN && userden==-1)) {
        r = usernum/userden;
    }
    print_int(r);
    return r;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** TAINTED_INT_DIVISION
**Impact:** Low
**CWE ID:** 190, 369
**CERT C ID:** API00-C, INT32-C, INT33-C
**ISO/IEC TS 17961 ID:** diverr

## See Also

Integer division by zero | Float division by zero | Tainted modulo operand

## Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Tainted modulo operand

Remainder % operands are from an unsecure source

## Description

**Tainted modulo operand** checks the operands of remainder % operations. Bug Finder flags modulo operations with one or more tainted operands.

### Risk

- If the second remainder operand is zero, your remainder operation fails, causing your program to crash.
- If the second remainder operand is -1, your remainder operation can overflow if the remainder operation is implemented based on the division operation that can overflow.
- If one of the operands is negative, the operation result is uncertain. For C89, the modulo operation is not standardized, so the result from negative operands is implementation-defined.

These risks can be exploited by attackers to gain access to your program or the target in general.

### Fix

Before performing the modulo operation, validate the values of the operands. Check the second operand for values of 0 and -1. Check both operands for negative values.

## Examples

### Modulo with Function Arguments

```
extern void print_int(int);
```

```
int taintedintmod(int userden) {
    int rem =  128%userden;
    print_int(rem);
    return rem;
}
```

In this example, the function performs a modulo operation by using an input argument. The argument is not checked before calculating the remainder for values that can crash the program, such as 0 and -1.

One possible correction is to check the values of the operands before performing the modulo operation. In this corrected example, the modulo operation continues only if the second operand is greater than zero.

```
extern void print_int(int);

int taintedintmod(int userden) {
    int rem = 0;
    if (userden > 0) {
        rem = 128 % userden;
    }
    print_int(rem);
    return rem;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** TAINTED_INT_MOD
**Impact:** Low
**CWE ID:** 369, 682
**CERT C ID:** API00-C, INT10-C, INT32-C, INT33-C
**ISO/IEC TS 17961 ID:** diverr, intoflow

## See Also

Integer division by zero | Tainted division operand

## Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2015b

# Tainted NULL or non-null-terminated string

Argument is from an unsecure source and may be NULL or not NULL-terminated

## Description

**Tainted NULL or non-null-terminated string** looks for strings from unsecure sources that are being used in string manipulation routines that implicitly dereference the string buffer. For example, `strcpy` or `sprintf`.

**Tainted NULL or non-null-terminated string** raises no defect for a string returned from a call to `scanf`-family variadic functions. Similarly, no defect is raised when you pass the string with a `%s` specifier to `printf`-family variadic functions.

**Note** If you reference a string using the form `ptr[i]`, `*ptr`, or pointer arithmetic, Bug Finder raises a **Use of tainted pointer** defect instead. The **Tainted NULL or non-null-terminated string** defect is raised only when the pointer is used as a string.

### Risk

If a string is from an unsecure source, it is possible that an attacker manipulated the string or pointed the string pointer to a different memory location.

If the string is NULL, the string routine cannot dereference the string, causing the program to crash. If the string is not null-terminated, the string routine might not know when the string ends. This error can cause you to write out of bounds, causing a buffer overflow.

### Fix

Validate the string before you use it. Check that:

- The string is not NULL.
- The string is null-terminated

- The size of the string matches the expected size.

# Examples

## Getting String from Input Argument

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>

#define SIZE128 128

extern void print_str(const char*);

void warningMsg(char* userstr)
{
    char str[SIZE128] = "Warning: ";
    strncat(str, userstr, SIZE128-(strlen(str)+1));
    print_str(str);
}

void errorMsg(char* userstr)
{
  char str[SIZE128] = "Error: ";
  strncat(str, userstr, SIZE128-(strlen(str)+1));
  print_str(str);
}
```

In this example, the string `str` is concatenated with the argument `userstr`. The value of `userstr` is unknown. If the size of `userstr` is greater than the space available, the concatenation overflows.

One possible correction is to check the size of `userstr` and make sure that the string is null-terminated before using it in `strncat`. This example uses a helper function, `sansitize_str`, to validate the string. The defects are concentrated in this function.

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
```

```
#define SIZE128 128

extern void print_str(const char*);

int sanitize_str(char* s) {
  int res = 0;
  if (s && (strlen(s) > 0)) { // TAINTED_STRING only flagged here
    // - string is not null
    // - string has a positive and limited size
    // - TAINTED_STRING on strlen used as a firewall
    res = 1;
  }
  return res;
}

void warningMsg(char* userstr)
{
    char str[SIZE128] = "Warning: ";
    if (sanitize_str(userstr))
      strncat(str, userstr, SIZE128-(strlen(str)+1));
    print_str(str);
}

void errorMsg(char* userstr)
{
  char str[SIZE128] = "Error: ";
  if (sanitize_str(userstr))
    strncat(str, userstr, SIZE128-(strlen(str)+1));
  print_str(str);
}
```

Another possible correction is to call function `errorMsg` and `warningMsg` with specific strings.

```
#include <stdio.h>
#include <string.h>
#include <stdlib.h>

#define SIZE128 128

extern void print_str(const char*);

void warningMsg(char* userstr)
{
    char str[SIZE128] = "Warning: ";
    strncat(str, userstr, SIZE128-(strlen(str)+1));
    print_str(str);
}

void errorMsg(char* userstr)
{
  char str[SIZE128] = "Error: ";
  strncat(str, userstr, SIZE128-(strlen(str)+1));
  print_str(str);
}

int manageSensorValue(int sensorValue) {
  int ret = sensorValue;
  if ( sensorValue < 0 ) {
    errorMsg("sensor value should be positive");
    exit(1);
  } else if ( sensorValue > 50 ) {
    warningMsg("sensor value greater than 50 (applying threshold)...");
    sensorValue = 50;
  }

  return sensorValue;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_STRING`
**Impact:** Low
**CWE ID:** 120, 170, 476, 822
**CERT C ID:** API00-C, ARR33-C, ENV01-C, FIO17-C, STR31-C, STR32-C, STR35-C
**ISO/IEC TS 17961 ID:** `nonnullcs`, `taintstrcpy`, `taintformatio`

## See Also

`Tainted string format`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Tainted sign change conversion

Value from an unsecure source changes sign

## Description

**Tainted sign change conversion** looks for values from unsecure sources that are converted, implicitly or explicitly, from signed to unsigned values.

For example, functions that use `size_t` as arguments implicitly convert the argument to an unsigned integer. Some functions that implicitly convert `size_t` are:

```
bcmp
memcpy
memmove
strncmp
strncpy
calloc
malloc
memalign
```

### Risk

If you convert a small negative number to unsigned, the result is a large positive number. The large positive number can create security vulnerabilities. For example, if you use the unsigned value in:

- Memory size routines — causes allocating memory issues.
- String manipulation routines — causes buffer overflow.
- Loop boundaries — causes infinite loops.

### Fix

To avoid converting unsigned negative values, check that the value being converted is within an acceptable range. For example, if the value represents a size, validate that the value is not negative and less than the maximum value size.

# Examples

## Set Memory Value with Size Argument

```
#include <stdlib.h>
#include <string.h>

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

void bug_taintedsignchange(int size) {
    char str[SIZE128] = "";
    if (size<SIZE128) {
        memset(str, 'c', size);
    }
}
```

In this example, a `char` buffer is created and filled using `memset`. The size argument to `memset` is an input argument to the function.

The call to `memset` implicitly converts `size` to unsigned integer. If `size` is a large negative number, the absolute value could be too large to represent as an integer, causing a buffer overflow.

One possible correction is to check if `size` is inside the valid range. This correction checks if `size` is greater than zero and less than the buffer size before calling `memset`.

```
#include <stdlib.h>
#include <string.h>

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

void corrected_taintedsignchange(int size) {
    char str[SIZE128] = "";
    if (size>0 && size<SIZE128) {
        memset(str, 'c', size);
    }
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** TAINTED_SIGN_CHANGE
**Impact:** Medium
**CWE ID:** 194, 195
**CERT C ID:** API00-C, INT02-C, INT31-C, MEM04-C, MEM11-C, MSC21-C
**ISO/IEC TS 17961 ID:** taintsink

## See Also

Sign change integer conversion overflow

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Tainted size of variable length array

Size of the variable-length array (VLA) is from an unsecure source and may be zero, negative, or too large

## Description

**Tainted size of variable length array** detects variable length arrays (VLA) whose size is from an unsecure source.

### Risk

If an attacker changed the size of your VLA to an unexpected value, it can cause your program to crash or behave unexpectedly.

If the size is non-positive, the behavior of the VLA is undefined. Your program does not perform as expected.

If the size is unbounded, the VLA can cause memory exhaustion or stack overflow.

### Fix

Validate your VLA size to make sure that it is positive and less than a maximum value.

## Examples

### Input Argument Used as Size of VLA

```
enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

int taintedvlasize(int size) {
    int tabvla[size];
    int res = 0;
    for (int i=0 ; i<SIZE10 ; ++i) {
        tabvla[i] = i*i;
        res += tabvla[i];
    }
    return res;
}
```

In this example, a variable length array size is based on an input argument. Because this input argument value is not checked, the size may be negative or too large.

One possible correction is to check the size variable before creating the variable length array. This example checks if the size is larger than 10 and less than 100, before creating the VLA

```
enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};

int taintedvlasize(int size) {
    int res = 0;
    if (size>SIZE10 && size<SIZE100) {
        int tabvla[size];
        for (int i=0 ; i<SIZE10 ; ++i) {
            tabvla[i] = i*i;
            res += tabvla[i];
        }
    }
    return res;
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_VLA_SIZE`
**Impact:** Medium

**CWE ID:** 770, 789
**CERT C ID:** API00-C, ARR32-C, INT04-C, MEM04-C, MEM05-C
**ISO/IEC TS 17961 ID:** `taintsink`

## See Also

`Memory allocation with tainted size`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Tainted string format

Input format argument is from an unsecure source

## Description

**Tainted string format** detects string formatting with printf-style functions that contain elements from unsecure sources.

### Risk

If you use externally controlled elements to format a string, you can cause buffer overflow or data-representation problems. An attacker can use these string formatting elements to view the contents of a stack using %x or write to a stack using %n.

### Fix

Pass a static string to format string functions. This fix ensures that an external actor cannot control the string.

Another possible fix is to allow only the expected number of arguments. If possible, use functions that do not support the vulnerable %n operator in format strings.

## Examples

### Get Elements from User Input

```
#include "stdio.h"

void taintedstringformat(char* userstr) {
    printf(userstr);
}
```

This example prints the input argument userstr. The string is unknown. If it contains elements such as %, printf can interpret userstr as a string format instead of a string, causing your program to crash.

One possible correction is to print `userstr` explicitly as a string so that there is no ambiguity.

```
#include "stdio.h"

void taintedstringformat(char* userstr) {
    printf("%.20s", userstr);
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_STRING_FORMAT`
**Impact:** Low
**CWE ID:** 134
**CERT C ID:** API00-C, FIO30-C
**ISO/IEC TS 17961 ID:** `usrfmt`

## See Also

`Tainted NULL or non-null-terminated string`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Typedef mismatch

Mismatch between `typedef` statements

## Description

**Typedef mismatch** detects `typedef` statements with different underlying types for these fundamental types:

- `size_t`
- `ssize_t`
- `wchar_t`
- `ptrdiff_t`

### Risk

If you change the underlying type of `size_t`, `ssize_t`, `wchar_t`, or `ptrdiff_t`, you have inconsistent definitions of the same type. Compilation units with different include paths can potentially use different-sized types causing conflicts in your program.

For example, say that you define a function in one compilation unit that redefines `size_t` as unsigned long. But in another compilation unit that uses the `size_t` definition from `<stddef.h>`, you use the same function as an `extern` declaration. Your program will encounter a mismatch between the function declaration and function definition.

### Fix

Use consistent type definitions. For example:

- Remove custom type definitions for these fundamental types. Only use system definitions.
- Use the same size for all compilation units. Move your `typedef` to a shared header file.

# Examples

## Two Definitions of **size_t**

file1.c

```
typedef unsigned char size_t;

void func2()
{
    size_t var = 0;
    /*... more code ... */
}
```

file2.c

```
#include <stddef.h>

void func1()
{
    size_t var = 0;
    /*... more code ... */
}
```

In this example, Polyspace flags the definition of `size_t` in `file1.c` as a defect. This definition is a `typedef` mismatch because another file in your project, `file2.c`, includes `stddef.h`, which defines `size_t` as unsigned long.

One possible correction is to use the system definition of `size_t` in `stddef.h` to avoid conflicting type definitions.

file1.c

```
#include <stddef.h>

void func2()
{
    size_t var = 0;
    /*... more code ... */
}
```

file2.c

```
#include <stddef.h>

void func1()
{
    size_t var = 0;
    /*... more code ... */
}
```

One possible correction is to use a shared header file to store your type definition that gets included in both files.

types.h

```
typedef unsigned char size_t;
```

file1.c

```
#include "types.h"

void func2()
{
    size_t var = 0;
    /*... more code ... */
}
```

file2.c

```
#include "types.h"

void func1()
{
    size_t var = 0;
    /*... more code ... */
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `TYPEDEF_MISMATCH`
**Impact:** High

## See Also

`Declaration mismatch`

Introduced in R2016b

# Umask used with chmod-style arguments

Argument to `umask` allows external user too much control

## Description

**Umask used with `chmod`-style arguments** checks for `umask` commands that have an argument specified in the style of arguments to `chmod`.

For new files, the umask value specifies which permissions *not* to set, in other words which permissions to remove. The umask argument is bitwise-negated and then applied to new file permissions.

In contrast, chmod sets the permissions as you specify them.

### Risk

If you use chmod-style arguments, you specify opposite permissions of what you want. This mistake can give external users unintended read/write access to new files and folders.

### Fix

Set the umask so that the user (`u`) has fewer permissions turned off than the group (`g`). Set umask so that the group has fewer permissions turned off than other users (`o`), or `u <= g <= o`.

You can see the umask value by calling,

```
umask
```

or the symbolic value by calling,

```
umask -S
```

# Examples

## Setting the Default Mask

```
#include <stdio.h>
#include <assert.h>
#include <sys/types.h>
#include <sys/stat.h>

typedef mode_t (*umask_func)(mode_t);

const mode_t default_mode = (
    S_IRUSR    /* 00400 */
    | S_IWUSR  /* 00200 */
    | S_IRGRP  /* 00040 */
    | S_IWGRP  /* 00020 */
    | S_IROTH  /* 00004 */
    | S_IWOTH  /* 00002 */
    );         /* 00666 (i.e. -rw-rw-rw-) */

static void my_umask(mode_t mode)
{
    umask(mode);
}

int umask_use(mode_t m)
{
    my_umask(default_mode);
    return 0;
}
```

This example uses a function called `my_umask` to set the default mask mode. However, the `default_mode` variable gives the permissions 666 or `-rw-rw-rw`. `umask` negates this value. However, this negation means the default mask mode turns off read/write permissions for the user, group users, and other outside users.

One possible correction is to negate the `default_mode` argument to `my_umask`. This correction nullifies the negation `umask` for new files.

```
#include <stdio.h>
#include <assert.h>
#include <sys/types.h>
```

```
#include <sys/stat.h>

typedef mode_t (*umask_func)(mode_t);

const mode_t default_mode = (
    S_IRUSR    /* 00400 */
    | S_IWUSR  /* 00200 */
    | S_IRGRP  /* 00040 */
    | S_IWGRP  /* 00020 */
    | S_IROTH  /* 00004 */
    | S_IWOTH  /* 00002 */
    );         /* 00666 (i.e. -rw-rw-rw-) */

static void my_umask(mode_t mode)
{
    umask(mode);
}

int umask_use(mode_t m)
{
    my_umask(~default_mode);
    return 0;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BAD_UMASK`
**Impact:** Low
**CWE ID:** 560
**CERT C ID:** FIO06-C

## See Also

`Vulnerable permission assignments`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

## External Websites

`umask` — Linux Manual Page

### Introduced in R2015b

# Uncleared sensitive data in stack

Variable in stack is not cleared and contains sensitive data

## Description

**Uncleared sensitive data in stack** detects static memory containing sensitive data. If you do not clear the sensitive data from your stack before exiting the function or program, Bug Finder raises a defect on the last curly brace.

### Risk

Leaving sensitive information in your stack, such as passwords or user information, allows an attacker additional access to the information after your program has ended.

### Fix

Before exiting a function or program, clear out the memory zones that contain sensitive data by using `memset` or `SecureZeroMemory`.

## Examples

### Static Buffer of Password Information

```
#include <unistd.h>
#include <sys/types.h>
#include <pwd.h>

void bug_sensitivestacknotcleared(const char * my_user) {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[1024] = "";
    getpwnam_r(my_user, &pwd, buf, bufsize, &result);
}
```

In this example, a static buffer is filled with password information. The program frees the stack memory at the end of the program. However, the data is still accessible from the memory.

One possible correction is to write over the memory before exiting the function. This example uses `memset` to clear the data from the buffer memory.

```
#include <unistd.h>
#include <string.h>
#include <sys/types.h>
#include <pwd.h>
#include <assert.h>

#define isNull(arr) for(int i=0; i<(sizeof(arr)/sizeof(arr[0])); i++) assert(arr[i]==0)

void corrected_sensitivestacknotcleared(const char * my_user) {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[1024] = "";
    getpwnam_r(my_user, &pwd, buf, bufsize, &result);
    memset(buf, 0, (size_t)1024);
    isNull(buf);
}
```

## Result Information

**Group:** Security<br>
**Language:** C | C++<br>
**Default:** Off<br>
**Command-Line Syntax:** `SENSITIVE_STACK_NOT_CLEARED`<br>
**Impact:** Medium<br>
**CWE ID:** 226<br>
**CERT C ID:** MEM03-C, MSC18-C

## See Also

`Sensitive heap memory not cleared before release` | `Sensitive data printed out`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Unprotected dynamic memory allocation

Pointer returned from dynamic allocation not checked for NULL value

## Description

**Unprotected dynamic memory allocation** occurs when the code does not check whether or not the dynamic memory allocation succeeded.

When memory is dynamically allocated using malloc, calloc, or realloc, it returns a value NULL if the requested memory is not available. If the code following the allocation accesses the memory block without checking for the NULL value, this access is not protected from failures.

## Examples

### Unprotected dynamic memory allocation error

```
#include <stdlib.h>

void Assign_Value(void)
{
  int* p = (int*)calloc(5, sizeof(int));

  *p = 2;
  /* Defect: p is not checked for NULL value */

  free(p);
}
```

If the memory allocation fails, the function calloc returns NULL to p. Before accessing the memory through p, the code does not check whether p is NULL

One possible correction is to check whether p has value NULL before dereference.

```
#include <stdlib.h>
```

```
void Assign_Value(void)
 {
   int* p = (int*)calloc(5, sizeof(int));

   /* Fix: Check if p is NULL */
   if(p!=NULL) *p = 2;

   free(p);
 }
```

## Check Information

**Group:** Dynamic memory
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `UNPROTECTED_MEMORY_ALLOCATION`
**Impact:** Low
**CWE ID:** 789
**CERT C ID:** ERR33-C, FIO04-C, FIO33-C, MEM10-C, MEM11-C
**ISO/IEC TS 17961 ID:** `liberr`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Unreachable code

Code following control-flow statements

## Description

**Unreachable code** defects occur on code which cannot be reached because the preceding code.

Statements such as `break`, `goto`, and `return`, move the flow of the program to another section or function. Because of this flow escape, the statements following the control-flow code, statistically, do not execute, and therefore the statements are unreachable.

This check also finds code following trivial infinite loops, such as `while(1)`. These types of loops only release the flow of the program by exiting the program. This type of exit causes code after the infinite loop to be unreachable.

## Examples

### Unreachable Code After Return

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void guess(suit s);

suit deal(void){
    suit card = nextcard();
    if( (card < SPADES) || (card > CLUBS) )
        card = UNKNOWN_SUIT;
        return card;

    if (card < HEARTS) {
        guess(card);
    }
    return card;
}
```

In this example, there are missing braces and misleading indentation. The first `return` statement changes the flow of code back to where the function was called. Because of this return statement, the `if`-block and second `return` statement do not execute.

If you correct the indentation and the braces, the error becomes clearer.

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void guess(suit s);

suit deal(void){
    suit card = nextcard();
    if( (card < SPADES) || (card > CLUBS) ){
        card = UNKNOWN_SUIT;
    }
    return card;

    if (card < HEARTS) {
        guess(card);
    }
    return card;
}
```

One possible correction is to remove the escape statement. In this example, remove the first `return` statement to reach the final `if` statement.

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void guess(suit s);

suit deal(void){
    suit card = nextcard();
    if( (card < SPADES) || (card > CLUBS) )
    {
        card = UNKNOWN_SUIT;
    }

    if(card < HEARTS)
    {
        guess(card);
    }
    return card;
}
```

Another possible correction is to remove the unreachable code if you do not need it. Because the function does not reach the second `if`-statement, removing it simplifies the code and does not change the program behavior.

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void guess(suit s);

suit deal(void){
    suit card = nextcard();
    if( (card < SPADES) || (card > CLUBS) )
    {
        card = UNKNOWN_SUIT;
    }
    return card;
}
```

## Infinite Loop Causing Unreachable Code

```
int add_apples(int apple) {
    int count = 1;
    while(1) {
        if(apple < 99){
            apple++;
            count++;
        }else{
            count--;
        }
    }
    return count;
}
```

In this example, the `while(1)` statement creates an infinite loop. The `return count` statement following this infinite loop is unreachable because the only way to exit this infinite loop is to exit the program.

One possible correction is to change the loop condition to make the `while` loop finite. In the example correction here, the loop uses the statement from the `if` condition: `apple < 99`.

```
int add_apples1(int apple) {
    int count = 0;
    while(apple < 99) {
        apple++;
        count++;
    }
    if(count == 0)
        count = -1;
    return count;
}
```

Another possible correction is to add a break from the infinite loop, so there is a possibility of reaching code after the infinite loop. In this example, a `break` is added to the `else` block making the `return count` statement reachable.

```
int add_apples(int apple) {
    int count = 1;
    while(1) {
        if(apple < 99)
        {
            apple++;
            count++;
        }else{
            count--;
            break;
        }
    }
    return count;
}
```

Another possible correction is to remove the unreachable code. This correction cleans up the code and makes it easier to review and maintain. In this example, remove the return statement and change the function return type to `void`.

```
void add_apples(int apple) {
    int count = 1;
    while(1) {
        if(apple < 99)
        {
            apple++;
            count++;
        }else{
            count--;
        }
    }
}
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `UNREACHABLE`
**Impact:** Medium
**CWE ID:** 561
**CERT C ID:** MSC01-C, MSC07-C, MSC12-C
**ISO/IEC TS 17961 ID:** `swtchdflt`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Code deactivated by constant false condition` | `Dead code` | `Useless if`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2013b

# Unreliable cast of function pointer

Function pointer cast to another function pointer with different argument or return type

## Description

**Unreliable cast of function pointer** occurs when a function pointer is cast to another function pointer that has different argument or return type.

This defect applies only if the code language for the project is C.

## Examples

### Unreliable cast of function pointer error

```
#include <math.h>
#include <stdio.h>
#define PI 3.142

double Calculate_Sum(int (*fptr)(double))
{
    double  sum = 0.0;
    double  y;

    for (int i = 0;  i <= 100;  i++)
    {
        y = (*fptr)(i*PI/100);
        sum += y;
    }
    return sum / 100;
}

int main(void)
{
    double  (*fp)(double);
    double  sum;

    fp = sin;
    sum = Calculate_Sum(fp);
    /* Defect: fp implicitly cast to int(*) (double) */

    printf("sum(sin): %f\n", sum);
    return 0;
}
```

The function pointer `fp` is declared as `double (*)(double)`. However in passing it to function `Calculate_Sum`, `fp` is implicitly cast to `int (*)(double)`.

One possible correction is to check that the function pointer in the definition of `Calculate_Sum` has the same argument and return type as `fp`. This step makes sure that `fp` is not implicitly cast to a different argument or return type.

```
#include <math.h>
#include <stdio.h>
# define PI 3.142

/*Fix: fptr has same argument and return type everywhere*/
double Calculate_Sum(double (*fptr)(double))
{
    double  sum = 0.0;
    double y;

    for (int i = 0;  i <= 100;  i++)
    {
        y = (*fptr)(i*PI/100);
        sum += y;
    }
    return sum / 100;
}

int main(void)
{
    double  (*fp)(double);
    double  sum;


    fp = sin;
    sum = Calculate_Sum(fp);
    printf("sum(sin): %f\n", sum);
    return 0;
}
```

## Check Information

**Group:** Static memory
**Language:** C/C++
**Default:** On
**Command-Line Syntax:** `FUNC_CAST`
**Impact:** Medium
**CERT C ID:** EXP37-C, MSC15-C
**ISO/IEC TS 17961 ID:** `argcomptaintnoproto`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Unreliable cast of pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Unreliable cast of pointer

Pointer implicitly cast to different data type

## Description

**Unreliable cast of pointer** occurs when a pointer is implicitly cast to a data type different from its declaration type. Such an implicit casting can take place, for instance, when a pointer to data type `char` is assigned the address of an integer.

This defect applies only if the code language for the project is C.

## Examples

### Unreliable cast of pointer error

```
#include <string.h>

void Copy_Integer_To_String()
{
 int src[]={1,2,3,4,5,6,7,8,9,10};
 char buffer[]="Buffer_Text";
 strcpy(buffer,src);
 /* Defect: Implicit cast of (int*) to (char*) */
}
```

`src` is declared as an `int*` pointer. The `strcpy` statement, while copying to `buffer`, implicitly casts `src` to `char*`.

One possible correction is to declare the pointer `src` with the same data type as `buffer`.

```
#include <string.h>
 void Copy_Integer_To_String()
{
 /* Fix: Declare src with same type as buffer */
 char *src[10]={"1","2","3","4","5","6","7","8","9","10"};
 char *buffer[10];
```

```
  for(int i=0;i<10;i++)
    buffer[i]="Buffer_Text";

  for(int i=0;i<10;i++)
    buffer[i]= src[i];
  }
```

## Check Information

**Group:** Static memory
**Language:** C
**Default:** On
**Command-Line Syntax:** `PTR_CAST`
**Impact:** Medium
**CWE ID:** 704, 843
**CERT C ID:** EXP36-C, EXP39-C, MSC15-C, STR38-C
**ISO/IEC TS 17961 ID:** `alignconv`, `ptrcomp`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Unreliable cast of function pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Unsafe call to a system function

Unsanitized command argument has exploitable vulnerabilities

## Description

**Unsafe call to a system function** occurs when you use a function that invokes an implementation-defined command processor. These functions include:

- The C standard `system()` function.
- The POSIX `popen()` function.
- The Windows `_popen()` and `_wpopen()` functions.

### Risk

If the argument of a function that invokes a command processor is not sanitized, it can cause exploitable vulnerabilities. An attacker can execute arbitrary commands or read and modify data anywhere on the system.

### Fix

Do not use a `system`-family function to invoke a command processor. Instead, use safer functions such as POSIX `execve()` and WinAPI `CreateProcess()`.

## Examples

### `system()` Called

```
# include <string.h>
# include <stdlib.h>
# include <stdio.h>
# include <unistd.h>

enum {
```

```
SIZE512=512,
SIZE3=3};

void func(char *arg)
{
    char buf[SIZE512];
    int retval=sprintf(buf, "/usr/bin/any_cmd %s", arg);

    if (retval<=0 || retval>SIZE512){
        /* Handle error */
        abort();
    }
    /* Use of system() to pass any_cmd with
    unsanitized argument to command processor */

    if (system(buf) == -1) {
    /* Handle error */
  }
}
```

In this example, `system()` passes its argument to the host environment for the command processor to execute. This code is vulnerable to an attack by command-injection.

In the following code, the argument of `any_cmd` is sanitized, and then passed to `execve()` for execution. `exec`-family functions are not vulnerable to command-injection attacks.

```
# include <string.h>
# include <stdlib.h>
# include <stdio.h>
# include <unistd.h>

enum {
SIZE512=512,
SIZE3=3};


void func(char *arg)
{
  char *const args[SIZE3] = {"any_cmd", arg, NULL};
  char  *const env[] = {NULL};
  /* Sanitize argument */

  /* Use execve() to execute any_cmd. */

  if (execve("/usr/bin/time", args, env) == -1) {
    /* Handle error */
  }
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** UNSAFE_SYSTEM_CALL
**Impact:** High
**CWE ID:** 78, 88
**CERT C ID:** ENV33-C
**ISO/IEC TS 17961 ID:** syscall

## See Also

Command executed from externally controlled path | Execution of externally controlled command

Introduced in R2017b

# Unsafe conversion between pointer and integer

Misaligned or invalid results from conversions between pointer and integer types

## Description

**Unsafe conversion between pointer and integer** checks for pointer to integer and integer to pointers conversions. If you convert between a pointer, `intptr_t`, or `uintprt_t` and an integer type, such as `enum`, `ptrdiff_t`, or `pid_t`, Polyspace raises a defect.

### Risk

The mapping between pointers and integers is not always consistent with the addressing structure of the environment.

Converting from pointers to integers can create:

- Truncated or out of range integer values.
- Invalid integer types.

Converting from integers to pointers can create:

- Misaligned pointers or misaligned objects.
- Invalid pointer addresses.

### Fix

Where possible, avoid pointer-to-integer or integer-to-pointer conversions. If you want to convert a `void` pointer to an integer, so that you do not change the value, use types:

- C99 — `intptr_t` or `uintptr_t`
- C90 — `size_t` or `ssize_t`

# Examples

## Integer to Pointer Conversions

```
unsigned int *badintptrcast(void)
{
    unsigned int *ptr0 = (unsigned int *)0xdeadbeef;
    char *ptr1 = (char *)0xdeadbeef;
    return (unsigned int *)(ptr0 - (unsigned int *)ptr1);
}
```

In this example, there are three conversions, two unsafe conversions and one safe conversion. The first conversion of `0xdeadbeef` to `unsigned int*` causes alignment issues for the pointer. The second conversion of `0xdeadbeef` to `char *` is safe because there are no alignment issues for `char`. The third conversion in the return casts `ptrdiff_t` to a pointer. This pointer might or might not point to an invalid address.

One possible correction is to use `intptr_t` types to store the pointer address `0xdeadbeef`. Also, you can change the second pointer to an integer offset so that there is no longer a conversion from `ptrdiff_t` to a pointer.

```
#include <stdint.h>

unsigned int *badintptrcast(void)
{
    intptr_t iptr0 = (intptr_t)0xdeadbeef;
    int offset = 0;
    return (unsigned int *)(iptr0 - offset);
}
```

# Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BAD_INT_PTR_CAST`
**Impact:** Medium
**CWE ID:** 465, 466, 587, 758
**CERT C ID:** INT36-C

**ISO/IEC TS 17961 ID:** `intptrconv`

Introduced in R2016b

# Unsafe conversion from string to numerical value

String to number conversion without validation checks

## Description

**Unsafe conversion from string to numerical value** detects conversions from strings to integer or floating-point values. If your conversion method does not include robust error handling, a defect is raised.

### Risk

Converting a string to numerical value can cause data loss or misinterpretation. Without validation of the conversion or error handling, your program continues with invalid values.

### Fix

- Add additional checks to validate the numerical value.
- Use a more robust string-to-numeric conversion function such as `strtol`, `strtoll`, `strtoul`, or `strtoull`.

## Examples

### Conversion With `atoi`

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

static int demo_check_string_not_empty(char *s)
{
    if (s != NULL)
        return strlen(s) > 0; /* check string null-terminated and not empty */
    else
```

```
        return 0;
}

int unsafestrtonumeric(char* argv1)
{
    int s = 0;
    if (demo_check_string_not_empty(argv1))
    {
        s = atoi(argv1);
    }
    return s;
}
```

In this example, `argv1` is converted to an integer with `atoi`. `atoi` does not provide errors for an invalid integer string. The conversion can fail unexpectedly.

One possible correction is to use `strtol` to validate the input string and the converted integer.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <limits.h>
#include <errno.h>

static int demo_check_string_not_empty(char *s)
{
    if (s != NULL)
        return strlen(s) > 0; /* check string null-terminated and not empty */
    else
        return 0;
}

int unsafestrtonumeric(char *argv1)
{
    char *c_str = argv1;
    char *end;
    long sl;

    if (demo_check_string_not_empty(c_str))
    {
        errno = 0; /* set errno for error check */
        sl = strtol(c_str, &end, 10);
        if (end == c_str)
        {
            (void)fprintf(stderr, "%s: not a decimal number\n", c_str);
        }
        else if ('\0' != *end)
        {
            (void)fprintf(stderr, "%s: extra characters: %s\n", c_str, end);
        }
        else if ((LONG_MIN == sl || LONG_MAX == sl) && ERANGE == errno)
        {
            (void)fprintf(stderr, "%s out of range of type long\n", c_str);
        }
        else if (sl > INT_MAX)
        {
            (void)fprintf(stderr, "%ld greater than INT_MAX\n", sl);
        }
        else if (sl < INT_MIN)
        {
            (void)fprintf(stderr, "%ld less than INT_MIN\n", sl);
        }
        else
        {
            return (int)sl;
        }
    }
    return 0;
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `UNSAFE_STR_TO_NUMERIC`
**Impact:** Low
**CWE ID:** 20, 676
**CERT C ID:** INT06-C

Introduced in R2016b

# Unsafe standard encryption function

Function is not reentrant or uses a risky encryption algorithm

## Description

**Unsafe standard encryption function** detects use of functions with a broken or weak cryptographic algorithm. For example, `crypt` is not reentrant and is based on the risky Data Encryption Standard (DES).

### Risk

The use of a broken, weak, or nonstandard algorithm can expose sensitive information to an attacker. A determined hacker can access the protected data using various techniques.

If the weak function is nonreentrant, when you use the function in concurrent programs, there is an additional race condition risk.

### Fix

Avoid functions that use these encryption algorithms. Instead, use a reentrant function that uses a stronger encryption algorithm.

**Note** Some implementations of `crypt` support additional, possibly more secure, encryption algorithms.

## Examples

### Decrypting Password Using `crypt`

```
#define _GNU_SOURCE
#include <pwd.h>
#include <string.h>
```

```
#include <crypt.h>

volatile int rd = 1;

const char *salt = NULL;
struct crypt_data input, output;

int verif_pwd(const char *pwd, const char *cipher_pwd, int safe)
{
    int r = 0;
    char *decrypted_pwd = NULL;

    switch(safe)
    {
      case 1:
        decrypted_pwd = crypt_r(pwd, cipher_pwd, &output);
        break;

      case 2:
        decrypted_pwd = crypt_r(pwd, cipher_pwd, &output);
        break;

      default:
        decrypted_pwd = crypt(pwd, cipher_pwd);
        break;
    }

    r = (strcmp(cipher_pwd, decrypted_pwd) == 0);

    return r;
}
```

In this example, `crypt_r` and `crypt` decrypt a password. However, `crypt` is nonreentrant and uses the unsafe Data Encryption Standard algorithm.

One possible correction is to replace `crypt` with `crypt_r`.

```
#define _GNU_SOURCE
#include <pwd.h>
#include <string.h>
#include <crypt.h>

volatile int rd = 1;
```

```
const char *salt = NULL;
struct crypt_data input, output;

int verif_pwd(const char *pwd, const char *cipher_pwd, int safe)
{
    int r = 0;
    char *decrypted_pwd = NULL;

    switch(safe)
    {
      case 1:
        decrypted_pwd = crypt_r(pwd, cipher_pwd, &output);
        break;

      case 2:
        decrypted_pwd = crypt_r(pwd, cipher_pwd, &output);
        break;

      default:
        decrypted_pwd = crypt_r(pwd, cipher_pwd, &output);
        break;
    }

    r = (strcmp(cipher_pwd, decrypted_pwd) == 0);

    return r;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `UNSAFE_STD_CRYPT`
**Impact:** Medium
**CWE ID:** 327, 663
**CERT C ID:** MSC18-C

## See Also

`Deterministic random output from constant seed` | `Predictable random output from predictable seed` | `Vulnerable pseudo-random number generator`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

**Introduced in R2015b**

# Unsafe standard function

Function unsafe for security-related purposes

## Description

**Unsafe standard function** looks for functions that are unsafe and must not be used for security-related programming. Functions can be unsafe for many reasons. Some functions are unsafe because they are nonreentrant. Other functions change depending on the target or platform, making some implementations unsafe.

### Risk

Some unsafe functions are not reentrant, meaning that the contents of the function are not locked during a call. So, an attacker can change the values midstream.

`getlogin` specifically can be unsafe depending on the implementation. Some implementations of `getlogin` return only the first eight characters of a log-in name. An attacker can use a different login with the same first eight characters to gain entry and manipulate the program.

### Fix

Avoid unsafe functions for security-related purposes. If you cannot avoid unsafe functions, use a safer version of the function instead. For `getlogin`, use `getlogin_r`.

## Examples

### Using `getlogin`

```
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <pwd.h>
#include <string.h>
```

```
#include <stdlib.h>


volatile int rd = 1;

int login_name_check(char *user)
{
    int r = -2;
    char *name = getlogin();
    if (name != NULL)
    {
        if (strcmp(name, user) == 0)
        {
            r = 0;
        }
        else
            r = -1;
    }

    return r;
}
```

This example uses `getlogin` to compare the user name of the current user to the given user name . However, `getlogin` can return something other than the current user name because a parallel process can change the string.

One possible correction is to use `getlogin_r` instead of `getlogin`. `getlogin_r` is reentrant, so you can trust the result.

```
#define _POSIX_C_SOURCE 199506L // use of getlogin_r
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <pwd.h>
#include <string.h>
#include <stdlib.h>


volatile int rd = 1;

enum {  NAME_MAX_SIZE=64  };

int login_name_check(char *user)
```

```
{
    int r;
    char name[NAME_MAX_SIZE];

    if (getlogin_r(name, sizeof(name)) == 0)
    {
        if ((strlen(user) < sizeof(name)) &&
                     (strncmp(name, user, strlen(user)) == 0))
        {
            r = 0;
        }
        else
            r = -1;
    }
    else
        r = -2;
    return r;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `UNSAFE_STD_FUNC`
**Impact:** Medium
**CWE ID:** 558, 663

## See Also

`Use of obsolete standard function` | `Use of dangerous standard function` | `Invalid use of standard library string routine`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Unsigned integer conversion overflow

Overflow when converting between unsigned integer types

## Description

**Unsigned integer conversion overflow** occurs when converting an unsigned integer to a smaller unsigned integer type. If the variable does not have enough bytes to represent the original constant, the conversion overflows.

The exact storage allocation for different integer types depends on your processor. See `Target processor type (-target)`.

## Examples

### Converting from `int` to `char`

```
unsigned char convert(void) {
    unsigned int unum = 1000000U;

    return (unsigned char)unum;
}
```

In the return statement, the unsigned integer variable `unum` is converted to an unsigned character type. However, the conversion overflows because 1000000 requires at least 20 bits. The C programming language standard does not view unsigned overflow as an error because the program automatically reduces the result by modulo the maximum value plus 1. In this example, `unum` is reduced by modulo `2^8` because a character data type can only represent `2^8-1`.

One possible correction is to convert to a different integer type that can represent the entire number. For example, `long`.

```
unsigned long convert(void) {
    unsigned int unum = 1000000U;
    return (unsigned long)unum;
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `UINT_CONV_OVFL`
**Impact:** Low
**CWE ID:** 190, 191, 197
**CERT C ID:** FLP34-C, INT02-C, INT18-C, INT31-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Float conversion overflow` | `Integer conversion overflow` | `Sign change integer conversion overflow`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Unsigned integer overflow

Overflow from operation between unsigned integers

## Description

**Unsigned integer overflow** occurs when an operation on unsigned integer variables exceeds the space available to represent the resulting value. The exact storage allocation for different integer types depends on your processor. See `Target processor type (-target)`.

## Examples

### Add One to Maximum Unsigned Integer

```
#include <limits.h>

unsigned int plusplus(void) {

    unsigned uvar = UINT_MAX;
    uvar++;
    return uvar;
}
```

In the third statement of this function, the variable `uvar` is increased by 1. However, the value of `uvar` is the maximum unsigned integer value, so 1 plus the maximum integer value cannot be represented by an `unsigned int`. The C programming language standard does not view unsigned overflow as an error because the program automatically reduces the result by modulo the maximum value plus 1. In this example, `uvar` is reduced by modulo `UINT_MAX`. The result is `uvar = 1`.

One possible correction is to store the operation result in a larger data type. In this example, by returning an `unsigned long long` instead of an `unsigned int`, the overflow error is fixed.

```
#include <limits.h>
```

```
unsigned long long plusplus(void) {

    unsigned long long ullvar = UINT_MAX;
    ullvar++;
    return ullvar;
}
```

## Check Information

**Group:** Numerical
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `UINT_OVFL`
**Impact:** Low
**CWE ID:** 190, 191
**CERT C ID:** INT18-C, INT30-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Integer overflow` | `Float overflow`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

**Introduced in R2013b**

# Unused parameter

Function prototype has parameters not read or written in function body

## Description

**Unused parameter** occurs when a function parameter is neither read nor written in the function body.

### Risk

Unused function parameters cause the following issues:

- Indicate that the code is possibly incomplete. The parameter is possibly intended for an operation that you forgot to code.
- If the copied objects are large, redundant copies can slow down performance.

### Fix

Determine if you intend to use the parameters. Otherwise, remove parameters that you do not use in the function body.

You can intentionally have unused parameters. For instance, you have parameters that you intend to use later when you add enhancements to the function. Add a code comment indicating your intention for later use. The code comment helps you or a code reviewer understand why your function has unused parameters.

Alternatively, add a statement such as `(void)var;` in the function body. `var` is the unused parameter. You can define a macro that expands to this statement and add the macro to the function body.

# Examples

## Unused Parameter

```
void func(int* xptr, int* yptr, int flag) {
    if(flag==1) {
        *xptr=0;
    }
    else {
        *xptr=1;
    }
}

int main() {
    int x,y;
    func(&x,&y,1);
    return 0;
}
```

In this example, the parameter `yptr` is not used in the body of `func`.

One possible correction is to check if you intended to use the parameter. Fix your code if you intended to use the parameter.

```
void func(int* xptr, int* yptr, int flag) {
    if(flag==1) {
        *xptr=0;
        *yptr=1;
    }
    else {
        *xptr=1;
        *yptr=0;
    }
}

int main() {
    int x,y;
    func(&x,&y,1);
    return 0;
}
```

Another possible correction is to explicitly indicate that you are aware of the unused parameter.

```
#define UNUSED(x) (void)x

void func(int* xptr, int* yptr, int flag) {
    UNUSED(yptr);
    if(flag==1) {
        *xptr=0;
    }
    else {
        *xptr=1;
    }
}

int main() {
    int x,y;
    func(&x,&y,1);
    return 0;
}
```

## Result Information

**Group:** Good practice
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `UNUSED_PARAMETER`
**Impact:** Low
**CERT C ID:** MSC13-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Useless if

Unnecessary if conditional

## Description

**Useless if** occurs on if-statements where the condition is always true. This defect occurs only on if-statements that do not have an else-statement.

This defect shows unnecessary if-statements when there is no difference in code execution if the if-statement is removed.

## Examples

### `if` with Enumerated Type

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void do_something(suit s);

void bridge(void)
{
    suit card = nextcard();
    if ((card < SPADES) || (card > CLUBS)){
        card = UNKNOWN_SUIT;
    }

    if (card < 7) {
        do_something(card);
    }
}
```

The type `suit` is enumerated with five options. However, the conditional expression `card < 7` always evaluates to true because `card` can be at most 5. The `if` statement is unnecessary.

One possible correction is to change the if-condition in the code. In this correction, the 7 is changed to `UNKNOWN_SUIT` to relate directly to the type of `card`.

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void do_something(suit s);

void bridge(void)
{
    suit card = nextcard();
    if ((card < SPADES) || (card > CLUBS)){
        card = UNKNOWN_SUIT;
    }

    if (card > UNKNOWN_SUIT) {
        do_something(card);
    }
}
```

Another possible correction is to remove the if-condition in the code. Because the condition is always true, you can remove the condition to simplify your code.

```
typedef enum _suit {UNKNOWN_SUIT, SPADES, HEARTS, DIAMONDS, CLUBS} suit;
suit nextcard(void);
void do_something(suit s);

void bridge(void)
{
    suit card = nextcard();
    if ((card < SPADES) || (card > CLUBS)){
        card = UNKNOWN_SUIT;
    }

    do_something(card);
}
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On

**Command-Line Syntax:** `USELESS_IF`
**Impact:** Medium

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Code deactivated by constant false condition` | `Dead code` | `Unreachable code`

## Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Use of automatic variable as putenv-family function argument

putenv-family function argument not accessible outside its scope

## Description

**Use of automatic variable as `putenv`-family function argument** occurs when the argument of a `putenv`-family function is a local variable with automatic duration.

### Risk

The function `putenv(char *string)` inserts a pointer to its supplied argument into the environment array, instead of making a copy of the argument. If the argument is an automatic variable, its memory can be overwritten after the function containing the `putenv()` call returns. A subsequent call to `getenv()` from another function returns the address of an out-of-scope variable that cannot be dereferenced legally. This out-of-scope variable can cause environment variables to take on unexpected values, cause the program to stop responding, or allow arbitrary code execution vulnerabilities.

### Fix

Use `setenv()`/`unsetenv()` to set and unset environment variables. Alternatively, use `putenv`-family function arguments with dynamically allocated memory, or, if your application has no reentrancy requirements, arguments with static duration. For example, a single thread execution with no recursion or interrupts does not require reentrancy. It cannot be called (reentered) during its execution.

## Examples

### Automatic Variable as Argument of `putenv()`

```
#include <stdio.h>
#include <stdlib.h>
```

```
#include <string.h>

#define SIZE1024 1024

void func(int var)
{
    char env[SIZE1024];
    int retval = sprintf(env, "TEST=%s", var ? "1" : "0");
    if (retval <= 0) {
        /* Handle error */
    }
    /* Environment variable TEST is set using putenv().
    The argument passed to putenv is an automatic variable. */
    retval = putenv(env);
    if (retval != 0) {
        /* Handle error */
    }
}
```

In this example, `sprintf()` stores the character string `TEST=var` in `env`. The value of the environment variable `TEST` is then set to `var` by using `putenv()`. Because `env` is an automatic variable, the value of `TEST` can change once `func()` returns.

Declare `env` as a static-duration variable. The memory location of `env` is not overwritten for the duration of the program, even after `func()` returns.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define SIZE1024 1024
void func(int var)
{
    /* static duration variable */
    static char env[SIZE1024];
    int retval = sprintf(env,"TEST=%s", var ? "1" : "0");
    if (retval <= 0) {
        /* Handle error */
    }

    /* Environment variable TEST is set using putenv() */
    retval=putenv(env);
    if (retval != 0) {
        /* Handle error */
    }
}
```

To set the value of `TEST` to `var`, use `setenv()`.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define SIZE1024 1024

void func(int var)
{
    /* Environment variable TEST is set using setenv() */
    int retval = setenv("TEST", var ? "1" : "0", 1);

    if (retval != 0) {
        /* Handle error */
    }
}
```

## Result Information

**Group:** Static memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `PUTENV_AUTO_VAR`
**Impact:** High
**CWE ID:** 562, 686
**CERT C ID:** POS34-C
**ISO/IEC TS 17961 ID:** `addrescape`

## See Also

`Pointer or reference to stack variable leaving scope`

**Introduced in R2017b**

# Use of dangerous standard function

Dangerous functions cause possible buffer overflow in destination buffer

## Description

The **Use of dangerous standard function** check highlights uses of functions that are inherently dangerous or potentially dangerous given certain circumstances. The following table lists possibly dangerous functions, the risks of using each function, and what function to use instead.

| Dangerous Function | Risk Level | Safer Function |
|---|---|---|
| `gets` | Inherently dangerous — You cannot control the length of input from the console. | `fgets` |
| `cin` | Inherently dangerous — You cannot control the length of input from the console. | Avoid or prefaces calls to `cin` with `cin.width`. |
| `strcpy` | Possibly dangerous — If the source length is greater than the destination, buffer overflow can occur. | `strncpy` |
| `stpcpy` | Possibly dangerous — If the source length is greater than the destination, buffer overflow can occur. | `stpncpy` |
| `lstrcpy` or `StrCpy` | Possibly dangerous — If the source length is greater than the destination, buffer overflow can occur. | `StringCbCopy`, `StringCchCopy`, `strncpy`, `strcpy_s`, or `strlcpy` |
| `strcat` | Possibly dangerous — If the concatenated result is greater than the destination, buffer overflow can occur. | `strncat`, `strlcat`, or `strcat_s` |

| Dangerous Function | Risk Level | Safer Function |
|---|---|---|
| lstrcat or StrCat | Possibly dangerous — If the concatenated result is greater than the destination, buffer overflow can occur. | StringCbCat, StringCchCat, strncay, strcat_s, or strlcat |
| wcpcpy | Possibly dangerous — If the source length is greater than the destination, buffer overflow can occur. | wcpncpy |
| wcscat | Possibly dangerous — If the concatenated result is greater than the destination, buffer overflow can occur. | wcsncat, wcslcat, or wcncat_s |
| wcscpy | Possibly dangerous — If the source length is greater than the destination, buffer overflow can occur. | wcsncpy |
| sprintf | Possibly dangerous — If the output length depends on unknown lengths or values, buffer overflow can occur. | snprintf |
| vsprintf | Possibly dangerous — If the output length depends on unknown lengths or values, buffer overflow can occur. | vsnprintf |

## Risk

These functions can cause buffer overflow, which attackers can use to infiltrate your program.

# Examples

## Using **sprintf**

```
#include <stdio.h>
#include <string.h>
#include <iostream>

#define BUFF_SIZE 128


int dangerous_func(char *str)
{
    char dst[BUFF_SIZE];
    int r = 0;

    if (sprintf(dst, "%s", str) == 1)
    {
        r += 1;
        dst[BUFF_SIZE-1] = '\0';
    }

    return r;
}
```

This example function uses `sprintf` to copy the string `str` to `dst`. However, if `str` is larger than the buffer, `sprintf` can cause buffer overflow.

One possible correction is to use `snprintf` instead and specify a buffer size.

```
#include <stdio.h>
#include <string.h>
#include <iostream>

#define BUFF_SIZE 128


int dangerous_func(char *str)
{
    char dst[BUFF_SIZE];
    int r = 0;
    if (snprintf(dst, sizeof(dst), "%s", str) == 1)
    {
        r += 1;
        dst[BUFF_SIZE-1] = '\0';
    }

    return r;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** DANGEROUS_STD_FUNC
**Impact:** Low
**CWE ID:** 242, 676
**CERT C ID:** API02-C, ARR33-C, ENV01-C, PRE09-C, STR07-C, STR08-C, STR31-C, STR35-C
**ISO/IEC TS 17961 ID:** taintformatio

## See Also

Use of obsolete standard function | Unsafe standard function | Invalid use of standard library string routine

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Use of externally controlled environment variable

Value of environment variable from an unsecure source

## Description

**Use of externally controlled environment variable** checks for functions that add or change environment variables, such as `putenv` and `setenv`. If the new environment variable value is from an unsecure source, Polyspace raises a defect on the function or function pointer.

### Risk

If the environment variable is tainted, an attacker can control your system settings. This control can disrupt an application or service in potentially malicious ways.

### Fix

Before using the new environment variable, check its value to avoid giving control to external users.

## Examples

### Set Path in Environment

```
#define _XOPEN_SOURCE
#define _GNU_SOURCE
#include "stdlib.h"

void taintedenvvariable(char* path)
{
    putenv(path);
}
```

In this example, `putenv` changes an environment variable. The path `path` has not been checked to make sure that it is the intended path.

One possible correction is to sanitize the path, checking that it matches what you expect.

```
#define _XOPEN_SOURCE
#define _GNU_SOURCE
#define SIZE128 128
#include "stdlib.h"
#include "string.h"

/* Function to sanitize a string */
int sanitize_str(char* str, size_t n) {
    int res = 0;

    if (str && n > 0 && n < SIZE128) {
        /* string is not NULL, with size between 1 and max    */
        str[n-1] = '\0';  /* Add a null char at end of string */
        /* Tainted pointer detected above, used as "firewall" */
        res = 1;
    }
    return res;
}

void taintedenvvariable(char* path, size_t n)
{
    if (sanitize_str(path, n))
    {
        unsigned int n2 = strlen("PATH=")+strnlen(path, n);
        char *env_path = (char *)malloc(n2+1);
        if (env_path)
        {
            strcpy(env_path, "PATH=");
            strncat(env_path, path, n2);
            putenv(env_path);
        }
    }
}
```

# Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** TAINTED_ENV_VARIABLE

**Impact:** Medium
**CWE ID:** 15
**CERT C ID:** API00-C

## See Also

`Execution of externally controlled command` | `Host change using externally controlled elements` | `Command executed from externally controlled path` | `Library loaded from externally controlled path`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Use of indeterminate string

Use of buffer from fgets-family function

## Description

**Use of indeterminate string** occurs when you do not check the validity of the buffer returned from `fgets`-family functions. The checker raises a defect when such a buffer is used as:

- An argument in standard functions that print or manipulate strings or wide strings.
- A return value.
- An argument in external functions with parameter type `const char *` or `const wchar_t *`.

### Risk

If an `fgets`-family function fails, the content of its output buffer is indeterminate. Use of such a buffer has undefined behavior and can result in a program that stops working or other security vulnerabilities.

### Fix

Reset the output buffer of an `fgets`-family function to a known string value when the function fails.

## Examples

### Output of `fgets()` Passed to External Function

```
#include <stdio.h>
#include <wchar.h>
#include <string.h>
#include <stdlib.h>
```

```
#define SIZE20 20

extern void display_text(const char *txt);

void func(void) {
    char buf[SIZE20];

    /* Check fgets() error */
    if (fgets (buf, sizeof (buf), stdin) == NULL)
    {
        /* 'buf' may contain an indeterminate string.  */
        ;
    }
    /* 'buf passed to external function */
    display_text(buf);
}
```

In this example, the output `buf` is passed to the external function `display_text()`, but its value is not reset if `fgets()` fails.

If `fgets()` fails, reset `buf` to a known value before you pass it to an external function.

```
#include <stdio.h>
#include <wchar.h>
#include <string.h>
#include <stdlib.h>

#define SIZE20 20

extern void display_text(const char *txt);

void func1(void) {
    char buf[SIZE20];
    /* Check fgets() error */
    if (fgets (buf, sizeof (buf), stdin) == NULL)
    {
        /* value of 'buf' reset after fgets() failure. */
        buf[0] = '\0';
    }
    /* 'buf' passed to external function */
    display_text(buf);
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `INDETERMINATE_STRING`
**Impact:** Medium
**CERT C ID:** FIO40-C

## See Also

`Invalid use of standard library string routine` | `Returned value of a sensitive function not checked` | `Use of dangerous standard function`

Introduced in R2017b

# Use of memset with size argument zero

Size argument of function in memset family is zero

## Description

**Use of memset with size argument zero** occurs when you call a function in the memset family with size argument zero. Functions include memset, wmemset, bzero, SecureZeroMemory, RtlSecureZeroMemory, and so on.

### Risk

void *memset (void *ptr, int value, size_t num) fills the first num bytes of the memory block that ptr points to with the specified value. A zero value of num renders the call to memset redundant. The memory that ptr points to:

- Remains uninitialized, if not previously initialized.
- Is not cleared and can contain sensitive data, if previously initialized.

### Fix

Determine if the zero size argument occurs because of a previous error in your code. Fix the error.

## Examples

### Zero Size Argument of **memset**

```
#include <stdio.h>
#include <string.h>

void func (unsigned int size)
{
    char str[] = "Buffer to be filled.";
    memset (str,'-',size);
    puts (str);
}

void calling_func(void) {
    unsigned int buf_size=0;
    func(buf_size);
}
```

In this example, the argument `size` of `memset` is zero.

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `MEMSET_INVALID_SIZE`
**Impact:** Medium
**CWE ID:** 665
**CERT C ID:** MSC12-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Call to memset with unintended value`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Use of non-secure temporary file

Temporary generated file name not secure

## Description

**Use of non-secure temporary file** looks for temporary file routines that are not secure.

### Risk

If an attacker guesses the file name generated by a standard temporary file routine, the attacker can:

- Cause a race condition when you generate the file name.
- Precreate a file of the same name, filled with malicious content. If your program reads the file, the attacker's file can inject the malicious code.
- Create a symbolic link to a file storing sensitive data. When your program writes to the temporary file, the sensitive data is deleted.

### Fix

To create temporary files, use a more secure standard temporary file routine, such as `mkstemp` from POSIX.1-2001.

Also, when creating temporary files with routines that allow flags, such as `mkostemp`, use the exclusion flag `O_EXCL` to avoid race conditions.

## Examples

### Temp File Created With **`tempnam`**

```
#define _BSD_SOURCE
#define _XOPEN_SOURCE
```

```
#define _GNU_SOURCE

#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <unistd.h>

int test_temp()
{
    char tpl[] = "abcXXXXXX";
    char suff_tpl[] = "abcXXXXXXsuff";
    char *filename = NULL;
    int fd;

    filename = tempnam("/var/tmp", "foo_");

    if (filename != NULL)
    {
        printf("generated tmp name (%s) in (%s:%s:%s)\n",
               filename, getenv("TMPDIR") ? getenv("TMPDIR") : "$TMPDIR",
               "/var/tmp", P_tmpdir);

        fd = open(filename, O_CREAT, S_IRWXU|S_IRUSR);
        if (fd != -1)
        {
            close(fd);
            unlink(filename);
            return 1;
        }
    }
    return 0;
}
```

In this example, Bug Finder flags `open` because it tries to use an unsecure temporary file. The file is opened without exclusive privileges. An attacker can access the file causing various risks on page 3-591.

One possible correction is to add the `O_EXCL` flag when you open the temporary file.

```
#define _BSD_SOURCE
#define _XOPEN_SOURCE
```

```
#define _GNU_SOURCE

#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <unistd.h>

int test_temp()
{
    char tpl[] = "abcXXXXXX";
    char suff_tpl[] = "abcXXXXXXsuff";
    char *filename = NULL;
    int fd;

    filename = tempnam("/var/tmp", "foo_");

    if (filename != NULL)
    {
        printf("generated tmp name (%s) in (%s:%s:%s)\n",
               filename, getenv("TMPDIR") ? getenv("TMPDIR") : "$TMPDIR",
               "/var/tmp", P_tmpdir);

        fd = open(filename, O_CREAT|O_EXCL, S_IRWXU|S_IRUSR);
        if (fd != -1)
        {
            close(fd);
            unlink(filename);
            return 1;
        }
    }
    return 0;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `NON_SECURE_TEMP_FILE`
**Impact:** High
**CWE ID:** 377

**CERT C ID:** FIO03-C, FIO21-C

## See Also

`Data race`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Use of obsolete standard function

Obsolete routines can cause security vulnerabilities and portability issues

## Description

**Use of obsolete standard function** detects calls to standard function routines that are considered legacy, removed, deprecated, or obsolete by C/C++ coding standards.

| Obsolete Function | Standards | Risk | Replacement Function |
|---|---|---|---|
| asctime | Deprecated in POSIX.1-2008 | Not thread-safe. | strftime or asctime_s |
| asctime_r | Deprecated in POSIX.1-2008 | Implementation based on unsafe function sprintf. | strftime or asctime_s |
| bcmp | Deprecated in 4.3BSD<br>Marked as legacy in POSIX.1-2001. | Returns from function after finding the first differing byte, making it vulnerable to timing attacks. | memcmp |
| bcopy | Deprecated in 4.3BSD<br>Marked as legacy in POSIX.1-2001. | Returns from function after finding the first differing byte, making it vulnerable to timing attacks. | memcpy or memmove |
| brk and sbrk | Marked as legacy in SUSv2 and POSIX.1-2001. | | malloc |
| bsd_signal | Removed in POSIX.1-2008 | | sigaction |
| bzero | Marked as legacy in POSIX.1-2001. Removed in POSIX.1-2008. | | memset |
| ctime | Deprecated in POSIX.1-2008 | Not thread-safe. | strftime or asctime_s |

| Obsolete Function | Standards | Risk | Replacement Function |
|---|---|---|---|
| ctime_r | Deprecated in POSIX.1-2008 | Implementation based on unsafe function sprintf. | strftime or asctime_s |
| cuserid | Removed in POSIX.1-2001. | Not reentrant. Precise functionality not standardized causing portability issues. | getpwuid |
| ecvt and fcvt | Marked as legacy in POSIX.1-2001. Removed in POSIX.1-2008 | Not reentrant | snprintf |
| ecvt_r and fcvt_r | Marked as legacy in POSIX.1-2001. Removed in POSIX.1-2008 | | snprintf |
| ftime | Removed in POSIX.1-2008 | | time,<br>gettimeofday,<br>clock_gettime |
| gamma, gammaf, gammal | Function not specified in any standard because of historical variations | Portability issues. | tgamma, lgamma |
| gcvt | Marked as legacy in POSIX.1-2001. Removed in POSIX.1-2008. | | snprintf |
| getcontext | Removed in POSIX.1-2008. | Portability issues. | Use POSIX thread instead. |
| getdtablesize | BSD API function not included in POSIX.1-2001 | Portability issues. | sysconf( _SC_OPEN_MAX ) |
| gethostbyaddr | Removed in POSIX.1-2008 | Not reentrant | getaddrinfo |
| gethostbyname | Removed in POSIX.1-2008 | Not reentrant | getnameinfo |
| getpagesize | BSD API function not included in POSIX.1-2001 | Portability issues. | sysconf( _SC_PAGESIZE ) |
| getpass | Removed in POSIX.1-2001. | Not reentrant. | getpwuid |
| getw | Not present in POSIX.1-2001. | | fread |

| Obsolete Function | Standards | Risk | Replacement Function |
|---|---|---|---|
| getwd | Marked legacy in POSIX.1-2001. Removed in POSIX.1-2008. | | getcwd |
| index | Marked as legacy in POSIX.1-2001. Removed in POSIX.1-2008. | | strchr |
| makecontext | Removed in POSIX.1-2008. | Portability issues. | Use POSIX thread instead. |
| memalign | Appears in SunOS 4.1.3. Not in 4.4 BSD or POSIX.1-2001 | | posix_memalign |
| mktemp | Removed in POSIX.1-2008. | Generated names are predictable and can cause a race condition. | mkstemp removes race risk |
| pthread_attr_getstackaddr and pthread_attr_setstackaddr | | Ambiguities in the specification of the stackaddr attribute cause portability issues | pthread_attr_getstack and pthread_attr_setstack |
| putw | Not present in POSIX.1-2001. | Portability issues. | fwrite |
| qecvt and qfcvt | Marked as legacy in POSIX.1-2001, removed in POSIX.1-2008 | | snprintf |
| qecvt_r and qfcvt_r | Marked as legacy in POSIX.1-2001, removed in POSIX.1-2008 | | snprintf |
| rand_r | Marked as obsolete in POSIX.1-2008 | | |
| re_comp | BSD API function | Portability issues | regcomp |
| re_exes | BSD API function | Portability issues | regexec |
| rindex | Marked as legacy in POSIX.1-2001. Removed in POSIX.1-2008. | | strrchr |

| Obsolete Function | Standards | Risk | Replacement Function |
|---|---|---|---|
| scalb | Removed in POSIX.1-2008 | | scalbln, scalblnf, or scalblnl |
| sigblock | 4.3BSD signal API whose origin is unclear | | sigprocmask |
| sigmask | 4.3BSD signal API whose origin is unclear | | sigprocmask |
| sigsetmask | 4.3BSD signal API whose origin is unclear | | sigprocmask |
| sigstack | Interface is obsolete and not implemented on most platforms. | Portability issues. | sigaltstack |
| sigvec | 4.3BSD signal API whose origin is unclear | | sigaction |
| swapcontext | Removed in POSIX.1-2008 | Portability issues. | Use POSIX threads. |
| tmpnam and tmpnam_r | Marked as obsolete in POSIX. 1-2008. | This function generates a different string each time it is called, up to TMP_MAX times. If it is called more than TMP_MAX times, the behavior is implementation-defined. | mkstemp, tmpfile |
| ttyslot | Removed in POSIX.1-2001. | | |
| ualarm | Marked as legacy in POSIX. 1-2001. Removed in POSIX. 1-2008. | Errors are under-specified | setitimer or POSIX timer_create |
| usleep | Removed in POSIX.1-2008. | | nanosleep |
| utime | SVr4, POSIX.1-2001. POSIX. 1-2008 marks as obsolete. | | |

| Obsolete Function | Standards | Risk | Replacement Function |
|---|---|---|---|
| `valloc` | Marked as obsolete in 4.3BSD.<br>Marked as legacy in SUSv2.<br>Removed from POSIX.1-2001 | | `posix_memalign` |
| `vfork` | Removed from POSIX.1-2008 | Under-specified in previous standards. | `fork` |
| `wcswcs` | This function was not included in the final ISO/IEC 9899:1990/ Amendment 1:1995 (E). | | `wcsstr` |
| `WinExec` | WinAPI provides this function only for 16-bit Windows compatibility. | | `CreateProcess` |
| `LoadModule` | WinAPI provides this function only for 16-bit Windows compatibility. | | `CreateProcess` |

# Examples

## Printing Out Time

```
#include <stdio.h>
#include <time.h>

void timecheck_bad(int argc, char *argv[])
{
    time_t ticks;

    ticks = time(NULL);
    printf("%.24s\r\n", ctime(&ticks));
}
```

In this example, the function `ctime` formats the current time and prints it out. However, `ctime` was removed after C99 because it does not work on multithreaded programs.

One possible correction is to use `strftime` instead because this function uses a set buffer size.

```
#include <stdio.h>
#include <string.h>
#include <time.h>

void timecheck_good(int argc, char *argv[])
{
    char outBuff[1025];
    time_t ticks;
    struct tm * timeinfo;

    memset(outBuff, 0, sizeof(outBuff));

    ticks = time(NULL);
    timeinfo = localtime(&ticks);
    strftime(outBuff,sizeof(outBuff),"%I:%M%p.",timeinfo);
    fprintf(stdout, outBuff);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `OBSOLETE_STD_FUNC`
**Impact:** Low
**CWE ID:** 477
**CERT C ID:** MSC24-C, MSC33-C, POS33-C, PRE09-C

## See Also

`Use of dangerous standard function` | `Unsafe standard function` | `Invalid use of standard library string routine`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Use of path manipulation function without maximum sized buffer checking

Destination buffer of getwd or realpath is smaller than PATH_MAX bytes

## Description

**Use of path manipulation function without maximum-sized buffer checking** occurs when the destination argument of a path manipulation function such as realpath or getwd has a buffer size less than PATH_MAX bytes.

### Risk

A buffer smaller than PATH_MAX bytes can overflow but you cannot test the function return value to determine if an overflow occurred. If an overflow occurs, following the function call, the content of the buffer is undefined.

For instance, char *getwd(char *buf) copies an absolute path name of the current folder to its argument. If the length of the absolute path name is greater than PATH_MAX bytes, getwd returns NULL and the content of *buf is undefined. You can test the return value of getwd for NULL to see if the function call succeeded.

However, if the allowed buffer for buf is less than PATH_MAX bytes, a failure can occur for a smaller absolute path name. In this case, getwd does not return NULL even though a failure occurred. Therefore, the allowed buffer for buf must be PATH_MAX bytes long.

### Fix

Possible fixes are:

- Use a buffer size of PATH_MAX bytes. If you obtain the buffer from an unknown source, before using the buffer as argument of getwd or realpath function, make sure that the size is less than PATH_MAX bytes.
- Use a path manipulation function that allows you to specify a buffer size.

For instance, if you are using getwd to get the absolute path name of the current folder, use char *getcwd(char *buf, size_t size); instead. The additional argument size allows you to specify a size greater than or equal to PATH_MAX.

- Allow the function to allocate additional memory dynamically, if possible.

  For instance, char *realpath(const char *path, char *resolved_path); dynamically allocates memory if resolved_path is NULL. However, you have to deallocate this memory later using the free function.

# Examples

## Possible Buffer Overflow in Use of **getwd** Function

```
#include <unistd.h>
#include <linux/limits.h>
#include <stdio.h>

void func(void) {
    char buf[PATH_MAX];
    if (getwd(buf+1)!= NULL)         {
        printf("cwd is %s\n", buf);
    }
}
```

In this example, although the array buf has PATH_MAX bytes, the argument of getwd is buf + 1, whose allowed buffer is less than PATH_MAX bytes.

One possible correction is to use an array argument with size equal to PATH_MAX bytes.

```
#include <unistd.h>
#include <linux/limits.h>
#include <stdio.h>

void func(void) {
    char buf[PATH_MAX];
    if (getwd(buf)!= NULL)         {
        printf("cwd is %s\n", buf);
    }
}
```

## Result Information

**Group:** Static memory
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `PATH_BUFFER_OVERFLOW`
**Impact:** High
**CWE ID:** 785
**ISO/IEC TS 17961 ID:** `libptr`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Use of plain char type for numerical value

Plain `char` variable in arithmetic operation without explicit signedness

## Description

**Use of plain char type for numerical value** detects `char` variables without explicit signedness that are being used in these ways:

- To store non-char constants
- In an arithmetic operation when the `char` is:
  - A negative value.
  - The result of a sign changing overflow.
- As a buffer offset.

`char` variables without a `signed` or `unsigned` qualifier can be either signed or unsigned depending on your compiler.

### Risk

Operations on a plain char can result in unexpected numerical values. If the char is used as an offset, the char can cause buffer overflow or underflow.

### Fix

When initializing a char variable, to avoid implementation-defined confusion, explicitly state whether the char is signed or unsigned.

## Examples

### Divide by `char` Variable

```
#include <stdio.h>
```

```
void badplaincharuse(void)
{
    char c = 200;
    int i = 1000;
    (void)printf("i/c = %d\n", i/c);
}
```

In this example, the char variable `c` can be signed or unsigned depending on your compiler. Assuming 8-bit, two's complement character types, the result is either `i/c = 5` (unsigned char) or `i/c = -17` (signed char). The correct result is unknown without knowing the signedness of `char`.

One possible correction is to add a `signed` qualifier to `char`. This clarification makes the operation defined.

```
#include <stdio.h>

void badplaincharuse(void)
{
    signed char c = -56;
    int i = 1000;
    (void)printf("i/c = %d\n", i/c);
}
```

## Result Information

**Group:** Numerical
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `BAD_PLAIN_CHAR_USE`
**Impact:** Medium
**CWE ID:** 682, 758
**CERT C ID:** INT07-C

**Introduced in R2016b**

# Use of previously closed resource

Function operates on a previously closed stream

## Description

**Use of previously closed resource** occurs when a function operates on a stream that you closed earlier in your code.

### Risk

The standard states that the value of a `FILE*` pointer is indeterminate after you close the stream associated with it. Operations using the `FILE*` pointer can produce unintended results.

### Fix

One possible fix is to close the stream only at the end of operations. Another fix is to reopen the stream before using it again.

## Examples

### Use of `FILE*` Pointer After Closing Stream

```
#include <stdio.h>

void func(void) {
    FILE *fp;
    void *ptr;

    fp = fopen("tmp","w");
    if(fp != NULL) {
        fclose(fp);
        fprintf(fp,"text");
    }
}
```

In this example, `fclose` closes the stream associated with `fp`. When you use `fprintf` on `fp` after `fclose`, the **Use of previously closed resource** defect appears.

One possible correction is to reverse the order of the `fprintf` and `fclose` operations.

```
#include <stdio.h>

void func(void) {
    FILE *fp;
    void *ptr;

    fp = fopen("tmp","w");
    if(fp != NULL) {
        fprintf(fp,"text");
        fclose(fp);
    }
}
```

## Result Information

**Group:** Resource management
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `CLOSED_RESOURCE_USE`
**Impact:** High
**CWE ID:** 672
**CERT C ID:** FIO46-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`MISRA C:2012 Rule 22.6`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Use of previously freed pointer

Memory accessed after deallocation

## Description

**Use of previously freed pointer** occurs when a block of memory is accessed after it is freed using the `free` function.

## Examples

### Use of Previously Freed Pointer Error

```
#include <stdlib.h>
#include <stdio.h>
 int increment_content_of_address(int base_val, int shift)
   {
    int j;
    int* pi = (int*)malloc(sizeof(int));
    if (pi == NULL) return 0;

    *pi = base_val;
    free(pi);

    j = *pi + shift;
    /* Defect: Reading a freed pointer */

    return j;
   }
```

The `free` statement releases the block of memory that `pi` refers to. Therefore, dereferencing`pi` after the `free` statement is not valid.

One possible correction is to free the pointer `pi` only after the last instance where it is accessed.

```
#include <stdlib.h>
```

```
int increment_content_of_address(int base_val, int shift)
{
    int j;
    int* pi = (int*)malloc(sizeof(int));
    if (pi == NULL) return 0;

    *pi = base_val;

    j = *pi + shift;
    *pi = 0;

    /* Fix: The pointer is freed after its last use */
    free(pi);
    return j;
}
```

## Check Information

**Group:** Dynamic memory
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `FREED_PTR`
**Impact:** High
**CWE ID:** 416
**CERT C ID:** MEM00-C, MEM30-C
**ISO/IEC TS 17961 ID:** `accfree`, `dblfree`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Deallocation of previously deallocated pointer`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Use of setjmp/longjmp

`setjmp` and `longjmp` cause deviation from normal control flow

## Description

**Use of setjmp/longjmp** occurs when you use a combination of `setjmp` and `longjmp` or `sigsetjmp` and `siglongjmp` to deviate from normal control flow and perform non-local jumps in your code.

### Risk

Using `setjmp` and `longjmp`, or `sigsetjmp` and `siglongjmp` has the following risks:

- Nonlocal jumps are vulnerable to attacks that exploit common errors such as buffer overflows. Attackers can redirect the control flow and potentially execute arbitrary code.
- Resources such as dynamically allocated memory and open files might not be closed, causing resource leaks.
- If you use `setjmp` and `longjmp` in combination with a signal handler, unexpected control flow can occur. POSIX does not specify whether `setjmp` saves the signal mask.
- Using `setjmp` and `longjmp` or `sigsetjmp` and `siglongjmp` makes your program difficult to understand and maintain.

### Fix

Perform nonlocal jumps in your code using `setjmp/longjmp` or `sigsetjmp/siglongjmp` only in contexts where such jumps can be performed securely. Alternatively, use POSIX threads if possible.

In C++, to simulate throwing and catching exceptions, use standard idioms such as `throw` expressions and `catch` statements.

# Examples

## Use of setjmp and longjmp

```
#include <setjmp.h>
#include <signal.h>

extern int update(int);
extern void print_int(int);

static jmp_buf env;
void sighandler(int signum) {
    longjmp(env, signum);
}
void func_main(int i) {
    signal(SIGINT, sighandler);
    if (setjmp(env)==0) {
        while(1) {
            /* Main loop of program, iterates until SIGINT signal catch */
            i = update(i);
        }
    } else {
        /* Managing longjmp return */
        i = -update(i);
    }

    print_int(i);
    return;
}
```

In this example, the initial return value of `setjmp` is 0. The `update` function is called in an infinite `while` loop until the user interrupts it through a signal.

In the signal handling function, the `longjmp` statement causes a jump back to `main` and the return value of `setjmp` is now 1. Therefore, the `else` branch is executed.

To emulate the same behavior more securely, use a `volatile` global variable instead of a combination of `setjmp` and `longjmp`.

```
#include <setjmp.h>
#include <signal.h>
```

```
extern int update(int);
extern void print_int(int);

volatile sig_atomic_t eflag = 0;

void sighandler(int signum) {
     eflag = signum;                   /* Fix: using global variable */
}

void func_main(int i) {
      /* Fix: Better design to avoid use of setjmp/longjmp */
    signal(SIGINT, sighandler);
    while(!eflag) {                   /* Fix: using global variable */
        /* Main loop of program, iterates until eflag is changed */
        i = update(i);
    }

    print_int(i);
    return;
}
```

## Result Information

**Group:** Good practice
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `SETJMP_LONGJMP_USE`
**Impact:** Low
**CWE ID:** 691
**CERT C ID:** MSC22-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

## External Websites

Linux man page for setjmp

**Introduced in R2015b**

# Use of tainted pointer

Pointer from an unsecure source may be NULL or point to unknown memory

## Description

**Use of tainted pointer** defect is raised when:

- Tainted NULL pointer — the pointer is not validated against NULL.
- Tainted size pointer — the size of the memory zone that a pointer points to is not validated.

**Note** On a single pointer, your code can have instances of **Use of tainted pointer**, **Pointer dereference with tainted offset**, and **Tainted NULL or non-null-terminated string**. Bug Finder raises only the first tainted pointer defect that it finds.

### Risk

An attacker can give your program a pointer that points to unexpected memory locations. If the pointer is dereferenced to write, the attacker can:

- Modify the state variables of a critical program.
- Cause your program to crash.
- Execute unwanted code.

If the pointer is dereferenced to read, the attacker can:

- Read sensitive data.
- Cause your program to crash.
- Modify a program variable to an unexpected value.

## Fix

If you expect a valid memory location, check that the pointer is not NULL. Also, check the size of the memory location. This second check validates whether the size of the data the pointer points to matches the size your program expects.

# Examples

## Function to Change Pointer

```
void taintedptr(int* p, int i) {
    *p = i;
}
```

In this example, the pointer `*p` is passed as an argument, and the value is changed. The pointer can be null or point to unknown memory, which can be vulnerable.

One possible correction is to sanitize the pointer before using it. This example uses a second function to check if the pointer is null and can be dereferenced.

```
#include <stdlib.h>

int* sanitize_ptr(int* p) {
    int* res = NULL;
    if (p && *p) { /* Tainted pointer detected here, used as "firewall" */
        /* Pointer is not null and dereference ok */
        res = p;
    }
    return res;
}
void taintedptr(int* p, int i) {
    p = sanitize_ptr(p);
    if (p) {
        *p = i;
    }
}
```

## Result Information

**Group:** Tainted Data
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `TAINTED_PTR`
**Impact:** Low
**CWE ID:** 822
**CERT C ID:** API00-C, API02-C, ARR30-C, ARR38-C, EXP34-C, MEM10-C, MSC15-C
**ISO/IEC TS 17961 ID:** `invptr`, `nullref`

## See Also

`Pointer dereference with tainted offset`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Variable length array with nonpositive size

Size of variable-length array is zero or negative

## Description

**Variable length array with non-positive size** occurs when size of a variable-length array is zero or negative.

### Risk

If the size of a variable-length array is zero or negative, unexpected behavior can occur, such as stack overflow.

### Fix

When you declare a variable-length array as a local variable in a function:

- If you use a function parameter as the array size, check that the parameter is positive.
- If you use the result of a computation on a function parameter as the array size, check that the result is positive.

You can place a test for positive value either before the function call or the array declaration in the function body.

## Examples

### Nonpositive Array Size

```
int input(void);

void add_scalar(int n, int m) {
    int r=0;
    int arr[m][n];
    for (int i=0; i<m; i++) {
        for (int j=0; j<n; j++) {
            arr[i][j] = input();
            r += arr[i][j];
        }
    }
}

void main() {
    add_scalar(2,2);
    add_scalar(-1,2);
    add_scalar(2,0);
}
```

In this example, the second and third calls to `add_scalar` result in a negative and zero size of `arr`.

One possible correction is fix or remove calls that result in a nonpositive array size.

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `NON_POSITIVE_VLA_SIZE`
**Impact:** High
**CWE ID:** 687
**CERT C ID:** MEM04-C, MEM05-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Variable shadowing

Variable hides another variable of same name with nested scope

## Description

**Variable shadowing** occurs when a variable hides another variable of the same name with nested scope.

## Examples

### Variable Shadowing Error

```
#include <stdio.h>

int fact[5]={1,2,6,24,120};

int factorial(int n)
 {
  int fact=1;
  /*Defect: Local variable hides global array with same name */

  for(int i=1;i<=n;i++)
    fact*=i;

  return(fact);
 }
```

Inside the `factorial` function, the integer variable `fact` hides the global integer array `fact`.

One possible correction is to change the name of one of the variables, preferably the one with more local scope.

```
#include <stdio.h>

int fact[5]={1,2,6,24,120};
int factorial(int n)
 {
  /* Fix: Change name of local variable */
  int f=1;

  for(int i=1;i<=n;i++)
    f*=i;

  return(f);
 }
```

## Check Information

**Group:** Data flow
**Language:** C | C++
**Default:** On for handwritten code, off for generated code
**Command-Line Syntax:** `VAR_SHADOWING`
**Impact:** Low
**CERT C ID:** DCL01-C

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2013b

# Vulnerable path manipulation

Path argument with /../, /abs/path/, or other unsecure elements

## Description

**Vulnerable path manipulation** detects relative or absolute path traversals. If the path traversal contains a tainted source, or you use the path to open/create files, Bug Finder raises a defect.

### Risk

Relative path elements, such as ".." can resolve to locations outside the intended folder. Absolute path elements, such as "/abs/path" can also resolve to locations outside the intended folder.

An attacker can use these types of path traversal elements to traverse to the rest of the file system and access other files or folders.

### Fix

Avoid vulnerable path traversal elements such as /../ and /abs/path/. Use fixed file names and locations wherever possible.

## Examples

### Relative Path Traversal

```
# include <stdio.h>
# include <string.h>
# include <wchar.h>
# include <sys/types.h>
# include <sys/stat.h>
# include <fcntl.h>
# include <unistd.h>
# include <stdlib.h>
# define BASEPATH "/tmp/"
# define FILENAME_MAX 512

static void Relative_Path_Traversal(void)
{
    char * data;
    char data_buf[FILENAME_MAX] = BASEPATH;
    char sub_buf[FILENAME_MAX];

    if (fgets(sub_buf, FILENAME_MAX, stdin) == NULL) exit (1);
    data = data_buf;
    strcat(data, sub_buf);

    FILE *file = NULL;
    file = fopen(data, "wb+");
    if (file != NULL) fclose(file);
}

int path_call(void){
    Relative_Path_Traversal();
}
```

This example opens a file from "/tmp/", but uses a relative path to the file. An external user can manipulate this relative path when fopen opens the file.

One possible correction is to use a fixed file name instead of a relative path. This example uses file.txt.

```
# include <stdio.h>
# include <string.h>
# include <wchar.h>
# include <sys/types.h>
# include <sys/stat.h>
# include <fcntl.h>
# include <unistd.h>
# include <stdlib.h>
# define BASEPATH "/tmp/"
# define FILENAME_MAX 512

static void Relative_Path_Traversal(void)
{
    char * data;
    char data_buf[FILENAME_MAX] = BASEPATH;
    data = data_buf;

    /* FIX: Use a fixed file name */
    strcat(data, "file.txt");
    FILE *file = NULL;
    file = fopen(data, "wb+");
    if (file != NULL) fclose(file);
}

int path_call(void){
    Relative_Path_Traversal();
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `PATH_TRAVERSAL`
**Impact:** Low
**CWE ID:** 22, 23, 36
**CERT C ID:** FIO02-C

## See Also

`Use of path manipulation function without maximum sized buffer checking`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Vulnerable permission assignments

Argument gives read/write/search permissions to external users

## Description

**Vulnerable permission assignments** looks at functions that can change file permissions, such as chmod, umask, creat, or open. If the specified permissions allow unintended actors to modify or read the resource, Bug Finder flags the functions as a defect.

### Risk

If you give outside users or outside groups a wider range or permissions than required, you potentially expose your sensitive information and your modifications. This defect is especially dangerous for permissions related to:

- Program configurations
- Program executions
- Sensitive user data

### Fix

Set your permissions so that the user (u) has more permissions than the group (g), and so the group has more permissions than other users (o), or u >= g >= o.

## Examples

### Create File with Other Permissions

```
#include <unistd.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
```

```
void bug_dangerouspermissions(const char * log_path) {
    mode_t mode = S_IROTH | S_IXOTH | S_IWOTH;
    int fd = creat(log_path, mode);

    if (fd) {
        write(fd, "Hello\n", 6);
    }
    close(fd);
    unlink(log_path);
}
```

In this example, the `log_path` file is created with more rights for the other outside users, than the current user. The permissions are `---------rwx`.

One possible correction is to modify the user permissions for the file. In this correction, the user has read/write/execute permissions, but other users do not.

```
#include <unistd.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>

void corrected_dangerouspermissions(const char * log_path) {
    mode_t mode = S_IRUSR | S_IXUSR | S_IWUSR;
    int fd = creat(log_path, mode);

    if (fd) {
        write(fd, "Hello\n", 6);
    }
    close(fd);
    unlink(log_path);
}
```

## Result Information

**Group:** Security<br>
**Language:** C | C++<br>
**Default:** Off<br>
**Command-Line Syntax:** `DANGEROUS_PERMISSIONS`<br>
**Impact:** Medium

**CWE ID:** 732
**CERT C ID:** FIO06-C

## See Also

`Umask used with chmod-style arguments`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Vulnerable pseudo-random number generator

Using a cryptographically weak pseudo-random number generator

## Description

The **Vulnerable pseudo-random number generator** identifies uses of cryptographically weak pseudo-random number generator (PRNG) routines.

The list of cryptographically weak routines flagged by this checker include:

- `rand`, `random`
- `drand48`, `lrand48`, `mrand48`, `erand48`, `nrand48`, `jrand48`, and their `_r` equivalents such as `drand48_r`
- `RAND_pseudo_bytes`

### Risk

These cryptographically weak routines are predictable and must not be used for security purposes. When a predictable random value controls the execution flow, your program is vulnerable to malicious attacks.

### Fix

Use more cryptographically sound random number generators, such as `CryptGenRandom` (Windows), `OpenSSL/RAND_bytes`(Linux/UNIX).

## Examples

### Random Loop Numbers

```
#include <stdio.h>
#include <stdlib.h>
```

```
volatile int rd = 1;
int main(int argc, char *argv[])
{
    int j, r, nloops;
    struct random_data buf;
    int i = 0;

    nloops = rand();

    for (j = 0; j < nloops; j++) {
        if (random_r(&buf, &i))
            exit(1);
        printf("random_r: %ld\n", (long)i);
    }
    return 0;
}
```

This example uses `rand` and `random_r` to generate random numbers. If you use these functions for security purposes, these PRNGs can be the source of malicious attacks.

One possible correction is to replace the vulnerable PRNG with a stronger random number generator.

```
#include <stdio.h>
#include <stdlib.h>
#include <openssl/rand.h>

volatile int rd = 1;
int main(int argc, char* argv[])
{
    int j, r, nloops;
    unsigned char buf;
    unsigned int seed;
    int i = 0;

    if (argc != 3)
    {
        fprintf(stderr, "Usage: %s <seed> <nloops>\n", argv[0]);
        exit(EXIT_FAILURE);
    }

    seed = atoi(argv[1]);
    nloops = atoi(argv[2]);

    for (j = 0; j < nloops; j++) {
        if (RAND_bytes(&buf, i) != 1)
            exit(1);
        printf("RAND_bytes: %u\n", (unsigned)buf);
    }
    return 0;
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `VULNERABLE_PRNG`
**Impact:** Medium
**CWE ID:** 330, 338
**CERT C ID:** MSC30-C

## See Also

`Deterministic random output from constant seed` | `Predictable random output from predictable seed` | `Unsafe standard encryption function`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Weak cipher algorithm

Encryption algorithm associated with the cipher context is weak

## Description

**Weak cipher algorithm** occurs when you associate a weak encryption algorithm with the cipher context.

### Risk

Some encryption algorithms have known flaws. Though the OpenSSL library still supports the algorithms, you must avoid using them.

If your cipher algorithm is weak, an attacker can decrypt your data by exploiting a known flaw or brute force attacks.

### Fix

Use algorithms that are well-studied and widely acknowledged as secure.

For instance, the Advanced Encryption Standard (AES) is a widely accepted cipher algorithm.

## Examples

### Use of DES Algorithm

```
#include <openssl/evp.h>
#include <stdlib.h>

void func(unsigned char *key, unsigned char *iv) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);
    const EVP_CIPHER * ciph = EVP_des_cbc();
    EVP_EncryptInit_ex(ctx, ciph, NULL, key, iv);
}
```

In this example, the routine `EVP_des_cbc()` invokes the Data Encryption Standard (DES) algorithm, which is now considered as non-secure and relatively slow.

One possible correction is to use the faster and more secure Advanced Encryption Standard (AES) algorithm instead.

```
#include <openssl/evp.h>
#include <stdlib.h>

void func(unsigned char *key, unsigned char *iv) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);
    const EVP_CIPHER * ciph = EVP_aes_128_cbc();
    EVP_EncryptInit_ex(ctx, ciph, NULL, key, iv);
}
```

## Result Information

**Group:** Security<br>
**Language:** C | C++<br>
**Default:** Off<br>
**Command-Line Syntax:** `CRYPTO_CIPHER_WEAK_CIPHER`<br>
**Impact:** Medium<br>
**CWE ID:** 310, 326, 327

Introduced in R2017a

# Weak cipher mode

Encryption mode associated with the cipher context is weak

## Description

**Weak cipher mode** occurs when you associate a weak block cipher mode with the cipher context.

The cipher mode that is especially flagged by this defect is the Electronic Code Book (ECB) mode.

### Risk

The ECB mode does not support protection against dictionary attacks.

An attacker can decrypt your data even using brute force attacks.

### Fix

Use a cipher mode more secure than ECB.

For instance, the Cipher Block Chaining (CBC) mode protects against dictionary attacks by:

- XOR-ing each block of data with the encrypted output from the previous block.
- XOR-ing the first block of data with a random initialization vector (IV).

## Examples

### Use of ECB Mode

```
#include <openssl/evp.h>
```

```
#include <stdlib.h>

void func(unsigned char *key, unsigned char *iv) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);
    const EVP_CIPHER * ciph = EVP_aes_128_ecb();
    EVP_EncryptInit_ex(ctx, ciph, NULL, key, iv);
}
```

In this example, the routine `EVP_aes_128_ecb()` invokes the Advanced Encryption Standard (AES) algorithm in the Electronic Code Book (ECB) mode. The ECB mode does not support protection against dictionary attacks.

One possible correction is to use the Cipher Block Chaining (CBC) mode instead.

```
#include <openssl/evp.h>
#include <stdlib.h>

void func(unsigned char *key, unsigned char *iv) {
    EVP_CIPHER_CTX *ctx = EVP_CIPHER_CTX_new();
    EVP_CIPHER_CTX_init(ctx);
    const EVP_CIPHER * ciph = EVP_aes_128_cbc();
    EVP_EncryptInit_ex(ctx, ciph, NULL, key, iv);
}
```

## Result Information

**Group:** Security
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `CRYPTO_CIPHER_WEAK_MODE`
**Impact:** Medium
**CWE ID:** 310, 326, 327

Introduced in R2017a

# Write without a further read

Variable never read after assignment

## Description

**Write without a further read** occurs when a value assigned to a variable is never read.

For instance, you write a value to a variable and then write a second value before reading the previous value. The first write operation is redundant.

## Examples

### Write Without Further Read Error

```
void sensor_amplification(void)
{
    extern int getsensor(void);
    int level;

    level = 4 * getsensor();
    /* Defect: Useless write */
}
```

After the variable `level` gets assigned the value `4 * getsensor()`, it is not read.

One possible correction is to use the variable `level` after the assignment.

```
#include <stdio.h>

void sensor_amplification(void)
{
    extern int getsensor(void);
    int level;

    level = 4 * getsensor();
    /* Fix: Use level after assignment */
    printf("The value is %d", level);

}
```

The variable `level` is printed, reading the new value.

## Check Information

**Group:** Data flow<br>
**Language:** C | C++<br>
**Default:** On for handwritten code, off for generated code<br>
**Command-Line Syntax:** `USELESS_WRITE`<br>
**Impact:** Low<br>
**CWE ID:** 398<br>
**CERT C ID:** DCL22-C, MSC13-C

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`MISRA C:2012 Rule 2.2`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

### Introduced in R2013b

# Writing to const qualified object

Object declared with a `const` qualifier is modified

## Description

**Writing to `const` qualified object** occurs when you do one of the following:

- Use a `const`-qualified object as the destination of an assignment.
- Pass a `const`-qualified object to a function that modifies the argument.

For instance, the defect can occur in the following situations:

| Situation | Risk | Fix |
|---|---|---|
| You pass a `const`-qualified object as first argument of one of the following functions:<br>• `mkstemp`<br>• `mkostemp`<br>• `mkostemps`<br>• `mkdtemp` | These functions replace the last six characters of their first argument with a string. Therefore, they expect a modifiable `char` array as their first argument. | Pass a non-`const` object as first argument of the function. |
| You pass a `const`-qualified object as the destination argument of one of the following functions:<br>• `strcpy`<br>• `strncpy`<br>• `strcat`<br>• `memset` | These functions modify their destination argument. Therefore, they expect a modifiable `char` array as their destination argument. | Pass a non-`const` object as destination argument of the function. |

| Situation | Risk | Fix |
|---|---|---|
| You perform a write operation on a const-qualified object. | The const qualifier implies an agreement that the value of the object will not be modified. By writing to a const-qualified object, you break the agreement. The result of the operation is undefined. | Perform the write operation on a non-const object. |

# Examples

## Writing to const-Qualified Object

```
#include <string.h>

const char* buffer = "abcdeXXXXXXX";

void func(char* string) {
    char *ptr = (char*)strchr(buffer,'X');
    if(ptr)
        strcpy(ptr,string);
}
```

In this example, because buffer is const-qualified, strchr(buffer,'X') returns a const-qualified char* pointer. When this char* pointer is used as the destination argument of strcpy, a **Writing to const qualified object** error appears.

One possible correction is to assign the constant string to a non-const object and use the non-const object as destination argument of strchr.

```
#include <string.h>

char buffer[] = "abcdeXXXXXXX";

void func(char* string) {
    char *ptr = (char*)strchr(buffer,'X');
    if(ptr)
```

```
        strcpy(ptr,string);
}
```

## Result Information

**Group:** Programming
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `CONSTANT_OBJECT_WRITE`
**Impact:** High
**CWE ID:** 227, 471, 686
**CERT C ID:** EXP40-C, MSC15-C, STR05-C, STR06-C, STR30-C
**ISO/IEC TS 17961 ID:** `strmod`

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Writing to read-only resource

File initially opened as read only is modified

## Description

**Writing to read-only resource** occurs when you attempt to write to a file that you have opened earlier in read-only mode.

For instance, you open a file using `fopen` with the access mode argument `r`. You write to that file with a function in the `fprintf` family.

### Risk

Writing to a read-only file causes undefined behavior.

### Fix

If you want to write to the file, open the file in a mode that is suitable for writing.

## Examples

### Writing to Read-Only File

```
#include <stdio.h>

void func(void) {
    FILE* fp ;

    fp = fopen("file.txt", "r");
    fprintf(fp, "Some data");
    fclose(fp);
}
```

In this example, the file `file.txt` is opened in read-only mode. When the `FILE` pointer associated with `file.txt` is used as an argument of `fprintf`, a **Writing to read-only resource** defect occurs.

One possible correction is to use the access specifier `"a"` instead of `"r"`. `file.txt` is now open for output at the end of the file.

```
#include <stdio.h>

void func(void) {
    FILE* fp ;

    fp = fopen("file.txt", "a");
    fprintf(fp, "Some data");
    fclose(fp);
}
```

## Result Information

**Group:** Resource management
**Language:** C | C++
**Default:** On
**Command-Line Syntax:** `READ_ONLY_RESOURCE_WRITE`
**Impact:** High

## See Also

`Find defects (-checkers)`

### Topics

"Navigate to Root Cause of Defect"
"Review and Fix Results"

Introduced in R2015b

# Wrong allocated object size for cast

Allocated memory does not match destination pointer

## Description

**Wrong allocated object size for cast** occurs during pointer conversion when the pointer’s address is unaligned. If a pointer is converted to a different pointer type, the size of the allocated memory must be a multiple of the size of the destination pointer.

## Examples

### Dynamic Allocation of Pointers

```
#include <stdlib.h>

void dyn_non_align(void){
    void *ptr = malloc(13);
    long *dest;

    dest = (long*)ptr; //defect
}
```

In this example, the software raises a defect on the conversion of `ptr` to a `long*` in line 5. The dynamically allocated memory of `ptr`, 13 bytes, is not a multiple of the size of `dest`, 4 bytes. This misalignment causes the **Wrong allocated object size for cast** defect.

One possible correction is to use a pointer size that is a multiple of the destination size. In this example, resolve the defect by changing the allocated memory to 12 instead of 13.

```
#include <stdlib.h>

void dyn_non_align(void){
    void *ptr = malloc(12);
    long *dest;
    dest = (long*)ptr;
}
```

## Static Allocation of Pointers

```
void static_non_align(void){
    char arr[13], *ptr;
    int *dest;

    ptr = &arr[0];
    dest = (int*)ptr; //defect
}
```

In this example, the software raises a defect on the conversion of `ptr` to an `int*` in line 6. `ptr` has a memory size of 13 bytes because the array `arr` has a size of 13 bytes. The size of `dest` is 4 bytes, which is not a multiple of 13. This misalignment causes the **Wrong allocated object size for cast** defect.

One possible correction is to use a pointer size that is a multiple of the destination size. In this example, resolve the defect by changing the size of the array `arr` to a multiple of 4.

```
void static_non_align(void){
    char arr[12], *ptr;
    int *dest;

    ptr = &arr[0];
    dest = (int*)ptr;
}
```

## Allocation with a Function

```
#include <stdlib.h>

void *my_alloc(int size) {
    void *ptr_func = malloc(size);
    if(ptr_func == NULL) exit(-1);
    return ptr_func;
}

void fun_non_align(void){
    int *dest1;
    char *dest2;

    dest1 = (int*)my_alloc(13);  //defect
    dest2 = (char*)my_alloc(13); //not a defect
}
```

In this example, the software raises a defect on the conversion of the pointer returned by `my_alloc(13)` to an `int*` in line 11. `my_alloc(13)` returns a pointer with a dynamically allocated size of 13 bytes. The size of `dest1` is 4 bytes, which is not a divisor of 13. This misalignment causes the **Wrong allocated object size for cast** defect. In line 12, the same function call, `my_alloc(13)`, does not call a defect for the conversion to `dest2` because the size of `char*`, 1 byte, a divisor of 13.

One possible correction is to use a pointer size that is a multiple of the destination size. In this example, resolve the defect by changing the argument for `my_alloc` to a multiple of 4.

```
#include <stdlib.h>

void *my_alloc(int size) {
    void *ptr_func = malloc(size);
    if(ptr_func == NULL) exit(-1);
    return ptr_func;
}

void fun_non_align(void){
    int *dest1;
    char *dest2;

    dest1 = (int*)my_alloc(12);
    dest2 = (char*)my_alloc(13);
}
```

## Check Information

**Group:** Static Memory
**Language:** C | C++
**Default:** Off
**Command-Line Syntax:** `OBJECT_SIZE_MISMATCH`
**Impact:** High

**CWE ID:** 704<br>
**CERT C ID:** EXP36-C, MEM02-C, STR38-C<br>
**ISO/IEC TS 17961 ID:** `ALIGNCONV`, `INSUFMEM`

## See Also

### Polyspace Analysis Options

`Find defects (-checkers)`

### Polyspace Results

`Unreliable cast of pointer`

## Topics

"Navigate to Root Cause of Defect"<br>
"Review and Fix Results"

### Introduced in R2013b

# Wrong type used in sizeof

`sizeof` argument does not match pointed type

## Description

**Wrong type used in sizeof** occurs when both of the following conditions hold:

- You assign the address of a block of memory to a pointer, or transfer data between two blocks of memory. The assignment or copy uses the `sizeof` operator.

  For instance, you initialize a pointer using `malloc(sizeof(`*`type`*`))` or copy data between two addresses using `memcpy(`*`destination_ptr, source_ptr`*`, sizeof(`*`type`*`))`.
- You use an incorrect type as argument of the `sizeof` operator. You use the pointer type instead of the type that the pointer points to.

  For instance, to initialize a *`type*`* pointer, you use `malloc(sizeof(`*`type*`*`))` instead of `malloc(sizeof(`*`type`*`))`.

### Rationale

Irrespective of what *`type`* stands for, the expression `sizeof(`*`type*`*`)` always returns a fixed size. The size returned is the pointer size on your platform in bytes. The appearance of `sizeof(`*`type*`*`)` often indicates an unintended usage. The error can cause allocation of a memory block that is much smaller than what you need and lead to weaknesses such as buffer overflows.

For instance, assume that `structType` is a structure with ten `int` variables. If you initialize a `structType*` pointer using `malloc(sizeof(structType*))` on a 32-bit platform, the pointer is assigned a memory block of four bytes. However, to be allocated completely for one `structType` variable, the `structType*` pointer must point to a memory block of `sizeof(structType) = 10 * sizeof(int)` bytes. The required size is much greater than the actual allocated size of four bytes.

## Fix

To initialize a *type** pointer, replace sizeof(*type**) in your pointer initialization expression with sizeof(*type*).

# Examples

### Allocate a Char Array With **sizeof**

```
void test_case_1(void) {
    char* str;

    str = (char*)malloc(sizeof(char*) * 5);
    free(str);

}
```

In this example, memory is allocated for the character pointer str using a malloc of five char pointers. However, str is a pointer to a character, not a pointer to a character pointer. Therefore the sizeof argument, char*, is incorrect.

One possible correction is to match the argument to the pointer type. In this example, str is a character pointer, therefore the argument must also be a character.

```
void test_case_1(void) {
    char* str;

    str = (char*)malloc(sizeof(char) * 5);
    free(str);

}
```

# Check Information

**Group:** Programming<br>
**Language:** C | C++
**Default:** On for handwritten code, off for generated code
**Command-Line Syntax:** PTR_SIZEOF_MISMATCH

**Impact:** High
**CWE ID:** 467
**CERT C ID:** ARR00-C, ARR01-C, EXP01-C, MEM02-C, MEM35-C
**ISO/IEC TS 17961 ID:** `insufmem`

## See Also

`Find defects (-checkers)`

### Topics

“Navigate to Root Cause of Defect”
“Review and Fix Results”

Introduced in R2013b

4

# Functions, Properties, Classes, and Apps

# pslinkfun

Manage model analysis at the command line

## Syntax

```
pslinkfun('annotations','type',typeValue,'kind',kindValue,
Name,Value)
```

```
pslinkfun('openresults',systemName)
```

```
pslinkfun('settemplate',psprjFile)
prjTemplate = pslinkfun('gettemplate')
```

```
pslinkfun('advancedoptions')
pslinkfun('enablebacktomodel')
pslinkfun('help')
pslinkfun('metrics')
pslinkfun('jobmonitor')
pslinkfun('stop')
```

## Description

`pslinkfun('annotations','type',typeValue,'kind',kindValue, Name,Value)` adds an annotation of type `typeValue` and kind `kindValue` to the selected block in the model. You can specify a different block using a `Name,Value` pair argument. You can also add notes about a severity classification, an action status, or other comments using `Name,Value` pairs.

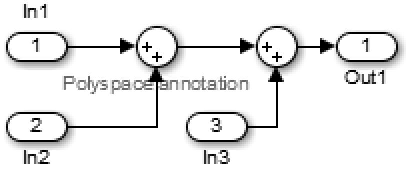
In the generated code associated with the annotated block, Polyspace adds code comments before and after the lines of code. Polyspace reads these comments and marks Polyspace results of the specified `kind` with the annotated information.

Syntax limitations:

- You can have only one annotation per block. If a block produces both a rule violation and an error, you can annotate only one type.

- Even though you apply annotations to individual blocks, the scope of the annotation can be larger. The generated code from one block can overlap with another, causing the annotation to also overlap.

  For example, consider this model. The first summation block has a Polyspace annotation, but the second does not.

  However, the associated generated code adds all three inputs in one line of code.

  ```
  /* polyspace:begin<RTE:OVFL:Medium:To Fix>*/
  annotate_y.Out1=(annotate_u.In1+annotate_U.In2)+annotate_U.In3;
  /* polyspace:end<RTE:OVFL:Medium:To Fix> */
  ```

  Therefore, the annotation justifies both summations.

`pslinkfun('openresults',systemName)` opens the Polyspace results associated with the model or subsystem `systemName` in the Polyspace environment.

`pslinkfun('settemplate',psprjFile)` sets the configuration file for new verifications.

`prjTemplate = pslinkfun('gettemplate')` returns the template configuration file used for new analyses.

`pslinkfun('advancedoptions')` opens the advanced verification options window to configure additional options for the current model.

`pslinkfun('enablebacktomodel')` enables the back-to-model feature of the Simulink plug-in. If your Polyspace results do not properly link to back to the model blocks, run this command.

`pslinkfun('help')` opens the Polyspace documentation in a separate window. Use this option for only pre-R2013b versions of MATLAB.

`pslinkfun('metrics')` opens the Polyspace Metrics interface.

pslinkfun('jobmonitor') opens the Polyspace Job Monitor to display remote verifications in the queue.

pslinkfun('stop') kills the code analysis that is currently running. Use this option for local analyses only.

## Examples

### Annotate a Block and Run a Polyspace Bug Finder Analysis

Use the Polyspace annotation function to annotate a block and see the annotation in the analysis results.

In the example model WhereAreTheErrors, add an annotation to the switch block for MISRA C rule 13.7 violations with a comment, a severity, and a status.

```
model = 'WhereAreTheErrors';
open(model)
pslinkfun('annotations','type','Misra-C', 'kind', '13.7','block',...
    'WhereAreTheErrors/Switch1','status','to fix','comment','must fix')
```

In the open model, you can see a Polyspace annotation added to the Switch block.

Generate code for the model and run an analysis. After the analysis is finished, open the results in the Polyspace environment:

```
slbuild(model)
opts = pslinkoptions(model);
opts.VerificationMode = 'BugFinder';
opts.VerificationSettings = 'PrjConfigAndMisra';
pslinkrun(model,opts)
pslinkfun('openresults',model)
```

The five MISRA C 13.7 rule violations are annotated with the information you added to the switch block. The annotations appear in the **Status** and **Comment** columns.

### Add Batch Options to Default Configuration Template

Change advanced Polyspace options and set the new configuration as a template.

Load the model WhereAreTheErrors and open the advanced options window.

```
model = 'WhereAreTheErrors';
load_system(model)
pslinkfun('advancedoptions')
```

In the **Run Settings** pane, select the options **Run Bug Finder analysis on a remote cluster** and **Upload results to Polyspace Metrics**.

Set the configuration template for new Polyspace analyses to have these options.

```
pslinkfun('settemplate',fullfile(cd,'pslink_config',...
    'WhereAreTheErrors_config.psprj'))
```

View the current Polyspace template.

```
template = pslinkfun('gettemplate')
```

```
template =
C:\ModelLinkDemo\pslink_config\WhereAreTheErrors_config.psprj
```

### View Polyspace Queue and Metrics

Run a remote analysis, view the analysis in the queue, and review the metrics.

Before performing this example, check that your Polyspace configuration is set up for remote analysis and Polyspace Metrics.

Build the model WhereAreTheErrors, create a Polyspace options object, set the verification mode, and open the advanced options window.

```
model = 'WhereAreTheErrors';
load_system(model)
slbuild(model)
opts = pslinkoptions(model);
opts.VerificationMode = 'BugFinder';
pslinkfun('advancedoptions')
```

In the **Run Settings** pane, select the options **Run Bug Finder analysis on a remote cluster** and **Upload results to Polyspace Metrics**.

Run Polyspace, then open the Job Monitor to monitor your remote job.

```
pslinkrun(model,opts)
pslinkfun('jobmonitor')
```

After your job is finished, open the metrics server to see your job in the repository.

```
pslinkfun('metrics')
```

## Input Arguments

### `typeValue` — type of result

'DEFECT' | 'MISRA-C' | 'MISRA-AC-AGC' | 'MISRA-CPP' | 'JSF'

The type of result with which to annotate the block, specified as:

- `'DEFECT'` for defects.
- `'MISRA-C'` for MISRA C coding rule violations (C code only).
- `'MISRA-AC-AGC'` for MISRA C coding rule violations (C code only).
- `'MISRA-CPP'` for MISRA C++ coding rule violations (C++ code only).
- `'JSF'` for JSF C++ coding rule violations (C++ code only).

Example: `'type','MISRA-C'`

### `kindValue` — specific check or coding rule

check acronym | rule number

The specific check or coding rule specified by the acronym of the check or the coding rule number. For the specific input for each type of annotation, see the following table.

| `type` Value | `kind` Values |
|---|---|
| `'DEFECT'` | Use the abbreviation associated with the type of defect that you want to annotate. For example, `'int_ovfl'` – Integer overflow.<br>For the list of possible checks, see: “Polyspace Bug Finder Results”. |

| **type** Value | **kind** Values |
|---|---|
| 'MISRA-C' | Use the rule number that you want to annotate. For example, '2.2'.<br>For the list of supported MISRA C rules and their numbers, see "MISRA C:2004 and MISRA AC AGC Coding Rules". |
| 'MISRA-AC-AGC' | Use the rule number that you want to annotate. For example, '2.2'.<br>For the list of supported MISRA C rules and their numbers, see "MISRA C:2004 and MISRA AC AGC Coding Rules". |
| 'MISRA-CPP' | Use the rule number that you want to annotate. For example, '0-1-1'.<br>For the list of supported MISRA C++ rules and their numbers, see "MISRA C++ Coding Rules". |
| 'JSF' | Use the rule number that you want to annotate. For example, '3'.<br>For the list of supported JSF C++ rules and their numbers, see "JSF C++ Coding Rules". |

Example: `pslinkfun('annotations','type','MISRA-CPP','kind','1-2-3')`

Data Types: `char`

### `systemName` — Simulink model

system | subsystem

Simulink model specified by the system or subsystem name.

Example: `pslinkfun('openresults','WhereAreTheErrors')`

### `psprjFile` — Polyspace project file

standard Polyspace template (default) | absolute path to `.psprj` file

Polyspace project file specified as the absolute path to the `.psprj` project file. If `psprjFile` is empty, Polyspace uses the standard Polyspace template file. New Polyspace projects start with this project configuration.

Example: `pslinkfun('settemplate', fullfile(matlabroot, 'polyspace', 'examples', 'cxx', 'Bug_Finder_Example', 'Bug_Finder_Example.bf.psprj'));`

## Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'block','MyModel\Sum', 'status','to fix'`

### **`block`** — block to be annotated

`gcb` (default) | block name

The block you want to annotate specified by the block name. If you do not use this option, the block returned by the function `gcb` is annotated.

Example: `'block','MyModel\Sum'`

### **`class`** — severity of the check

`'high'` | `'medium'` | `'low'` | `'not a defect'` | `'unset'`

Severity of the check specified as `high`, `medium`, `low`, `not a defect`, or `unset`.

Example: `'class','high'`

### **`status`** — action status

`'undecided'` | `'to investigate'` | `'to fix'` | `'justified'` | `'no action planned'` | `'other'`

Action status of the check specified as `to investigate`, `to fix`, `justified`, `no action planned`, or `other`.

Example: `'status','no action planned'`

### **`comment`** — additional comments

character vector

Additional comments specified as a character vector. The comments provide more information about why the results are justified.

Example: `'comment','defensive code'`

## See Also

`pslinkrun` | `pslinkoptions` | `gcb`

Introduced in R2014a

# pslinkoptions

Create options object to customize Polyspace runs from MATLAB command line

## Syntax

```
opts = pslinkoptions(codegen)
opts = pslinkoptions(model)
opts = pslinkoptions(sfunc)
```

## Description

`opts = pslinkoptions(codegen)` returns an options object with the configuration options for code generated by `codegen`.

`opts = pslinkoptions(model)` returns an options object with the configuration options for the Simulink model.

`opts = pslinkoptions(sfunc)` returns an options object with the configuration options for the S-Function.

## Examples

### Use a Simulink model to create and edit an options objects

Load psdemo_model_link_sl and create a Polyspace® options object from the model:

```
load_system('psdemo_model_link_sl');
model_opt = pslinkoptions('psdemo_model_link_sl')
```

```
model_opt =

                  ResultDir: 'results_$ModelName$'
       VerificationSettings: 'PrjConfig'
         OpenProjectManager: 1
         AddSuffixToResultDir: 0
     EnableAdditionalFileList: 0
           AdditionalFileList: {}
             VerificationMode: 'CodeProver'
          EnablePrjConfigFile: 0
                PrjConfigFile: ''
         AddToSimulinkProject: 0
               InputRangeMode: 'DesignMinMax'
               ParamRangeMode: 'None'
              OutputRangeMode: 'None'
           ModelRefVerifDepth: 'All'
      ModelRefByModelRefVerif: 0
                  AutoStubLUT: 0
      CxxVerificationSettings: 'PrjConfig'
    CheckConfigBeforeAnalysis: 'OnWarn'
```

The model is already configured for Embedded Coder®, so only the Embedded Coder configuration options appear.

Change the results folder name option and set `OpenProjectManager` to true.

```
model_opt.ResultDir = 'results_v1_$ModelName$';
model_opt.OpenProjectManager = true
```

```
model_opt = 

                    ResultDir: 'results_v1_$ModelName$'
         VerificationSettings: 'PrjConfig'
           OpenProjectManager: 1
         AddSuffixToResultDir: 0
     EnableAdditionalFileList: 0
           AdditionalFileList: {}
             VerificationMode: 'CodeProver'
          EnablePrjConfigFile: 0
                PrjConfigFile: ''
         AddToSimulinkProject: 0
               InputRangeMode: 'DesignMinMax'
               ParamRangeMode: 'None'
              OutputRangeMode: 'None'
           ModelRefVerifDepth: 'All'
      ModelRefByModelRefVerif: 0
                  AutoStubLUT: 0
      CxxVerificationSettings: 'PrjConfig'
    CheckConfigBeforeAnalysis: 'OnWarn'
```

### Create and edit an options object for Embedded Coder at the command line

Create a Polyspace® options object called `new_opt` with Embedded Coder® parameters:

```
new_opt = pslinkoptions('ec')
```

```
new_opt = 

                    ResultDir: 'results_$ModelName$'
         VerificationSettings: 'PrjConfig'
           OpenProjectManager: 0
         AddSuffixToResultDir: 0
     EnableAdditionalFileList: 0
           AdditionalFileList: {}
             VerificationMode: 'CodeProver'
          EnablePrjConfigFile: 0
                PrjConfigFile: ''
         AddToSimulinkProject: 0
               InputRangeMode: 'DesignMinMax'
               ParamRangeMode: 'None'
              OutputRangeMode: 'None'
           ModelRefVerifDepth: 'Current model only'
      ModelRefByModelRefVerif: 0
                  AutoStubLUT: 1
      CxxVerificationSettings: 'PrjConfig'
    CheckConfigBeforeAnalysis: 'OnWarn'
```

To Follow the progress in the Polyspace interface, set the `OpenProjectManager` option to true. Change the configuration to check for both checks and MISRA C® 2012 coding rule violations:

```
new_opt.OpenProjectManager = true;
new_opt.VerificationSettings = 'PrjConfigAndMisraC2012'
```

```
new_opt = 

                    ResultDir: 'results_$ModelName$'
```

```
          VerificationSettings: 'PrjConfigAndMisraC2012'
            OpenProjectManager: 1
          AddSuffixToResultDir: 0
      EnableAdditionalFileList: 0
            AdditionalFileList: {}
              VerificationMode: 'CodeProver'
           EnablePrjConfigFile: 0
                 PrjConfigFile: ''
          AddToSimulinkProject: 0
                InputRangeMode: 'DesignMinMax'
                ParamRangeMode: 'None'
               OutputRangeMode: 'None'
            ModelRefVerifDepth: 'Current model only'
       ModelRefByModelRefVerif: 0
                   AutoStubLUT: 1
       CxxVerificationSettings: 'PrjConfig'
     CheckConfigBeforeAnalysis: 'OnWarn'
```

### Create and edit an options object for TargetLink at the command line

Create a Polyspace® options object called `new_opt` with TargetLink® parameters:

```
new_opt = pslinkoptions('tl')
```

```
new_opt = 

                     ResultDir: 'results_$ModelName$'
          VerificationSettings: 'PrjConfig'
            OpenProjectManager: 0
          AddSuffixToResultDir: 0
      EnableAdditionalFileList: 0
            AdditionalFileList: {}
              VerificationMode: 'CodeProver'
           EnablePrjConfigFile: 0
                 PrjConfigFile: ''
          AddToSimulinkProject: 0
                InputRangeMode: 'DesignMinMax'
                ParamRangeMode: 'None'
               OutputRangeMode: 'None'
                   AutoStubLUT: 1
```

Set the `OpenProjectManager` option to true to follow the progress in the Polyspace interface. Also change the configuration to check for both run-time errors and MISRA C® coding rule violations:

```
new_opt.OpenProjectManager = true;
new_opt.VerificationSettings = 'PrjConfigAndMisra'
```

```
new_opt = 

                   ResultDir: 'results_$ModelName$'
        VerificationSettings: 'PrjConfigAndMisra'
          OpenProjectManager: 1
        AddSuffixToResultDir: 0
    EnableAdditionalFileList: 0
          AdditionalFileList: {}
            VerificationMode: 'CodeProver'
         EnablePrjConfigFile: 0
               PrjConfigFile: ''
        AddToSimulinkProject: 0
              InputRangeMode: 'DesignMinMax'
              ParamRangeMode: 'None'
             OutputRangeMode: 'None'
                 AutoStubLUT: 1
```

## Input Arguments

### **`codegen`** — Code generator

`'ec'` | `'tl'`

Code generator, specified as either `'ec'` for Embedded Coder® or `'tl'` for TargetLink®. Each argument creates a Polyspace options object with properties specific to that code generator.

For a description of all configuration options and their values, see pslinkoptions.

Example: `ec_opt = pslinkoptions('ec')`

Example: `tl_opt = pslinkoptions('tl')`

Data Types: `char`

### `model` — Simulink model name

model name

Simulink model, specified by the model name. Creates a Polyspace options object with the configuration options of that model. If you have not set any options, the object has the default configuration options. If you have set a code generator, the object has the default options for that code generator.

For a description of all configuration options and their values, see pslinkoptions.

Example: `model_opt = pslinkoptions('my_model')`

Data Types: `char`

### `sfunc` — path to S-Function

character vector

Path to S-Function, specified as a character vector. Creates a Polyspace options object with the configuration options for the S-function. If you have not set any options, the object has the default configuration options.

For a description of all configuration options and their values, see pslinkoptions.

Example: `sfunc_opt = pslinkoptions('path/to/sfunction')`

Data Types: `char`

## Output Arguments

### `opts` — Polyspace configuration options

options object

Polyspace configuration options, returned as an options object. The object is used with `pslinkrun` to run Polyspace from the MATLAB command line.

For the list of object properties, see pslinkoptions.

Example:
```
opts= pslinkoptions('ec')
opts.VerificationSettings = 'Misra'
```

## See Also

`pslinkfun` | `pslinkrun`

### Topics

pslinkoptions

Introduced in R2012a

# pslinkrun

Run Polyspace analysis on model, system, or S-Function

## Syntax

```
[polyspaceFolder, resultsFolder] = pslinkrun
[polyspaceFolder, resultsFolder]= pslinkrun(target)
[polyspaceFolder, resultsFolder] = pslinkrun(target,opts)
[polyspaceFolder, resultsFolder] = pslinkrun(target,opts,asModelRef)
```

## Description

`[polyspaceFolder, resultsFolder] = pslinkrun` analyzes code generated from the current system using the configuration options associated with the current system. It returns the location of the results folder. The current system is the system returned by the command `bdroot`.

`[polyspaceFolder, resultsFolder]= pslinkrun(target)` analyzes `target` with the configuration options associated with the model containing `target`. Before you run an analysis, you must:

- Generate code for models and subsystems.
- Compile S-Functions.

`[polyspaceFolder, resultsFolder] = pslinkrun(target,opts)` analyzes `target` with the configuration options from the options object `opts`. It returns the location of the results folder.

`[polyspaceFolder, resultsFolder] = pslinkrun(target,opts,asModelRef)` uses `asModelRef` to specify which type of generated code to analyze—standalone code or model reference code. This option is useful when you want to analyze only a referenced model instead of an entire model hierarchy.

# Examples

## Analyze Generated Code

Use a Simulink model to generate code, set configuration options, and then run an analysis from the command line.

```
% Generate code from the model WhereAreTheErrors.
model = 'WhereAreTheErrors';
load_system(model);
slbuild(model);

% Create a Polyspace options object from the model.
opts = pslinkoptions(model);

% Set properties that define the Polyspace analysis.
opts.VerificationMode = 'CodeProver';
opts.VerificationSettings = 'PrjConfigAndMisraC2012';

% Run Polyspace using the options object.
[polyspaceFolder, resultsFolder] = pslinkrun(model,opts);
bdclose(model);
```

The results and the corresponding Polyspace project are saved to the `results_WhereAreTheErrors` folder, listed in the `polyspaceFolder` variable. The full path to the results folder is in the `resultsFolder` variable.

## Analyze Referenced Model Code

Use a Simulink model to generate model reference code, set configuration options, and then run an analysis from the command line.

```
% Generate code from the model WhereAreTheErrors.
% Treat WhereAreTheErrors as if referenced by another model.
model = 'WhereAreTheErrors';
load_system(model);
slbuild(model,'ModelReferenceRTWTargetOnly');

% Create a Polyspace options object from the model.
opts = pslinkoptions(model);
```

```
% Set properties that define the Polyspace analysis.
opts.VerificationMode = 'CodeProver';
opts.VerificationSettings = 'PrjConfigAndMisraC2012';

% Run Polyspace with the options object.
[polyspaceFolder, resultsFolder] = pslinkrun(model,opts,true);
bdclose(model);
```

The results and corresponding Polyspace project are saved to the `results_mr_WhereAreTheErrors` folder, listed in the `polyspaceFolder` variable. The full path to the results folder is in the `resultsFolder` variable.

## Reuse Analysis Options for Multiple Models

This example shows how to reuse a subset of options for Polyspace analysis of multiple models. Create a generic options object and specify properties that describe the common options. Associate the generic options object with a model-specific options object. Optionally, set some model-specific options and run the Polyspace analysis.

```
% Generate code from the model WhereAreTheErrors.
model = 'psdemo_model_link_sl';
load_system(model);
slbuild(model);

% Create a generic options object to use for multiple model analyses.
opts = polyspace.ModelLinkOptions();
opts.CodingRulesCodeMetrics.EnableMisraC3 = true;
opts.CodingRulesCodeMetrics.MisraC3Subset = 'all';
opts.MergedReporting.ReportOutputFormat = 'PDF';
opts.MergedReporting.EnableReportGeneration = true;

% Create a model-specific options object.
mlopts = pslinkoptions(model);

% Create a project from the generic options object.
% Associate the project with the model-specific options object.
prjfile = opts.generateProject('model_link_opts');
mlopts.EnablePrjConfigFile = true;
mlopts.PrjConfigFile = prjfile;
mlopts.VerificationMode = 'BugFinder';
```

```
% Run Polyspace with the model-specific options object.
[polyspaceFolder, resultsFolder] = pslinkrun(model,mlopts);
bdclose(model);
```

After the analysis completes, results open automatically in the Polyspace interface.

## Input Arguments

### `target` — Target of the analysis

`bdroot` (default) | model or system name | path to S-Function block

Target of the analysis specified as a character vector, with the model, system, or S-function in single quotes. The default value is the system returned by `bdroot`.

Example: `[polyspaceFolder, resultsFolder] = pslinkrun('demo')` where `demo` is the name of a model.

Example: `[polyspaceFolder, resultsFolder] = pslinkrun('path/to/sfunction')`

Data Types: `char`

### `opts` — Configuration options

options associated with `target` (default) | options object

Configuration options for the analysis, specified as a Polyspace options object. The function `pslinkoptions` creates an options object. You can customize the options object by changing the `pslinkoption` properties.

Example: `pslinkrun('demo', opts_demo)` where `demo` is the name of a model and `opts_demo` is an options object.

### `asModelRef` — Indicator for model reference analysis

`false` (default) | `true`

Indicator for model reference analysis, specified as true or false.

- If `asModelRef` is false (default), Polyspace analyzes code that is generated as standalone code. This option is equivalent to choosing **Verify Code Generated For** > **Model** in the Simulink Polyspace options.
- If `asModelRef` is true, Polyspace analyzes code that is generated as model referenced code. This option is equivalent to choosing **Verify Code Generated For** >

**Referenced Model** in the Simulink Polyspace options. Specifying model reference code indicates that Polyspace must look for the generated code in a different location from the location for standalone code.

Data Types: `logical`

## Output Arguments

### `polyspaceFolder` — Folder containing Polyspace project and results

character vector

Name of the folder containing Polyspace project and results, specified as a character vector. The default value of this variable is `results_$ModelName$`.

To change this value, see “Output folder” on page 9-18.

### `resultsFolder` — Full path to subfolder containing Polyspace results

character vector

Full path to subfolder containing Polyspace results, specified as a character vector.

The folder `results_$ModelName$` contains your Polyspace project and a subfolder `$ModelName$` with the analysis results. This variable gives you the full path to the subfolder. You can use this path with the `polyspace.BugFinderResults` class.

To change the parent folder `results_$ModelName$`, see “Output folder” on page 9-18.

## See Also

`pslinkfun` | `pslinkoptions` | pslinkoptions

### Topics

“Verify S-Function Code”
“Recommended Model Settings for Code Analysis”

**Introduced in R2012a**

# polyspaceBugFinder

Run Polyspace Bug Finder analysis from MATLAB

**Note** For easier scripting, run Polyspace® analysis using a `polyspace.Project` object.

## Syntax

```
polyspaceBugFinder
polyspaceBugFinder(projectFile)

polyspaceBugFinder(optsObject)
polyspaceBugFinder(projectFile, '-nodesktop')

polyspaceBugFinder(resultsFile)
polyspaceBugFinder('-results-dir',resultsFolder)

polyspaceBugFinder('-help')

polyspaceBugFinder('-sources',sourceFiles)
polyspaceBugFinder('-sources',sourceFiles,Name,Value)
```

## Description

`polyspaceBugFinder` opens Polyspace Bug Finder.

`polyspaceBugFinder(projectFile)` opens a Polyspace project file in Polyspace Bug Finder.

`polyspaceBugFinder(optsObject)` runs an analysis on the Polyspace options object in MATLAB.

`polyspaceBugFinder(projectFile, '-nodesktop')` runs an analysis on the Polyspace project file in MATLAB.

Alternatively, you can use the function `polyspaceBugFinderNoDesktop` with the syntax `polyspaceBugFinderNoDesktop(projectfile)`.

`polyspaceBugFinder(resultsFile)` opens a Polyspace results file in Polyspace Bug Finder.

`polyspaceBugFinder('-results-dir',resultsFolder)` opens a Polyspace results file from `resultsFolder` in Polyspace Bug Finder.

`polyspaceBugFinder('-help')` displays options that can be supplied to the `polyspaceBugFinder` command to run a Polyspace Bug Finder analysis.

`polyspaceBugFinder('-sources',sourceFiles)` runs a Polyspace Bug Finder analysis on the source files specified in `sourceFiles`.

`polyspaceBugFinder('-sources',sourceFiles,Name,Value)` runs a Polyspace Bug Finder analysis on the source files with additional options specified by one or more `Name,Value` pair arguments.

## Examples

### Open Polyspace Projects from MATLAB

This example shows how to open a Polyspace project file with extension `.psprj` from MATLAB. In this example, you open the project file `Bug_Finder_Example.psprj` from the folder *`matlabroot`*`\polyspace\examples\cxx\Bug_Finder_Example`.

Open the project `Bug_Finder_Example.psprj` in the Polyspace interface.

```
prjFile = fullfile(matlabroot, 'polyspace', 'examples', 'cxx', ...
          'Bug_Finder_Example', 'Bug_Finder_Example.psprj');
polyspaceBugFinder(prjFile);
```

### Open Polyspace Results from MATLAB

This example shows how to open a Polyspace results file from MATLAB. In this example, you open the results file from the folder *`matlabroot`*`\polyspace\examples\cxx\Bug_Finder_Example\Results`.

Open the results of `resFolder`.

```
resFolder = fullfile(matlabroot, 'polyspace', 'examples',  ...
         'cxx', 'Bug_Finder_Example', 'Results');
polyspaceBugFinder('-results-dir',resFolder)
```

### Run Polyspace Analysis with Options Object

This example shows how to run a Polyspace analysis from the MATLAB command-line. For this example:

- Save a C source file, `source.c`, in the folder `C:\Polyspace_Sources`.
- Save an include file in the folder `C:\Polyspace_Includes`.

Create an options object and add the source file and include folder to the properties.

```
opts = polyspace.BugFinderOptions;
opts.Sources = {'C:\Polyspace_Sources\source.c'};
opts.EnvironmentSettings.IncludeFolders = {'C:\Polyspace_Includes'};
opts.ResultsDir = 'C:\Polyspace_Results';
```

Polyspace runs on the file `C:\Polyspace_Sources\source.c` and stores the result in `C:\Polyspace_Results`.

Run the analysis and view the results.

```
polyspaceBugFinder(opts);
polyspaceBugFinder('-results-dir',opts.ResultsDir)
```

### Run Polyspace Analysis from MATLAB with DOS/UNIX Options

This example shows how to run a Polyspace analysis in MATLAB. For this example:

- Save a C source file, `source.c`, in the folder `C:\Polyspace_Sources`.
- Save an include file in the folder `C:\Polyspace_Includes`.

To analyze `C:\Polyspace_Sources\source.c`, run the following command.

```
polyspaceBugFinder('-sources','C:\Polyspace_Sources\source.c', ...
    '-I','C:\Polyspace_Includes', ...
    '-results-dir','C:\Polyspace_Results')
```

To view the results, enter:

```
polyspaceBugFinder('-results-dir','C:\')
```

### Run Polyspace Analysis with Coding Rules Checking

This example shows two different ways to customize an analysis in MATLAB. You can customize as many additional options as you want by changing properties in an options object or by using Name-Value pairs. Here you specify checking of MISRA C 2012 coding rules.

Create variables to save the source file path and results folder path. You can use these variables for either analysis method.

```
sourceFileName = fullfile(matlabroot, 'polyspace','examples', 'cxx', ...
    'Bug_Finder_Example','sources','dataflow.c');
resFolder1 = fullfile('Polyspace_Results_1');
resFolder2 = fullfile('Polyspace_Results_2');
```

Analyze coding rules with an options object.

```
opts = polyspace.BugFinderOptions();
opts.Sources = {sourceFileName};
opts.ResultsDir = resFolder1;
opts.CodingRulesCodeMetrics.MisraC3Subset = 'all';
opts.CodingRulesCodeMetrics.EnableMisraC3 = true;
polyspaceBugFinder(opts);
polyspaceBugFinder('-results-dir',resFolder1);
```

Analyze coding rules with DOS/UNIX options.

```
polyspaceBugFinder('-sources',sourceFileName,'-results-dir',resFolder2,...
    '-misra3','all');
polyspaceBugFinder('-results-dir',resFolder2);
```

- “Run Polyspace Analysis by Using MATLAB Scripts”

## Input Arguments

### `optsObject` — Polyspace options object name

object handle

Polyspace options object name, specified as the object handle.

To create an options object, use one of the Polyspace options classes.

Example: `opts`

### `projectFile` — Name of `.psprj` file

character vector

Name of project file with extension `.psprj`, specified as a character vector.

If the file is not in the current folder, `projectFile` must include a full or relative path.

Example: `'C:\Polyspace_Projects\myProject.psprj'`

Data Types: `char`

### `resultsFile` — Name of `.psbf` file

character vector

Name of results file with extension `.psbf`, specified as a character vector.

If the file is not in the current folder, `resultsFile` must include a full or relative path.

Example: `'myResults.psbf'`

Data Types: `char`

### `resultsFolder` — Name of result folder

character vector

Name of result folder, specified as a character vector. The folder must contain the results file with extension `.psbf`. If the results file resides in a subfolder of the specified folder, this command does not open the results file.

If the folder is not in the current folder, `resultsFolder` must include a full or relative path.

Example: `'C:\Polyspace\Results\'`

Data Types: `char`

### `sourceFiles` — Comma-separated names of C or C++ files

character vector

Comma-separated C or C++ source file names, specified as a single character vector.

If the files are not in the current folder, `sourceFiles` must include a full or relative path.

Example: `'myFile.c'`, `'C:\mySources\myFile1.c,C:\mySources\myFile2.c'`

### Name-Value Pair Arguments

Specify optional comma-separated pairs of `Name,Value` arguments. `Name` is the argument name and `Value` is the corresponding value. `Name` must appear inside single quotes (`' '`). You can specify several name and value pair arguments in any order as `Name1,Value1,...,NameN,ValueN`.

Example: `'-target','i386','-compiler','gnu4.6'` specifies that the source code is intended for a i386 target and contains non-ANSI C syntax for GCC 4.6.

For option names and values, see the **Command-Line Information** section in “Analysis Options”.

## See Also

`polyspace.BugFinderOptions` | `polyspace.ModelLinkBugFinderOptions`

### Topics

“Run Polyspace Analysis by Using MATLAB Scripts”

Introduced in R2013b

# polyspaceConfigure

Create Polyspace project from your build system at the MATLAB command line

## Syntax

```
polyspaceConfigure buildCommand
```

```
polyspaceConfigure -option value buildCommand
```

## Description

`polyspaceConfigure buildCommand` traces your build system and creates a Polyspace project with information gathered from your build system.

`polyspaceConfigure -option value buildCommand` traces your build system and uses `-option value` to modify the default operation of `polyspaceConfigure`. Specify the modifiers before `buildCommand`, otherwise they are considered as options in the build command itself.

## Examples

### Create Polyspace Project from Makefile

This example shows how to create a Polyspace project if you use the command `make` *`targetName buildOptions`* to build your source code.

Create a Polyspace project specifying a unique project name. Use the `-B` or `-W` *`makefileName`* option with `make` so that the all prerequisite targets in the makefile are remade.

```
polyspaceConfigure  -prog myProject ...
          make -B targetName buildOptions
```

Open the Polyspace project in the **Project Browser**.

```
polyspaceBugFinder('myProject.psprj')
```

### Run Command-Line Polyspace Analysis from Makefile

This example shows how to run Polyspace analysis if you use the command `make` *`targetName buildOptions`* to build your source code. In this example, you use `polyspaceConfigure` to trace your build system but do not create a Polyspace project. Instead you create an options file that you can use to run Polyspace analysis from command-line.

Create a Polyspace options file specifying the `-output-options-file` command. Use the `-B` or `-W` *`makefileName`* option with `make` so that all prerequisite targets in the makefile are remade.

```
polyspaceConfigure  -no-project -output-options-file ...
         myOptions make -B targetName buildOptions
```

Use the options file that you created to run a Polyspace analysis at the command line:

```
polyspaceBugFinder -options-file myOptions
```

- "Create Project Automatically"

## Input Arguments

**`buildCommand`** — Command for building source code
build command

Build command specified exactly as you use to build your source code.

Example: `make -B`, `make -W` *`makefileName`*

**`-option value`** — Options for changing default operation of **`polyspaceConfigure`**
single option starting with -, followed by argument | multiple space-separated option-argument pairs

**Basic Options**

| Option | Argument | Description |
|---|---|---|
| `-allow-build-error` | None | Option to create a Polyspace project even if an error occurs in the build process.<br>If an error occurs, the build trace log shows the following message:<br>`polyspace-configure ERROR: build command` `command_name fail [status=status_value]`<br>*`command_name`* is the build command name that you use and *`status_value`* is the non-zero exit status or error level that indicates which error occurred in your build process. |
| `-allow-overwrite` | None | Option to overwrite a project with the same name, if it exists.<br>By default, `polyspaceConfigure` throws an error if a project with the same name already exists in the output folder. Use this option to overwrite the project. |
| `-author` | Author name | Name of project author.<br>**Example:** `-author jsmith` |
| `-debug` | None | Option used by MathWorks technical support |
| `-help` | None | Option to display the full list of `polyspaceConfigure` commands |

| Option | Argument | Description |
|---|---|---|
| `-lang` | `auto` (default) \| `c` \| `cpp` \| `cpp11` | Option to specify source code language. The languages are:<br>- C99: Use argument `c`.<br>- C++03: Use argument `cpp`.<br>- C++11: Use argument `cpp11`.<br>By default,`polyspaceConfigure` detects the language.<br>The argument to this option maps to the **Source code language** option in your Polyspace project. See `Source code language (-lang)`. |
| `-output-options-file` | None | Option to create a Polyspace analysis options file. Use this file for command-line analysis using `polyspaceBugFinder`. |
| `-output-project` | Path | Project file name and location for saving project. The default is the file `polyspace.psprj` in the current folder.<br>**Example:** `-output-project ../myProjects/project1` creates a project `project1.psprj` in the folder with the relative path `../myProjects/`. |
| `-prog` | Project name | Project name that appears in the Polyspace user interface. The default is `polyspace`.<br>If you do not use the option `-output-project`, the `-prog` argument also sets the project name.<br>**Example:** `-prog myProject` creates a project that has the name `myProject` in the user interface. If you do not use the option `-output-project`, the project name is also `myProject.psrprj`. |

| Option | Argument | Description |
|---|---|---|
| `-silent` (default) \| `-verbose` | None | Option to suppress or display additional messages from running `polyspaceConfigure`. |

**Advanced Options**

| Option | Argument | Description |
|---|---|---|
| `-compiler-config` | Path and file name | Location and name of compiler configuration file.<br>The file must be in a specific format. For guidance, see the existing configuration files in *`matlabroot`*`\polyspace\configure\compiler_configuration\`. For information on the contents of the file, see "Compiler Not Supported for Project Creation from Build Systems".<br>**Example:** `-compiler-configuration myCompiler.xml` |
| `-no-build` | None | Option to create a Polyspace project using previously saved build trace information.<br>To use this option, you must have the build trace information saved from an earlier run of `polyspaceConfigure` with the `-no-project` option.<br>If you use this option, you do not need to specify the `buildCommand` argument. |
| `-no-project` | None | Option to trace your build system without creating a Polyspace project and save the build trace information.<br>Use this option to save your build trace information for a later run of `polyspaceConfigure` with the `-no-build` option. |

| Option | Argument | Description |
|---|---|---|
| `-tmp-path` | Path | Location of folder where temporary files are stored. |

**Cache Control Options**

| Option | Argument | Description |
|---|---|---|
| `-build-trace` | Path and file name | Location and name of file where build information is stored. The default is `./polyspace_configure_build_trace.log`.<br>**Example:** `-build-trace ../build_info/trace.log` |
| `-no-cache` \| `-cache-sources` (default) \| `-cache-all-files` | None | Option to perform one of the following:<br>• Not create a cache<br>• Cache only source and header files.<br>• Cache all files including binaries. |
| `-keep-cache` \| `-no-keep-cache` (default) | None | Option to preserve or clean up cache information after `polyspaceConfigure` completes execution.<br>If `polyspaceConfigure` fails, you can provide this cache information to technical support for debugging purposes. |
| `-cache-path` | Path | Location of folder where cache information is stored.<br>**Example:** `-cache-path ../cache` |

## See Also

### Topics

“Create Project Automatically”
“Requirements for Project Creation from Build Systems”
“Compiler Not Supported for Project Creation from Build Systems”

Introduced in R2013b

# polyspaceJobsManager

Manage Polyspace jobs on a MATLAB Distributed Computing Server cluster

## Syntax

```
polyspaceJobsManager('listjobs')
polyspaceJobsManager('cancel','-job',jobNumber)
polyspaceJobsManager('remove','-job',jobNumber)
polyspaceJobsManager('getlog','-job',jobNumber)
polyspaceJobsManager('wait','-job',jobNumber)
polyspaceJobsManager('promote','-job',jobNumber)
polyspaceJobsManager('demote','-job',jobNumber)

polyspaceJobsManager('download','-job',jobNumber)
polyspaceJobsManager('download','-job',jobNumber,'-results-folder',
resultsFolder)

polyspaceJobsManager(___,'-scheduler',scheduler)
```

## Description

`polyspaceJobsManager('listjobs')` lists all Polyspace jobs in your cluster.

`polyspaceJobsManager('cancel','-job',jobNumber)` cancels the specified job. The job appears in your queue as cancelled.

`polyspaceJobsManager('remove','-job',jobNumber)` removes the specified job from your cluster.

`polyspaceJobsManager('getlog','-job',jobNumber)` displays the log for the specified job.

`polyspaceJobsManager('wait','-job',jobNumber)` pauses until the specified job is done.

`polyspaceJobsManager('promote','-job',jobNumber)` moves the specified job up in the MATLAB job scheduler queue.

`polyspaceJobsManager('demote','-job',jobNumber)` moves the specified job down in the MATLAB job scheduler queue.

`polyspaceJobsManager('download','-job',jobNumber)` downloads the results from the specified job. The results are downloaded to the folder you specified when starting analysis, using the `-results-dir` on page 2-37 option.

`polyspaceJobsManager('download','-job',jobNumber,'-results-folder', resultsFolder)` downloads the results from the specified job to `resultsFolder`.

`polyspaceJobsManager(___,'-scheduler',scheduler)` performs the specified action on the job scheduler specified. If you do not specify a server with any of the previous syntaxes, Polyspace uses the server stored in your Polyspace preferences.

## Examples

### Manipulate Two Jobs in the Cluster

In this example, use a MJS scheduler to run Polyspace remotely and monitor your jobs through the queue.

Before performing this example, set up an MJS and Polyspace Metrics. This example uses the *myMJS@myCompany.com* scheduler. When you perform this example, replace this scheduler with your own cluster name.

Set up your source files.

```
mkdir 'C:\psdemo\src'
demo = fullfile(matlabroot,'polyspace','examples','cxx',...
'Bug_Finder_Example','sources');
copyfile(demo,'C:\psdemo\src\')
```

Submit two jobs to your scheduler.

```
polyspaceBugFinder -batch -scheduler myMJS@myCompany.com
    -sources C:\psdemo\src\*.c'
    -results-dir 'C:\psdemo\res1'
```

```
polyspaceBugFinder -batch -scheduler myMJS@myCompany.com
    -sources 'C:\psdemo\src\numeric.c'
    -results-dir 'C:\psdemo\res2'
    -add-to-results-repository
polyspaceJobsManager('listjobs','-scheduler','myMJS@myCompany.com')
```

If your jobs have not started running, promote the second job to run before the first job.

```
polyspaceJobsManager('promote','-job','20','-scheduler',...
    'myMJS@myCompany.com')
```

Job 20 starts running before job 19.

Cancel job 19.

```
polyspaceJobsManager('cancel','-job','19','-scheduler',...
   'myMJS@myCompany.com')
polyspaceJobsManager('listjobs','-scheduler','myMJS@myCompany.com')
```

Remove job 19.

```
polyspaceJobsManager('remove','-job','19','-scheduler',...
   'myMJS@myCompany.com')
polyspaceJobsManager('listjobs','-scheduler','myMJS@myCompany.com')
```

Get the log for job 20.

```
polyspaceJobsManager('getlog','-job','20','-scheduler',...
   'myMJS@myCompany.com')
```

Download the information from job 20.

```
polyspaceJobsManager('download','-job','20','-results-folder', ...
   'C:\psdemo\res3','-scheduler','myCluster')
```

## Input Arguments

### `jobNumber` — Queued job number

character vector of job number

Number of the queued job that you want to manage, specified as a character vector in single quotes.

Example: `'-job','10'`

**`resultsFolder`** — Path to results folder

character vector

Path to results folder specified as a character vector in single quotes. This folder stores the downloaded results files.

Example: `'-results-folder','C:\psdemo\myresults'`

**`scheduler`** — job scheduler

head node of your cluster | job scheduler name | cluster profile

Job scheduler for remote verifications specified as one of the following:

- Name of the computer that hosts the head node of your MATLAB Distributed Computing Server cluster (*`NodeHost`*).
- Name of the MJS on the head node host (*`MJSName@NodeHost`*).
- Name of a MATLAB cluster profile (*`ClusterProfile`*).

Example: `'-scheduler','myscheduler@mycompany.com'`

## See Also

`polyspaceBugFinder`

### Topics

"Discover Clusters and Use Cluster Profiles" (Parallel Computing Toolbox)
"Run Remote Analysis at the Command Line" (Polyspace Code Prover)

**Introduced in R2013b**

# polyspace-bug-finder-nodesktop

Run a Bug Finder analysis from the DOS or UNIX command line

## Syntax

```
polyspace-bug-finder-nodesktop -sources sourceFiles
polyspace-bug-finder-nodesktop -sources sourceFiles -option value

polyspace-bug-finder-nodesktop -sources-list-file listOfSources
polyspace-bug-finder-nodesktop -sources-list-file listOfSources -
option value

polyspace-bug-finder-nodesktop -options-file optFile

polyspace-bug-finder-nodesktop -h[elp]
```

## Description

`polyspace-bug-finder-nodesktop -sources sourceFiles` runs a Bug Finder analysis on the source file or files `sourceFiles`. The analysis uses the default analysis options.

`polyspace-bug-finder-nodesktop -sources sourceFiles -option value` customizes the analysis of `sourceFiles` with the `-option value` pairs specified.

`polyspace-bug-finder-nodesktop -sources-list-file listOfSources` runs a Bug Finder analysis on the source files listed in the text file `listOfSources`. The analysis uses the default analysis options. Using a sources list file is recommended when you have many source files. By keeping the list of sources in a text file, the command is shorter and updates to the list are easier.

`polyspace-bug-finder-nodesktop -sources-list-file listOfSources -option value` customizes the analysis of `listOfSources` using the `-option value` pairs specified.

`polyspace-bug-finder-nodesktop -options-file optFile` runs a Bug Finder analysis with the options specified in the option file. When you have many analysis options, an options file makes it easier to run the same analysis again.

`polyspace-bug-finder-nodesktop -h[elp]` lists a summary of possible analysis options.

## Examples

### Run Analysis by Directly Specifying Options

Run a local Bug Finder analysis by specifying analysis options in the command itself. This example uses source files from the Polyspace Bug Finder example. To run this example, replace *`matlabroot`* with the path to your MATLAB installation, for example `C:\Program Files\MATLAB\R2017a`.

Run an analysis on `numerical.c` and `programming.c`, checking for MISRA C:2012 mandatory rules, programming and numerical defects, and using GNU 4.7 compiler settings. This example command is split by ^ characters for readability. In practice, you can put all commands on one line.

```
matlabroot\polyspace\bin\polyspace-bug-finder-nodesktop^
 -sources ^
matlabroot\polyspace\examples\cxx\Bug_Finder_Example\sources\numerical.c,^
matlabroot\polyspace\examples\cxx\Bug_Finder_Example\sources\programming.c ^
-compiler gnu4.7 -misra3 mandatory -checkers numerical,programming ^
-author jlittle -prog myProject -results-dir C:\Polyspace_Workspace\Results\
```

Open the results.

```
matlabroot\polyspace\bin\polyspace-bug-finder C:\Polyspace_Workspace\Results\^
ps_results.psbf
```

To rerun the analysis, you must rerun it from the command line.

### Run Local Analysis with Options File

Run a local Bug Finder analysis by specifying analysis options in the command itself. This example uses source files from the Polyspace Bug Finder example. To run this example, replace *matlabroot* with the path to your MATLAB installation, for example C:\Program Files\MATLAB\R2017a.

Save this text to a text file called myOptionsFile.txt.

```
# Options for analyzing numerical.c and programming.c
-sources matlabroot\polyspace\examples\cxx\Bug_Finder_Example\sources\numerical.c
-sources matlabroot\polyspace\examples\cxx\Bug_Finder_Example\sources\programming.c
-compiler gnu4.7
-misra3 mandatory
-checkers numerical,programming
-author jlittle
-prog myProject
-results-dir C:\Polyspace_Workspace\Results\
```

Run the analysis with the options specified in the text file.

```
matlabroot\polyspace\bin\polyspace-bug-finder-nodesktop -options-file myOptionsFile.txt
```

Open the results.

```
matlabroot\polyspace\bin\polyspace-bug-finder C:\Polyspace_Workspace\Results\^
ps_results.psbf
```

To rerun the analysis, you must rerun it from the command line.

- "Run Local Analysis from DOS or UNIX Command Line"
- "Run Remote Analysis at the Command Line"

## Input Arguments

### **sourceFiles** — Comma-separated names of C or C++ files to analyze

-sources string

Comma-separated C or C++ source file names, specified as -sources followed by a string. If the files are not in the current folder (pwd), sourceFiles must include a full or relative path. For more information, see -sources.

Example: -sources myFile.c, -sources C:\mySources\myFile1.c,C:\mySources\myFile2.c

**`listOfSources`** — **Text file listing names of C or C++ files to analyze**
`-sources-list-file` file

Text file which lists the name of C or C++ files, specified as `-sources-list-file` followed by the file. If the files are not in the current folder (`pwd`), `listOfSources` must include a full or relative path. For more information, see `-sources-list-file`.

Example: `-sources-list-file filename.txt`, `-sources-list-file "C:\ps_analysis\source_files.txt"`

**`-option value`** — **Analysis option and corresponding value**
option syntax

Analysis options and their corresponding values, specified by the option name and if applicable value. For syntax specifications, see the individual analysis option reference pages.

Example: `-lang C-CPP` `-compiler diab`

**`optFile`** — **Text file listing analysis options and values**
`-options-file` file

Text file listing analysis options and values, specified as `-options-file` followed by the file. For more information, see `-options-file`.

Example: `-options-file opts.txt`, `-options-file "C:\ps_analysis\options.txt"`

## See Also

`polyspaceBugFinder`

### Topics

"Run Local Analysis from DOS or UNIX Command Line"
"Run Remote Analysis at the Command Line"
"Analysis Options"

**Introduced in R2013b**

# Polyspace Bug Finder

Identify software defects via static analysis

## Description

The **Polyspace Bug Finder** app uses static analysis to quickly find run-time errors, data flow problems, and other defects in C and C++ code.

You can also add check compliance with MISRA C, MISRA C++, JSF++, and custom coding rules.

## Open the Polyspace Bug Finder App

- MATLAB Toolstrip: On the **Apps** tab, under **Code Verification**, click the app icon.
- MATLAB command prompt: Enter `polyspaceBugFinder`.

## Examples

- "Find Defects from the Polyspace Environment"
- "Run Local Analysis from DOS or UNIX Command Line"

### Programmatic Use

```
polyspaceBugFinder
```

## See Also

Apps
**Polyspace Code Prover**

### Functions

`polyspaceBugFinder` | `polyspaceConfigure`

## Topics

"Find Defects from the Polyspace Environment"
"Run Local Analysis from DOS or UNIX Command Line"
"Polyspace Bug Finder"

Introduced in R2013b

# polyspace.Project class

**Package:** polyspace

Run Polyspace analysis on C and C++ code and read results

## Description

Run a Polyspace analysis on C and C++ source files by using this MATLAB object.

- To specify source files and customize analysis options, use the `Configuration` property.
- To run the analysis, use the `run` method.
- To read results after analysis, use the `Results` property.

## Construction

`proj = polyspace.Project` creates an object that you can use to configure and run a Polyspace analysis, and then read the analysis results.

## Properties

### **`Configuration`** — Analysis options

`polyspace.Options` object

Options for running Polyspace analysis, implemented as a `polyspace.Options` object. The object has properties corresponding to the analysis options. For more information on those properties, see polyspace.Options.

You can retain the default options or change them in one of these ways:

- Modify the properties directly.

```
proj = polyspace.Project;
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
```

- Obtain the options from another `polyspace.Project` object.

  ```
  proj1 = polyspace.Project;
  proj1.Configuration.TargetCompiler.Compiler = 'gnu4.9';

  proj2 = proj1;
  ```

  To use common analysis options across multiple projects, follow this approach. For instance, you want to reuse all options and change only the source files.
- Obtain the options from a project created in the user interface (`.psprj` file).

  ```
  proj = polyspace.Project;
  projectLocation = fullfile(matlabroot, 'polyspace', ...
      'examples', 'cxx', 'Bug_Finder_Example', 'Bug_Finder_Example.psprj')
  proj.Configuration = polyspace.loadProject(projectLocation);
  ```

  To determine the optimal set of options, set your options in the user interface and then import them to a `polyspace.Project` object. In the user interface, you can access help from features such as the Compilation Assistant and get tooltip help on options.
- Obtain the options from a Simulink model. Before obtaining the options, generate code from the model.

  ```
  modelName = 'sldemo_bounce';
  load_system(modelName);

  % Set parameters for Embedded Coder target
  set_param(modelname, 'SystemTargetFile', 'ert.tlc');
  set_param('sldemo_bounce','Solver','FixedStepAuto');
  set_param('sldemo_bounce','SupportContinuousTime','on')


  % Generate code
  rtwbuild(modelName);

  % Obtain configuration from model
  proj = polyspace.Project;
  proj.Configuration = polyspace.ModelLinkOptions(modelName);
  ```

  Use the options to analyze the code generated from the model.

### `Results` — Analysis results

`polyspace.BugFinderResults` or `polyspace.CodeProverResults` object

Results of Polyspace analysis. When you create a `polyspace.Project` object, this property is initially empty. The property is populated only after you execute the `run` method of the object. Depending on the argument to the `run` method, `'bugFinder'` or `'codeProver'`, the property is implemented as a `polyspace.BugFinderResults` or `polyspace.CodeProverResults` object.

To read the results, use these methods of the `polyspace.BugFinderResults` or `polyspace.CodeProverResults` object:

- `getSummary`: Obtain a summarized format of the results into a MATLAB table.

  ```
  proj = polyspace.Project;
  proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', 'examples',...
      'cxx', 'Code_Prover_Example', 'sources', 'single_file_analysis.c')};
  proj.Configuration.ResultsDir = fullfile(pwd,'results');

  proj.run('bugFinder');

  resTable = proj.Results.getSummary('defects');
  ```

  For more information, see `polyspace.BugFinderResults.getSummary` or `polyspace.CodeProverResults.getSummary`.
- `getResults`: Obtain the full results or a more readable format into a MATLAB table.

  ```
  proj = polyspace.Project;
  proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', 'examples',...
      'cxx', 'Code_Prover_Example', 'sources', 'single_file_analysis.c')};
  proj.Configuration.ResultsDir = fullfile(pwd,'results');

  proj.run('bugFinder');

  resTable = proj.Results.getResults('readable');
  ```

  For more information, see `polyspace.BugFinderResults.getResults` or `polyspace.CodeProverResults.getResults`.

## Methods

| | |
|---|---|
| run | Run a Polyspace analysis |

# Examples

### Check for Bugs

Run a Polyspace Bug Finder analysis on the example file `numerical.c`. Configure these options:

- Specify GCC 4.9 as your compiler.
- Save the results in a `results` subfolder of the current working folder.

```
proj = polyspace.Project

% Configure analysis
proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', ...
    'examples', 'cxx', 'Bug_Finder_Example', 'sources', 'numerical.c')};
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
proj.Configuration.ResultsDir = fullfile(pwd,'results');

% Run analysis
bfStatus = proj.run('bugFinder');

% Read results
bfSummary = proj.Results.getSummary('defects');
```

### Prove Absence of Run-Time Errors

Run a Polyspace Code Prover analysis on the example file `single_file_analysis.c`. Configure these options:

- Specify GCC 4.9 as your compiler.
- Save the results in a `results` subfolder of the current working folder.
- Specify that a `main` function must be generated, if the function does not exist in the source code.

```
proj = polyspace.Project

% Configure analysis
proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', 'examples',...
    'cxx', 'Code_Prover_Example', 'sources', 'single_file_analysis.c')};
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
proj.Configuration.ResultsDir = fullfile(pwd,'results');
proj.Configuration.CodeProverVerification.MainGenerator = true;
```

```
% Run analysis
cpStatus = proj.run('codeProver');

% Read results
cpSummary = proj.Results.getSummary('runtime');
```

### Check for Bugs and MISRA C:2012 Violations

Run a Polyspace Bug Finder analysis on the example file `single_file_analysis.c`. Configure these options:

- Specify GCC 4.9 as your compiler.
- Save the results in a `results` subfolder of the current working folder.
- Enable checking of MISRA C:2012 rules. Check for the mandatory rules only.

```
proj = polyspace.Project

% Configure analysis
proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', ...
    'examples', 'cxx', 'Bug_Finder_Example', 'sources', 'numerical.c')};
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
proj.Configuration.ResultsDir = fullfile(pwd,'results');
proj.Configuration.CodingRulesCodeMetrics.EnableMisraC3 = true;
proj.Configuration.CodingRulesCodeMetrics.MisraC3Subset = 'mandatory';

% Run analysis
bfStatus = proj.run('bugFinder');

% Read results
defectsSummary = proj.Results.getSummary('defects');
misraSummary = proj.Results.getSummary('misraC2012');
```

# See Also

## Topics

“Run Polyspace Analysis by Using MATLAB Scripts”
“Generate MATLAB Scripts from Polyspace User Interface”
“Troubleshoot Polyspace Analysis from MATLAB”

Introduced in R2017b

# polyspace.Options class

**Package:** polyspace

Create object for running Polyspace analysis on handwritten code

**Note** For easier scripting, specify the Polyspace® analysis options using the `Configuration` property of a `polyspace.Project` object. Do not create a `polyspace.Options` object directly.

## Description

Run a Polyspace analysis from MATLAB by using an options object. To specify source files and customize analysis options, change the object properties.

To analyze model-generated code, use `polyspace.ModelLinkOptions` instead.

## Construction

`opts = polyspace.Options` creates an object whose properties correspond to options for running a Polyspace analysis.

`proj = polyspace.Project` creates a `polyspace.Projectpolyspace.Project` object. The object has a property `Configuration`, which is a `polyspace.Options` object.

`opts = polyspace.Options(lang)` creates a Polyspace options object with options that are applicable to the language `lang`.

`opts = polyspace.loadProject(projectFile)` creates a Polyspace options object from an existing Polyspace project `projectFile`. You set the options in your project in the Polyspace user interface and create the options object from that project for programmatically running the analysis.

### Input Arguments

**`lang` — Language of analysis**
`'C-CPP'` (default) | `'C'` | `'CPP'`

The language of the analysis specified as `'C-CPP'`, `'C'`, or `'CPP'`. This argument determines the object properties.

Data Types: `char`

**`projectFile` — Name of `.psprj` file**
character vector

Name of Polyspace project file with extension `.psprj`, specified as a character vector.

If the file is not in the current folder, `projectFile` must include a full or relative path. To identify the current folder, use `pwd`. To change the current folder, use `cd`.

Example: `'C:\projects\myProject.psprj'`

## Properties

The object properties correspond to the analysis options for Polyspace projects. The properties are organized in the same categories as the Polyspace interface. The property names are a shortened version of the DOS/UNIX command-line name. For syntax details, see polyspace.Options.

## Methods

| | |
|---|---|
| copyTo | Copy common settings between Polyspace options objects |
| generateProject | Generate psprj project from options object |
| toScript | Add Polyspace options object definition to a script |

## Examples

### Customize and Run Analysis

Create a Polyspace analysis options object and customize the properties. Then, run an analysis.

Create object and customize properties. In case you do not have write access to your current folder, a temporary folder is being used for storing analysis results.

```
sources = fullfile(matlabroot, 'polyspace','examples','cxx','Bug_Finder_Example',...
    'sources','numerical.c');
opts = polyspace.Options();
opts.Prog = 'MyProject';
opts.Sources = {sources};
opts.TargetCompiler.Compiler = 'gnu4.7';
opts.ResultsDir = tempname;
```

Run a Bug Finder analysis. To run a Code Prover analysis, use `polyspaceCodeProver` instead of `polyspaceBugFinder`.

```
results = polyspaceBugFinder(opts);
```

Open the results in the Polyspace user interface.

```
polyspaceBugFinder('-results-dir',opts.ResultsDir);
```

### Run Polyspace by Generating a Project File

Create a Polyspace analysis options object and customize the properties. Then, run a Bug Finder analysis.

Create object and customize properties.

```
sources = fullfile(matlabroot, 'polyspace','examples','cxx','Bug_Finder_Example',...
    'sources','numerical.c');
opts = polyspace.Options();
opts.Prog = 'MyProject';
opts.Sources = {sources};
opts.TargetCompiler.Compiler = 'gnu4.7';
opts.ResultsDir = tempname;
```

Generate a Polyspace project, name it using the `Prog` property, and open the project in the Polyspace interface.

```
psprj = opts.generateProject(opts.Prog);
polyspaceBugFinder(psprj);
```

You can also analyze the project from the command line. Run the analysis and open the results in the Polyspace interface.

```
results = polyspaceBugFinder(psprj, '-nodesktop');
polyspaceBugFinder('-results-dir',opts.ResultsDir);
```

- “Run Polyspace Analysis by Using MATLAB Scripts”
- “Generate MATLAB Scripts from Polyspace User Interface”

## Alternatives

If you are analyzing code generated from a model, use `polyspace.ModelLinkOptions` instead.

## See Also

`polyspace.ModelLinkOptions` | `polyspace.Project` | `polyspaceBugFinder`

### Topics

“Run Polyspace Analysis by Using MATLAB Scripts”
“Generate MATLAB Scripts from Polyspace User Interface”

**Introduced in R2017a**

# polyspace.ModelLinkOptions class

**Package:** polyspace

Create object for running Polyspace analysis on generated code

## Description

Run a Polyspace analysis from MATLAB by using an options object. To specify source files and customize analysis options, change the object properties.

This class is intended for model-generated code. If you are analyzing handwritten code, use `polyspace.Options` instead.

## Construction

`opts = polyspace.ModelLinkOptions` creates an object whose properties correspond to options for running a Polyspace analysis on generated code.

`opts = polyspace.ModelLinkOptions(lang)` creates a Polyspace options object with options that are applicable to the language `lang`.

`opts = polyspace.ModelLinkOptions(model)` creates a Polyspace options object with options that are applicable to `model`. Prior to extracting options from the model, you must load the model and generate code.

### Input Arguments

**`lang` — Language of analysis**
`'C-CPP'` (default) | `'C'` | `'CPP'`

The language of the analysis specified as `'C-CPP'`, `'C'`, or `'CPP'`. This argument determines the object properties.

**`model` — Model or subsystem name**
character vector

Name or path to model or subsystem, specified as a character vector.

Prior to extracting options from the model, you must:

1. Load the model. Use `load_system` or `open_system`.
2. Generate code from the model. Use `rtwbuild`.

Example: `'psdemo_model_link_sl'`

## Properties

The object properties correspond to the analysis options for Polyspace projects. The properties are organized in the same categories as the Polyspace interface. The property names are a shortened version of the DOS command-line name. For syntax details, see polyspace.ModelLinkOptions.

## Methods

| | |
|---|---|
| copyTo | Copy common settings between Polyspace options objects |
| generateProject | Generate psprj project from options object |
| toScript | Add Polyspace options object definition to a script |

## Examples

### Script Analysis of Model Generated Code

This example shows how to customize and run an analysis on code generated from a model.

Generate code from the model `sldemo_bounce`. Before code generation, set a system target file appropriate for code analysis. See also “Recommended Model Settings for Code Analysis”.

```
modelName = 'sldemo_bounce';
load_system(modelName);
```

```
% Set parameters for Embedded Coder target
set_param(modelname, 'SystemTargetFile', 'ert.tlc');
set_param('sldemo_bounce','Solver','FixedStepAuto');
set_param('sldemo_bounce','SupportContinuousTime','on')


if exist(fullfile(pwd,'sldemo_bounce_ert_rtw'), 'dir') == 0
    rtwbuild(modelName);
end
```

Associate a `polyspace.ModelLinkOptions` object with the model. A subset of the object properties are set from the configuration parameters associated with the model. The other properties take their default values. For details on the configuration parameters, see “Configure Model Options”.

```
opts = polyspace.ModelLinkOptions(modelName);
```

Change the property values if needed. For instance, you can specify that the analysis must check for all MISRA C: 2012 violations and generate a PDF report of the results. You can also specify a folder for the analysis results.

```
opts.CodingRulesCodeMetrics.EnableMisraC3 = true;
opts.CodingRulesCodeMetrics.MisraC3Subset = 'all';

opts.MergedReporting.EnableReportGeneration = true;
opts.MergedReporting.ReportOutputFormat = 'PDF';

opts.ResultsDir = 'newResfolder';
```

Create a `polyspace.Projectpolyspace.Project` object. Associate the `Configuration` property of this object to the options that you previously specified.

```
proj = polyspace.Project;
proj.Configuration = opts;
```

Run analysis and open results.

```
cpStatus = proj.run('codeProver');
proj.Results.getResults('readable');
```

- “Run Polyspace Analysis by Using MATLAB Scripts”

## Alternatives

If you are analyzing handwritten code, use a `polyspace.Project` object directly. Alternatively, use a `polyspace.Options` object.

## See Also

`polyspace.Options` | `polyspace.Project` | `polyspaceBugFinder` | `pslinkrun`

### Topics

"Run Polyspace Analysis by Using MATLAB Scripts"

**Introduced in R2017a**

# polyspace.BugFinderOptions class

**Package:** polyspace

Create Polyspace Bug Finder object for handwritten code

**Note** This class is deprecated and will be removed in a future release. Use `polyspace.Options` instead.

## Description

Customize a Polyspace Bug Finder analysis from MATLAB by creating a Bug Finder options object. To specify source files and customize analysis options, change the object properties.

If you are analyzing model-generated code, use `polyspace.ModelLinkBugFinderOptions` instead.

## Construction

`opts = polyspace.BugFinderOptions` creates a Bug Finder options object with available options.

`opts = polyspace.BugFinderOptions(lang)` creates a Bug Finder options object with options that are applicable for the language `lang`.

### Input Arguments

**`lang` — Language of analysis**

`'C-CPP'` (default) | `'C'` | `'CPP'`

The language of the analysis specified as `'C-CPP'`, `'C'`, or `'CPP'`. This argument determines which properties the object has.

## Properties

The object properties are the analysis options for Polyspace Bug Finder projects. The properties are organized in the same categories as the Polyspace interface. The property names are a shortened version of the DOS/UNIX command-line name. For syntax details, see polyspace.Options.

## Methods

| | |
|---|---|
| copyTo | Copy common settings between Polyspace options objects |
| generateProject | Generate psprj project from options object |
| toScript | Add Polyspace options object definition to a script |

## Examples

### Customize and Run Analysis

Create a Bug Finder analysis options object and customize the properties. Then, run an analysis.

Create object and customize properties.

```
sources = fullfile(matlabroot, 'polyspace','examples','cxx','Bug_Finder_Example',...
    'sources','numerical.c');
optsBF = polyspace.BugFinderOptions();
optsBF.Prog = 'MyProject';
optsBF.Sources = {sources};
optsBF.TargetCompiler.Compiler = 'gnu4.7';
optsBF.ResultsDir = tempname;
```

Run the analysis and open the results in the Polyspace interface.

```
results = polyspaceBugFinder(optsBF);
polyspaceBugFinder('-results-dir',optsBF.ResultsDir);
```

### Run Polyspace by Generating a Project File

Create a Bug Finder analysis options object and customize the properties. Then, run an analysis.

Create object and customize properties.

```
sources = fullfile(matlabroot, 'polyspace','examples','cxx','Bug_Finder_Example',...
    'sources','numerical.c');
optsBF = polyspace.BugFinderOptions();
optsBF.Prog = 'MyProject';
optsBF.Sources = {sources};
optsBF.TargetCompiler.Compiler = 'gnu4.7';
optsBF.ResultsDir = tempname;
```

Generate a Polyspace project, name it using the `Prog` property, and open the project in the Polyspace interface.

```
psprj = generateProject(optsBF, optsBF.Prog);
polyspaceBugFinder(psprj);
```

Run the analysis and open the results in the Polyspace interface.

```
results = polyspaceBugFinder(psprj, '-nodesktop');
polyspaceBugFinder('-results-dir',optsBF.ResultsDir);
```

- “Run Polyspace Analysis by Using MATLAB Scripts”

## Alternatives

If you are analyzing code generated from a model, use `polyspace.ModelLinkBugFinderOptions` instead.

## See Also

`polyspace.ModelLinkBugFinderOptions` | polyspace.Options | `polyspaceBugFinder`

### Topics

“Run Polyspace Analysis by Using MATLAB Scripts”

Introduced in R2016b

# polyspace.ModelLinkBugFinderOptions class

**Package:** polyspace

Create Polyspace Bug Finder object for generated code

**Note** This class is deprecated and will be removed in a future release. Use `polyspace.ModelLinkOptions` instead.

## Description

Customize a Polyspace Bug Finder analysis from MATLAB by creating a Bug Finder options object. To specify source files and customize analysis options, change the object properties.

This class is intended for model-generated code. If you are analyzing handwritten code, use `polyspace.BugFinderOptions` instead.

## Construction

`opts = polyspace.BugFinderOptions` creates a Bug Finder options object for generated code with available options for C/C++ generated code.

## Properties

The object properties are the analysis options for Polyspace Bug Finder model link projects. The properties are organized in the same categories as the Polyspace interface. The property names are a shortened version of the DOS command-line name. For syntax details, see polyspace.ModelLinkOptions.

## Methods

| | |
|---|---|
| copyTo | Copy common settings between Polyspace options objects |
| generateProject | Generate psprj project from options object |
| toScript | Add Polyspace options object definition to a script |

## Examples

### Script Analysis of Model Generated Code

This example shows how to customize and run an analysis on model generated code with MATLAB functions and objects.

Create a custom configuration that checks MISRA C 2012 rules and generates a PDF report.

```
opts = polyspace.ModelLinkBugFinderOptions();
opts.CodingRulesCodeMetrics.EnableMisraC3 = true;
opts.CodingRulesCodeMetrics.MisraC3Subset = 'all';
opts.MergedReporting.ReportOutputFormat = 'PDF';
opts.MergedReporting.EnableReportGeneration = true;
```

Generate code from `psdemo_model_link_sl`.

```
model = 'psdemo_model_link_sl';
load_system(model);
slbuild(model);
```

Add the configuration to `pslinkoptions` object.

```
prjfile = opts.generateProject('model_link_opts');
mlopts = pslinkoptions(model);
mlopts.EnablePrjConfigFile = true;
mlopts.PrjConfigFile = prjfile;
mlopts.VerificationMode = 'BugFinder';
```

Run analysis.

```
[polyspaceFolder, resultsFolder] = pslinkrun(model);
```

- “Run Polyspace Analysis by Using MATLAB Scripts”

## Alternatives

If you are analyzing handwritten code, use `polyspace.BugFinderOptions` instead.

## See Also

`polyspace.BugFinderOptions` | polyspace.ModelLinkOptions | `polyspaceBugFinder` | `pslinkrun`

### Topics

“Run Polyspace Analysis by Using MATLAB Scripts”

# polyspace.DefectsOptions class

**Package:** polyspace

Create custom list of defects to check

## Description

Create a custom list of defects to check. This object is useful if you want to check only a custom subset of the Bug Finder defects. To use your custom list of defects in an analysis, you must add it to a `polyspace.BugFinderOptions` or `polyspace.ModelLinkBugFinderOptions` object. In your Bug Finder options object, set the following properties:

- Add your defect options object to the `BugFinderAnalysis.CheckersList` property.
- Change the `BugFinderAnalysis.CheckersPreset` property to `'custom'`.

## Construction

`defectList = polyspace.DefectsOptions` creates the defect options object `defectList`. You can customize the list of active defects by changing the properties.

## Properties

An object is created with supported defects as properties. The defects are listed by their command-line name, found on the individual defect reference pages.

By default, all defects are off. To turn on a defect, set the defect to true. For example:

```
defectList.FLOAT_ZERO_DIV = true
```

## Copy Semantics

Value. To learn how value classes affect copy operations, see Copying Objects (MATLAB).

## Examples

### Customize List of Defects to Check

Use a polyspace.DefectsOptions object to customize the list of defects checked during a Polyspace Bug Finder analysis.

Create options objects.

```
defects = polyspace.DefectsOptions;
opts = polyspace.Options;
```

Set Bug Finder object properties to analyze with the customized defect list.

```
opts.BugFinderAnalysis.CheckersList = defects;
opts.BugFinderAnalysis.CheckersPreset = 'custom';
```

Activate the numerical defects.

```
defects.FLOAT_ZERO_DIV = true;
defects.INT_ZERO_DIV = true;
defects.FLOAT_ABSORPTION = true;
defects.BITWISE_NEG = true;
defects.FLOAT_CONV_OVFL = true;
defects.FLOAT_OVFL = true;
defects.INT_CONV_OVFL = true;
defects.INT_OVFL = true;
defects.FLOAT_STD_LIB = true;
defects.INT_STD_LIB = true;
defects.SHIFT_NEG = true;
defects.SHIFT_OVFL = true;
defects.SIGN_CHANGE = true;
defects.UINT_CONV_OVFL = true;
defects.UINT_OVFL = true;
defects.BAD_PLAIN_CHAR_USE = true;
```

## See Also

polyspace.BugFinderOptions | polyspace.CodingRulesOptions | polyspace.ModelLinkBugFinderOptions

## Topics

"Defects"

Introduced in R2016b

# polyspace.GenericTargetOptions class

**Package:** polyspace

Create a generic target configuration

## Description

If your target processor does not match one of the preset targets on page 1-11, use this object to create a custom generic target. To use your custom target in an analysis, you must add it to a `polyspace.BugFinderOptions` or `polyspace.ModelLinkBugFinderOptions` object. In your options object, add your generic target options object to the `TargetCompiler.Target` property.

## Construction

`genericTarget = polyspace.GenericTargetOptions` creates a generic target that you can customize. To specify the size and alignment of types, change the properties of the `genericTarget` object.

## Properties

For more details about any of these properties, see `Generic target options`.

### `Alignment` — Largest alignment of struct or array objects

32 (default) | 16 | 8

Largest alignment of struct or array objects, specified as `32`, `16`, or `8`. Comparable with the DOS/UNIX command-line option `-align`.

Example: `target.Alignment = 8`

### `CharNumBits` — Define the number of bits for a `char`

8 (default) | 16

Define the number of bits for a `char`, specified as `8` or `16`. Comparable with the DOS/UNIX command-line option `-char-is-16bits`.

Example: `target.CharNumBits = 16`

**`DoubleNumBits` — Define the number of bits for a `double`**
32 (default) | 64

Define the number of bits for a `double`, specified as `32` or `64`. Comparable with the DOS/UNIX command-line option `-double-is-64bits`.

Example: `target.DoubleNumBits = 64`

**`Endianess` — Endianess of target architecture**
`little` (default) | `big`

Endianess of target architecture, specified as `little` or `big`. Comparable with the DOS/UNIX command-line options `-little-endian` or `-big-endian`.

Example: `target.Endianess = 'big'`

**`IntNumBits` — Define the number of bits for an `int`**
16 (default) | 32

Define the number of bits for an `int`, specified as `16` or `32`. Comparable with the DOS/UNIX command-line option `-int-is-32bits`.

Example: `target.IntNumBits = 32`

**`LongLongNumBits` — Define the number of bits for a `long long`**
32 (default) | 64

Define the number of bits for a `long long`, specified as `32` or `64`. Comparable with the DOS/UNIX command-line option `-long-long-is-64bits`.

Example: `target.LongNumBits = 64`

**`LongNumBits` — Define the number of bits for a `long`**
32 (default)

Define the number of bits for a `long`, specified as `32`. Comparable with the DOS/UNIX command-line option `-long-is-32bits`.

Example: `target.LongNumBits = 32`

**`PointerNumBits` — Define the number of bits for a pointer**
16 (default) | 24 | 32

Define the number of bits for a pointer, specified as `16`, `24`, or `32`. Comparable with the DOS/UNIX command-line options `-pointer-is-24bits` and `-pointer-is-32bits`.

Example: `target.PointerNumBits = 32`

**`ShortNumBits` — Define the number of bits for a `short`**
16 (default) | 8

Define the number of bits for an `int`, specified as `16` or `8`. Comparable with the DOS/UNIX command-line option `-short-is-8bits`.

Example: `target.ShortNumBits = 8`

**`SignOfChar` — Default sign of plain `char`**
`signed` (default) | `unsigned`

Default sign of plain `char`, specified as `signed` or `unsigned`. Comparable with the DOS/UNIX command-line option `-default-sign-of-char`.

Example: `target.SignOfChar = 'unsigned'`

# Copy Semantics

Value. To learn how value classes affect copy operations, see Copying Objects (MATLAB).

# Examples

### Customize Generic Target Settings

Use a polyspace.GenericTargetOptions object to customize a generic target for your analysis.

Create options objects.

```
target = polyspace.GenericTargetOptions;
opts = polyspace.Options;
```

Add the custom target to the Bug Finder options object.

```
opts.TargetCompiler.Target = target;
```

Customize the generic target.

```
target.Endianess = 'big';
target.LongLongNumBits = 64;
target.ShortNumBits = 8;
```

## See Also

Target processor type (-target) | polyspace.BugFinderOptions | polyspace.ModelLinkBugFinderOptions

**Introduced in R2016b**

# polyspace.CodingRulesOptions class

**Package:** polyspace

Create custom list of coding rules to check

## Description

Create a custom list of coding rules to check for one of the supported standard coding rule sets. To use your custom target in an analysis, you must add it to a `polyspace.Options` or `polyspace.ModelLinkOptions` object. In your options object:

- Add your coding rules options object to one of the `CodingRulesCodeMetrics.`*`RULESET`*`Subset` properties.
- Activate your coding rule set with one of the `CodingRulesCodeMetrics.Enable`*`RULESET`* properties.

## Construction

`ruleList = polyspace.CodingRulesOptions(RuleSet)` creates the coding rules object `ruleList` for the `RuleSet` coding rule set. Set the active rules in the coding rules object.

### Input Arguments

**`RuleSet` — Standard coding rule set**

`misraC` (default) | `misraC2012` | `misraAcAgc` | `misraCpp` | `jsf`

Standard coding rule set specified as one of the coding rule acronyms.

Example: `'misraCpp'`

Data Types: `char`

## Properties

For each coding rule set, an object is created with all supported rules for that rule set. By default, all rules are on. To turn off a rule, set the rule to false. For example:

```
ruleList.rule_20_1 = false
```

## Copy Semantics

Value. To learn how value classes affect copy operations, see Copying Objects (MATLAB).

## Examples

### Customize List of Coding Rules to Check

Customize the coding rules that are checked during your analysis by using a coding rules options object.

Create options objects.

```
misraRules = polyspace.CodingRulesOptions('misraC2012');
opts = polyspace.Options;
```

Add the customized list of coding rules to the Bug Finder options object and activate them.

```
opts.CodingRulesCodeMetrics.MisraC3Subset = misraRules;
opts.CodingRulesCodeMetrics.EnableMisraC3 = true;
```

Customize the coding rule list by turning off rules 2.1-2.7.

```
misraRules.rule_2_1 = false;
misraRules.rule_2_2 = false;
misraRules.rule_2_3 = false;
misraRules.rule_2_4 = false;
misraRules.rule_2_5 = false;
misraRules.rule_2_6 = false;
misraRules.rule_2_7 = false;
```

- “Select Specific MISRA or JSF Coding Rules”

## See Also

`polyspace.BugFinderOptions` | `polyspace.ModelLinkBugFinderOptions`

### Topics

“Select Specific MISRA or JSF Coding Rules”

**Introduced in R2016b**

# polyspace.BugFinderResults class

**Package:** polyspace

Read Polyspace Bug Finder results from MATLAB

## Description

Read Polyspace Bug Finder analysis results to MATLAB tables by using this object.

You can obtain a high-level overview or read each individual result, for example, each instance of a defect.

## Construction

`resObj = polyspace.BugFinderResults(resultsFolder)` creates an object for reading a specific set of Bug Finder results into MATLAB tables. Use the object methods to read the results.

`proj = polyspace.Project` creates a `polyspace.Project` object. The object has a property `Results`. If you run a Bug Finder analysis, this property is a `polyspace.BugFinderResults` object.

### Input Arguments

**`resultsFolder`** — Name of result folder
character vector

Name of result folder, specified as a character vector. The folder must contain the results file with extension `.psbf`. Even if the results file resides in a *subfolder* of the specified folder, it cannot be accessed.

If the folder is not in the current folder, `resultsFolder` must include a full or relative path.

Example: `'C:\Polyspace\Results\'`

## Methods

| | |
|---|---|
| getSummary | View number of defects organized by defect type |
| getResults | Read Bug Finder results into MATLAB table |

## Examples

### Copy Existing Results to MATLAB Tables

This example shows how to read Bug Finder analysis results from MATLAB.

Copy a demo result set to a temporary folder.

```
resPath = fullfile(matlabroot,'polyspace','examples','cxx','Bug_Finder_Example', ...
'Module_1','BF_Result');
userResPath = tempname;
copyfile(resPath,userResPath);
```

Create the results object.

```
resObj = polyspace.BugFinderResults(userResPath);
```

Read results to MATLAB tables using the object.

```
resSummary = getSummary (resObj);
resTable = getResults (resObj);
```

### Run Analysis and Read Results to MATLAB Tables

Run a Polyspace Bug Finder analysis on the demo file `numerical.c`. Configure these options:

- Specify GCC 4.9 as your compiler.
- Save the results in a `results` subfolder of the current working folder.

```
proj = polyspace.Project

% Configure analysis
proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', ...
    'examples', 'cxx', 'Bug_Finder_Example', 'sources', 'numerical.c')};
```

```
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
proj.Configuration.ResultsDir = fullfile(pwd,'results');

% Run analysis
bfStatus = proj.run('bugFinder');

% Read results
bfSummary = proj.Results.getResults('readable');
```

## Alternatives

To read Code Prover results from MATLAB, use the class `polyspace.CodeProverResults`.

Introduced in R2017a

# pslinkoptions Properties

Properties for the `pslinkoptions` object

## Description

You can create a `pslinkoptions` object to customize your analysis at the command-line. Use these properties to specify configuration options, where and how to store results, additional files to include, and data range modes.

## Properties

### Configuration Options

**`VerificationSettings` — Coding rule and configuration settings for C code**
`'PrjConfig'` (default) | `'PrjConfigAndMisraAGC'` | `'PrjConfigAndMisra'` | `'PrjConfigAndMisraC2012'` | `'MisraAGC'` | `'Misra'` | `'MisraC2012'`

Coding rule and configuration settings for C code specified as:

- `'PrjConfig'` – Inherit options from the project configuration.
- `'PrjConfigAndMisraAGC'` – Inherit options from the project configuration and enable MISRA AC AGC rule checking.
- `'PrjConfigAndMisra'` – Inherit options from the project configuration and enable MISRA C:2004 rule checking.
- `'PrjConfigAndMisraC2012'` – Inherit options from the project configuration and enable MISRA C:2012 guideline checking.
- `'MisraAGC'` – Enable MISRA AC AGC rule checking. This option runs only compilation and rule checking.
- `'Misra'` – Enable MISRA C:2004 rule checking. This option runs only compilation and rule checking.
- `'MisraC2012'` – Enable MISRA C:2012 rule checking. This option runs only compilation and guideline checking.

Example: `opt.VerificationSettings = 'PrjConfigAndMisraC2012'`

### `VerificationMode` — Polyspace mode

`'BugFinder'` (default) | `'CodeProver'`

Polyspace mode specified as `'BugFinder'`, for a Bug Finder analysis, or `'CodeProver'`, for a Code Prover verification.

Example: `opt.VerificationMode = 'BugFinder';`

### `EnablePrjConfigFile` — Allow a custom configuration file

`false` (default) | `true`

Allows a custom configuration file instead of the default configuration specified as true or false. Use the `PrjConfigFile` option to specify the configuration file.

Example: `opt.EnablePrjConfigFile = true;`

### `PrjConfigFile` — Custom configuration file

`''` (default) | full path to a `.prprj` file

Custom configuration file to use instead of the default configuration specified by the full path to a `.psprj` file. Use the `EnablePrjConfigFile` option to use this configuration file during your analysis.

Example: `opt.PrjConfigFile = 'C:\Polyspace\config.psprj';`

### `CheckConfigBeforeAnalysis` — Configuration check before analysis

`'OnWarn'` (default) | `'OnHalt'` | `'Off'`

This property sets the level of configuration checking done before the analysis starts. The configuration check before analysis is specified as:

- **`'Off'`** — Checks only for errors. Stops if errors are found.
- **`'OnWarn'`** — Stops for errors. Displays a message for warnings.
- **`'OnHalt'`** — Stops for errors and warnings.

Example: `opt.CheckConfigBeforeAnalysis = 'OnHalt';`

## Results

### `ResultDir` — Results folder name and location

`'{'C:\Polyspace_Results\results_$ModelName$'` (default) | folder name | folder path

Results folder name and location specified as the local folder name or the folder path. This folder is where Polyspace writes the analysis results. This folder name can be either an absolute path or a path relative to the current folder. The text `$ModelName$` is replaced with the name of the original model.

Example: `opt.ResultDir = '\results_v1_$ModelName$';`

#### `AddSuffixToResultDir` — Add unique number to the results folder name

`false` (default) | `true`

Add unique number to the results folder name specified as true or false. If true, a unique number is added to the end of every new result. Using this option helps you avoid overwriting the previous results folders.

Example: `opt.AddSuffixToResultDir = true;`

#### `OpenProjectManager` — Open the Polyspace environment

`false` (default) | `true`

Open the Polyspace environment to monitor the progress of the analysis, specified as true or false. Afterward, you can review the results.

Example: `opt.OpenProjectManager = true;`

#### `AddToSimulinkProject` — Add results to the open Simulink project

`false` (default) | `true`

Add your results to the currently open Simulink project, if any, specified as true or false. This option allows you to keep your Polyspace results organized with the rest of your project files. If a Simulink project is not open, the results are not added to a Simulink project.

Example: `opt.AddToSimulinkProject = true;`

### Additional Files

#### `EnableAdditionalFileList` — Allow an additional file list

`false` (default) | `true`

Allow an additional file list to be analyzed, specified as true or false. Use with the `AdditionalFileList` option.

Example: `opt.EnableAdditionalFileList = true;`

### `AdditionalFileList` — List of additional files to be analyzed

`{0x1 cell}` (default) | cell array of files

List of additional files to be analyzed specified as a cell array of files. Use with the `EnableAdditionalFileList` option to add these files to the analysis.

Example: `opt.AdditionalFileList = {'sources\file1.c', 'sources\file2.c'};`

Data Types: `cell`

#### Data Ranges

### `InputRangeMode` — Enable design range information

`'DesignMinMax'` (default) | `'FullRange'`

Enable design range information specified as `'DesignMinMax'`, to use data ranges defined in blocks and workspaces, or `'FullRange'`, to treat inputs as full-range values.

Example: `opt.InputRangeMode = 'FullRange';`

### `ParamRangeMode` — Enable constant parameter values

`'None'` (default) | `'DesignMinMax'`

Enable constant parameter values, specified as `'None'`, to use constant parameters values specified in the code, or `'DesignMinMax'` to use a range defined in blocks and workspaces.

Example: `opt.ParamRangeMode = 'DesignMinMax';`

### `OutputRangeMode` — Enable output assertions

`'None'` (default) | `'DesignMinMax'`

Enable output assertions specified by `'None'`, to not apply assertions, or `'DesignMinMax'` to apply assertions to outputs using a range defined in blocks and workspace.

Example: `opt.ParamRangeMode = 'DesignMinMax';`

#### Embedded Coder Only

### `ModelRefVerifDepth` — Depth of verification

`'Current model only'` (default) | `'1'` | `'2'` | `'3'` | `'All'`

Depth of verification specified by the model reference level to which you want to analyze.

*Only for Embedded Coder*

Example: `opt.ModelRefVerifDepth = '3';`

### `ModelRefByModelRefVerif` — Model reference analysis mode

`false` (default) | `true`

Model reference analysis mode specified as `false` to verify reference models within the model hierarchy, or `true` to verify referenced models individually.

*Only for Embedded Coder*

Example: `opt.ModelRefByModelRefVerif = true;`

### `CxxVerificationSettings` — Coding rule and configuration settings for C++ code

`'PrjConfig'` (default) | `'PrjConfigAndMisraCxx'` | `'PrjConfigAndJSF'` | `'MisraCxx'` | `'JSF'`

Coding rule and configuration settings for C++ code specified as:

- `'PrjConfig'` – Inherit options from project configuration and run complete analysis.
- `'PrjConfigAndMisraCxx'` – Inherit options from project configuration, enable MISRA C++ rule checking, and run complete analysis.
- `'PrjConfigAndJSF'` – Inherit options from project configuration, enable JSF rule checking, and run complete analysis.
- `'MisraCxx'` – Enable MISRA C++ rule checking, and run compilation phase only.
- `'JSF'` – Enable JSF rule checking, and run compilation phase only.

*Only for Embedded Coder*

Example: `opt.CxxVerificationSettings = 'MisraCxx';`

#### TargetLink Only

### `AutoStubLUT` — Lookup Table code usage

`false` (default) | `true`

Lookup Table code usage, specified as true or false.

- `true` — use Lookup Table code during the analysis.
- `false` — stub Lookup Table code.

*Only for TargetLink*

Example: `opts.AutoStubLUT = true;`

## See Also

`pslinkoptions` | `pslinkrun`

# polyspace.Project.Configuration Properties

Customize Polyspace analysis of handwritten code with options object properties

## Description

To customize your Polyspace analysis, use these `polyspace.Options` or `polyspace.Project.Configuration` properties. Each property corresponds to an analysis option on the **Configuration** pane in the Polyspace user interface.

The properties are grouped using the same categories as the **Configuration** pane. This page only shows what values each property can take. For details about:

- The different options, see the analysis option reference pages.
- How to create and use the object, see `polyspace.Options` or `polyspace.Project`.

  The same properties are also available with the deprecated classes `polyspace.BugFinderOptions` and `polyspace.CodeProverOptions`.

Each property description below also highlights if the option affects only one of Bug Finder or Code Prover.

**Note** Some options might not be available depending on the language setting of the object. You can set the source code language (`Language`) to `'C'`, `'CPP'` or `'C-CPP'` during object creation, but cannot change it later.

## Properties

### Advanced

**`Additional`** — Additional flags for analysis
character vector

Additional flags for analysis specified as a character vector.

For more information, see `OtherOther`.

Example: `opts.Advanced.Additional = '-extra-flags -option -extra-flags value'`

**`PostAnalysisCommand`** **— Command or script software should execute after analysis finishes**
character vector

Command or script software should execute after analysis finishes, specified as a character vector.

For more information, see `Command/script to apply after the end of the code verification (-post-analysis-command)`.

Example: `opts.Advanced.PostAnalysisCommand = '"C:\Program Files\perl\win32\bin\perl.exe" "C:\My_Scripts\send_email"'`

**`AutomaticOrangeTester`** **— Run the Automatic Orange Tester**
false (default) | true

*This property affects Code Prover analysis only.*

Run the Automatic Orange Tester after verification, specified as true or false.

For more information, see `Automatic Orange Tester (-automatic-orange-tester)`.

Example: `opts.Advanced.AutomaticOrangeTester = true`

**`AutomaticOrangeTesterLoopMaxIteration`** **— Number of loop iterations after which Automatic Orange Tester considers infinite loop**
1000 (default) | positive integer

*This property affects Code Prover analysis only.*

Number of loop iterations after which Automatic Orange Tester considers the test an infinite loop, specified as a positive integer, maximum of 1000.

For more information, see `Maximum loop iterations (-automatic-orange-tester-loop-max-iteration)`.

Example: `opts.Advanced.AutomaticOrangeTesterLoopMaxIteration = 500`

**`AutomaticOrangeTesterTestsNumber`** **— Number of tests that Automatic Orange Tester must run**

500 (default) | positive integer

*This property affects Code Prover analysis only.*

Number of tests that Automatic Orange Tester must run, specified as a positive integer, maximum of 100,000.

For more information, see `Number of automatic tests (-automatic-orange-tester-tests-number)`.

Example: `opts.Advanced.AutomaticOrangeTesterTestsNumber = 1000`

**`AutomaticOrangeTesterTimeout`** **— Time in seconds allowed for a single test in Automatic Orange Tester**

5 (default) | positive integer

*This property affects Code Prover analysis only.*

Time in seconds allowed for a single test in Automatic Orange Tester, specified as a positive integer, maximum of 60.

For more information, see `Maximum test time (-automatic-orange-tester-timeout)`.

Example: `opts.Advanced.AutomaticOrangeTesterTimeout = 10`

### BugFinderAnalysis (Affects Bug Finder Only)

**`CheckersList`** **— List of custom checkers to activate**

name of defects options object | cell array of defect acronyms

*This property affects Bug Finder analysis only.*

List of custom checkers to activate specified by using the name of a `polyspace.DefectsOptions` object or a cell array of defect acronyms. To use this custom list in your analysis, set `CheckersPreset` to `custom`.

For more information, see `polyspace.DefectsOptions`.

Example: `defects = polyspace.DefectsOptions;`
`opts.BugFinderAnalysis.CheckersList = defects`

Example: `opts.BugFinderAnalysis.CheckersList = {'INT_ZERO_DIV','FLOAT_ZERO_DIV'}`

**`CheckersPreset`** — Subset of Bug Finder defects
`default` (default) | `all` | `custom`

*This property affects Bug Finder analysis only.*

Preset checker list, specified as a character vector of one the preset options: `default`, `all`, or `custom`. To use `custom`, specify a `CheckersList`.

For more information, see `Find defects (-checkers)`.

Example: `opts.BugFinderAnalysis.CheckersPreset = 'all'`

**`EnableCheckers`** — Activate defect checking
true (default) | false

*This property affects Bug Finder analysis only.*

Activate defect checking, specified as true or false. Setting this property to false disables all defects. If you want to disable defect checking but still get results, turn on coding rules checking or code metric checking.

This property is equivalent to the **Find defects** check box in the Polyspace interface.

Example: `opts.BugFinderAnalysis.EnableCheckers = false`

### ChecksAssumption (Affects Code Prover Only)

**`AllowNegativeOperandInShift`** — Allow left shift operations on a negative number
false (default) | true

*This property affects Code Prover analysis only.*

Allow left shift operations on a negative number, specified as true or false.

For more information, see `Allow negative operand for left shifts (-allow-negative-operand-in-shift)`.

Example: `opts.ChecksAssumption.AllowNegativeOperandInShift = true`

**`AllowNonFiniteFloats`** — Incorporate infinities and/or NaNs
false (default) | true

*This property affects Code Prover analysis only.*

Incorporate infinities and/or NaNs, specified as true or false.

For more information, see `Consider non finite floats (-allow-non-finite-floats)`.

Example: `opts.ChecksAssumption.AllowNonFiniteFloats = true`

**`AllowPtrArithOnStruct` — Allow arithmetic on pointer to a structure field so that it points to another field**
false (default) | true

*This property affects Code Prover analysis only.*

Allow arithmetic on pointer to a structure field so that it points to another field, specified as true or false.

For more information, see `Enable pointer arithmetic across fields (-allow-ptr-arith-on-struct)`.

Example: `opts.ChecksAssumption.AllowPtrArithOnStruct = true`

**`CheckSubnormal` — Detect operations that result in subnormal floating point values**
`allow` (default) | `warn-first` | `warn-all` | `forbid`

*This property affects Code Prover analysis only.*

Detect operations that result in subnormal floating point values.

For more information, see `Subnormal detection mode (-check-subnormal)`.

Example: `opts.ChecksAssumption.CheckSubnormal = 'forbid'`

**`DetectPointerEscape` — Find cases where a function returns a pointer to one of its local variables**
false (default) | true

*This property affects Code Prover analysis only.*

Find cases where a function returns a pointer to one of its local variables, specified as true or false.

For more information, see `Detect stack pointer dereference outside scope (-detect-pointer-escape)`.

Example: `opts.ChecksAssumption.DetectPointerEscape = true`

### `DisableInitializationChecks` — Disable checks for noninitialized variables and pointers

false (default) | true

*This property affects Code Prover analysis only.*

Disable checks for noninitialized variables and pointers, specified as true or false.

For more information, see `Disable checks for non-initialization (-disable-initialization-checks)`.

Example: `opts.ChecksAssumption.DisableInitializationChecks = true`

### `IgnoreConstantOverflows` — Allow overflow in computations involving constants

false (default) | true

*This property affects Code Prover analysis only.*

Allow overflow in computations involving constants, specified as true or false.

For more information, see `Ignore overflowing computations on constants (-ignore-constant-overflows)`.

Example: `opts.ChecksAssumption.IgnoreConstantOverflows = true`

### `PermissiveFunctionPointer` — Allow type mismatch between function pointers and the functions they point to

false (default) | true

*This property affects Code Prover analysis only.*

Allow type mismatch between function pointers and the functions they point to, specified as true or false.

For more information, see `Permissive function pointer calls (-permissive-function-pointer)`.

Example: `opts.ChecksAssumption.PermissiveFunctionPointer = true`

### `ScalarOverflowsBehavior` — Behavior of scalar overflows

`wrap-around` (default) | `truncate-on-error`

*This property affects Code Prover analysis only.*

Behavior of scalar overflows, specified as `wrap-around` or `truncate-on-error`.

For more information, see `Overflow computation mode (-scalar-overflows-behavior)`.

Example: `opts.ChecksAssumption.ScalarOverflowsBehavior = 'truncate-on-error'`

### `ScalarOverflowsChecks` — Check for integer overflows on signed and unsigned variables

`signed` (default) | `signed-and-unsigned` | `none`

*This property affects Code Prover analysis only.*

Check for integer overflows on signed and unsigned variables, specified as `signed`, `signed-and-unsigned`, or `none`.

For more information, see `Detect overflows (-scalar-overflows-checks)`.

Example: `opts.ChecksAssumption.ScalarOverflowsChecks = 'signed-and-unsigned'`

### `SizeInBytes` — Allow a pointer with insufficient memory buffer to point to a structure

false (default) | true

*This property affects Code Prover analysis only.*

Allow a pointer with insufficient memory buffer to point to a structure, specified as true or false.

For more information, see `Allow incomplete or partial allocation of structures (-size-in-bytes)`.

Example: `opts.ChecksAssumption.SizeInBytes = true`

### `UncalledFunctionCheck` — Detect functions that are not called directly or indirectly from main or another entry-point function

`none` (default) | `never-called` | `called-from-unreachable` | `all`

*This property affects Code Prover analysis only.*

Detect functions that are not called directly or indirectly from main or another entry-point function, specified as `none`, `never-called`, `called-from-unreachable`, or `all`.

For more information, see `Detect uncalled functions (-uncalled-function-checks)`.

Example: `opts.ChecksAssumption.UncalledFunctionCheck = 'all'`

### CodeProverVerification (Affects Code Prover only)

#### `ClassAnalyzer` — Classes that you want to verify

`all` (default) | `none` | cell array of class names

*This property affects Code Prover analysis only.*

Classes that you want to verify, specified as `all`, `none`, or a cell array of class names.

For more information, see `Class (-class-analyzer)`.

Example: `opts.CodeProverVerification.ClassAnalyzer = 'none'`

#### `ClassAnalyzerCalls` — Class methods that you want to verify

`unused` (default) | `all` | `all-public` | `inherited-all` | `inherited-all-public` | `unused-public` | `inherited-unused` | `inherited-unused-public` | cell array of class methods

*This property affects Code Prover analysis only.*

Class methods that you want to verify, specified as one of the predefined sets or a cell array of class methods that you want to verify.

For more information, see `Functions to call within the specified classes (-class-analyzer-calls)`.

Example: `opts.CodeProverVerification.ClassAnalyzerCalls = 'unused-public'`

#### `ClassOnly` — Analyze only class methods

false (default) | true

*This property affects Code Prover analysis only.*

Analyze only class methods, specified as true or false.

For more information, see `Analyze class contents only (-class-only)`.

Example: `opts.CodeProverVerification.ClassOnly = true`

### `EnableMain` — Use `main` function provided in application

false (default) | true

*This property affects Code Prover analysis only.*

Use `main` function provided in application, specified as true or false. If you set this property to false, the analysis generates a `main` function, if it is not present in the source files.

For more information, see `Verify whole application`.

Example: `opts.CodeProverVerification.EnableMain = true`

### `FunctionsCalledBeforeMain` — Functions that you want the generated main to call ahead of other functions

cell array of function names

*This property affects Code Prover analysis only.*

Functions that you want the generated main to call ahead of other functions, specified as a cell array of function names.

For more information, see `Initialization functions (-functions-called-before-main)`.

Example: `opts.CodeProverVerification.FunctionsCalledBeforeMain = {'func1','func2'}`

### `Main` — Use a Microsoft Visual C++ extensions of main

`_tmain` (default) | `wmain` | `_tWinMain` | `wWinMain` | `WinMain` | `DllMain`

*This property applies to a Code Prover analysis only .*

Use a Microsoft Visual C++ extension of main, specified as one of the predefined main extensions.

For more information, see `Main entry point (-main)`.

Example: `opts.CodeProverVerification.Main = 'wmain'`

**`MainGenerator`** — Generate a main function if it is not present in source files
true (default) | false

*This property applies to a Code Prover analysis only .*

Generate a main function if it is not present in source files, specified as true or false.

For more information, see `Verify module or library (-main-generator)`.

Example: `opts.CodeProverVerification.MainGenerator = false`

**`MainGeneratorCalls`** — Functions that you want the generated main to call after the initialization functions
`unused` (default) | `none` | `all` | cell array of function names

*This property applies to a Code Prover analysis only .*

Functions that you want the generated main to call after the initialization functions, specified as `unused`, `all`, `none`, or a cell array of function names.

For more information, see `Functions to call (-main-generator-calls)`.

Example: `opts.CodeProverVerification.MainGeneratorCalls = 'all'`

**`MainGeneratorWriteVariables`** — Global variables that you want the generated main to initialize
`uninit` (C++ default) | `public` (C default) | `none` | `all` | cell array of global variable names

*This property applies to a Code Prover analysis only .*

Global variables that you want the generated main to initialize, specified as one of the predefined sets or a cell array of global variable names.

For more information, see `Variables to initialize (-main-generator-writes-variables)`.

Example: `opts.CodeProverVerification.MainGeneratorWriteVariables = 'all'`

**`NoConstructorsInitCheck`** — Do not check if class constructor initializes class members
false (default) | true

*This property applies to a Code Prover analysis only .*

Do not check if class constructor initializes class members, specified as true or false.

For more information, see `Skip member initialization check (-no-constructors-init-check)`.

Example: `opts.CodeProverVerification.NoConstructorsInitCheck = true`

### `UnitByUnit` — Verify each source file independently of other source files

false (default) | true

*This property affects Code Prover analysis only.*

Verify each source file independently of other source files, specified as true or false.

For more information, see `Verify files independently (-unit-by-unit)`.

Example: `opts.CodeProverVerification.UnitByUnit = true`

### `UnitByUnitCommonSource` — Files that you want to include with each source file during a file-by-file verification

cell array of file paths

*This property affects Code Prover analysis only.*

Files that you want to include with each source file during a file-by-file verification, specified as a cell array of file paths.

For more information, see `Common source files (-unit-by-unit-common-source)`.

Example: `opts.CodeProverVerification.UnitByUnitCommonSource = {'/inc/file1.h','/inc/file2.h'}`

## CodingRulesCodeMetrics

### `AcAgcSubset` — Subset of MISRA AC AGC rules to check

`OBL-rules` (default) | `OBL-REC-rules` | `all-rules` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA AC AGC rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA AC AGC (-misra-ac-agc)`.
- MISRA AC AGC coding rules object created with `polyspace.CodingRulesOptions('misraAcAgc')`.
- Full path to a file containing your MISRA AC AGC subset. You can create this file manually or in the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check MISRA AC AGC rules, also set `EnableAcAgc` to true.

Example: `opts.CodingRulesCodeMetrics.AcAgcSubset = 'all-rules'`

Data Types: `char`

### `AllowedPragmas` — Pragma directives for which MISRA C:2004 rule 3.4 or MISRA C++ 16-6-1 must not be applied

cell array of character vectors

Pragma directives for which MISRA C:2004 rule 3.4 or MISRA C++ 16-6-1 must not be applied, specified as a cell array of character vectors. This property affects only MISRA C:2004 or MISRA AC AGC rule checking.

For more information, see `Allowed pragmas (-allowed-pragmas)`.

Example: `opts.CodingRulesCodeMetrics.AllowedPragmas = {'pragma_01','pragma_02'}`

Data Types: `cell`

### `BooleanTypes` — Data types the coding rule checker must treat as effectively Boolean

cell array of character vectors

Data types that the coding rule checker must treat as effectively Boolean, specified as a cell array of character vectors.

For more information, see `Effective boolean types (-boolean-types)`.

Example: `opts.CodingRulesCodeMetrics.BooleanTypes = {'boolean1_t','boolean2_t'}`

Data Types: `cell`

### `CodeMetrics` — Activate code metric calculations

false (default) | true

Activate code metric calculations, specified as true or false. If this property is turned off, Polyspace does not calculate code metrics even if you upload your results to Polyspace Metrics.

For more information about the code metrics, see `Calculate code metrics (-code-metrics)`.

Example: `opts.CodingRulesCodeMetrics.CodeMetrics = true`

### `CustomRulesSubset` — Custom naming conventions to check against

custom coding rules file

Custom naming conventions to check against, specified as a custom coding rules file. You can create the custom coding rules file manually or in the Polyspace interface.

For more information, see `Check custom rules (-custom-rules)`.

Example: `opts.CodingRulesCodeMetrics.CustomRulesSubset = 'C:\ps_settings\coding_rules\custom_rules.txt'`

Data Types: `char`

### `EnableAcAgc` — Check MISRA AC AGC rules

false (default) | true

Check MISRA AC AGC rules, specified as true or false. To customize which rules are checked, use `AcAgcSubset`.

For more information about the MISRA AC AGC checker, see `Check MISRA AC AGC (-misra-ac-agc)`.

Example: `opts.CodingRulesCodeMetrics.EnableAcAgc = true;`

### `EnableCustomRules` — Check custom coding rules

false (default) | true

Check custom coding rules, specified as true or false. Use with `CustomRulesSubset`.

For more information, see `Check custom rules (-custom-rules)`.

Example: `opts.CodingRulesCodeMetrics.EnableCustomRules = true;`

### `EnableJsf` — Check JSF C++ rules

false (default) | true

Check JSF C++ rules, specified as true or false. To customize which rules are checked, use `JsfSubset`.

For more information, see `Check JSF C++ rules (-jsf-coding-rules)`.

Example: `opts.CodingRulesCodeMetrics.EnableJsf = true;`

### `EnableMisraC` — Check MISRA C:2004 rules

false (default) | true

Check MISRA C:2004 rules, specified as true or false. To customize which rules are checked, use `MisraCSubset`.

For more information, see `Check MISRA C:2004 (-misra2)`.

Example: `opts.CodingRulesCodeMetrics.EnableMisraC = true;`

### `EnableMisraC3` — Check MISRA C:2012 rules

false (default) | true

Check MISRA C:2012 rules, specified as true or false. To customize which rules are checked, use `MisraC3Subset`.

For more information about the MISRA C:2012 checker, see `Check MISRA C:2012 (-misra3)`.

Example: `opts.CodingRulesCodeMetrics.EnableMisraC3 = true;`

### `EnableMisraCpp` — Check MISRA C++:2008 rules

false (default) | true

Check MISRA C++:2008 rules, specified as true or false. To customize which rules are checked, use `MisraCppSubset`.

For more information about the MISRA C++:2008 checker, see `Check MISRA C++ rules (-misra-cpp)`.

Example: `opts.CodingRulesCodeMetrics.EnableMisraCpp = true;`

### `JsfSubset` — Subset of JSF C++ rules to check

`shall-rules` (default) | `shall-will-rules` | `all-rules` | coding rules object | file

Subset of JSF C++ rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check JSF C++ rules (-jsf-coding-rules)`.
- JSF C++ coding rules object created with `polyspace.CodingRulesOptions('jsf')`.
- Full path to a file containing your JSF C++ subset. You can create this file manually or from the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check JSF C++ rules, set `EnableJsf` to true.

Example: `opts.CodingRulesCodeMetrics.JsfSubset = 'all-rules'`

Data Types: `char`

### `Misra3AgcMode` — Use the MISRA C:2012 categories for automatically generated code

false (default) | true

Use the MISRA C:2012 categories for automatically generated code, specified as true or false.

For more information, see `Use generated code requirements (-misra3-agc-mode)`.

Example: `opts.CodingRulesCodeMetrics.Misra3AgcMode = true;`

### `MisraC3Subset` — Subset of MISRA C:2012 rules to check

`mandatory-required` (default) | `mandatory` | `all` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA C:2012 rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA C:2012 (-misra3)`.
- MISRA C:2012 coding rules object created with `polyspace.CodingRulesOptions('misraC2012')`.
- Full path to a file containing your MISRA C:2012 subset. You can create the custom coding rules file manually or in the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check MISRA C:2012 rules, also set `EnableMisraC3` to true.

Example: `opts.CodingRulesCodeMetrics.MisraC3Subset = 'all'`

Data Types: `char`

### `MisraCSubset` — Subset of MISRA C:2004 rules to check

`required-rules` (default) | `all-rules` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA C:2004 rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA C:2004 (-misra2)`.
- MISRA C:2004 coding rules object created with `polyspace.CodingRulesOptions('misraC')`.
- Full path to a file containing your MISRA C:2004 subset. You can create the custom coding rules file manually or in the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check MISRA C:2004 rules, also set `EnableMisraC` to true.

Example: `opts.CodingRulesCodeMetrics.MisraCSubset = 'all-rules'`

Data Types: `char`

### `MisraCppSubset` — Subset of MISRA C++ rules

`required-rules` (default) | `all-rules` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA C++:2008 rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA C++ rules (-misra-cpp)`.
- MISRA C++ coding rules object created with `polyspace.CodingRulesOptions('misraCpp')`.
- Full path to a file containing your MISRA C++ subset. You can create this file manually or from the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check MISRA C++ rules, set `EnableMisraCpp` to true.

Example: `opts.CodingRulesCodeMetrics.MisraCppSubset = 'all-rules'`

Data Types: `char`

EnvironmentSettings

### `Dos` — Consider that file paths are in MS-DOS style

true (default) | false

Consider that file paths are in MS-DOS style, specified as true or false.

For more information, see `Code from DOS or Windows file system (-dos)`.

Example: `opts.EnvironmentSettings.Dos = true;`

### `IncludeFolders` — Include folders needed for compilation

cell array of include folder paths

Include folders needed for compilation, specified as a cell array of the include folder paths.

To specify all subfolders of a folder, use folder path followed by `**`, for instance, `'C:\includes\**'`. The notation follows the syntax of the `dir` function. See also "Specify Multiple Source Files".

For more information, see `-I`.

Example: `opts.EnvironmentSettings.IncludeFolders = {'/includes','/com1/inc'};`

Example: `opts.EnvironmentSettings.IncludeFolders = {'C:\project1\common\includes'};`

Data Types: `cell`

### `Includes` — Files to be `#include`-ed by each C file

cell array of files

Files to be `#include`-ed by each C source file in the analysis, specified by a cell array of files.

For more information, see `Include (-include)`.

Example: `opts.EnvironmentSettings.Includes = {'/inc/inc_file.h','/inc/inc_math.h'}`

### `NoExternC` — Ignore linking errors inside extern blocks

false (default) | true

Ignore linking errors inside extern blocks, specified as true or false.

For more information, see `Ignore link errors (-no-extern-c)`.

Example: `opts.EnvironmentSettings.NoExternC = false;`

**`PostPreProcessingCommand` — Command or script to run on source files after preprocessing**
character vector

Command or script to run on source files after preprocessing, specified as a character vector of the command to run.

For more information, see `Command/script to apply to preprocessed files (-post-preprocessing-command)`.

Example: Linux — `opts.EnvironmentSettings.PostPreProcessingCommand = ''pwd'/replace_keyword.pl'`

Example: Windows — `opts.EnvironmentSettings.PostPreProcessingCommand = '"C:\Program Files\MATLAB\R2015b\sys\perl\win32\bin\perl.exe" "C:\My_Scripts\replace_keyword.pl"'`

**`StopWithCompileError` — Stop analysis if a file does not compile**
false (default) | true

Stop analysis if a file does not compile, specified as true or false.

For more information, see `Stop analysis if a file does not compile (-stop-if-compile-error)`.

Example: `opts.EnvironmentSettings.StopWithCompileError = true;`

### InputsStubbing

**`DataRangeSpecifications` — Constrain global variables, function inputs, and return values of stubbed functions**
file path

Constrain global variables, function inputs, and return values of stubbed functions specified by the path to an XML constraint file. For more information about the constraint file, see “Specify External Constraints”.

For more information about this option, see `Constraint setup (-data-range-specifications)`.

Example: `opts.InputsStubbing.DataRangeSpecifications = 'C:\project \constraint_file.xml'`

### `DoNotGenerateResultsFor` — Files on which you do not want analysis results

`include-folders` (default) | `all-headers` | cell array of files or folders

Files on which you do not want analysis results, specified by `include-folders`, `all-headers`, or a character array beginning with `custom=` and containing a comma-separated file or folder names.

Use this option with `InputsStubbing.GenerateResultsFor`. For more information, see `Do not generate results for (-do-not-generate-results-for)`.

Example: `opts.InputsStubbing.DoNotGenerateResultsFor = 'custom=C: \project\file1.c,C:\project\file2.c'`

### `GenerateResultsFor` — Files on which you want analysis results

`source-headers` (default) | `all-headers` | character array

Files on which you do not want analysis results, specified by `source-headers`, `all-headers`, or a character array beginning with `custom=` and containing a comma-separated file or folder names.

Use this option with `InputsStubbing.DoNotGenerateResultsFor`. For more information, see `Generate results for sources and (-generate-results-for)`.

Example: `opts.InputsStubbing.GenerateResultsFor = 'custom=C:\project \includes_common_1,C:\project\includes_common_2'`

### `FunctionsToStub` — Functions to stub during analysis

cell array of function names

*This property affects Code Prover analysis only.*

Functions to stub during analysis, specified as a cell array of function names.

For more information, see .

Example: `opts.InputsStubbing.FunctionsToStub = {'func1', 'func2'}`

### `NoDefInitGlob` — Consider global variables as uninitialized

false (default) | true

*This property affects Code Prover analysis only.*

Consider global variables as uninitialized, specified as true or false.

For more information, see .

Example: `opts.InputsStubbing.NoDefInitGlob = true`

### `NoStlStubs` — Do not use Polyspace implementations of functions in the Standard Template Library

false (default) | true

*This property applies only to a Code Prover analysis of C++ code.*

Do not use Polyspace implementations of functions in the Standard Template Library, specified as true or false.

For more information, see .

Example: `opts.InputsStubbing.NoStlStubs = true`

### `StubECoderLookupTables` — Specify that the analysis must stub functions in the generated code that use lookup tables

`true` (default) | `false`

*This property applies only to a Code Prover analysis of code generated from models.*

Specify that the analysis must stub functions in the generated code that use lookup tables. By replacing the functions with stubs, the analysis assumes more precise return values for the functions.

For more information, see `Generate stubs for Embedded Coder lookup tables (-stub-embedded-coder-lookup-table-functions)`.

Example: `opts.InputsStubbing.StubECoderLookupTables = true`

## Macros

### `DefinedMacros` — Macros to be replaced

cell array of macros

In preprocessed code, macros are replaced by the definition, specified in a cell array of macros and definitions. Specify the macro as `Macro=Value`. If you want Polyspace to ignore the macro, leave the `Value` blank. A macro with no equal sign replaces all instances of that macro by 1.

For more information, see `Preprocessor definitions (-D)`.

Example: `opts.Macros.DefinedMacros = {'uint32=int','name3=','var'}`

### **`UndefinedMacros`** — Macros to undefine

cell array of macros

In preprocessed code, macros are undefined, specified by a cell array of macros to undefine.

For more information, see `Disabled preprocessor definitions (-U)`.

Example: `opts.Macros.DefinedMacros = {'name1','name2'}`

## MergedComputingSettings

### **`AddToResultsRepositoryBugFinder`** — Upload Bug Finder results to Polyspace Metrics web dashboard

false (default) | true

*This property affects Bug Finder analysis only.*

Upload Bug Finder analysis results to Polyspace Metrics web dashboard, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Upload results to Polyspace Metrics (-add-to-results-repository)`.

Example: `opts.MergedComputingSettings.AddToResultsRepositoryBugFinder = true;`

### **`AddToResultsRepositoryCodeProver`** — Upload Code Prover results to Polyspace Metrics web dashboard

false (default) | true

*This property affects Code Prover analysis only.*

Upload Code Prover analysis results to Polyspace Metrics web dashboard, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Upload results to Polyspace Metrics (-add-to-results-repository)`.

Example: `opts.MergedComputingSettings.AddToResultsRepositoryCodeProver = true;`

### `BatchBugFinder` — Send Bug Finder analysis to remote server

false (default) | true

*This property affects Bug Finder analysis only.*

Send Bug Finder analysis to remote server, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`.

Example: `opts.MergedComputingSettings.BatchBugFinder = true;`

### `BatchCodeProver` — Send Code Prover analysis to remote server

false (default) | true

*This property affects Code Prover analysis only.*

Send Code Prover analysis to remote server, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`.

Example: `opts.MergedComputingSettings.BatchCodeProver = true;`

### `FastAnalysis` — Run Bug Finder analysis using faster local mode

false (default) | true

*This property affects Bug Finder analysis only.*

Use fast analysis mode for Bug Finder analysis, specified as true or false.

For more information, see `Use fast analysis mode for Bug Finder (-fast-analysis)`.

Example: `opts.MergedComputingSettings.FastAnalysis = true;`

### MergedReporting

**`EnableReportGeneration`** **— Generate a report after the analysis**
false (default) | true

After the analysis, generate a report, specified as true or false.

For more information, see `Generate report`.

Example: `opts.MergedReporting.EnableReportGeneration = true`

**`ReportOutputFormat`** **— Output format of generated report**
`Word` (default) | `HTML` | `PDF`

Output format of generated report, specified as one of the report formats. To activate this option, specify `Reporting.EnableReportGeneration`.

For more information about the different values, see `Output format (-report-output-format)`.

Example: `opts.MergedReporting.ReportOutputFormat = 'PDF'`

**`BugFinderReportTemplate`** **— Template for generating Bug Finder analysis report**
`BugFinderSummary` (default) | `BugFinder` | `BugFinder_CWE` | `CodeMetrics` | `Metrics`

*This property affects a Bug Finder analysis only.*

Template for generating analysis report, specified as one of the report formats. To activate this option, specify `Reporting.EnableReportGeneration`.

For more information about the different values, see `Bug Finder and Code Prover report (-report-template)`.

Example: `opts.MergedReporting.BugFinderReportTemplate = 'CodeMetrics'`

**`CodeProverReportTemplate`** **— Template for generating Code Prover analysis report**
`Developer` (default) | `CallHierarchy` | `CodeMetrics` | `CodingRules` | `Developer` | `DeveloperReview` | `Developer_withGreenChecks` | `Quality` |

SoftwareQualityObjectives | SoftwareQualityObjectives_Summary | VariableAccess

*This property affects a Code Prover analysis only.*

Template for generating analysis report, specified as one of the predefined report formats. To activate this option, specify `Reporting.EnableReportGeneration`.

For more information about the different values, see `Bug Finder and Code Prover report (-report-template)`.

Example: `opts.MergedReporting.CodeProverReportTemplate = 'CodeMetrics'`

#### Multitasking

**`CriticalSectionBegin`** — Functions that begin critical sections
cell array of critical section function names

Functions that begin critical sections specified as a cell array of critical section function names. To activate this option, specify `Multitasking.EnableMultitasking` and `Multitasking.CriticalSectionEnd`.

For more information, see `Critical section details (-critical-section-begin -critical-section-end)`.

Example: `opts.Multitasking.CriticalSectionBegin = {'function1:cs1','function2:cs2'}`

**`CriticalSectionEnd`** — Functions that end critical sections
cell array of critical section function names

Functions that end critical sections specified as a cell array of critical section function names. To activate this option, specify `Multitasking.EnableMultitasking` and `Multitasking.CriticalSectionBegin`.

For more information, see `Critical section details (-critical-section-begin -critical-section-end)`.

Example: `opts.Multitasking.CriticalSectionEnd = {'function1:cs1','function2:cs2'}`

**`CyclicTasks`** — Specify functions that represent cyclic tasks
cell array of function names

Specify functions that represent cyclic tasks.

To activate this option, also specify `Multitasking.EnableMultitasking`.

For more information, see `Cyclic tasks (-cyclic-tasks)`.

Example: `opts.Multitasking.CyclicTasks = {'function1','function2'}`

### `EnableConcurrencyDetection` — Enable automatic detection of certain families of threading functions

false (default) | true

*This property affects Code Prover analysis only.*

Enable automatic detection of certain families of threading functions, specified as true or false.

For more information, see `Enable automatic concurrency detection for Code Prover (-enable-concurrency-detection)`.

Example: `opts.Multitasking.EnableConcurrencyDetection = true`

### `EnableMultitasking` — Configure multitasking manually

false (default) | true

Configure multitasking manually by specifying `true`. This property activates the other manual, multitasking properties.

For more information, see `Configure multitasking manually`.

Example: `opts.Multitasking.EnableMultitasking = 1`

### `EnableOsekMultitasking` — Enable automatic multitasking configuration for OSEK project

false (default) | true

Enable multitasking configuration of your OSEK project from the OIL files you provide. Activate this option to enable `Multitasking.OsekMultitasking`.

For more information, see `OSEK multitasking configuration (-osek-multitasking)`

Example: `opts.Multitasking.EnableOsekMultitasking = 1`

**`EntryPoints`** — **Functions that serve as entry-points to your multitasking application**
cell array of entry-point function names

Functions that serve as entry-points to your multitasking application specified as a cell array of entry-point function names. To activate this option, also specify `Multitasking.EnableMultitasking`.

For more information, see `Entry points (-entry-points)`.

Example: `opts.Multitasking.EntryPoints = {'function1','function2'}`

**`Interrupts`** — **Specify functions that represent nonpreemptable interrupts**
cell array of function names

Specify functions that represent nonpreemptable interrupts.

To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Interrupts (-interrupts)`.

Example: `opts.Multitasking.Interrupts = {'function1','function2'}`

**`InterruptsDisableAll`** — **Specify routine that disable interrupts**
cell array with one function name

*This property affects Bug Finder analysis only.*

Specify function that disables all interrupts.

To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`.

Example: `opts.Multitasking.InterruptsDisableAll = {'function'}`

**`InterruptsEnableAll`** — **Specify routine that reenable interrupts**
cell array with one function name

*This property affects Bug Finder analysis only.*

Specify function that reenables all interrupts.

To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`.

Example: `opts.Multitasking.InterruptsEnableAll = {'function'}`

**`OsekMultitasking`** — Specify path of OIL files to parse for multitasking configuration
`auto` | cell array of files

Specify the path to the OIL files the software parses to set up your multitasking configuration:

- In `auto` mode, the analysis uses OIL files in your project source and include folders, but not their subfolders.
- In `custom` mode, the analysis uses the OIL files at the specified path, and the path subfolders.

To activate this option, specify `MultitaskingEnableOsekMultitasking`.

For more information, see `OSEK multitasking configuration (-osek-multitasking)`

Example: `opts.Multitasking.OsekMultitasking = 'custom='file_path, dir_path'`

**`TemporalExclusion`** — Entry-point functions that cannot execute concurrently
cell array of entry-point function names

Entry-point functions that cannot execute concurrently specified as a cell array of entry-point function names. Each set of exclusive tasks is one cell array entry with functions separated by spaces. To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Temporally exclusive tasks (-temporal-exclusions-file)`.

Example: `opts.Multitasking.TemporalExclusion = {'function1 function2', 'function3 function4 function5'}` where function1 and function2 are temporally exclusive, and function3, function4, and function 5 are temporally exclusive.

### Precision (Affects Code Prover Only)

**`ContextSensitivity` — Store call context information to identify function call that caused errors**
`none` (default) | `auto` | cell array of function names

*This property affects Code Prover analysis only.*

Store call context information to identify a function call that caused errors, specified as `none`, `auto`, or a cell array of function names.

For more information, see `Sensitivity context (-context-sensitivity)`.

Example: `opts.Precision.ContextSensitivity = 'auto'`

Example: `opts.Precision.ContextSensitivity = 'custom=func1'`

**`ModulesPrecision` — Source files you want to verify at higher precision**
cell array of file names and precision levels

*This property affects Code Prover analysis only.*

Source files that you want to verify at higher precision, specified as a cell array of file names without the extension and precision levels using this syntax: `*filename*:O*level*`

For more information, see `Specific precision (-modules-precision)`.

Example: `opts.Precision.ModulesPrecision = {'file1:O0', 'file2:O3'}`

**`OLevel` — Precision level for the verification**
2 (default) | 0 | 1 | 3

*This property affects Code Prover analysis only.*

Precision level for the verification, specified as 0, 1, 2, or 3.

For more information, see `Precision level (-O)`.

Example: `opts.Precision.OLevel = 3`

**`PathSensitivityDelta` — Avoid certain verification approximations for code with fewer lines**
positive integer

*This property affects Code Prover analysis only.*

Avoid certain verification approximations for code with fewer lines, specified as a positive integer representing how sensitive the analysis is. Higher values can increase verification time exponentially.

For more information, see `Improve precision of interprocedural analysis (-path-sensitivity-delta)`.

Example: `opts.Precision.PathSensitivityDelta = 2`

### `Timeout` — Time limit on your verification

character vector

*This property affects Code Prover analysis only.*

Time limit on your verification, specified as a character vector of time in hours.

For more information, see `Verification time limit (-timeout)`.

Example: `opts.Precision.Timeout = '5.75'`

### `To` — Number of times the verification process runs

`Software Safety Analysis level 2` (default) | `Software Safety Analysis level 0` | `Software Safety Analysis level 1` | `Software Safety Analysis level 3` | `Software Safety Analysis level 4` | `Source Compliance Checking` | `other`

*This property affects Code Prover analysis only.*

Number of times the verification process runs, specified as one of the preset analysis levels.

For more information, see `Verification level (-to)`.

Example: `opts.Precision.To = 'Software Safety Analysis level 3'`

## Scaling (Affects Code Prover Only)

### `Inline` — Functions on which separate results must be generated for each function call

cell array of function names

*This property affects Code Prover analysis only.*

Functions on which separate results must be generated for each function call, specified as a cell array of function names.

For more information, see `Inline (-inline)`.

Example: `opts.Scaling.Inline = {'func1','func2'}`

**`KLimiting` — Limit depth of analysis for nested structures**
positive integer

*This property affects Code Prover analysis only.*

Limit depth of analysis for nested structures, specified as a positive integer indicating how many levels into a nested structure to verify.

For more information, see `Depth of verification inside structures (-k-limiting)`.

Example: `opts.Scaling.KLimiting = 3`

TargetCompiler

**`Compiler` — Compiler that builds your source code**
`generic` (default) | `clang3.5` | `gnu3.4` | `gnu4.6` | `gnu4.7` | `gnu4.8` | `gnu4.9` | `iar` | `iso` | `keil` | `visual9.0` | `visual10` | `visual11.0` | `visual12.0` | `visual14.0`

Compiler that builds your source code.

For more information, see `Compiler (-compiler)`.

Example: `opts.TargetCompiler.Compiler = 'Visual11.0'`

**`Cpp11Extension` — Allow C++11 language extensions**
false (default) | true

Allow C++11 language extensions, specified as true or false.

For more information, see `C++11 extensions (-cpp11-extension)`.

Example: `opts.TargetCompiler.Cpp11Extension = true`

**`DivRoundDown` — Round down quotients from division or modulus of negative numbers**
false (default) | true

Round down quotients from division or modulus of negative numbers, specified as true or false.

For more information, see `Division round down (-div-round-down)`.

Example: `opts.TargetCompiler.DivRoundDown = true`

### `EnumTypeDefinition` — Base type representation of enum

`defined-by-compiler` (default) | `auto-signed-first` | `auto-unsigned-first`

Base type representation of enum, specified by an allowed base-type set. For more information about the different values, see `Enum type definition (-enum-type-definition)`.

Example: `opts.TargetCompiler.EnumTypeDefinition = 'auto-unsigned-first'`

### `IgnorePragmaPack` — Ignore #pragma pack directives

false (default) | true

Ignore #pragma pack directives, specified as true or false.

For more information, see `Ignore pragma pack directives (-ignore-pragma-pack)`.

Example: `opts.TargetCompiler.IgnorePragmaPack = true`

### `Language` — Language of analysis

`C-CPP` (default) | `C` | `CPP`

This property is read-only.

Language of the analysis, specified during the object construction. This value changes which properties appear.

For more information, see `Source code language (-lang)`.

### `LogicalSignedRightShift` — Treatment of signed bit on signed variables

`Arithmetical` (default) | `Logical`

Treatment of signed bit on signed variables, specified as `Arithmetical` or `Logical`. For more information, see `Signed right shift (-logical-signed-right-shift)`.

Example: `opts.TargetCompiler.LogicalSignedRightShift = 'Logical'`

### `NoLanguageExtensions` — Restrict analysis to C language specified in ANSI C standard

false (default) | true

Restrict analysis to the C language that is specified in the ANSI C standard, specified as true or false. For more information, see `Respect C90 standard (-no-language-extensions)`.

Example: `opts.TargetCompiler.NoLanguageExtensions = true`

### `NoUliterals` — Do not use predefined typedefs for char16_t or char32_t

false (default) | true

Do not use predefined typedefs for char16_t or char32_t, specified as true or false. For more information, see `Block char16/32_t types (-no-uliterals)`.

Example: `opts.TargetCompiler.NoUliterals = true`

### `PackAlignmentValue` — Default structure packing alignment

`8` (default) | `1` | `2` | `4` | `16`

Default structure packing alignment, specified as `1`,`2`, `4`, `8`, or `16`. This property is available only for Visual C++ code.

For more information, see `Pack alignment value (-pack-alignment-value)`.

Example: `opts.TargetCompiler.PackAlignmentValue = '4'`

### `SizeTTypeIs` — Underlying type of `size_t`

`defined-by-compiler` (default) | `unsigned-int` | `unsigned-long` | `unsigned-long-long`

Underlying type of `size_t`, specified as `unsigned-int`, `unsigned-long` or `unsigned-long-long`. See `Management of size_t (-size-t-type-is)`.

Example: `opts.TargetCompiler.SizeTTypeIs = 'unsigned-long'`

### `WcharTTypeIs` — Underlying type of `wchar_t`

`defined-by-compiler` (default) | `signed-short` | `unsigned-short` | `signed-int` | `unsigned-int` | `signed-long` | `unsigned-long`

Underlying type of `wchar_t`, specified as `signed-short`, `unsigned-short`, `signed-int`, `unsigned-int`, `signed-long` or `unsigned-long`. See `Management of wchar_t (-wchar-t-type-is)`.

Example: `opts.TargetCompiler.WcharTTypeIs = 'unsigned-int'`

**`SfrTypes` — sfr types**
cell array of `sfr` keywords

`sfr` types, specified as a cell array of `sfr` keywords using the syntax *`sfr_name=size_in_bits`*. For more information, see `Sfr type support (-sfr-types)`.

Example: `opts.TargetCompiler.SfrTypes = {'sfr32=32'}`

**`Target` — Target processor**
`i386` (default) | `sparc` | `m68k` | `powerpc` | `powerpc64` | `c-167` | `tms320c3x` | `sharc21x61` | `necv580` | `hc08` | `hc12` | `mpc5xx` | `c18` | `x86_64` | generic target object

Set size of data types and endienness of processor, specified as one of the predefined target processors or a generic target object.

For more information about the predefined processors, see `Target processor type (-target)`.

For more information about creating a generic target, see `polyspace.GenericTargetOptions`.

Example: `opts.TargetCompiler.Target = 'hc12'`

### VerificationAssumption (Affects Code Prover Only)

**`ConsiderVolatileQualifierOnFields` — Assume that volatile qualified structure fields can have all possible values at any point in code**
false (default) | true

*This property affects Code Prover analysis only.*

Assume that volatile qualified structure fields can have all possible values at any point in code.

For more information, see `Consider volatile qualifier on fields (-consider-volatile-qualifier-on-fields)`.

Example: `opts.VerificationAssumption.ConsiderVolatileQualifierOnFields = true`

### `ConstraintPointersMayBeNull` — Specify that environment pointers can be NULL unless constrained otherwise

false (default) | true

*This property affects Code Prover analysis only.*

Specify that environment pointers can be NULL unless constrained otherwise.

For more information, see `Consider environment pointers as unsafe (-stubbed-pointers-are-unsafe)`.

Example: `opts.VerificationAssumption.ConstraintPointersMayBeNull = true`

### `FloatRoundingMode` — Rounding modes to consider when determining the results of floating-point arithmetic

`to-nearest` (default) | `all`

*This property affects Code Prover analysis only.*

Rounding modes to consider when determining the results of floating-point arithmetic, specified as `to-nearest` or `all`.

For more information, see `Float rounding mode (-float-rounding-mode)`.

Example: `opts.VerificationAssumption.FloatRoundingMode = 'all'`

### `RespectTypesInFields` — Do not cast nonpointer fields of a structure to pointers

false (default) | true

*This property affects Code Prover analysis only.*

Do not cast nonpointer fields of a structure to pointers, specified as true or false.

For more information, see `Respect types in fields (-respect-types-in-fields)`.

Example: `opts.VerificationAssumption.RespectTypesInFields = true`

### `RespectTypesInGlobals` — Do not cast nonpointer global variables to pointers

false (default) | true

*This property affects Code Prover analysis only.*

Do not cast nonpointer global variables to pointers, specified as true or false.

For more information, see `Respect types in global variables (-respect-types-in-globals)`.

Example: `opts.VerificationAssumption.RespectTypesInGlobals = true`

## Other Properties

### `Prog` — Project name

`PolyspaceProject` (default) | character vector

Project name, specified as a character vector.

For more information, see `-prog`.

Example: `opts.Prog = 'myProject'`

### `ResultsDir` — Location to store results

folder path

Location to store results, specified as a folder path. By default, the results are stored in the current folder.

For more information, see `-results-dir`.

Example: `opts.ResultsDir = 'C:\project\myproject\results\'`

### `Sources` — Source files

cell array of files

Source files to analyze, specified as a cell array of files.

To specify all files in a folder, use folder path followed by `*`, for instance, `'C:\src\*'`. To specify all files in a folder and its subfolders, use folder path followed by `**`, for instance, `'C:\src\**'`. The notation follows the syntax of the `dir` function. See also “Specify Multiple Source Files”.

For more information, see `-sources`.

Example: `opts.Sources = {'file1.c', 'file2.c', 'file3.c'}`

Example: `opts.Sources = {'project/src1/file1.c', 'project/src2/file2.c', 'project/src3/file3.c'}`

**`Version` — Project version number**

`1.0` (default) | character array of a number

Version number of project, specified as a character array of a number. This option is useful if you upload your results to Polyspace Metrics. If you increment version numbers each time that you reanalyze your object, you can compare the results from two versions in Polyspace Metrics.

For more information, see `-v[ersion]`.

Example: `opts.Version = '2.3'`

## See Also

### Topics

"Analysis Options"

Introduced in R2017a

# polyspace.ModelLinkOptions Properties

Customize Polyspace analysis of generated code with options object properties

## Description

To customize your Polyspace analysis of generated code, modify the `polyspace.ModelLinkOptions` object properties. Each property corresponds to an analysis option on the **Configuration** pane in the Polyspace user interface.

The properties are grouped using the same categories as the **Configuration** pane. This page only shows what values each property can take. For details about:

- The different options, see the analysis options reference pages.
- How to create and use the object, see `polyspace.ModelLinkOptions`.

  The same properties are also available with the deprecated classes `polyspace.ModelLinkBugFinderOptions` and `polyspace.ModelLinkCodeProverOptions`.

Each property description below also highlights if the option affects only one of Bug Finder or Code Prover.

**Note** Some options might not be available depending on the language setting of the object. You can set the source code language (`Language`) to `'C'`, `'CPP'` or `'C-CPP'` during object creation, but cannot change it later.

## Properties

### Advanced

**`Additional`** — Additional flags for analysis
character vector

Additional flags for analysis specified as a character vector.

For more information, see `OtherOther`.

Example: `opts.Advanced.Additional = '-extra-flags -option -extra-flags value'`

**`PostAnalysisCommand` — Command or script software should execute after analysis finishes**
character vector

Command or script software should execute after analysis finishes, specified as a character vector.

For more information, see `Command/script to apply after the end of the code verification (-post-analysis-command)`.

Example: `opts.Advanced.PostAnalysisCommand = '"C:\Program Files\perl\win32\bin\perl.exe" "C:\My_Scripts\send_email"'`

**`AutomaticOrangeTester` — Run the Automatic Orange Tester**
false (default) | true

*This property affects Code Prover analysis only.*

Run the Automatic Orange Tester after verification, specified as true or false.

For more information, see `Automatic Orange Tester (-automatic-orange-tester)`.

Example: `opts.Advanced.AutomaticOrangeTester = true`

**`AutomaticOrangeTesterLoopMaxIteration` — Number of loop iterations after which Automatic Orange Tester considers infinite loop**
1000 (default) | positive integer

*This property affects Code Prover analysis only.*

Number of loop iterations after which Automatic Orange Tester considers the test an infinite loop, specified as a positive integer, maximum of 1000.

For more information, see `Maximum loop iterations (-automatic-orange-tester-loop-max-iteration)`.

Example: `opts.Advanced.AutomaticOrangeTesterLoopMaxIteration = 500`

### `AutomaticOrangeTesterTestsNumber` — Number of tests that Automatic Orange Tester must run

500 (default) | positive integer

*This property affects Code Prover analysis only.*

Number of tests that Automatic Orange Tester must run, specified as a positive integer, maximum of 100,000.

For more information, see `Number of automatic tests (-automatic-orange-tester-tests-number)`.

Example: `opts.Advanced.AutomaticOrangeTesterTestsNumber = 1000`

### `AutomaticOrangeTesterTimeout` — Time in seconds allowed for a single test in Automatic Orange Tester

5 (default) | positive integer

*This property affects Code Prover analysis only.*

Time in seconds allowed for a single test in Automatic Orange Tester, specified as a positive integer, maximum of 60.

For more information, see `Maximum test time (-automatic-orange-tester-timeout)`.

Example: `opts.Advanced.AutomaticOrangeTesterTimeout = 10`

## BugFinderAnalysis (Affects Bug Finder Only)

### `CheckersList` — List of custom checkers to activate

name of defects options object | cell array of defect acronyms

*This property affects Bug Finder analysis only.*

List of custom checkers to activate specified by using the name of a `polyspace.DefectsOptions` object or a cell array of defect acronyms. To use this custom list in your analysis, set `CheckersPreset` to `custom`.

For more information, see `polyspace.DefectsOptions`.

Example: 
```
defects = polyspace.DefectsOptions;
opts.BugFinderAnalysis.CheckersList = defects
```

Example: `opts.BugFinderAnalysis.CheckersList = {'INT_ZERO_DIV','FLOAT_ZERO_DIV'}`

**`CheckersPreset`** — Subset of Bug Finder defects
`default` (default) | `all` | `custom`

*This property affects Bug Finder analysis only.*

Preset checker list, specified as a character vector of one the preset options: `default`, `all`, or `custom`. To use `custom`, specify a `CheckersList`.

For more information, see `Find defects (-checkers)`.

Example: `opts.BugFinderAnalysis.CheckersPreset = 'all'`

**`EnableCheckers`** — Activate defect checking
true (default) | false

*This property affects Bug Finder analysis only.*

Activate defect checking, specified as true or false. Setting this property to false disables all defects. If you want to disable defect checking but still get results, turn on coding rules checking or code metric checking.

This property is equivalent to the **Find defects** check box in the Polyspace interface.

Example: `opts.BugFinderAnalysis.EnableCheckers = false`

### ChecksAssumption (Affects Code Prover Only)

**`AllowNegativeOperandInShift`** — Allow left shift operations on a negative number
false (default) | true

*This property affects Code Prover analysis only.*

Allow left shift operations on a negative number, specified as true or false.

For more information, see `Allow negative operand for left shifts (-allow-negative-operand-in-shift)`.

Example: `opts.ChecksAssumption.AllowNegativeOperandInShift = true`

**`AllowNonFiniteFloats`** — Incorporate infinities and/or NaNs
false (default) | true

*This property affects Code Prover analysis only.*

Incorporate infinities and/or NaNs, specified as true or false.

For more information, see `Consider non finite floats (-allow-non-finite-floats)`.

Example: `opts.ChecksAssumption.AllowNonFiniteFloats = true`

### `AllowPtrArithOnStruct` — Allow arithmetic on pointer to a structure field so that it points to another field

false (default) | true

*This property affects Code Prover analysis only.*

Allow arithmetic on pointer to a structure field so that it points to another field, specified as true or false.

For more information, see `Enable pointer arithmetic across fields (-allow-ptr-arith-on-struct)`.

Example: `opts.ChecksAssumption.AllowPtrArithOnStruct = true`

### `CheckSubnormal` — Detect operations that result in subnormal floating point values

`allow` (default) | `warn-first` | `warn-all` | `forbid`

*This property affects Code Prover analysis only.*

Detect operations that result in subnormal floating point values.

For more information, see `Subnormal detection mode (-check-subnormal)`.

Example: `opts.ChecksAssumption.CheckSubnormal = 'forbid'`

### `DetectPointerEscape` — Find cases where a function returns a pointer to one of its local variables

false (default) | true

*This property affects Code Prover analysis only.*

Find cases where a function returns a pointer to one of its local variables, specified as true or false.

For more information, see `Detect stack pointer dereference outside scope (-detect-pointer-escape)`.

Example: `opts.ChecksAssumption.DetectPointerEscape = true`

### `DisableInitializationChecks` — Disable checks for noninitialized variables and pointers

false (default) | true

*This property affects Code Prover analysis only.*

Disable checks for noninitialized variables and pointers, specified as true or false.

For more information, see `Disable checks for non-initialization (-disable-initialization-checks)`.

Example: `opts.ChecksAssumption.DisableInitializationChecks = true`

### `IgnoreConstantOverflows` — Allow overflow in computations involving constants

false (default) | true

*This property affects Code Prover analysis only.*

Allow overflow in computations involving constants, specified as true or false.

For more information, see `Ignore overflowing computations on constants (-ignore-constant-overflows)`.

Example: `opts.ChecksAssumption.IgnoreConstantOverflows = true`

### `PermissiveFunctionPointer` — Allow type mismatch between function pointers and the functions they point to

false (default) | true

*This property affects Code Prover analysis only.*

Allow type mismatch between function pointers and the functions they point to, specified as true or false.

For more information, see `Permissive function pointer calls (-permissive-function-pointer)`.

Example: `opts.ChecksAssumption.PermissiveFunctionPointer = true`

### `ScalarOverflowsBehavior` — Behavior of scalar overflows

`wrap-around` (default) | `truncate-on-error`

*This property affects Code Prover analysis only.*

Behavior of scalar overflows, specified as `wrap-around` or `truncate-on-error`.

For more information, see `Overflow computation mode (-scalar-overflows-behavior)`.

Example: `opts.ChecksAssumption.ScalarOverflowsBehavior = 'truncate-on-error'`

### `ScalarOverflowsChecks` — Check for integer overflows on signed and unsigned variables

`signed` (default) | `signed-and-unsigned` | `none`

*This property affects Code Prover analysis only.*

Check for integer overflows on signed and unsigned variables, specified as `signed`, `signed-and-unsigned`, or `none`.

For more information, see `Detect overflows (-scalar-overflows-checks)`.

Example: `opts.ChecksAssumption.ScalarOverflowsChecks = 'signed-and-unsigned'`

### `SizeInBytes` — Allow a pointer with insufficient memory buffer to point to a structure

false (default) | true

*This property affects Code Prover analysis only.*

Allow a pointer with insufficient memory buffer to point to a structure, specified as true or false.

For more information, see `Allow incomplete or partial allocation of structures (-size-in-bytes)`.

Example: `opts.ChecksAssumption.SizeInBytes = true`

### `UncalledFunctionCheck` — Detect functions that are not called directly or indirectly from main or another entry-point function

`none` (default) | `never-called` | `called-from-unreachable` | `all`

*This property affects Code Prover analysis only.*

Detect functions that are not called directly or indirectly from main or another entry-point function, specified as `none`, `never-called`, `called-from-unreachable`, or `all`.

For more information, see `Detect uncalled functions (-uncalled-function-checks)`.

Example: `opts.ChecksAssumption.UncalledFunctionCheck = 'all'`

### CodeProverVerification (Affects Code Prover only)

**`ClassAnalyzer` — Classes that you want to verify**
`all` (default) | `none` | cell array of class names

*This property affects Code Prover analysis only.*

Classes that you want to verify, specified as `all`, `none`, or a cell array of class names.

For more information, see `Class (-class-analyzer)`.

Example: `opts.CodeProverVerification.ClassAnalyzer = 'none'`

**`FunctionsCalledAfterLoop` — Functions that the generated main must call after the cyclic code loop**
cell array of function names

*This property affects Code Prover analysis only.*

Functions that the generated main must call after the cyclic code loop, specified as a cell array of function names.

For more information, see `Termination functions (-functions-called-after-loop)`.

Example: `opts.CodeProverVerification.FunctionsCalledAfterLoop = {'func1','func2'}`

**`FunctionsCalledBeforeLoop` — Functions that the generated main must call before the cyclic code loop**
cell array of function names

*This property affects Code Prover analysis only.*

Model Link only. Functions that the generated main must call before the cyclic code loop, specified as a cell array of function names.

For more information, see `Initialization functions (-functions-called-before-loop)`.

Example: `opts.CodeProverVerification.FunctionsCalledBeforeLoop = {'func1','func2'}`

### `FunctionsCalledInLoop` — Functions that the generated main must call in the cyclic code loop

`none` (default) | `all` | cell array of function names

*This property affects Code Prover analysis only.*

Functions that the generated main must call in the cyclic code loop, specified as `none`, `all`, or a cell array of function names.

For more information, see `Step functions (-functions-called-in-loop)`.

Example: `opts.CodeProverVerification.FunctionsCalledInLoop = 'all'`

### `MainGenerator` — Generate a main function if it is not present in source files

true (default) | false

*This property affects Code Prover analysis only.*

Generate a main function if it is not present in source files, specified as true or false.

For more information, see `Verify module or library (-main-generator)`.

Example: `opts.CodeProverVerification.MainGenerator = false`

### `VariablesWrittenBeforeLoop` — Variables that the generated main must initialize before the cyclic code loop

`none` (default) | `all` | cell array of variable names

*This property affects Code Prover analysis only.*

Variables that the generated main must initialize before the cyclic code loop, specified as `none`, `all`, or a cell array of variable names.

For more information, see `Parameters (-variables-written-before-loop)`.

Example: `opts.CodeProverVerification.VariablesWrittenBeforeLoop = 'all'`

### `VariablesWrittenInLoop` — Variables that the generated main must initialize in the cyclic code loop

`none` (default) | `all` | cell array of variable names

*This property affects Code Prover analysis only.*

Variables that the generated main must initialize in the cyclic code loop, specified as `none`, `all`, or a cell array of variable names.

For more information, see `Inputs (-variables-written-in-loop)`.

Example: `opts.CodeProverVerification.VariablesWrittenInLoop = 'all'`

## CodingRulesCodeMetrics

### `AcAgcSubset` — Subset of MISRA AC AGC rules to check

`OBL-rules` (default) | `OBL-REC-rules` | `all-rules` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA AC AGC rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA AC AGC (-misra-ac-agc)`.
- MISRA AC AGC coding rules object created with `polyspace.CodingRulesOptions('misraAcAgc')`.
- Full path to a file containing your MISRA AC AGC subset. You can create this file manually or in the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check MISRA AC AGC rules, also set `EnableAcAgc` to true.

Example: `opts.CodingRulesCodeMetrics.AcAgcSubset = 'all-rules'`

Data Types: `char`

### `AllowedPragmas` — Pragma directives for which MISRA C:2004 rule 3.4 or MISRA C++ 16-6-1 must not be applied

cell array of character vectors

Pragma directives for which MISRA C:2004 rule 3.4 or MISRA C++ 16-6-1 must not be applied, specified as a cell array of character vectors. This property affects only MISRA C:2004 or MISRA AC AGC rule checking.

For more information, see `Allowed pragmas (-allowed-pragmas)`.

Example: `opts.CodingRulesCodeMetrics.AllowedPragmas = {'pragma_01','pragma_02'}`

Data Types: `cell`

### `BooleanTypes` — Data types the coding rule checker must treat as effectively Boolean

cell array of character vectors

Data types that the coding rule checker must treat as effectively Boolean, specified as a cell array of character vectors.

For more information, see `Effective boolean types (-boolean-types)`.

Example: `opts.CodingRulesCodeMetrics.BooleanTypes = {'boolean1_t','boolean2_t'}`

Data Types: `cell`

### `CodeMetrics` — Activate code metric calculations

false (default) | true

Activate code metric calculations, specified as true or false. If this property is turned off, Polyspace does not calculate code metrics even if you upload your results to Polyspace Metrics.

For more information about the code metrics, see `Calculate code metrics (-code-metrics)`.

Example: `opts.CodingRulesCodeMetrics.CodeMetrics = true`

### `CustomRulesSubset` — Custom naming conventions to check against

custom coding rules file

Custom naming conventions to check against, specified as a custom coding rules file. You can create the custom coding rules file manually or in the Polyspace interface.

For more information, see `Check custom rules (-custom-rules)`.

Example: `opts.CodingRulesCodeMetrics.CustomRulesSubset = 'C:\ps_settings\coding_rules\custom_rules.txt'`

Data Types: `char`

### `EnableAcAgc` — Check MISRA AC AGC rules

false (default) | true

Check MISRA AC AGC rules, specified as true or false. To customize which rules are checked, use `AcAgcSubset`.

For more information about the MISRA AC AGC checker, see `Check MISRA AC AGC (-misra-ac-agc)`.

Example: `opts.CodingRulesCodeMetrics.EnableAcAgc = true;`

### `EnableCustomRules` — Check custom coding rules

false (default) | true

Check custom coding rules, specified as true or false. Use with `CustomRulesSubset`.

For more information, see `Check custom rules (-custom-rules)`.

Example: `opts.CodingRulesCodeMetrics.EnableCustomRules = true;`

### `EnableJsf` — Check JSF C++ rules

false (default) | true

Check JSF C++ rules, specified as true or false. To customize which rules are checked, use `JsfSubset`.

For more information, see `Check JSF C++ rules (-jsf-coding-rules)`.

Example: `opts.CodingRulesCodeMetrics.EnableJsf = true;`

### `EnableMisraC` — Check MISRA C:2004 rules

false (default) | true

Check MISRA C:2004 rules, specified as true or false. To customize which rules are checked, use `MisraCSubset`.

For more information, see `Check MISRA C:2004 (-misra2)`.

Example: `opts.CodingRulesCodeMetrics.EnableMisraC = true;`

### `EnableMisraC3` — Check MISRA C:2012 rules

false (default) | true

Check MISRA C:2012 rules, specified as true or false. To customize which rules are checked, use `MisraC3Subset`.

For more information about the MISRA C:2012 checker, see `Check MISRA C:2012 (-misra3)`.

Example: `opts.CodingRulesCodeMetrics.EnableMisraC3 = true;`

### `EnableMisraCpp` — Check MISRA C++:2008 rules

false (default) | true

Check MISRA C++:2008 rules, specified as true or false. To customize which rules are checked, use `MisraCppSubset`.

For more information about the MISRA C++:2008 checker, see `Check MISRA C++ rules (-misra-cpp)`.

Example: `opts.CodingRulesCodeMetrics.EnableMisraCpp = true;`

### `JsfSubset` — Subset of JSF C++ rules to check

`shall-rules` (default) | `shall-will-rules` | `all-rules` | coding rules object | file

Subset of JSF C++ rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check JSF C++ rules (-jsf-coding-rules)`.
- JSF C++ coding rules object created with `polyspace.CodingRulesOptions('jsf')`.
- Full path to a file containing your JSF C++ subset. You can create this file manually or from the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check JSF C++ rules, set `EnableJsf` to true.

Example: `opts.CodingRulesCodeMetrics.JsfSubset = 'all-rules'`

Data Types: `char`

### `Misra3AgcMode` — Use the MISRA C:2012 categories for automatically generated code

false (default) | true

Use the MISRA C:2012 categories for automatically generated code, specified as true or false.

For more information, see `Use generated code requirements (-misra3-agc-mode)`.

Example: `opts.CodingRulesCodeMetrics.Misra3AgcMode = true;`

### `MisraC3Subset` — Subset of MISRA C:2012 rules to check

`mandatory-required` (default) | `mandatory` | `all` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA C:2012 rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA C:2012 (-misra3)`.
- MISRA C:2012 coding rules object created with `polyspace.CodingRulesOptions('misraC2012')`.
- Full path to a file containing your MISRA C:2012 subset. You can create the custom coding rules file manually or in the Polyspace interface. See "Select Specific MISRA or JSF Coding Rules".

To check MISRA C:2012 rules, also set `EnableMisraC3` to true.

Example: `opts.CodingRulesCodeMetrics.MisraC3Subset = 'all'`

Data Types: `char`

### `MisraCSubset` — Subset of MISRA C:2004 rules to check

`required-rules` (default) | `all-rules` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA C:2004 rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA C:2004 (-misra2)`.
- MISRA C:2004 coding rules object created with `polyspace.CodingRulesOptions('misraC')`.
- Full path to a file containing your MISRA C:2004 subset. You can create the custom coding rules file manually or in the Polyspace interface. See "Select Specific MISRA or JSF Coding Rules".

To check MISRA C:2004 rules, also set `EnableMisraC` to true.

Example: `opts.CodingRulesCodeMetrics.MisraCSubset = 'all-rules'`

Data Types: `char`

### `MisraCppSubset` — Subset of MISRA C++ rules

`required-rules` (default) | `all-rules` | `SQO-subset1` | `SQO-subset2` | coding rules object | file

Subset of MISRA C++:2008 rules to check, specified by:

- Character vector of one of the subset names. For more information about the different subsets, see `Check MISRA C++ rules (-misra-cpp)`.
- MISRA C++ coding rules object created with `polyspace.CodingRulesOptions('misraCpp')`.
- Full path to a file containing your MISRA C++ subset. You can create this file manually or from the Polyspace interface. See “Select Specific MISRA or JSF Coding Rules”.

To check MISRA C++ rules, set `EnableMisraCpp` to true.

Example: `opts.CodingRulesCodeMetrics.MisraCppSubset = 'all-rules'`

Data Types: `char`

## EnvironmentSettings

### `Dos` — Consider that file paths are in MS-DOS style

true (default) | false

Consider that file paths are in MS-DOS style, specified as true or false.

For more information, see `Code from DOS or Windows file system (-dos)`.

Example: `opts.EnvironmentSettings.Dos = true;`

### `IncludeFolders` — Include folders needed for compilation

cell array of include folder paths

Include folders needed for compilation, specified as a cell array of the include folder paths.

To specify all subfolders of a folder, use folder path followed by `**`, for instance, `'C:\includes\**'`. The notation follows the syntax of the `dir` function. See also “Specify Multiple Source Files”.

For more information, see `-I`.

Example: `opts.EnvironmentSettings.IncludeFolders = {'/includes','/com1/inc'};`

Example: `opts.EnvironmentSettings.IncludeFolders = {'C:\project1\common\includes'};`

Data Types: `cell`

### `Includes` — Files to be `#include`-ed by each C file

cell array of files

Files to be `#include`-ed by each C source file in the analysis, specified by a cell array of files.

For more information, see `Include (-include)`.

Example: `opts.EnvironmentSettings.Includes = {'/inc/inc_file.h','/inc/inc_math.h'}`

### `NoExternC` — Ignore linking errors inside extern blocks

false (default) | true

Ignore linking errors inside extern blocks, specified as true or false.

For more information, see `Ignore link errors (-no-extern-c)`.

Example: `opts.EnvironmentSettings.NoExternC = false;`

### `PostPreProcessingCommand` — Command or script to run on source files after preprocessing

character vector

Command or script to run on source files after preprocessing, specified as a character vector of the command to run.

For more information, see `Command/script to apply to preprocessed files (-post-preprocessing-command)`.

Example: Linux — `opts.EnvironmentSettings.PostPreProcessingCommand = ''pwd'/replace_keyword.pl'`

Example: Windows — `opts.EnvironmentSettings.PostPreProcessingCommand = '"C:\Program Files\MATLAB\R2015b\sys\perl\win32\bin\perl.exe" "C:\My_Scripts\replace_keyword.pl"'`

### `StopWithCompileError` — Stop analysis if a file does not compile

false (default) | true

Stop analysis if a file does not compile, specified as true or false.

For more information, see `Stop analysis if a file does not compile (-stop-if-compile-error)`.

Example: `opts.EnvironmentSettings.StopWithCompileError = true;`

## InputsStubbing

### `DataRangeSpecifications` — Constrain global variables, function inputs, and return values of stubbed functions

file path

Constrain global variables, function inputs, and return values of stubbed functions specified by the path to an XML constraint file. For more information about the constraint file, see “Specify External Constraints”.

For more information about this option, see `Constraint setup (-data-range-specifications)`.

Example: `opts.InputsStubbing.DataRangeSpecifications = 'C:\project\constraint_file.xml'`

### `DoNotGenerateResultsFor` — Files on which you do not want analysis results

`include-folders` (default) | `all-headers` | cell array of files or folders

Files on which you do not want analysis results, specified by `include-folders`, `all-headers`, or a character array beginning with `custom=` and containing a comma-separated file or folder names.

Use this option with `InputsStubbing.GenerateResultsFor`. For more information, see `Do not generate results for (-do-not-generate-results-for)`.

Example: `opts.InputsStubbing.DoNotGenerateResultsFor = 'custom=C:\project\file1.c,C:\project\file2.c'`

**`GenerateResultsFor`** — Files on which you want analysis results
`source-headers` (default) | `all-headers` | character array

Files on which you do not want analysis results, specified by `source-headers`, `all-headers`, or a character array beginning with `custom=` and containing a comma-separated file or folder names.

Use this option with `InputsStubbing.DoNotGenerateResultsFor`. For more information, see `Generate results for sources and (-generate-results-for)`.

Example: `opts.InputsStubbing.GenerateResultsFor = 'custom=C:\project\includes_common_1,C:\project\includes_common_2'`

**`FunctionsToStub`** — Functions to stub during analysis
cell array of function names

*This property affects Code Prover analysis only.*

Functions to stub during analysis, specified as a cell array of function names.

For more information, see .

Example: `opts.InputsStubbing.FunctionsToStub = {'func1', 'func2'}`

**`NoDefInitGlob`** — Consider global variables as uninitialized
false (default) | true

*This property affects Code Prover analysis only.*

Consider global variables as uninitialized, specified as true or false.

For more information, see .

Example: `opts.InputsStubbing.NoDefInitGlob = true`

**`NoStlStubs`** — Do not use Polyspace implementations of functions in the Standard Template Library
false (default) | true

*This property applies only to a Code Prover analysis of C++ code.*

Do not use Polyspace implementations of functions in the Standard Template Library, specified as true or false.

For more information, see .

Example: `opts.InputsStubbing.NoStlStubs = true`

### `StubECoderLookupTables` — Specify that the analysis must stub functions in the generated code that use lookup tables

`true` (default) | `false`

*This property applies only to a Code Prover analysis of code generated from models.*

Specify that the analysis must stub functions in the generated code that use lookup tables. By replacing the functions with stubs, the analysis assumes more precise return values for the functions.

For more information, see `Generate stubs for Embedded Coder lookup tables (-stub-embedded-coder-lookup-table-functions)`.

Example: `opts.InputsStubbing.StubECoderLookupTables = true`

#### Macros

### `DefinedMacros` — Macros to be replaced

cell array of macros

In preprocessed code, macros are replaced by the definition, specified in a cell array of macros and definitions. Specify the macro as `Macro=Value`. If you want Polyspace to ignore the macro, leave the `Value` blank. A macro with no equal sign replaces all instances of that macro by 1.

For more information, see `Preprocessor definitions (-D)`.

Example: `opts.Macros.DefinedMacros = {'uint32=int','name3=','var'}`

### `UndefinedMacros` — Macros to undefine

cell array of macros

In preprocessed code, macros are undefined, specified by a cell array of macros to undefine.

For more information, see `Disabled preprocessor definitions (-U)`.

Example: `opts.Macros.DefinedMacros = {'name1','name2'}`

MergedComputingSettings

**`AddToResultsRepositoryBugFinder`** — Upload Bug Finder results to Polyspace Metrics web dashboard
false (default) | true

*This property affects Bug Finder analysis only.*

Upload Bug Finder analysis results to Polyspace Metrics web dashboard, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Upload results to Polyspace Metrics (-add-to-results-repository)`.

Example: `opts.MergedComputingSettings.AddToResultsRepositoryBugFinder = true;`

**`AddToResultsRepositoryCodeProver`** — Upload Code Prover results to Polyspace Metrics web dashboard
false (default) | true

*This property affects Code Prover analysis only.*

Upload Code Prover analysis results to Polyspace Metrics web dashboard, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Upload results to Polyspace Metrics (-add-to-results-repository)`.

Example: `opts.MergedComputingSettings.AddToResultsRepositoryCodeProver = true;`

**`BatchBugFinder`** — Send Bug Finder analysis to remote server
false (default) | true

*This property affects Bug Finder analysis only.*

Send Bug Finder analysis to remote server, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`.

Example: `opts.MergedComputingSettings.BatchBugFinder = true;`

### `BatchCodeProver` — Send Code Prover analysis to remote server

false (default) | true

*This property affects Code Prover analysis only.*

Send Code Prover analysis to remote server, specified as true or false. To use this option, in your Polyspace preferences, you must specify a metrics server.

For more information, see `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`.

Example: `opts.MergedComputingSettings.BatchCodeProver = true;`

### `FastAnalysis` — Run Bug Finder analysis using faster local mode

false (default) | true

*This property affects Bug Finder analysis only.*

Use fast analysis mode for Bug Finder analysis, specified as true or false.

For more information, see `Use fast analysis mode for Bug Finder (-fast-analysis)`.

Example: `opts.MergedComputingSettings.FastAnalysis = true;`

## MergedReporting

### `EnableReportGeneration` — Generate a report after the analysis

false (default) | true

After the analysis, generate a report, specified as true or false.

For more information, see `Generate report`.

Example: `opts.MergedReporting.EnableReportGeneration = true`

### `ReportOutputFormat` — Output format of generated report

`Word` (default) | `HTML` | `PDF`

Output format of generated report, specified as one of the report formats. To activate this option, specify `Reporting.EnableReportGeneration`.

For more information about the different values, see `Output format (-report-output-format)`.

Example: `opts.MergedReporting.ReportOutputFormat = 'PDF'`

### `BugFinderReportTemplate` — Template for generating Bug Finder analysis report

`BugFinderSummary` (default) | `BugFinder` | `BugFinder_CWE` | `CodeMetrics` | `Metrics`

*This property affects a Bug Finder analysis only.*

Template for generating analysis report, specified as one of the report formats. To activate this option, specify `Reporting.EnableReportGeneration`.

For more information about the different values, see `Bug Finder and Code Prover report (-report-template)`.

Example: `opts.MergedReporting.BugFinderReportTemplate = 'CodeMetrics'`

### `CodeProverReportTemplate` — Template for generating Code Prover analysis report

`Developer` (default) | `CallHierarchy` | `CodeMetrics` | `CodingRules` | `Developer` | `DeveloperReview` | `Developer_withGreenChecks` | `Quality` | `SoftwareQualityObjectives` | `SoftwareQualityObjectives_Summary` | `VariableAccess`

*This property affects a Code Prover analysis only.*

Template for generating analysis report, specified as one of the predefined report formats. To activate this option, specify `Reporting.EnableReportGeneration`.

For more information about the different values, see `Bug Finder and Code Prover report (-report-template)`.

Example: `opts.MergedReporting.CodeProverReportTemplate = 'CodeMetrics'`

## Multitasking

### `CriticalSectionBegin` — Functions that begin critical sections

cell array of critical section function names

Functions that begin critical sections specified as a cell array of critical section function names. To activate this option, specify `Multitasking.EnableMultitasking` and `Multitasking.CriticalSectionEnd`.

For more information, see `Critical section details (-critical-section-begin -critical-section-end)`.

Example: `opts.Multitasking.CriticalSectionBegin = {'function1:cs1','function2:cs2'}`

### **`CriticalSectionEnd`** — Functions that end critical sections

cell array of critical section function names

Functions that end critical sections specified as a cell array of critical section function names. To activate this option, specify `Multitasking.EnableMultitasking` and `Multitasking.CriticalSectionBegin`.

For more information, see `Critical section details (-critical-section-begin -critical-section-end)`.

Example: `opts.Multitasking.CriticalSectionEnd = {'function1:cs1','function2:cs2'}`

### **`CyclicTasks`** — Specify functions that represent cyclic tasks

cell array of function names

Specify functions that represent cyclic tasks.

To activate this option, also specify `Multitasking.EnableMultitasking`.

For more information, see `Cyclic tasks (-cyclic-tasks)`.

Example: `opts.Multitasking.CyclicTasks = {'function1','function2'}`

### **`EnableConcurrencyDetection`** — Enable automatic detection of certain families of threading functions

false (default) | true

*This property affects Code Prover analysis only.*

Enable automatic detection of certain families of threading functions, specified as true or false.

For more information, see `Enable automatic concurrency detection for Code Prover (-enable-concurrency-detection)`.

Example: `opts.Multitasking.EnableConcurrencyDetection = true`

### **`EnableMultitasking`** — Configure multitasking manually

false (default) | true

Configure multitasking manually by specifying `true`. This property activates the other manual, multitasking properties.

For more information, see `Configure multitasking manually`.

Example: `opts.Multitasking.EnableMultitasking = 1`

### **`EnableOsekMultitasking`** — Enable automatic multitasking configuration for OSEK project

false (default) | true

Enable multitasking configuration of your OSEK project from the OIL files you provide. Activate this option to enable `Multitasking.OsekMultitasking`.

For more information, see `OSEK multitasking configuration (-osek-multitasking)`

Example: `opts.Multitasking.EnableOsekMultitasking = 1`

### **`EntryPoints`** — Functions that serve as entry-points to your multitasking application

cell array of entry-point function names

Functions that serve as entry-points to your multitasking application specified as a cell array of entry-point function names. To activate this option, also specify `Multitasking.EnableMultitasking`.

For more information, see `Entry points (-entry-points)`.

Example: `opts.Multitasking.EntryPoints = {'function1','function2'}`

### **`Interrupts`** — Specify functions that represent nonpreemptable interrupts

cell array of function names

Specify functions that represent nonpreemptable interrupts.

To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Interrupts (-interrupts)`.

Example: `opts.Multitasking.Interrupts = {'function1','function2'}`

### `InterruptsDisableAll` — Specify routine that disable interrupts

cell array with one function name

*This property affects Bug Finder analysis only.*

Specify function that disables all interrupts.

To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`.

Example: `opts.Multitasking.InterruptsDisableAll = {'function'}`

### `InterruptsEnableAll` — Specify routine that reenable interrupts

cell array with one function name

*This property affects Bug Finder analysis only.*

Specify function that reenables all interrupts.

To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`.

Example: `opts.Multitasking.InterruptsEnableAll = {'function'}`

### `OsekMultitasking` — Specify path of OIL files to parse for multitasking configuration

`auto` | cell array of files

Specify the path to the OIL files the software parses to set up your multitasking configuration:

- In `auto` mode, the analysis uses OIL files in your project source and include folders, but not their subfolders.
- In `custom` mode, the analysis uses the OIL files at the specified path, and the path subfolders.

To activate this option, specify `MultitaskingEnableOsekMultitasking`.

For more information, see `OSEK multitasking configuration (-osek-multitasking)`

Example: `opts.Multitasking.OsekMultitasking = 'custom='file_path, dir_path'`

**`TemporalExclusion`** **— Entry-point functions that cannot execute concurrently**
cell array of entry-point function names

Entry-point functions that cannot execute concurrently specified as a cell array of entry-point function names. Each set of exclusive tasks is one cell array entry with functions separated by spaces. To activate this option, specify `Multitasking.EnableMultitasking`.

For more information, see `Temporally exclusive tasks (-temporal-exclusions-file)`.

Example: `opts.Multitasking.TemporalExclusion = {'function1 function2', 'function3 function4 function5'}` where function1 and function2 are temporally exclusive, and function3, function4, and function 5 are temporally exclusive.

### Precision (Affects Code Prover Only)

**`ContextSensitivity`** **— Store call context information to identify function call that caused errors**
`none` (default) | `auto` | cell array of function names

*This property affects Code Prover analysis only.*

Store call context information to identify a function call that caused errors, specified as `none`, `auto`, or a cell array of function names.

For more information, see `Sensitivity context (-context-sensitivity)`.

Example: `opts.Precision.ContextSensitivity = 'auto'`

Example: `opts.Precision.ContextSensitivity = 'custom=func1'`

**`ModulesPrecision`** **— Source files you want to verify at higher precision**
cell array of file names and precision levels

*This property affects Code Prover analysis only.*

Source files that you want to verify at higher precision, specified as a cell array of file names without the extension and precision levels using this syntax: *`filename`*`:O`*`level`*

For more information, see `Specific precision (-modules-precision)`.

Example: `opts.Precision.ModulesPrecision = {'file1:O0', 'file2:O3'}`

### **`OLevel`** — Precision level for the verification

2 (default) | 0 | 1 | 3

*This property affects Code Prover analysis only.*

Precision level for the verification, specified as 0, 1, 2, or 3.

For more information, see `Precision level (-O)`.

Example: `opts.Precision.OLevel = 3`

### **`PathSensitivityDelta`** — Avoid certain verification approximations for code with fewer lines

positive integer

*This property affects Code Prover analysis only.*

Avoid certain verification approximations for code with fewer lines, specified as a positive integer representing how sensitive the analysis is. Higher values can increase verification time exponentially.

For more information, see `Improve precision of interprocedural analysis (-path-sensitivity-delta)`.

Example: `opts.Precision.PathSensitivityDelta = 2`

### **`Timeout`** — Time limit on your verification

character vector

*This property affects Code Prover analysis only.*

Time limit on your verification, specified as a character vector of time in hours.

For more information, see `Verification time limit (-timeout)`.

Example: `opts.Precision.Timeout = '5.75'`

**`To` — Number of times the verification process runs**
`Software Safety Analysis level 2` (default) | `Software Safety Analysis level 0` | `Software Safety Analysis level 1` | `Software Safety Analysis level 3` | `Software Safety Analysis level 4` | `Source Compliance Checking` | `other`

*This property affects Code Prover analysis only.*

Number of times the verification process runs, specified as one of the preset analysis levels.

For more information, see `Verification level (-to)`.

Example: `opts.Precision.To = 'Software Safety Analysis level 3'`

Scaling (Affects Code Prover Only)

**`Inline` — Functions on which separate results must be generated for each function call**
cell array of function names

*This property affects Code Prover analysis only.*

Functions on which separate results must be generated for each function call, specified as a cell array of function names.

For more information, see `Inline (-inline)`.

Example: `opts.Scaling.Inline = {'func1','func2'}`

**`KLimiting` — Limit depth of analysis for nested structures**
positive integer

*This property affects Code Prover analysis only.*

Limit depth of analysis for nested structures, specified as a positive integer indicating how many levels into a nested structure to verify.

For more information, see `Depth of verification inside structures (-k-limiting)`.

Example: `opts.Scaling.KLimiting = 3`

### TargetCompiler

**`Compiler` — Compiler that builds your source code**
`generic` (default) | `clang3.5` | `gnu3.4` | `gnu4.6` | `gnu4.7` | `gnu4.8` | `gnu4.9` | `iar` | `iso` | `keil` | `visual9.0` | `visual10` | `visual11.0` | `visual12.0` | `visual14.0`

Compiler that builds your source code.

For more information, see `Compiler (-compiler)`.

Example: `opts.TargetCompiler.Compiler = 'Visual11.0'`

**`Cpp11Extension` — Allow C++11 language extensions**
false (default) | true

Allow C++11 language extensions, specified as true or false.

For more information, see `C++11 extensions (-cpp11-extension)`.

Example: `opts.TargetCompiler.Cpp11Extension = true`

**`DivRoundDown` — Round down quotients from division or modulus of negative numbers**
false (default) | true

Round down quotients from division or modulus of negative numbers, specified as true or false.

For more information, see `Division round down (-div-round-down)`.

Example: `opts.TargetCompiler.DivRoundDown = true`

**`EnumTypeDefinition` — Base type representation of enum**
`defined-by-compiler` (default) | `auto-signed-first` | `auto-unsigned-first`

Base type representation of enum, specified by an allowed base-type set. For more information about the different values, see `Enum type definition (-enum-type-definition)`.

Example: `opts.TargetCompiler.EnumTypeDefinition = 'auto-unsigned-first'`

**`IgnorePragmaPack` — Ignore #pragma pack directives**
false (default) | true

Ignore #pragma pack directives, specified as true or false.

For more information, see `Ignore pragma pack directives (-ignore-pragma-pack)`.

Example: `opts.TargetCompiler.IgnorePragmaPack = true`

**`Language` — Language of analysis**
`C-CPP` (default) | `C` | `CPP`

This property is read-only.

Language of the analysis, specified during the object construction. This value changes which properties appear.

For more information, see `Source code language (-lang)`.

**`LogicalSignedRightShift` — Treatment of signed bit on signed variables**
`Arithmetical` (default) | `Logical`

Treatment of signed bit on signed variables, specified as `Arithmetical` or `Logical`. For more information, see `Signed right shift (-logical-signed-right-shift)`.

Example: `opts.TargetCompiler.LogicalSignedRightShift = 'Logical'`

**`NoLanguageExtensions` — Restrict analysis to C language specified in ANSI C standard**
false (default) | true

Restrict analysis to the C language that is specified in the ANSI C standard, specified as true or false. For more information, see `Respect C90 standard (-no-language-extensions)`.

Example: `opts.TargetCompiler.NoLanguageExtensions = true`

**`NoUliterals` — Do not use predefined typedefs for char16_t or char32_t**
false (default) | true

Do not use predefined typedefs for char16_t or char32_t, specified as true or false. For more information, see `Block char16/32_t types (-no-uliterals)`.

Example: `opts.TargetCompiler.NoUliterals = true`

**`PackAlignmentValue` — Default structure packing alignment**
`8` (default) | `1` | `2` | `4` | `16`

Default structure packing alignment, specified as `1`,`2`, `4`, `8`, or `16`. This property is available only for Visual C++ code.

For more information, see `Pack alignment value (-pack-alignment-value)`.

Example: `opts.TargetCompiler.PackAlignmentValue = '4'`

### `SizeTTypeIs` — Underlying type of `size_t`

`defined-by-compiler` (default) | `unsigned-int` | `unsigned-long` | `unsigned-long-long`

Underlying type of `size_t`, specified as `unsigned-int`, `unsigned-long` or `unsigned-long-long`. See `Management of size_t (-size-t-type-is)`.

Example: `opts.TargetCompiler.SizeTTypeIs = 'unsigned-long'`

### `WcharTTypeIs` — Underlying type of `wchar_t`

`defined-by-compiler` (default) | `signed-short` | `unsigned-short` | `signed-int` | `unsigned-int` | `signed-long` | `unsigned-long`

Underlying type of `wchar_t`, specified as `signed-short`, `unsigned-short`, `signed-int`, `unsigned-int`, `signed-long` or `unsigned-long`. See `Management of wchar_t (-wchar-t-type-is)`.

Example: `opts.TargetCompiler.WcharTTypeIs = 'unsigned-int'`

### `SfrTypes` — sfr types

cell array of `sfr` keywords

`sfr` types, specified as a cell array of `sfr` keywords using the syntax *`sfr_name=size_in_bits`*. For more information, see `Sfr type support (-sfr-types)`.

Example: `opts.TargetCompiler.SfrTypes = {'sfr32=32'}`

### `Target` — Target processor

`i386` (default) | `sparc` | `m68k` | `powerpc` | `powerpc64` | `c-167` | `tms320c3x` | `sharc21x61` | `necv580` | `hc08` | `hc12` | `mpc5xx` | `c18` | `x86_64` | generic target object

Set size of data types and endienness of processor, specified as one of the predefined target processors or a generic target object.

For more information about the predefined processors, see `Target processor type (-target)`.

For more information about creating a generic target, see `polyspace.GenericTargetOptions`.

Example: `opts.TargetCompiler.Target = 'hc12'`

### VerificationAssumption (Affects Code Prover Only)

#### `ConsiderVolatileQualifierOnFields` — Assume that volatile qualified structure fields can have all possible values at any point in code

false (default) | true

*This property affects Code Prover analysis only.*

Assume that volatile qualified structure fields can have all possible values at any point in code.

For more information, see `Consider volatile qualifier on fields (-consider-volatile-qualifier-on-fields)`.

Example: `opts.VerificationAssumption.ConsiderVolatileQualifierOnFields = true`

#### `ConstraintPointersMayBeNull` — Specify that environment pointers can be NULL unless constrained otherwise

false (default) | true

*This property affects Code Prover analysis only.*

Specify that environment pointers can be NULL unless constrained otherwise.

For more information, see `Consider environment pointers as unsafe (-stubbed-pointers-are-unsafe)`.

Example: `opts.VerificationAssumption.ConstraintPointersMayBeNull = true`

#### `FloatRoundingMode` — Rounding modes to consider when determining the results of floating-point arithmetic

`to-nearest` (default) | `all`

*This property affects Code Prover analysis only.*

Rounding modes to consider when determining the results of floating-point arithmetic, specified as `to-nearest` or `all`.

For more information, see `Float rounding mode (-float-rounding-mode)`.

Example: `opts.VerificationAssumption.FloatRoundingMode = 'all'`

### `RespectTypesInFields` — Do not cast nonpointer fields of a structure to pointers

false (default) | true

*This property affects Code Prover analysis only.*

Do not cast nonpointer fields of a structure to pointers, specified as true or false.

For more information, see `Respect types in fields (-respect-types-in-fields)`.

Example: `opts.VerificationAssumption.RespectTypesInFields = true`

### `RespectTypesInGlobals` — Do not cast nonpointer global variables to pointers

false (default) | true

*This property affects Code Prover analysis only.*

Do not cast nonpointer global variables to pointers, specified as true or false.

For more information, see `Respect types in global variables (-respect-types-in-globals)`.

Example: `opts.VerificationAssumption.RespectTypesInGlobals = true`

## Other Properties

### `Prog` — Project name

`PolyspaceProject` (default) | character vector

Project name, specified as a character vector.

For more information, see `-prog`.

Example: `opts.Prog = 'myProject'`

### `ResultsDir` — Location to store results

folder path

Location to store results, specified as a folder path. By default, the results are stored in the current folder.

For more information, see `-results-dir`.

Example: `opts.ResultsDir = 'C:\project\myproject\results\'`

### `Sources` — Source files

cell array of files

Source files to analyze, specified as a cell array of files.

To specify all files in a folder, use folder path followed by `*`, for instance, `'C:\src\*'`. To specify all files in a folder and its subfolders, use folder path followed by `**`, for instance, `'C:\src\**'`. The notation follows the syntax of the `dir` function. See also “Specify Multiple Source Files”.

For more information, see `-sources`.

Example: `opts.Sources = {'file1.c', 'file2.c', 'file3.c'}`

Example: `opts.Sources = {'project/src1/file1.c', 'project/src2/file2.c', 'project/src3/file3.c'}`

### `Version` — Project version number

`1.0` (default) | character array of a number

Version number of project, specified as a character array of a number. This option is useful if you upload your results to Polyspace Metrics. If you increment version numbers each time that you reanalyze your object, you can compare the results from two versions in Polyspace Metrics.

For more information, see `-v[ersion]`.

Example: `opts.Version = '2.3'`

# See Also

## Topics

“Analysis Options”

Introduced in R2017a

# copyTo

**Class:** polyspace.Options
**Package:** polyspace

Copy common settings between Polyspace options objects

## Syntax

```
optsFrom.copyTo(optsTo)
```

## Description

`optsFrom.copyTo(optsTo)` copies the common options from `optsFrom` to `optsTo`. The options objects do not need to be the same type of options object. This method copies only properties that are common between the two objects.

## Input Arguments

### `optsFrom` — Options object you want to copy properties from

`polyspace.Options` or `polyspace.ModelLinkOptions` object

Option object that you want to copy properties from, specified as a `polyspace.Options` or `polyspace.ModelLinkOptions` object.

Example: `opts = polyspace.Options;`

### `optsTo` — Options object you want to copy properties to

`polyspace.Options` object

Option object that you want to copy properties to, specified as a `polyspace.Options` or `polyspace.ModelLinkOptions` object.

Example: `opts = polyspace.Options;`

## Examples

### Copy Polyspace Options Object

This example shows how to set the properties of one options object and then copy that object to another one.

Create a Polyspace options object and set properties.

```
opts1 = polyspace.Options();
opts1.Prog = 'DataRaceProject';
opts1.Sources = {'datarace.c'};
opts1.TargetCompiler.Compiler = 'diab';
```

Create another object and use copyTo to copy over options from the previous object.

```
opts2 = polyspace.Options();
copyTo(opts1, opts2);
```

## See Also

`polyspace.BugFinderOptions` | `polyspace.ModelLinkBugFinderOptions` | `polyspace.Options` | `polyspace.Options.generateProject`

**Introduced in R2016b**

# generateProject

**Class:** polyspace.Options
**Package:** polyspace

Generate psprj project from options object

## Syntax

`opts.generateProject(projectName)`

## Description

`opts.generateProject(projectName)` creates a `.psprj` project called `projectName` from the options specified in the `polyspace.Options` object `opts`.

## Input Arguments

### `opts` — Options object to convert into a `psprj` file

`polyspace.Options` or `polyspace.ModelLinkOptions` object

Option object to convert into a `psprj` file specified as a `polyspace.Options` or `polyspace.ModelLinkOptions` object.

Example: `opts = polyspace.Options;`

### `projectName` — Project file name

character vector

Project file name specified as a character vector. This argument is used as the name of the `psprj` file.

Example: `'myProject'`

## Examples

### Generate Project from a Bug Finder Options Object

This example shows how to create and use a Polyspace project that was generated from an options object.

Create a Bug Finder object and set properties.

```
sources = fullfile(matlabroot, 'polyspace','examples','cxx','Bug_Finder_Example',...
   'sources','numerical.c');
opts = polyspace.Options();
opts.Prog = 'MyProject';
opts.Sources = {sources};
opts.TargetCompiler.Compiler = 'gnu4.7';
```

Generate a Polyspace project. Name the project using the `Prog` property.

```
psprj = opts.generateProject(opts.Prog);
```

Run a Bug Finder analysis using one of these commands. Both commands produce identical analysis results. The only difference is that the `psprj` project can be rerun in the Polyspace interface.

```
polyspaceBugFinder(psprj, '-nodesktop');
polyspaceBugFinder(opts);
```

To run a Code Prover analysis, use `polyspaceCodeProver` instead of `polyspaceBugFinder`.

## Tips

If you want to include an options object in a `pslinkoptions` object:

1. Use this method to convert your object to a project.
2. Add the project to the `pslinkoptions` property `PrjConfig`.
3. Turn on the property `EnablePrjConfig`.

## See Also

`polyspace.BugFinderOptions` | `polyspace.ModelLinkBugFinderOptions` | `polyspace.Options` | `polyspace.Options.copyTo`

Introduced in R2016b

# toScript

**Class:** polyspace.Options
**Package:** polyspace

Add Polyspace options object definition to a script

## Syntax

```
filePath = opts.toScript(fileName,positionInScript)
```

## Description

`filePath = opts.toScript(fileName,positionInScript)` adds the properties of a `polyspace.Options` object to a MATLAB script. The script shows the values assigned to all the properties of the object. You can run the script later to define the object in the MATLAB workspace and use it.

## Input Arguments

### `opts` — Options object with Polyspace analysis options

`polyspace.Options` or `polyspace.ModelLinkOptions` object

Option object to store in MATLAB script, specified as a `polyspace.Options` or `polyspace.ModelLinkOptions` object.

Example: `opts = polyspace.Options;`

### `fileName` — Script name

Character vector

Name or path to script, specified as a character vector. If you specify a relative path, the script is created in subfolder of the current working folder.

Example: `'runPolyspace.m'`

**`positionInScript`** — Where to add object definition
`'create'` (default) | `'append'`

Position in script where the object properties are added, specified as `'create'` or `'append'`. If you specify `'append'`, the object properties are added to the end of an existing script. Otherwise, a new script is created.

## Output Arguments

**`filePath`** — Full path to script
Character vector

Full path to script, specified as a character vector.

Example: `'C:\myScripts\runPolyspace.m'`

## See Also

`polyspace.BugFinderOptions` | `polyspace.ModelLinkBugFinderOptions` | `polyspace.Options` | `polyspace.Options.generateProject`

### Topics

"Generate MATLAB Scripts from Polyspace User Interface"

Introduced in R2017b

# run

**Class:** polyspace.Project
**Package:** polyspace

Run a Polyspace analysis

## Syntax

`proj.run(product)`

## Description

`status = proj.run(product)` runs a Polyspace Bug Finder or Polyspace Code Prover analysis using the configuration specified in the `polyspace.Project` object `proj`. The analysis results are also stored in `proj`.

## Input Arguments

### `proj` — Polyspace project

`polyspace.Project` object

Polyspace project with configuration and results, specified as a `polyspace.Project` object.

### `product` — Type of analysis

`'bugFinder'` | `'codeProver'`

Type of analysis to run.

## Output Arguments

### `status` — Results of a Code Prover analysis

`true` | `false`

Status of analysis. If the analysis fails, the status is false. Otherwise, it is true.

The analysis can fail for multiple reasons:

- You provide source files that do not exist.
- None of your files compile. Even if one file compiles, unless you set the property StopWithCompileError to true, the analysis succeeds and returns a true status.

There can be many other reasons why the analysis fails. If the analysis fails, in your results folder, check the log file. You can see the results folder using the Configuration property of the polyspace.Project object:

```
proj = polyspace.Project;
proj.Configuration.ResultsDir
```

The log file is named Polyspace_R20*##n*_*ProjectName*_*date*-*time*.log.

## Examples

### Read Results to MATLAB Tables

Run a Polyspace Bug Finder analysis on the demo file numerical.c. Configure these options:

- Specify GCC 4.9 as your compiler.
- Save the results in a results subfolder of the current working folder.

```
proj = polyspace.Project

% Configure analysis
proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', ...
    'examples', 'cxx', 'Bug_Finder_Example', 'sources', 'numerical.c')};
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
proj.Configuration.ResultsDir = fullfile(pwd,'results');

% Run analysis
bfStatus = proj.run('bugFinder');
```

```
% Read results
bfSummary = proj.Results.getSummary('defects');
```

Introduced in R2017b

# getSummary

**Class:** polyspace.BugFinderResults
**Package:** polyspace

View number of defects organized by defect type

## Syntax

```
resObj.getSummary(resultsType)
```

## Description

`resSummary = resObj.getSummary(resultsType)` returns the distribution of results of type `resultsType` in a Bug Finder result set denoted by the `polyspace.BugFinderResults` object `resObj`. For instance, if you choose to see defects, you can see how many defects of each type are present in the result set, for instance, how many non-initialized variables or declaration mismatches.

## Input Arguments

**`resultsType`** — Type of Bug Finder analysis result
`'defects'` (default) | `'misraC'` | `'misraCAGC'` | `'misraCPP'` | `'misraC2012'` | `'jsf'` | `'metrics'` | `'customRules'`

Type of result, specified as a character vector.

| Entry | Meaning |
|---|---|
| `'defects'` | Bugs or defects. See “Defects”. |
| `'misraC'` | MISRA C:2004 rules. See “MISRA C:2004 and MISRA AC AGC Rules”. |
| `'misraCAGC'` | MISRA C:2004 rules for generated code. See “MISRA C:2004 and MISRA AC AGC Rules”. |

| Entry | Meaning |
|---|---|
| `'misraCPP'` | MISRA C++ rules. See “MISRA C++:2008 Rules”. |
| `'misraC2012'` | MISRA C:2012 rules. See “MISRA C:2012 Directives and Rules”. |
| `'jsf'` | JSF C++ rules. See “JSF C++ Rules”. |
| `'metrics'` | Code complexity metrics. See “Code Metrics”. |
| `'customRules'` | Custom rules enforcing naming conventions for identifiers. See “Custom Coding Rules”. |

## Output Arguments

**`resSummary`** — Distribution of defects by defect type
table

Distribution of defects by defect type, specified as a table. For instance, an extract of the table looks like this:

| Category | Defect | Impact | Total |
|---|---|---|---|
| Concurrency | Data race | High | 2 |
| Concurrency | Deadlock | High | 1 |
| Data flow | Non-initialized variable | High | 2 |

The table above shows that the result set contains two data races, one deadlock and two non-initialized variables.

For more information on MATLAB tables, see “Tables” (MATLAB).

## Examples

### Copy Existing Results to MATLAB Tables

This example shows how to read Bug Finder analysis results from MATLAB.

Copy a demo result set to a temporary folder.

```
resPath = fullfile(matlabroot,'polyspace','examples','cxx','Bug_Finder_Example', ...
'Module_1','BF_Result');
userResPath = tempname;
copyfile(resPath,userResPath);
```

Create the results object.

```
resObj = polyspace.BugFinderResults(userResPath);
```

Read results to MATLAB tables using the object.

```
resSummary = resObj.getSummary('defects');
resTable = resObj.getResults();
```

### Run Analysis and Read Results to MATLAB Tables

Run a Polyspace Bug Finder analysis on the demo file `numerical.c`. Configure these options:

- Specify GCC 4.9 as your compiler.
- Save the results in a `results` subfolder of the current working folder.

```
proj = polyspace.Project

% Configure analysis
proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', ...
    'examples', 'cxx', 'Bug_Finder_Example', 'sources', 'numerical.c')};
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
proj.Configuration.ResultsDir = fullfile(pwd,'results');

% Run analysis
bfStatus = proj.run('bugFinder');

% Read results
bfSummary = proj.Results.getSummary('defects');
```

## See Also

`polyspace.BugFinderResults`

## Topics

"Defects"
"Bug Finder Defect Groups"
"Classification of Defects by Impact"

### Introduced in R2017a

# getResults

**Class:** polyspace.BugFinderResults
**Package:** polyspace

Read Bug Finder results into MATLAB table

## Syntax

```
getResults(content)
```

## Description

`resTable = getResults(content)` returns a table showing all results in a Bug Finder result set denoted by the `polyspace.BugFinderResults` object `resObj`. You can manipulate the table to produce graphs and statistics about your results that you cannot obtain readily from the user interface.

## Input Arguments

### `content` — Result information to include

`'full'` (default) | `'readable'`

Amount of information to be included for each result. If you specify `'full'`, all information is included. See “Export Polyspace Analysis Results”. If you specify `'readable'`, the following information is not included:

- ID: Unique number for a result for the current analysis.
- Group: Defect groups, MISRA C:2012 groups, etc.
- Status, Severity, Comment: Information that *you* enter about a result.

If you do not specify this argument, the full table is included.

# Output Arguments

### `resTable` — Results of a Bug Finder analysis

table

Table showing all results from a single Bug Finder analysis. For each result, the table has information such as file, family, and so on. If a particular information is not available for a result, the entry in the table states `<undefined>`.

For more information on:

- The columns of the table, see “Export Polyspace Analysis Results”.
- MATLAB tables, see “Tables” (MATLAB).

# Examples

### Copy Existing Results to MATLAB Tables

This example shows how to read Bug Finder analysis results from MATLAB.

Copy a demo result set to a temporary folder.

```
resPath = fullfile(matlabroot,'polyspace','examples','cxx','Bug_Finder_Example', ...
'Module_1','BF_Result');
userResPath = tempname;
copyfile(resPath,userResPath);
```

Create the results object.

```
resObj = polyspace.BugFinderResults(userResPath);
```

Read results to MATLAB tables using the object.

```
resSummary = getSummary (resObj);
resTable = getResults (resObj);
```

### Run Analysis and Read Results to MATLAB Tables

Run a Polyspace Bug Finder analysis on the demo file `numerical.c`. Configure these options:

- Specify GCC 4.9 as your compiler.
- Save the results in a `results` subfolder of the current working folder.

```
proj = polyspace.Project

% Configure analysis
proj.Configuration.Sources = {fullfile(matlabroot, 'polyspace', ...
    'examples', 'cxx', 'Bug_Finder_Example', 'sources', 'numerical.c')};
proj.Configuration.TargetCompiler.Compiler = 'gnu4.9';
proj.Configuration.ResultsDir = fullfile(pwd,'results');

% Run analysis
bfStatus = proj.run('bugFinder');

% Read results
bfSummary = proj.Results.getResults('readable');
```

## See Also

`polyspace.BugFinderResults`

**Introduced in R2017a**

# MISRA C 2012

# MISRA C:2012 Dir 1.1

Any implementation-defined behavior on which the output of the program depends shall be documented and understood

## Description

### Directive Definition

*Any implementation-defined behavior on which the output of the program depends shall be documented and understood.*

### Rationale

A code construct has implementation-defined behavior if the C standard allows compilers to choose their own specifications for the construct. The full list of implementation-defined behavior is available in Annex J.3 of the standard ISO/IEC 9899:1999 (C99) and in Annex G.3 of the standard ISO/IEC 9899:1990 (C90).

If you understand and document all implementation-defined behavior, you can be assured that all output of your program is intentional and not produced by chance.

### Polyspace Specification

The analysis detects the following possibilities of implementation-defined behavior in C99 and their counterparts in C90. If you know the behavior of your compiler implementation, justify the analysis result with appropriate comments. To justify a result, assign one of these statuses: `Justified`, `No action planned`, or `Not a defect`.

Tip To mass-justify all results that indicate the same implementation-defined behavior, use the **Detail** column on the **Results List** pane. Click the column header so that all results with the same entry are grouped together. Select the first result and then select the last result while holding the `Shift` key. Assign a status to one of the results. If you do not see the **Detail** column, right-click any other column header and enable this column.

| C99 Standard Annex Ref | Behavior to Be Documented | How Polyspace Helps |
|---|---|---|
| J.3.2: Environment | An alternative manner in which `main` function may be defined. | The analysis flags `main` with arguments and return types other than:<br>`int main(void) { ... }`<br>or<br>`int main(int argc, char *argv[]) { ... }`<br>See section 5.1.2.2.1 of the C99 Standard. |
| J.3.2: Environment | The set of environment names and the method for altering the environment list used by the `getenv` function. | The analysis flags uses of the `getenv` function. For this function, you need to know the list of environment variables and how the list is modified.<br>See section 7.20.4.5 of the C99 Standard. |
| J.3.6: Floating Point | The rounding behaviors characterized by non-standard values of `FLT_ROUNDS`. | The analysis flags the include of `float.h` if values of `FLT_ROUNDS` are outside the set, {-1, 0, 1, 2, 3}. Only the values in this set lead to well-defined rounding behavior.<br>See section 5.2.4.2.2 of the C99 Standard. |
| J.3.6: Floating Point | The evaluation methods characterized by non-standard negative values of `FLT_EVAL_METHOD`. | The analysis flags the include of `float.h` if values of `FLT_EVAL_METHOD` are outside the set, {-1, 0, 1, 2}. Only the values in this set lead to well-defined behavior for floating-point operations.<br>See section 5.2.4.2.2 of the C99 Standard. |

| C99 Standard Annex Ref | Behavior to Be Documented | How Polyspace Helps |
|---|---|---|
| J.3.6: Floating Point | The direction of rounding when an integer is converted to a floating-point number that cannot exactly represent the original value. | The analysis flags conversions from integer to floating-point data types of smaller size (for example, 64-bit `int` to 32-bit `float`).<br>See section 6.3.1.4 of the C99 Standard. |
| J.3.6: Floating Point | The direction of rounding when a floating-point number is converted to a narrower floating-point number. | The analysis flags these conversions:<br>• `double` to `float`<br>• `long double` to `double` or `float`<br>See section 6.3.1.5 of the C99 Standard. |
| J.3.6: Floating Point | The default state for the `FENV_ACCESS` pragma. | The analysis flags use of the pragma other than:<br>`#pragma STDC FENV_ACCESS ON`<br>or<br>`#pragma STDC FENV_ACCESS OFF`<br>See section 7.6.1 of the C99 Standard. |
| J.3.6: Floating Point | The default state for the `FP_CONTRACT` pragma. | The analysis flags use of the pragma other than:<br>`#pragma STDC FP_CONTRACT ON`<br>or<br>`#pragma STDC FP_CONTRACT OFF`<br>See section 7.12.2 of the C99 Standard. |

| C99 Standard Annex Ref | Behavior to Be Documented | How Polyspace Helps |
|---|---|---|
| J.3.11: Preprocessing Directives | The behavior on each recognized non-STDC #pragma directive. | The analysis flags the pragma usage:<br>`#pragma` *`pp-tokens`*<br>where the processing token `STDC` does not immediately follow`pragma`. For instance:<br>`#pragma FENV_ACCESS ON`<br>See section 6.10.6 of the C99 Standard. |
| J.3.12: Library Functions | Whether the `feraiseexcept` function raises the “inexact” floating-point exception in addition to the “overflow” or “underflow” floating-point exception. | The analysis flags calls to the `feraiseexcept` function.<br>See section 7.6.2.3 of the C99 Standard. |
| J.3.12: Library Functions | Strings other than `"C"` and `""` that may be passed as the second argument to the `setlocale` funtion. | The analysis flags calls to the `setlocale` function when its second argument is not `"C"` or `""`.<br>See section 7.11.1.1 of the C99 Standard. |
| J.3.12: Library Functions | The types defined for `float_t` and `double_t` when the value of the `FLT_EVAL_METHOD` macro is less than 0 or greater than 2. | The analysis flags the include of `math.h` if `FLT_EVAL_METHOD` has values outside the set {0,1,2}.<br>See section 7.12 of the C99 Standard. |

| C99 Standard Annex Ref | Behavior to Be Documented | How Polyspace Helps |
|---|---|---|
| J.3.12: Library Functions | The base-2 logarithm of the modulus used by the `remquo` functions in reducing the quotient. | The analysis flags calls to the `remquo`, `remquof` and `remquol` function.<br>See section 7.12.10.3 of the C99 Standard. |
| J.3.12: Library Functions | The termination status returned to the host environment by the `abort`, `exit`, or `_Exit` function. | The analysis flags calls to the `abort`, `exit`, or `_Exit` function.<br>See sections 7.20.4.1, 7.20.4.3 or 7.20.4.4 of the C99 Standard. |

## Check Information

**Group:** The implementation
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017b

# MISRA C:2012 Dir 2.1

All source files shall compile without any compilation errors

## Description

### Directive Definition

*All source files shall compile without any compilation errors.*

### Rationale

A conforming compiler is permitted to produce an object module despite the presence of compilation errors. However, execution of the resulting program can produce unexpected behavior.

### Polyspace Specification

The software raises a violation of this directive if it finds a compilation error. Because Code Prover is more strict about compilation errors compared to Bug Finder, the coding rules checking in the two products can produce different results for this directive.

### Message in Report

All source files shall compile without any compilation errors.

## Check Information

**Group:** Compilation and build
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 1.1`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

**Introduced in R2015b**

# MISRA C:2012 Dir 4.1

Run-time failures shall be minimized

## Description

### Directive Definition

*Run-time failures shall be minimized.*

### Rationale

Some areas to concentrate on are:

- Arithmetic errors
- Pointer arithmetic
- Array bound errors
- Function parameters
- Pointer dereferencing
- Dynamic memory

### Polyspace Specification

This directive is checked through the Polyspace analysis. For more information, see:

- “Defects”.
- “Run-Time Checks” (Polyspace Code Prover).

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

### Message in Report

Run-time failures shall be minimized.

## Check Information

**Group:** Code design
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Dir 4.11` | `MISRA C:2012 Rule 1.3` | `MISRA C:2012 Rule 18.1` | `MISRA C:2012 Rule 18.2` | `MISRA C:2012 Rule 18.3`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Dir 4.3

Assembly language shall be encapsulated and isolated

## Description

### Directive Definition

*Assembly language shall be encapsulated and isolated.*

### Rationale

Encapsulating assembly language is beneficial because:

- It improves readability.
- The name, and documentation, of the encapsulating macro or function makes the intent of the assembly language clear.
- All uses of assembly language for a given purpose can share encapsulation, which improves maintainability.
- You can easily substitute the assembly language for a different target or for purposes of static analysis.

### Polyspace Specification

Polyspace does not raise a warning on assembly language code encapsulated in the following:

- `asm` functions or `asm` pragmas
- Macros

### Message in Report

Assembly language shall be encapsulated and isolated

# Examples

## Assembly Language Code in C Function

```
enum boolVal {TRUE, FALSE};
enum boolVal isTaskActive;
void taskHandler(void);

void taskHandler(void) {
    isTaskActive = FALSE;
    // Software interrupt for task switching
    asm volatile
    (
        "SWI &02"     /* Service #1: calculate run-time */
    );
    return;
}
```

In this example, the rule violation occurs because the assembly language code is embedded directly in a C function `taskHandler` that contains other C language statements.

One possible correction is to encapsulate the assembly language code in a macro and invoke the macro in the function `taskHandler`.

```
#define  RUN_TIME_CALC \
asm volatile \
    ( \
        "SWI &02"     /* Service #1: calculate run-Time */ \
    )\

enum boolVal {TRUE, FALSE};
enum boolVal isTaskActive;
void taskHandler(void);

void taskHandler(void) {
    isTaskActive = FALSE;
    RUN_TIME_CALC;
    return;
}
```

## Check Information

**Group:** Code design
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 1.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Dir 4.5

Identifiers in the same name space with overlapping visibility should be typographically unambiguous

## Description

### Directive Definition

*Identifiers in the same name space with overlapping visibility should be typographically unambiguous.*

### Rationale

What “unambiguous” means depends on the alphabet and language in which source code is written. When you use identifiers that are typographically close, you can confuse between them.

For the Latin alphabet as used in English words, at a minimum, the identifiers should not differ by:

- The interchange of a lowercase letter with its uppercase equivalent.
- The presence or absence of the underscore character.
- The interchange of the letter `O` and the digit `0`.
- The interchange of the letter `I` and the digit `1`.
- The interchange of the letter `I` and the letter `l`.
- The interchange of the letter `S` and the digit `5`.
- The interchange of the letter `Z` and the digit `2`.
- The interchange of the letter `n` and the letter `h`.
- The interchange of the letter `B` and the digit `8`.
- The interchange of the letters `rn` and the letter `m`.

### Message in Report

Identifiers in the same name space with overlapping visibility should be typographically unambiguous.

## Examples

### Typographically Ambiguous Identifiers

```
void func(void) {
    int id1_numval;
    int id1_num_val;  /* Non-compliant */

    int id2_numval;
    int id2_numVal;   /* Non-compliant */

    int id3_lvalue;
    int id3_Ivalue;   /* Non-compliant */

    int id4_xyz;
    int id4_xy2;      /* Non-compliant */

    int id5_zerO;
    int id5_zer0;     /* Non-compliant */

    int id6_rn;
    int id6_m;        /* Non-compliant */
}
```

In this example, the rule is violated when identifiers that can be confused for each other are used.

## Check Information

**Group:** Code design
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Dir 4.6

`typedefs` that indicate size and signedness should be used in place of the basic numerical types

## Description

### Directive Definition

*`typedefs` that indicate size and signedness should be used in place of the basic numerical types.*

### Rationale

When the amount of memory being allocated is important, using specific-length types makes it clear how much storage is being reserved for each object.

### Polyspace Specification

Polyspace does consider the use of basic types in a `typedef` statement as a violation of this directive.

### Message in Report

typedefs that indicate size and signedness should be used in place of the basic numerical types

## Check Information

**Group:** Code design
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Dir 4.7

If a function returns error information, then that error information shall be tested

## Description

### Directive Definition

*If a function returns error information, then that error information shall be tested.*

### Rationale

Typically a function indicates whether an error occurred during execution, via a special return value or by another means.

If a function provides a mechanism to determine errors, before you use the function return value, you must check for such errors.

### Polyspace Specification

The checking of this directive follows the same specifications as the defect checker `Returned value of a sensitive function not checked`.

This directive is only partially supported.

### Message in Report

If a function returns error information, then that error information shall be tested.

## Check Information

**Group:** Code design
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2017a**

# MISRA C:2012 Dir 4.9

A function should be used in preference to a function-like macro where they are interchangeable

## Description

### Directive Definition

*A function should be used in preference to a function-like macro where they are interchangeable.*

### Rationale

In most circumstances, use functions instead of macros. Functions perform argument type-checking and evaluate their arguments once, avoiding problems with potential multiple side effects.

### Polyspace Specification

Polyspace considers all function-like macro definitions.

### Message in Report

A function should be used in preference to a function-like macro where they are interchangeable

## Check Information

**Group:** Code design
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 13.2` | `MISRA C:2012 Rule 20.7`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Dir 4.10

Precautions shall be taken in order to prevent the contents of a header file being included more than once

## Description

### Directive Definition

*Precautions shall be taken in order to prevent the contents of a header file being included more than once.*

### Rationale

When a translation unit contains a complex hierarchy of nested header files, it is possible for a particular header file to be included more than once, leading to confusion. If this multiple inclusion produces multiple or conflicting definitions, then your program can have undefined or erroneous behavior.

For instance, suppose that a header file contains:

```
#ifdef _WIN64
   int env_var;
#elseif
   long int env_var;
#endif
```

If the header file is contained in two inclusion paths, one that defines the macro `_WIN64` and another that undefines it, you can have conflicting definitions of `env_var`.

### Polyspace Specification

If you include a header file whose contents are not guarded from multiple inclusion, the analysis raises a violation of this directive. The violation is shown at the beginning of the header file.

You can guard the contents of a header file from multiple inclusion by using one of the following methods:

```
<start-of-file>
#ifndef <control macro>
#define <control macro>
    /* Contents of file */
#endif
<end-of-file>
```

or

```
<start-of-file>
#ifdef <control macro>
#error ...
#else
#define <control macro>
    /* Contents of file */
#endif
<end-of-file>
```

Unless you use one of these methods, Polyspace flags the header file inclusion as noncompliant.

### Message in Report

Precautions shall be taken in order to prevent the contents of a header file being included more than once.

## Examples

### Code After Macro Guard

```
#ifndef  __MY_MACRO__
#define __MY_MACRO__
    void func(void);
#endif
void func2(void);
```

If a header file contains this code, it is noncompliant because the macro guard does not cover the entire content of the header file. The line `void func2(void)` is outside the guard.

**Note** You can have comments outside the macro guard.

### Code Before Macro Guard

```
void func(void);
#ifndef  __MY_MACRO__
#define __MY_MACRO__
    void func2(void);
#endif
```

If a header file contains this code, it is noncompliant because the macro guard does not cover the entire content of the header file. The line `void func(void)` is outside the guard.

**Note** You can have comments outside the macro guard.

### Mismatch in Macro Guard

```
#ifndef  __MY_MACRO__
#define __MY_MARCO__
    void func(void);
    void func2(void);
#endif
```

If a header file contains this code, it is noncompliant because the macro name in the `#ifndef` statement is different from the name in the following `#define` statement.

## Check Information

**Group:** Code Design
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

**Introduced in R2014b**

# MISRA C:2012 Dir 4.11

The validity of values passed to library functions shall be checked

## Description

### Directive Definition

*The validity of values passed to library functions shall be checked.*

### Rationale

Many Standard C functions do not check the validity of parameters passed to them. Even if checks are performed by a compiler, there is no guarantee that the checks are adequate. For example, you should not pass negative numbers to `sqrt` or `log`.

### Polyspace Specification

Polyspace raises a violation result for library function arguments if the following are all true:

- Argument is a local variable.
- Local variable is not tested between last assignment and call to the library function.
- Corresponding parameter of the library function has a restricted input domain.
- Library function is one of the following common mathematical functions:
  - `sqrt`
  - `tan`
  - `pow`
  - `log`
  - `log10`
  - `fmod`
  - `acos`

- `asin`
- `acosh`
- `atanh`
- or `atan2`

---

Tip To mass-justify all results related to the same library function, use the **Detail** column on the **Results List** pane. Click the column header so that all results with the same entry are grouped together. Select the first result and then select the last result while holding the `Shift` key. Assign a status to one of the results. If you do not see the **Detail** column, right-click any other column header and enable this column.

---

### Message in Report

The validity of values passed to library functions shall be checked

## Check Information

**Group:** Code design
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Dir 4.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Dir 4.13

Functions which are designed to provide operations on a resource should be called in an appropriate sequence

## Description

### Directive Definition

*Functions which are designed to provide operations on a resource should be called in an appropriate sequence.*

### Rationale

You typically use functions operating on a resource in the following way:

1. You allocate the resource.

   For example, you open a file or critical section.
2. You use the resource.

   For example, you read from the file or perform operations in the critical section.
3. You deallocate the resource.

   For example, you close the file or critical section.

For your functions to operate as you expect, perform the steps in sequence. For instance, if you call a resource allocation function on a certain execution path, you must call a deallocation function on that path.

### Polyspace Specification

Polyspace Bug Finder detects a violation of this rule if you specify multitasking options and your code contains one of these defects:

- `Missing lock`: A task calls an unlock function before calling the corresponding lock function.

- Missing unlock: A task calls a lock function but ends without a call to the corresponding unlock function.
- Double lock: A task calls a lock function twice without an intermediate call to an unlock function.
- Double unlock: A task calls an unlock function twice without an intermediate call to a lock function.

For more information on the multitasking options, see “Multitasking”.

## Message in Report

Functions which are designed to provide operations on a resource should be called in an appropriate sequence.

# Examples

## Multitasking: Lock Function That Is Missing Unlock Function

```
typedef signed int int32_t;
typedef signed short int16_t;

typedef struct tag_mutex_t {
    int32_t value;
} mutex_t;


extern mutex_t mutex_lock   ( void );
extern void  mutex_unlock (  mutex_t m );

extern int16_t x;
void func(void);

void task1(void) {
     func();
}

void task2(void) {
     func();
}
```

```
void func ( void ) {
    mutex_t m = mutex_lock ( );  /* Non-compliant */

    if ( x > 0 )  {
        mutex_unlock ( m );
    }  else  {
        /* Mutex not unlocked on this path */
    }
}
```

In this example, the rule is violated when:

- You specify that the functions `mutex_lock` and `mutex_unlock` are paired.

  `mutex_lock` begins a critical section and `mutex_unlock` ends it.
- The function `mutex_lock` is called. However, if `x <= 0`, the function `mutex_unlock` is not called.

To enable detection of this rule violation, you must specify these analysis options.

| Option | Specification | |
|---|---|---|
| **Configure multitasking manually** | ☑ | |
| **Entry points** | `task1`<br>`task2` | |
| **Critical section details** | **Starting routine** | **Ending routine** |
| | `mutex_lock` | `mutex_unlock` |

For more information on the options, see:

- `Entry points (-entry-points)`
- `Critical section details (-critical-section-begin -critical-section-end)`

## Check Information

**Group:** Code design
**Category:** Advisory

**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 22.1` | `MISRA C:2012 Rule 22.2` | `MISRA C:2012 Rule 22.6`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Dir 4.14

The validity of values received from external sources shall be checked

## Description

### Directive Definition

*The validity of values received from external sources shall be checked.*

### Rationale

The values originating from external sources can be invalid because of errors or deliberate modification by attackers. Before using the data, you must check the data for validity.

For instance:

- Before using an external input as array index, you must check if it can potentially cause an array bounds error.
- Before using a variable to control a loop, you must check if it can potentially result in an infinite loop.

### Message in Report

The validity of values received from external sources shall be checked.

## Examples

### Validity of External Values Not Checked

```
#include <stdio.h>

void f1(char from_user[])
```

```
{
        char input [128];
        (void) sscanf (from_user, "%128c", input);
        (void) sprintf ("%s", input);
}
```

In this example, the `sscanf` statement is noncompliant as there is no check to ensure that the user input is null terminated. The subsequent `sprintf` statement that outputs the string can potentially lead to an array bounds error (buffer overrun).

## Check Information

**Group:** Code design
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 1.1

The program shall contain no violations of the standard C syntax and constraints, and shall not exceed the implementation's translation limits

## Description

### Rule Definition

*The program shall contain no violations of the standard C syntax and constraints, and shall not exceed the implementation's translation limits.*

### Polyspace Specification

The rule violation can come from multiple causes. Standard compilation error messages do not lead to a violation of this MISRA rule.

Tip To mass-justify all results that come from the same cause, use the **Detail** column on the **Results List** pane. Click the column header so that all results with the same entry are grouped together. Select the first result and then select the last result while holding the `Shift` key. Assign a status to one of the results. If you do not see the **Detail** column, right-click any other column header and enable this column.

### Message in Report

- Too many nesting levels of #includes: N1. The limit is N0.
- Integer constant is too large.
- ANSI C does not allow '#XX'.
- Text following preprocessing directive violates ANSI standard.
- Too many macro definitions: N1. The limit is N0.
- Array of zero size should not be used.
- Integer constant does not fit within long int.

- Integer constant does not fit within unsigned long int.
- Too many nesting levels for control flow: N1. The limit is N0.
- Assembly language should not be used.
- Too many enumeration constants: N1. The limit is N0.

## Check Information

**Group:** Standard C Environment
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 1.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 1.2

Language extensions should not be used

## Description

### Rule Definition

*Language extensions should not be used.*

### Rationale

If a program uses language extensions, its portability is reduced. Even if you document the language extensions, the documentation might not describe the behavior in all circumstances.

### Polyspace Specification

All the supported extensions lead to a violation of this MISRA rule.

### Message in Report

- ANSI C90 forbids hexadecimal floating-point constants.
- ANSI C90 forbids universal character names.
- ANSI C90 forbids mixed declarations and code.
- ANSI C90/C99 forbids case ranges.
- ANSI C90/C99 forbids local label declaration.
- ANSI C90 forbids mixed declarations and code.
- ANSI C90/C99 forbids typeof operator.
- ANSI C90/C99 forbids casts to union.
- ANSI C90 forbids compound literals.
- ANSI C90/C99 forbids statements and declarations in expressions.

- ANSI C90 forbids __func__ predefined identifier.
- ANSI C90 forbids keyword '_Bool'.
- ANSI C90 forbids 'long long int' type.
- ANSI C90 forbids long long integer constants.
- ANSI C90 forbids 'long double' type.
- ANSI C90/C99 forbids 'short long int' type.
- ANSI C90 forbids _Pragma preprocessing operator.
- ANSI C90 does not allow macros with variable arguments list.
- ANSI C90 forbids designated initializer.

  Keyword 'inline' should not be used.

## Check Information

**Group:** Standard C Environment
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 1.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 1.3

There shall be no occurrence of undefined or critical unspecified behaviour

## Description

### Rule Definition

*There shall be no occurrence of undefined or critical unspecified behaviour.*

### Message in Report

There shall be no occurrence of undefined or critical unspecified behavior

- 'defined' without an identifier.
- macro 'XX' used with too few arguments.
- macro 'XX used with too many arguments.

## Check Information

**Group:** Standard C Environment
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Dir 4.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 2.1

A project shall not contain unreachable code

## Description

### Rule Definition

*A project shall not contain unreachable code.*

### Rationale

Unless a program exhibits any undefined behavior, unreachable code cannot execute. The unreachable code cannot affect the program output. The presence of unreachable code can indicate an error in the program logic. Unreachable code that the compiler does not remove wastes resources, for example:

- It occupies space in the target machine memory.
- Its presence can cause a compiler to select longer, slower jump instructions when transferring control around the unreachable code.
- Within a loop, it can prevent the entire loop from residing in an instruction cache.

### Polyspace Specification

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

The Code Prover run-time check for unreachable code shows more cases than the MISRA checker for rule 2.1. See also `Unreachable code`. The run-time check performs a more exhaustive analysis. In the process, the check can show some instances that are not strictly unreachable code but unreachable only in the context of the analysis. For instance, in the following code, the run-time check shows a potential division by zero in the first line and then removes the zero value of `flag` for the rest of the analysis. Therefore, it considers the `if` block unreachable.

```
val=1.0/flag;
if(!flag) {}
```

The MISRA checker is designed to prevent these kinds of results.

## Message in Report

A project shall not contain unreachable code.

# Examples

## Code Following `return` Statement

```
enum light { red, amber, red_amber, green };

enum light next_light ( enum light color )
{
    enum light res;

    switch ( color )
    {
    case red:
        res = red_amber;
        break;
    case red_amber:
        res = green;
        break;
    case green:
        res = amber;
        break;
    case amber:
        res = red;
        break;
    default:
    {
        error_handler ();
        break;
    }
    }

    res = color;
    return res;
    res = color;     /* Non-compliant */
}
```

In this example, the rule is violated because there is an unreachable operation following the `return` statement.

## Check Information

**Group:** Unused Code
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

MISRA C:2012 Rule 14.3 | MISRA C:2012 Rule 16.4

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 2.2

There shall be no dead code

## Description

### Rule Definition

*There shall be no dead code.*

### Rationale

If an operation is reachable but removing the operation does not affect program behavior, the operation constitutes dead code.

The presence of dead code can indicate an error in the program logic. Because a compiler can remove dead code, its presence can cause confusion for code reviewers.

Operations involving language extensions such as `__asm ( "NOP" );` are not considered dead code.

### Polyspace Specification

Polyspace Bug Finder detects useless write operations during analysis.

### Message in Report

There shall be no dead code.

## Examples

### Redundant Operations

```
extern volatile unsigned int v;
extern char *p;
```

```
void f ( void ) {
    unsigned int x;


    ( void ) v;      /* Compliant - Exception*/
    ( int ) v;       /* Non-compliant  */
    v >> 3;          /* Non-compliant  */

    x = 3;           /* Non-compliant - Detected in Bug Finder only */

    *p++;            /* Non-compliant  */
    ( *p )++;        /* Compliant  */
}
```

In this example, the rule is violated when an operation is performed on a variable, but the result of that operation is not used. For instance,

- The operations `(int)` and >> on the variable `v` are redundant because the results are not used.
- The operation = is redundant because the local variable `x` is not read after the operation.
- The operation `*` on `p++` is redundant because the result is not used.

The rule is not violated when:

- A variable is cast to `void`. The cast indicates that you are intentionally not using the value.
- The result of an operation is used. For instance, the operation `*` on `p` is not redundant, because `*p` is incremented.

## Redundant Function Call

```
void g ( void ) {
               /* Compliant  */
}

void h ( void) {
     g( );     /* Non-compliant */
}
```

In this example, `g` is an empty function. Though the function itself does not violate the rule, a call to the function violates the rule.

## Check Information

**Group:** Unused Code
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 17.7` | `Write without a further read`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 2.3

A project should not contain unused type declarations

## Description

### Rule Definition

*A project should not contain unused type declarations.*

### Rationale

If a type is declared but not used, a reviewer does not know if the type is redundant or if it is unused by mistake.

### Message in Report

A project should not contain unused type declarations: type XX is not used.

## Examples

### Unused Local Type

```
signed short unusedType (void){

    typedef signed short myType;   /* Non-compliant */
    return 67;

}

signed short usedType (void){

    typedef signed short myType;  /* Compliant */
    myType tempVar = 67;
    return tempVar;
}
```

In this example, in function `unusedType`, the `typedef` statement defines a new local type `myType`. However, this type is never used in the function. Therefore, the rule is violated.

The rule is not violated in the function `usedType` because the new type `myType` is used.

## Check Information

**Group:** Unused Code
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 2.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 2.4

A project should not contain unused tag declarations

## Description

### Rule Definition

*A project should not contain unused tag declarations.*

### Rationale

If a tag is declared but not used, a reviewer does not know if the tag is redundant or if it is unused by mistake.

### Message in Report

A project should not contain unused tag declarations: tag *tag_name* is not used.

## Examples

### Tag Defined in Function but Not Used

```
void unusedTag ( void )
{
    enum state1 { S_init, S_run, S_sleep };    /* Non-compliant  */
}

void usedTag ( void )
{
    enum state2 { S_init, S_run, S_sleep };    /* Compliant  */
    enum state2 my_State = S_init;
}
```

In this example, in the function `unusedTag`, the tag `state1` is defined but not used. Therefore, the rule is violated.

### Tag Used in `typedef` Only

```
typedef struct record_t        /* Non-compliant  */
{
    unsigned short key;
    unsigned short val;
} record1_t;


typedef struct               /* Compliant */
{
    unsigned short key;
    unsigned short val;
} record2_t;

record1_t myRecord1_t;
record2_t myRecord2_t;
```

In this example, the tag `record_t` appears only in the `typedef` of `record1_t`. In the rest of the translation unit, the type `record1_t` is used. Therefore, the rule is violated.

## Check Information

**Group:** Unused Code
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 2.3`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 2.5

A project should not contain unused macro declarations

## Description

### Rule Definition

*A project should not contain unused macro declarations.*

### Rationale

If a macro is declared but not used, a reviewer does not know if the macro is redundant or if it is unused by mistake.

### Message in Report

A project should not contain unused macro declarations: macro *macro_name* is not used.

## Examples

### Unused Macro Definition

```
void use_macro (void)
{
    #define SIZE 4
    #define DATA 3

    use_int16(SIZE);
}
```

In this example, the macro DATA is never used in the use_macro function.

## Check Information

**Group:** Unused Code
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 2.6

A function should not contain unused label declarations

## Description

### Rule Definition

*A function should not contain unused label declarations.*

### Rationale

If you declare a label but do not use it, it is not clear to a reviewer of your code if the label is redundant or unused by mistake.

### Message in Report

A function should not contain unused label declarations.

Label *`label_name`* is not used.

## Examples

### Unused Label Declarations

```
void use_var(signed short);

void unused_label ( void )
{
    signed short x = 6;

label1:                         /* Non-compliant - label1 not used */
    use_var ( x );
}
```

```
void used_label ( void )
{
    signed short x = 6;

    for (int i=0; i < 5; i++) {
        if ( i==2 ) goto label1;
    }

label1:                        /* Compliant - label1 used */
    use_var ( x );
}
```

In this example, the rule is violated when the label `label1` in function `unused_label` is not used.

## Check Information

**Group:** Unused code
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Rule 2.7

There should be no unused parameters in functions

## Description

### Rule Definition

*There should be no unused parameters in functions.*

### Rationale

If a parameter is unused, it is possible that the implementation of the function does not match its specifications. This rule can highlight such mismatches.

### Message in Report

There should be no unused parameters in functions.

Parameter *`parameter_name`* is not used.

## Examples

### Unused Function Parameters

```
double func(int param1, int* param2) {
    return (param1/2.0);
}
```

In this example, the rule is violated because the parameter `param2` is not used.

## Check Information

**Group:** Unused code

**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`Unused parameter`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Rule 3.1

The character sequences /* and // shall not be used within a comment

## Description

### Rule Definition

*The character sequences /* and // shall not be used within a comment.*

### Rationale

These character sequences are not allowed in code comments because:

- If your code contains a /* or a // in a /* */ comment, it typically means that you have inadvertently commented out code.
- If your code contains a /* in a // comment, it typically means that you have inadvertently uncommented a /* */ comment.

### Polyspace Specification

You cannot annotate this rule in the source code.

For information on annotations, see “Annotate and Hide Known or Acceptable Results”.

### Message in Report

The character sequence /* shall not appear within a comment.

## Examples

### /* Used in // Comments

```
int x;
int y;
int z;

void non_compliant_comments ( void )
{
    x = y //      /* Non-compliant
        + z
        //  */
        ;
    z++;    //    Compliant with exception: // permitted within a // comment
}

void compliant_comments ( void )
{
    x = y /*      Compliant
      + z
      */
        ;
    z++;    //    Compliant with exception: // is permitted within a // comment
}
```

In this example, in the `non_compliant_comments` function, the `/*` character occurs in what appears to be a `//` comment, violating the rule. Because of the comment structure, the operation that takes place is `x = y + z;`. However, without the two `//`-s, an entirely different operation `x=y;` takes place. It is not clear which operation is intended.

Use a comment format that makes your intention clear. For instance, in the `compliant_comments` function, it is clear that the operation `x=y;` is intended.

## Check Information

**Group:** Comments
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"

“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 3.2

Line-splicing shall not be used in // comments

## Description

### Rule Definition

*Line-splicing shall not be used in // comments.*

### Rationale

Line-splicing occurs when the \ character is immediately followed by a new-line character. Line splicing is used for statements that span multiple lines.

If you use line-splicing in a // comment, the following line can become part of the comment. In most cases, the \ is spurious and can cause unintentional commenting out of code.

### Message in Report

Line-splicing shall not be used in // comments.

## Examples

### Line Splicing in // Comment

```
#include <stdbool.h>

extern _Bool b;

void func ( void )
{
    unsigned short x = 0;   // Non-compliant - Line-splicing \
    if ( b )
    {
        ++b;
    }
}
```

Because of line-splicing, the statement `if ( b )` is a part of the previous `//` comment. Therefore, the statement `b++` always executes, making the `if` block redundant.

## Check Information

**Group:** Comments
**Category:** Required
**AGC Category:** Required
**Language:** C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

Introduced in R2014b

# MISRA C:2012 Rule 4.1

Octal and hexadecimal escape sequences shall be terminated

## Description

### Rule Definition

*Octal and hexadecimal escape sequences shall be terminated.*

### Rationale

There is potential for confusion if an octal or hexadecimal escape sequence is followed by other characters. For example, the character constant `'\x1f'` consists of a single character, whereas the character constant `'\x1g'` consists of the two characters `'\x1'` and `'g'`. The manner in which multi-character constants are represented as integers is implementation-defined.

If every octal or hexadecimal escape sequence in a character constant or string literal is terminated, you reduce potential confusion.

### Message in Report

Octal and hexadecimal escape sequences shall be terminated.

## Examples

### Compliant and Noncompliant Escape Sequences

```
const char *s1 = "\x41g";      /* Non-compliant */
const char *s2 = "\x41" "g";   /* Compliant - Terminated by end of literal */
const char *s3 = "\x41\x67";   /* Compliant - Terminated by another escape sequence*/

int c1 = '\141t';              /* Non-compliant */
int c2 = '\141\t';             /* Compliant - Terminated by another escape sequence*/
```

In this example, the rule is violated when an escape sequence is not terminated with the end of string literal or another escape sequence.

## Check Information

**Group:** Character Sets and Lexical Conventions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 4.2

Trigraphs should not be used

## Description

### Rule Definition

*Trigraphs should not be used.*

### Rationale

You denote trigraphs with two question marks followed by a specific third character (for instance,`'??-'` represents a `'~'` (tilde) character and `'??)'` represents a `']'`). These trigraphs can cause accidental confusion with other uses of two question marks.

**Note** Digraphs (`<:  :>`, `<%  %>`, `%:`, `%:%:`) are permitted because they are tokens.

### Polyspace Specification

The Polyspace analysis converts trigraphs to the equivalent character for the defect analysis. However, Polyspace also raises a MISRA violation.

The standard requires that trigraphs must be transformed *before* comments are removed during preprocessing. Therefore, Polyspace raises a violation of this rule even if a trigraph appears in code comments.

### Message in Report

Trigraphs should not be used.

## Check Information

**Group:** Character Sets and Lexical Conventions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 5.1

External identifiers shall be distinct

## Description

### Rule Definition

*External identifiers shall be distinct.*

### Rationale

External identifiers are ones declared with global scope or storage class `extern`.

Polyspace considers two names as distinct if there is a difference between their first 31 characters. If the difference between two names occurs only beyond the first 31 characters, they can be easily mistaken for each other. The readability of the code is reduced. For C90, the difference must occur between the first 6 characters. To use the C90 rules checking, use the option, Respect C90 Standard on page 1-37.

### Message in Report

External `%s %s` conflicts with the external identifier XX in file YY.

## Examples

### C90: First Six Characters of Identifiers Not Unique

```
int engine_temperature_raw;
int engine_temperature_scaled;   /* Non-compliant */
int engin2_temperature;          /* Compliant */
```

In this example, the identifier `engine_temperature_scaled` has the same first six characters as a previous identifier, `engine_temperature_raw`.

### C99: First 31 Characters of Identifiers Not Unique

```
int engine_exhaust_gas_temperature_raw;
int engine_exhaust_gas_temperature_scaled; /* Non-compliant */

int eng_exhaust_gas_temp_raw;
int eng_exhaust_gas_temp_scaled;           /* Compliant */
```

In this example, the identifier `engine_exhaust_gas_temperature_scaled` has the same first 31 characters as a previous identifier, `engine_exhaust_gas_temperature_raw`.

### C90: First Six Characters Identifiers in Different Translation Units Differ in Case Alone

```
/* file1.c */
int abc = 0;

/* file2.c */
int ABC = 0; /* Non-compliant */
```

In this example, the implementation supports 6 significant case-insensitive characters in *external identifiers*. The identifiers in the two translation are different but are not distinct in their significant characters.

## Check Information

**Group:** Identifiers
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 5.2` | `MISRA C:2012 Rule 5.4` | `MISRA C:2012 Rule 5.5`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 5.2

Identifiers declared in the same scope and name space shall be distinct

## Description

### Rule Definition

*Identifiers declared in the same scope and name space shall be distinct.*

### Rationale

Polyspace considers two names as distinct if there is a difference between their first 63 characters. If the difference between two names occurs only beyond the first 63 characters, they can be easily mistaken for each other. The readability of the code is reduced. For C90, the difference must occur between the first 31 characters. To use the C90 rules checking, use the option, Respect C90 Standard on page 1-37.

### Message in Report

Identifier XX has same significant characters as identifier YY.

## Examples

### C90: First 31 Characters of Identifiers Not Unique

```
extern int engine_exhaust_gas_temperature_raw;
static int engine_exhaust_gas_temperature_scaled;      /* Non-compliant */

extern double engine_exhaust_gas_temperature_raw;
static double engine_exhaust_gas_temperature2_scaled;  /* Compliant */

void func ( void )
{
  /* Not in the same scope */
  int engine_exhaust_gas_temperature_local;            /* Compliant */
}
```

In this example, the identifier `engine_exhaust_gas_temperature_scaled` has the same 31 characters as a previous identifier, `engine_exhaust_gas_temperature_raw`.

The rule does not apply if the two identifiers have the same 31 characters but have different scopes. For instance, `engine_exhaust_gas_temperature_local` has the same 31 characters as `engine_exhaust_gas_temperature_raw` but different scope.

### C99: First 63 Characters of Identifiers Not Unique

```
extern int engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_x_raw;
static int engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_x_scale;
    /* Non-compliant */

extern int engine_gas_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx__raw;
static int engine_gas_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx__scale;
    /* Compliant */

void func ( void )
{
/* Not in the same scope */
    int engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_x_local;
          /* Compliant */
}
```

In this example, the identifier `engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_x_scale` has the same 63 characters as a previous identifier, `engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_x_raw`.

## Check Information

**Group:** Identifiers
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 5.1` | `MISRA C:2012 Rule 5.3` | `MISRA C:2012 Rule 5.4` | `MISRA C:2012 Rule 5.5`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 5.3

An identifier declared in an inner scope shall not hide an identifier declared in an outer scope

## Description

### Rule Definition

*An identifier declared in an inner scope shall not hide an identifier declared in an outer scope.*

### Rationale

If two identifiers have the same name but different scope, the identifier in the inner scope hides the identifier in the outer scope. All uses of the identifier name refers to the identifier in the inner scope. This behavior forces the developer to keep track of the scope and reduces code readability.

Polyspace considers two names as distinct if there is a difference between their first 63 characters. If the difference between two names occurs only beyond the first 63 characters, they can be easily mistaken for each other. The readability of the code is reduced. For C90, the difference must occur between the first 31 characters. To use the C90 rules checking, use the option, Respect C90 Standard on page 1-37.

### Message in Report

Variable XX hides variable XX (FILE line LINE column COLUMN).

## Examples

### Local Variable Hidden by Another Local Variable in Inner Block

```
typedef signed short int16_t;
```

```
void func( void )
{
    int16_t i;
    {
        int16_t i;                /* Non-compliant */
        i = 3;
    }
}
```

In this example, the identifier `i` defined in the inner block in `func` hides the identifier `i` with function scope.

It is not immediately clear to a reader which `i` is referred to in the statement `i=3`.

### Global Variable Hidden by Function Parameter

```
typedef signed short int16_t;

struct astruct
{
    int16_t m;
};

extern void g ( struct astruct *p );
int16_t xyz = 0;

void func ( struct astruct xyz )  /* Non-compliant */
{
    g ( &xyz );
}
```

In this example, the parameter `xyz` of function `func` hides the global variable `xyz`.

It is not immediately clear to a reader which `xyz` is referred to in the statement `g (&xyz )`.

## Check Information

**Group:** Identifiers
**Category:** Required
**AGC Category:** Advisory

**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 5.2` | `MISRA C:2012 Rule 5.8`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 5.4

Macro identifiers shall be distinct

## Description

### Rule Definition

*Macro identifiers shall be distinct.*

### Rationale

The names of macro identifiers must be distinct from both other macro identifiers and their parameters.

Polyspace considers two names as distinct if there is a difference between their first 63 characters. If the difference between two names occurs only beyond the first 63 characters, they can be easily mistaken for each other. The readability of the code is reduced. For C90, the difference must occur between the first 31 characters. To use the C90 rules checking, use the option, Respect C90 Standard on page 1-37.

### Message in Report

- Macro identifiers shall be distinct. Macro XX has same significant characters as macro YY.
- Macro identifiers shall be distinct. Macro parameter XX has same significant characters as macro parameter YY in macro ZZ.

## Examples

### C90: First 31 Characters of Macro Names Not Unique

```
#define engine_exhaust_gas_temperature_raw egt_r
#define engine_exhaust_gas_temperature_scaled egt_s   /* Non-compliant */
```

```
#define engine_exhaust_gas_temp_raw egt_r
#define engine_exhaust_gas_temp_scaled egt_s          /* Compliant */
```

In this example, the macro `engine_exhaust_gas_temperature_scaled egt_s` has the same first 31 characters as a previous macro `engine_exhaust_gas_temperature_scaled`.

### C99: First 63 Characters of Macro Names Not Unique

```
#define engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_raw egt_r
#define engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_raw_scaled egt_s
    /* Non-compliant */

/* 63 significant case-sensitive characters in macro identifiers */
#define new_engine_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_raw egt_r
#define new_engine_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_scaled egt_s
    /* Compliant */
```

In this example, the macro `engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx___gaz_scaled` has the same first 63 characters as a previous macro `engine_xxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx_xxxxxxxxx___raw`.

## Check Information

**Group:** Identifiers
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 5.1` | `MISRA C:2012 Rule 5.2` | `MISRA C:2012 Rule 5.5`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 5.5

Identifiers shall be distinct from macro names

## Description

### Rule Definition

*Identifiers shall be distinct from macro names.*

### Rationale

The rule requires that macro names that exist only prior to processing must be different from identifier names that also exist after preprocessing. Keeping macro names and identifiers distinct help avoid confusion.

Polyspace considers two names as distinct if there is a difference between their first 63 characters. If the difference between two names occurs only beyond the first 63 characters, they can be easily mistaken for each other. The readability of the code is reduced. For C90, the difference must occur between the first 31 characters. To use the C90 rules checking, use the option, Respect C90 Standard on page 1-37.

### Message in Report

Identifier XX has same significant characters as macro YY.

## Examples

### Macro Names Same as Identifier Names

```
#define Sum_1(x, y) ( ( x ) + ( y ) )
short Sum_1;                    /* Non-compliant */

#define Sum_2(x, y) ( ( x ) + ( y ) )
short x = Sum_2 ( 1, 2 );       /* Compliant */
```

In this example, `Sum_1` is both the name of an identifier and a macro. `Sum_2` is used only as a macro.

### C90: First 31 Characters of Macro Name Same as Identifier Name

```
#define       low_pressure_turbine_temperature_1 lp_tb_temp_1
static int low_pressure_turbine_temperature_2;      /* Non-compliant  */
```

In this example, the identifier `low_pressure_turbine_temperature_2` has the same first 31 characters as a previous macro `low_pressure_turbine_temperature_1`.

## Check Information

**Group:** Identifiers
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 5.1` | `MISRA C:2012 Rule 5.2` | `MISRA C:2012 Rule 5.4`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 5.6

A typedef name shall be a unique identifier

## Description

### Rule Definition

*A typedef name shall be a unique identifier*.

### Rationale

Reusing a `typedef` name as another `typedef` or as the name of a function, object or `enum` constant can cause developer confusion.

### Message in Report

XX conflicts with the typedef name YY.

## Examples

### `typedef` Names Reused

```
void func ( void ){
  {
    typedef unsigned char u8_t;
  }
  {
    typedef unsigned char u8_t; /* Non-compliant */
  }
}

typedef float mass;
void func1 ( void ){
  float mass = 0.0f;            /* Non-compliant */
}
```

In this example, the typedef name u8_t is used twice. The typedef name mass is also used as an identifier name.

### typedef Name Same as Structure Name

```
typedef struct list{          /* Compliant - exception */
  struct list *next;
  unsigned short element;
} list;

typedef struct{
  struct chain{               /* Non-compliant */
    struct chain *list2;
    unsigned short element;
  } s1;
  unsigned short length;
} chain;
```

In this example, the typedef name list is the same as the original name of the struct type. The rule allows this exceptional case.

However, the typedef name chain is not the same as the original name of the struct type. The name chain is associated with a different struct type. Therefore, it clashes with the typedef name.

## Check Information

**Group:** Identifiers
**Category:**
**AGC Category:** Required
**Language:** C90, C99

## See Also

MISRA C:2012 Rule 5.7

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 5.7

A tag name shall be a unique identifier

## Description

### Rule Definition

*A tag name shall be a unique identifier.*

### Rationale

Reusing a tag name can cause developer confusion.

### Message in Report

XX conflicts with the tag name YY.

## Check Information

**Group:** Identifiers
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 5.6`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 5.8

Identifiers that define objects or functions with external linkage shall be unique

## Description

### Rule Definition

*Identifiers that define objects or functions with external linkage shall be unique.*

### Rationale

External identifiers are those declared with global scope or with storage class `extern`. Reusing an external identifier name can cause developer confusion.

Identifiers defined within a function have smaller scope. Even if names of such identifiers are not unique, they are not likely to cause confusion.

### Message in Report

- Object XX conflicts with the object name YY.
- Function XX conflicts with the function name YY.

## Check Information

**Group:** Identifiers
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 5.3`

## Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 5.9

Identifiers that define objects or functions with internal linkage should be unique

## Description

### Rule Definition

*Identifiers that define objects or functions with internal linkage should be unique.*

### Polyspace Specification

This rule checker assumes that rule 5.8 is not violated.

### Message in Report

- Object XX conflicts with the object name YY.
- Function XX conflicts with the function name YY.

## Check Information

**Group:** Identifiers
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 8.10`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

“Software Quality Objective Subsets (C:2012)”

**Introduced in R2014b**

# MISRA C:2012 Rule 6.1

Bit-fields shall only be declared with an appropriate type

## Description

### Rule Definition

*Bit-fields shall only be declared with an appropriate type.*

### Rationale

Using `int` is implementation-defined because bit-fields of type `int` can be either `signed` or `unsigned`.

The use of `enum`, `short char`, or any other type of bit-field is not permitted in C90 because the behavior is undefined.

In C99, the implementation can potentially define other integer types that are permitted in bit-field declarations.

### Message in Report

Bit-fields shall only be declared with an appropriate type.

## Check Information

**Group:** Types
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 6.2

Single-bit named bit fields shall not be of a signed type

## Description

### Rule Definition

*Single-bit named bit fields shall not be of a signed type.*

### Rationale

According to the C99 Standard Section 6.2.6.2, a single-bit signed bit-field has one sign bit and no value bits. In any representation of integers, zero value bits cannot specify a meaningful value.

A single-bit signed bit-field is therefore unlikely to behave in a useful way. Its presence is likely to indicate programmer confusion.

Although the C90 Standard does not provide much detail regarding the representation of types, the same single-bit bit-field considerations apply.

### Polyspace Specification

This rule does not apply to unnamed bit fields because their values cannot be accessed.

### Message in Report

Single-bit named bit fields shall not be of a signed type.

## Check Information

**Group:** Types<br>
**Category:** Required<br>
**AGC Category:** Required

**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 7.1

Octal constants shall not be used

## Description

### Rule Definition

*Octal constants shall not be used.*

### Rationale

Octal constants are denoted by a leading zero. Developers can mistake an octal constant as a decimal constant with a redundant leading zero.

### Message in Report

Octal constants shall not be used.

## Examples

### Use of octal constants

```
#define CST     021
#define VALUE   010              /* Compliant - constant not used */
#if 010 == 01                    /* Non-Compliant - constant used */
#define CST 021                  /* Compliant - constant not used */
#endif

extern short code[5];
static char* str2 = "abcd\0efg";  /* Compliant */

void main(void) {
    int value1 = 0;               /* Compliant */
    int value2 = 01;              /* Non-Compliant - decimal 01 */
    int value3 = 1;              /* Compliant */
    int value4 = '\109';         /* Compliant */

    code[1] = 109;               /* Compliant     - decimal 109 */
    code[2] = 100;               /* Compliant     - decimal 100 */
    code[3] = 052;               /* Non-Compliant - decimal 42 */
    code[4] = 071;               /* Non-Compliant - decimal 57 */

    if (value1 != CST) {         /* Non-Compliant - decimal 17 */
        value1 = !(value1 != 0); /* Compliant */
    }
}
```

In this example, the rule is not violated when octal constants are used to define macros CST and VALUE. The rule is violated only when the macros are used.

## Check Information

**Group:** Literals and Constants
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 7.2

A “u” or “U” suffix shall be applied to all integer constants that are represented in an unsigned type

## Description

### Rule Definition

*A “u” or “U” suffix shall be applied to all integer constants that are represented in an unsigned type.*

### Rationale

The signedness of a constant is determined from:

- Value of the constant.
- Base of the constant: octal, decimal or hexadecimal.
- Size of the various types.
- Any suffixes used.

Unless you use a suffix `u` or `U`, another developer looking at your code cannot determine easily whether a constant is signed or unsigned.

### Message in Report

A “u” or “U” suffix shall be applied to all integer constants that are represented in an unsigned type.

## Check Information

**Group:** Literals and Constants
**Category:** Required
**AGC Category:** Readability

**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 7.3

The lowercase character “l” shall not be used in a literal suffix

## Description

### Rule Definition

*The lowercase character “l” shall not be used in a literal suffix.*

### Rationale

The lowercase character “l” can be confused with the digit “1”. Use the uppercase “L” instead.

### Message in Report

The lowercase character “l” shall not be used in a literal suffix.

## Check Information

**Group:** Literals and Constants
**Category:** Required
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 7.4

A string literal shall not be assigned to an object unless the object's type is "pointer to const-qualified char"

## Description

### Rule Definition

*A string literal shall not be assigned to an object unless the object's type is "pointer to const-qualified char".*

### Rationale

This rule prevents assignments that allow modification of a string literal.

An attempt to modify a string literal can result in undefined behavior. For example, some implementations can store string literals in read-only memory. An attempt to modify the string literal can result in an exception or crash.

### Message in Report

A string literal shall not be assigned to an object unless the object's type is "pointer to const-qualified char".

## Examples

### Incorrect Assignment of String Literal

```
char *str1 = "AccountHolderName";
const char *str2 = "AccountHolderName";

void checkAccount1(char*);              /* Non-Compliant */
void checkAccount2(const char*);        /* Compliant */
void main() {
 checkAccount1("AccountHolderName");    /* Non-Compliant */
 checkAccount2("AccountHolderName");    /* Compliant */
}
```

In this example, the rule is not violated when string literals are assigned to `const char*` pointers, either directly or through copy of function arguments. The rule is violated only when the `const` qualifier is not used.

## Check Information

**Group:** Literals and Constants
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 11.4` | `MISRA C:2012 Rule 11.8`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 8.1

Types shall be explicitly specified

## Description

### Rule Definition

*Types shall be explicitly specified.*

### Rationale

The C90 standard permits types to be omitted in some circumstances, in which case the `int` type is implicitly specified. Examples of potential circumstances in which you can use an implicit `int` are:

- Object declarations
- Parameter declarations
- Member declarations
- `typedef` declarations
- Function return types

The omission of an explicit type can lead to confusion. For example, in the declaration `extern void foo (char c, const k);`, the type of `k` is `const int`, but `const char` might have been expected.

### Message in Report

Types shall be explicitly specified.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required

**AGC Category:** Required
**Language:** C90

## See Also

`MISRA C:2012 Rule 8.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 8.2

Function types shall be in prototype form with named parameters

## Description

### Rule Definition

*Function types shall be in prototype form with named parameters.*

### Rationale

The mismatch between the number of arguments and parameters, their types, and the expected and actual return type of a function provides potential for undefined behavior. This rule also requires that you specify names for all the parameters in a declaration. The parameter names provide useful information regarding the function interface. A mismatch between a declaration and definition can indicate a programming error.

### Polyspace Specification

Polyspace also checks the function definition.

### Message in Report

- Too many arguments to *function_name*.
- Too few arguments to *function_name*.
- Function types shall be in prototype form with named parameters.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 8.1` | `MISRA C:2012 Rule 8.4` | `MISRA C:2012 Rule 17.3`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 8.3

All declarations of an object or function shall use the same names and type qualifiers

## Description

### Rule Definition

*All declarations of an object or function shall use the same names and type qualifiers.*

### Rationale

Consistently using types and qualifiers across declarations of the same object or function encourages stronger typing. By specifying parameter names in function prototypes, Polyspace can check for interface consistency between the function definition and declarations.

### Polyspace Specification

Polyspace generates some violations of this rule during the link phase.

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

### Message in Report

- Definition of function `function_name` incompatible with its declaration.
- Global declaration of `function_name` function has incompatible type with its definition.
- Global declaration of `variable_name` variable has incompatible type with its definition.
- All declarations of an object or function shall use the same names and type qualifiers.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 8.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 8.4

A compatible declaration shall be visible when an object or function with external linkage is defined

## Description

### Rule Definition

*A compatible declaration shall be visible when an object or function with external linkage is defined.*

### Rationale

If a declaration for an object or function is visible when the object or function is defined, a compiler must check that the declaration and definition are compatible. In the presence of function prototypes, as required by rule 8.2, checking extends to the number and type of function parameters. A better way of implementing declarations of objects and functions with external linkage is to declare them in a header file. Then include the header file in all those code files that require them, including the one that defines them.

### Message in Report

- Global definition of *`variable_name`* variable has no previous declaration.
- Function *`function_name`* has no visible compatible prototype at definition.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 8.2` | `MISRA C:2012 Rule 8.3` | `MISRA C:2012 Rule 8.5` | `MISRA C:2012 Rule 17.3`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 8.5

An external object or function shall be declared once in one and only one file

## Description

### Rule Definition

*An external object or function shall be declared once in one and only one file.*

### Rationale

Typically, a single declaration is made in a header file that you include in any translation unit in which the identifier is defined or used. This inclusion ensures consistency between:

- The declaration and the definition
- The declarations in different translation units

**Note** It is possible to have many header files in a project, but each external object or function is declared in only one header file.

### Polyspace Specification

Polyspace checks only explicit `extern` declarations (tentative definitions are ignored). The rule checker considers that variables or functions declared `extern` in a non-header file violates this rule.

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

### Message in Report

- Object *`object_name`* has external declarations in multiples files.

- Function `function_name` has external declarations in multiples files.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 8.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 8.6

An identifier with external linkage shall have exactly one external definition

## Description

### Rule Definition

*An identifier with external linkage shall have exactly one external definition.*

### Rationale

The behavior is undefined if you use an identifier for which multiple definitions exist (in different files) or no definition exists. Multiple definitions in different files are not permitted by this rule even if the definitions are the same. If the declarations are different, or initialize the identifier to different values, it is undefined behavior.

### Polyspace Specification

The checker flags multiple definitions only if the definitions occur in different files. The checker does not:

- Consider tentative definitions as definitions.

  For instance, the following code does not violate the rule:

  ```
  int val;
  int val=1;
  ```
- Does not show a violation for functions that are called in the source code with external linkage but not defined.

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

### Message in Report

- Forbidden multiple definitions for function *function_name*.
- Forbidden multiple tentative definitions for object *object_name*.
- Global variable *variable_name* multiply defined.
- Function *function_name* multiply defined.
- Global variable has multiple tentative definitions.
- Undefined global variable *variable_name*.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 8.7

Functions and objects should not be defined with external linkage if they are referenced in only one translation unit

## Description

### Rule Definition

*Functions and objects should not be defined with external linkage if they are referenced in only one translation unit.*

### Rationale

Restricting or reducing the visibility of an object by giving it internal linkage or no linkage reduces the chance that it is accessed inadvertently. Compliance with this rule also avoids any possibility of confusion between your identifier and an identical identifier in another translation unit or a library.

### Polyspace Specification

If your program does not use the externally defined function or object, Polyspace does not raise a warning.

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

### Message in Report

- Variable *`variable_name`* should have internal linkage.
- Function *`function_name`* should have internal linkage.

## Check Information

**Group:** Declarations and Definitions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 8.8

The static storage class specifier shall be used in all declarations of objects and functions that have internal linkage

## Description

### Rule Definition

*The static storage class specifier shall be used in all declarations of objects and functions that have internal linkage.*

### Rationale

If you have an object or function declared with `extern`, and another declaration of the object or function is already visible, the linkage can be confusing. You expect that the `extern` storage class specifier creates external linkage. Apply the `static` storage class specifier to objects and functions with internal linking.

### Message in Report

The static storage class specifier shall be used in all declarations of objects and functions that have internal linkage.

## Examples

### Internal and External Linkage Conflicts

```
static int foo = 0;
extern int foo;         /* Non-compliant */

extern int hhh;
static int hhh;         /* Non-compliant */
```

In this example, the first line defines foo with internal linkage. Because the example uses the static keyword, the first line is compliant. However, the second line does not use static in the declaration, so the declaration is noncompliant. By comparison, the third line declares hhh with an extern keyword creating external linkage. The fourth line declares hhh with internal linkage, but this declaration conflicts with the first declaration of hhh.

One possible correction is to use static and extern consistently:

```
static int foo = 0;
static int foo;

extern int hhh;
extern int hhh;
```

### Internal linkage

```
static int fee(void);  /* Compliant - declaration: internal linkage */
int fee(void){         /* Non-compliant */
  return 1;
}

static int ggg(void);  /* Compliant - declaration: internal linkage */
extern int ggg(void){  /* Non-compliant */
  return 1 + x;
}
```

This example shows two internal linkage violations. Because fee and ggg have internal linkage, you must use a static class specifier to be compliant with MISRA

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 8.9

An object should be defined at block scope if its identifier only appears in a single function

## Description

### Rule Definition

*An object should be defined at block scope if its identifier only appears in a single function.*

### Rationale

Defining an object at block scope reduces the possibility that you inadvertently access the object . It ensures your program does not access the object elsewhere.

### Polyspace Specification

Polyspace raises a warning only for static objects.

### Message in Report

An object should be defined at block scope if its identifier only appears in a single function.

## Check Information

**Group:** Declarations and Definitions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 8.10

An inline function shall be declared with the static storage class

## Description

### Rule Definition

*An inline function shall be declared with the static storage class.*

### Rationale

If you call an inline function with external linkage, you can call the external definition of the function or the inline definition. This behavior can affect the execution time and therefore impact your program.

**Tip** To make an inline function available to several translation units, place its definition in a header file.

### Message in Report

An inline function shall be declared with the static storage class.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Required
**Language:** C99

## See Also

`MISRA C:2012 Rule 5.9`

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 8.11

When an array with external linkage is declared, its size should be explicitly specified

## Description

### Rule Definition

*When an array with external linkage is declared, its size should be explicitly specified.*

### Rationale

Although it is possible to declare an array with incomplete type and access its elements, it is safer to state the size of the array explicitly. Providing size information for each declaration allows the software to check the declarations for consistency. It also allows a static checker to perform array bounds analysis without analyzing more than one unit.

### Message in Report

Size of array *array_name* should be explicitly stated. When an array with external linkage is declared, its size should be explicitly specified.

## Examples

### Array Declarations

```
extern int32_t array1[10];    /*  Compliant  */
extern int32_t array2[];      /*  Non-compliant  */
```

In this example, two arrays are declared array1 and array2. array1 has external linkage (the extern keyword) and a size of 10. array2 also has external linkage, but no specified size. array2 is noncompliant because for arrays with external linkage, you must explicitly specify a size.

## Check Information

**Group:** Declarations and Definitions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 8.12

Within an enumerator list, the value of an implicitly-specified enumeration constant shall be unique

## Description

### Rule Definition

*Within an enumerator list, the value of an implicitly-specified enumeration constant shall be unique.*

### Rationale

An implicitly specified enumeration constant has a value 1 greater than its predecessor. If the first enumeration constant is implicitly specified, then its value is 0. An explicitly specified enumeration constant has the value of the associate constant expression.

If implicitly and explicitly specified constants are mixed within an enumeration list, it is possible for your program to replicate values. Such replications can be unintentional and can cause unexpected behavior.

### Message in Report

The constant `constant1` has same value as the constant `constant2`.

## Check Information

**Group:** Declarations and Definitions<br>
**Category:** Required<br>
**AGC Category:** Required<br>
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”<br>
“Review Coding Rule Violations”<br>
“Polyspace MISRA C:2012 Checker”<br>
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 8.13

A pointer should point to a const-qualified type whenever possible

## Description

### Rule Definition

*A pointer should point to a const-qualified type whenever possible.*

### Rationale

This rule ensures that you do not inadvertently use pointers to modify objects.

### Polyspace Specification

Polyspace issues a warning if a non-`const` pointer parameter either:

- Does not modify the addressed object.
- Is passed to a call of a function that is declared with a `const` pointer parameter.

### Message in Report

A pointer should point to a const-qualified type whenever possible.

## Examples

### Pointer Parameters

```
#include <string.h>

typedef unsigned short uint16_t;

uint16_t ptr_ex(uint16_t *p) {      /* Non-compliant */
```

```
    return *p;
}

char last_char(char * const s){     /* Non-compliant */
    return s[strlen(s) - 1u];
}

uint16_t first(uint16_t a[5]){      /* Non-compliant */
    return a[0];
}
```

This example shows three different noncompliant pointer parameters. In the ptr_ex function, p does not modify an object. However, the type to which p points is not const-qualified, so it is noncompliant. In last_char, the pointer s is const-qualified but the type it points to is not. Because s does not modify an object, this parameter is noncompliant. The function first does not modify the elements of the array a. However, the element type is not const-qualified, so a is also noncompliant.

One possible correction is to add const qualifiers to the definitions.

```
#include <string.h>

typedef unsigned short uint16_t;

uint16_t ptr_ex(const uint16_t *p){     /* Compliant */
    return *p;
}

char last_char(const char * const s){   /* Compliant */
    return s[strlen( s ) - 1u];
}

uint16_t first(const uint16_t a[5]) {   /* Compliant */
    return a[0];
}
```

## Check Information

**Group:** Declarations and Definitions
**Category:** Advisory
**AGC Category:** Advisory

**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 8.14

The restrict type qualifier shall not be used

## Description

### Rule Definition

*The restrict type qualifier shall not be used.*

### Rationale

When you use a `restrict` qualifier carefully, it improves the efficiency of code generated by a compiler. It can also improve static analysis. However, when using the `restrict` qualifier, make sure that the memory areas operated on by two or more pointers do not overlap.

### Message in Report

The restrict type qualifier shall not be used.

## Check Information

**Group:** Declarations and Definitions
**Category:** Required
**AGC Category:** Advisory
**Language:** C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 9.1

The value of an object with automatic storage duration shall not be read before it has been set

## Description

**Message in Report:**

### Rule Definition

*The value of an object with automatic storage duration shall not be read before it has been set.*

### Rationale

A variable with an automatic storage duration is allocated memory at the beginning of an enclosing code block and deallocated at the end. All non-global variables have this storage duration, except those declared `static` or `extern`.

Variables with automatic storage duration are not automatically initialized and have indeterminate values. Therefore, you must not read such a variable before you have set its value through a write operation.

### Polyspace Specification

The Polyspace analysis checks some of the violations as non-initialized variables. For more information, see `Non-initialized variable`.

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

### Message in Report

The value of an object with automatic storage duration shall not be read before it has been set.

## Check Information

**Group:** Initialization
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.1` | `MISRA C:2012 Rule 15.3`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 9.2

The initializer for an aggregate or union shall be enclosed in braces

## Description

### Rule Definition

*The initializer for an aggregate or union shall be enclosed in braces.*

### Rationale

The rule applies to both objects and subobjects. For example, when initializing a structure that contains an array, the values assigned to the structure must be enclosed in braces. Within these braces, the values assigned to the array must be enclosed in another pair of braces.

Enclosing initializers in braces improves clarity of code that contains complex data structures such as multidimensional arrays and arrays of structures.

**Tip** To avoid nested braces for subobjects, use the syntax `{0}`, which sets all values to zero.

### Message in Report

The initializer for an aggregate or union shall be enclosed in braces.

## Examples

### Initialization of Two-dimensional Arrays

```
void initialize(void) {
    int x[4][2] = {{0,0},{1,0},{0,1},{1,1}}; /* Compliant */
    int y[4][2] = {{0},{1,0},{0,1},{1,1}};   /* Compliant */
    int z[4][2] = {0};                       /* Compliant */
    int w[4][2] = {0,0,1,0,0,1,1,1};         /* Non-compliant */
}
```

In this example, the rule is not violated when:

- Initializers for each row of the array are enclosed in braces.
- The syntax `{0}` initializes all elements to zero.

The rule is violated when a separate pair of braces is not used to enclose the initializers for each row.

## Check Information

**Group:** Initialization  
**Category:** Required  
**AGC Category:** Readability  
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"  
"Review Coding Rule Violations"  
"Polyspace MISRA C:2012 Checker"  
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 9.3

Arrays shall not be partially initialized

## Description

### Rule Definition

*Arrays shall not be partially initialized.*

### Rationale

Providing an explicit initialization for each array element makes it clear that every element has been considered.

### Message in Report

Arrays shall not be partially initialized.

## Examples

### Partial and Complete Initializations

```
void func(void) {
    int x[3] = {0,1,2};                /* Compliant */
    int y[3] = {0,1};                  /* Non-compliant */
    int z[3] = {0};                    /* Compliant - exception */
    int a[30] = {[1] = 1,[15]=1};      /* Compliant - exception */
    int b[30] = {{1} = 1, 1};          /* Non-compliant */
    char c[20] = "Hello World";        /* Compliant - exception */
}
```

In this example, the rule is not violated when each array element is explicitly initialized.

The rule is violated when some elements of the array are implicitly initialized. Exceptions include the following:

- The initializer has the form `{0}`, which initializes all elements to zero.
- The array initializer consists *only* of designated initializers. Typically, you use this approach for sparse initialization.
- The array is initialized using a string literal.

## Check Information

**Group:** Initialization
**Category:** Required
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

#### Introduced in R2014b

# MISRA C:2012 Rule 9.4

An element of an object shall not be initialized more than once

## Description

### Rule Definition

*An element of an object shall not be initialized more than once.*

### Rationale

Designated initializers allow explicitly initializing elements of objects such as arrays in any order. However, using designated initializers, one can inadvertently initialize the same element twice and therefore overwrite the first initialization.

### Message in Report

An element of an object shall not be initialized more than once.

## Examples

### Array Initialization Using Designated Initializers

```
void func(void) {
    int a[5] = {-2,-1,0,1,2};               /* Compliant */
    int b[5] = {[0]=-2, [1]=-1, [2]=0, [3]=1, [4]=2};
                                            /* Compliant */
    int c[5] = {[0]=-2, [1]=-1, [1]=0, [3]=1, [4]=2};
                                            /* Non-compliant */
}
```

In this example, the rule is violated when the array element `c[1]` is initialized twice using a designated initializer.

### Structure Initialization Using Designated Initializers

```
struct myStruct {
    int a;
    int b;
    int c;
    int d;
};

void func(void) {
    struct myStruct struct1 = {-4,-2,2,4};   /* Compliant */
    struct myStruct struct2 = {.a=-4, .b=-2, .c=2, .d=4};
                                             /* Compliant */
    struct myStruct struct3 = {.a=-4, .b=-2, .b=2, .d=4};
                                             /* Non-compliant */
}
```

In this example, the rule is violated when `struct3.b` is initialized twice using a designated initializer.

## Check Information

**Group:** Initialization
**Category:** Required
**AGC Category:** Required
**Language:** C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 9.5

Where designated initializers are used to initialize an array object the size of the array shall be specified explicitly

## Description

### Rule Definition

*Where designated initializers are used to initialize an array object the size of the array shall be specified explicitly.*

### Rationale

If the size of an array is not specified explicitly, it is determined by the highest index of the elements that are initialized. When using long designated initializers, it might not be immediately apparent which element has the highest index.

### Message in Report

Where designated initializers are used to initialize an array object the size of the array shall be specified explicitly.

## Examples

### Using Designated Initializers Without Specifying Array Size

```
int a[5] = {[0]= 1, [2] = 1, [4]= 1, [1] = 1};        /* Compliant */
int b[] = {[0]= 1, [2] = 1, [4]= 1, [1] = 1};         /* Non-compliant */
int c[] = {[0]= 1, [1] = 1, [2]= 1, [3]=0, [4] = 1};  /* Non-compliant */

void display(int);

void main() {
    func(a,5);
    func(b,5);
    func(c,5);
}

void func(int* arr, int size) {
    for(int i=0; i<size; i++)
        display(arr[i]);
}
```

In this example, the rule is violated when the arrays `b` and `c` are initialized using designated initializers but the array size is not specified.

## Check Information

**Group:** Initialization
**Category:** Required
**AGC Category:** Readability
**Language:** C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 10.1

Operands shall not be of an inappropriate essential type

## Description

### Rule Definition

*Operands shall not be of an inappropriate essential type.*

### Rationale

An essential type category defines the essential type of an object or expression.

| Essential type category | Standard types |
|---|---|
| Essentially Boolean | `bool` or `_Bool` (defined in `stdbool.h`)<br>If you define a boolean type through a `typedef`, you must specify this type name before coding rules checking. For more information, see "Specify Boolean Types". |
| Essentially character | `char` |
| Essentially enum | named `enum` |
| Essentially signed | signed `char`, signed `short`, signed `int`, signed `long`, signed `long long` |
| Essentially unsigned | unsigned `char`, unsigned `short`, unsigned `int`, unsigned `long`, unsigned `long long` |
| Essentially floating | `float`, `double`, `long double` |

For operands of some operators, you cannot use certain essential types. In the table below, each row represents an operator/operand combination. If the essential type column is not empty for that row, there is a MISRA restriction when using that type as the operand. The number in the table corresponds to the rationale list after the table.

| Operation | | Essential type category of arithmetic operand | | | | | |
|---|---|---|---|---|---|---|---|
| **Operator** | **Operand** | **Boolean** | **character** | **enum** | **signed** | **unsigned** | **floating** |
| [ ] | integer | 3 | 4 | | | | 1 |
| + (unary) | | 3 | 4 | 5 | | | |
| – (unary) | | 3 | 4 | 5 | | 8 | |
| + - | either | 3 | | 5 | | | |
| * / | either | 3 | 4 | 5 | | | |
| % | either | 3 | 4 | 5 | | | 1 |
| < > <= >= | either | 3 | | | | | |
| == != | either | | | | | | |
| ! && \|\| | any | | 2 | 2 | 2 | 2 | 2 |
| << >> | left | 3 | 4 | 5,6 | 6 | | 1 |
| << >> | right | 3 | 4 | 7 | 7 | | 1 |
| ~ & \| ^ | any | 3 | 4 | 5,6 | 6 | | 1 |
| ?: | 1st | | 2 | 2 | 2 | 2 | 2 |
| ?: | 2nd and 3rd | | | | | | |

1 An expression of essentially floating type for these operands is a constraint violation.

2 When an operand is interpreted as a Boolean value, use an expression of essentially Boolean type.

3 When an operand is interpreted as a numeric value, do not use an operand of essentially Boolean type.

4 When an operand is interpreted as a numeric value, do not use an operand of essentially character type. The numeric values of character data are implementation-defined.

5 In an arithmetic operation, do not use an operand of essentially enum type. An enum object uses an implementation-defined integer type. An operation involving an enum object can therefore yield a result with an unexpected type.

6 Perform only shift and bitwise operations on operands of essentially unsigned type. When you use shift and bitwise operations on essentially signed types, the resulting numeric value is implementation-defined.

7 To avoid undefined behavior on negative shifts, use an essentially unsigned right-hand operand.

8 For the unary minus operator, do not use an operand of essentially unsigned type. The implemented size of int determines the signedness of the result.

## Message in Report

The *operand_name* operand of the *operator_name* operator is of an inappropriate essential type category *category_name*.

# Examples

## Violation of Rule 10.1, Rationale 2: Inappropriate Operand Types for Operators That Take Essentially Boolean Operands

```
typedef unsigned char boolean;

extern float f32a;
extern char cha;
extern signed char s8a;
extern unsigned char u8a;
enum enuma { a1, a2, a3 } ena;

extern boolean bla, blb, rbla;

void foo(void) {

  rbla = cha && bla;        /* Non-compliant: cha is essentially char  */
  enb = ena ? a1 : a2;      /* Non-compliant: ena is essentially enum  */
  rbla = s8a && bla;        /* Non-compliant: s8a is essentially signed char  */
  ena = u8a ? a1 : a2;      /* Non-compliant: u8a is essentially unsigned char  */
  rbla = f32a && bla;       /* Non-compliant: f32a is essentially float */

  rbla = bla && blb;        /* Compliant */
  ru8a = bla ? u8a : u8b;   /* Compliant */

}
```

In the noncompliant examples, rule 10.1 is violated because:

- The operator `&&` expects only essentially Boolean operands. However, at least one of the operands used has a different type.
- The first operand of `?:` is expected to be essentially Boolean. However, a different operand type is used.

**Note** For Polyspace to detect the rule violation, you must define the type name `boolean` as an effective Boolean type. For more information, see “Specify Boolean Types”.

## Violation of Rule 10.1, Rationale 3: Inappropriate Boolean Operands

```
typedef unsigned char boolean;


enum enuma { a1, a2, a3 } ena;
enum { K1 = 1, K2 = 2 };    /* Essentially signed */
extern char cha, chb;
extern boolean bla, blb, rbla;
extern signed char rs8a, s8a;


void foo(void) {

  rbla = bla * blb;      /* Non-compliant - Boolean used as a numeric value */
  rbla = bla > blb;      /* Non-compliant - Boolean used as a numeric value */

  rbla = bla && blb;     /* Compliant */
  rbla = cha > chb;      /* Compliant */
  rbla = ena > a1;       /* Compliant */
  rbla = u8a > 0U;       /* Compliant */
  rs8a = K1 * s8a;       /* Compliant - K1 obtained from anonymous enum */

}
```

In the noncompliant examples, rule 10.1 is violated because the operators `*` and > do not expect essentially Boolean operands. However, the operands used here are essentially Boolean.

**Note** For Polyspace to detect the rule violation, you must define the type name `boolean` as an effective Boolean type. For more information, see “Specify Boolean Types”.

## Violation of Rule 10.1, Rationale 4: Inappropriate Character Operands

```
extern char rcha, cha, chb;
extern unsigned char ru8a, u8a;

void foo(void) {

  rcha = cha & chb;      /* Non-compliant - char type used as a numeric value */
  rcha = cha << 1;       /* Non-compliant - char type used as a numeric value */

  ru8a = u8a & 2U;       /* Compliant */
  ru8a = u8a << 2U;      /* Compliant */

}
```

In the noncompliant examples, rule 10.1 is violated because the operators `&` and << do not expect essentially character operands. However, at least one of the operands used here has essentially character type.

## Violation of Rule 10.1, Rationale 5: Inappropriate Enum Operands

```
typedef unsigned char boolean;

enum enuma { a1, a2, a3 } rena, ena, enb;

void foo(void) {

  ena--;             /* Non-Compliant - arithmetic operation with enum type*/
  rena = ena * a1;   /* Non-Compliant - arithmetic operation with enum type*/
  ena += a1;         /* Non-Compliant - arithmetic operation with enum type*/

}
```

In the noncompliant examples, rule 10.1 is violated because the arithmetic operators `--`, `*` and += do not expect essentially enum operands. However, at least one of the operands used here has essentially enum type.

## Violation of Rule 10.1, Rationale 6: Inappropriate Signed Operand for Bitwise Operations

```
extern signed char s8a;
extern unsigned char ru8a, u8a;
```

```
void foo(void) {

  ru8a = s8a & 2;        /* Non-compliant - bitwise operation on signed type */
  ru8a = 2 << 3U;        /* Non-compliant - shift operation on signed type */

  ru8a = u8a << 2U;      /* Compliant */

}
```

In the noncompliant examples, rule 10.1 is violated because the `&` and << operations must not be performed on essentially signed operands. However, the operands used here are signed.

### Violation of Rule 10.1, Rationale 7: Inappropriate Signed Right Operand for Shift Operations

```
extern signed char s8a;
extern unsigned char ru8a, u8a;

void foo(void) {

  ru8a = u8a << s8a;     /* Non-compliant - shift magnitude uses signed type */
  ru8a = u8a << -1;      /* Non-compliant - shift magnitude uses signed type */

  ru8a = u8a << 2U;      /* Compliant */
  ru8a = u8a << 1;       /* Compliant - exception */

}
```

In the noncompliant examples, rule 10.1 is violated because the operation << does not expect an essentially signed right operand. However, the right operands used here are signed.

## Check Information

**Group:** The Essential Type Model
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 10.2`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 10.2

Expressions of essentially character type shall not be used inappropriately in addition and subtraction operations

## Description

### Rule Definition

*Expressions of essentially character type shall not be used inappropriately in addition and subtraction operations.*

### Rationale

Essentially character type expressions are `char` variables. Do not use character data arithmetically because the data does not represent numeric values.

For information on essential types, see `MISRA C:2012 Rule 10.1`.

### Message in Report

- The *`operand_name`* operand of the + operator applied to an expression of essentially character type shall have essentially signed or unsigned type.
- The right operand of the - operator applied to an expression of essentially character type shall have essentially signed or unsigned or character type.
- The left operand of the - operator shall have essentially character type if the right operand has essentially character type.

## Check Information

**Group:** The Essential Type Model
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 10.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 10.3

The value of an expression shall not be assigned to an object with a narrower essential type or of a different essential type category

## Description

### Rule Definition

*The value of an expression shall not be assigned to an object with a narrower essential type or of a different essential type category.*

### Rationale

The use of implicit conversions between types can lead to unintended results, including possible loss of value, sign, or precision.

For information on essential types, see `MISRA C:2012 Rule 10.1`.

### Message in Report

- The expression is assigned to an object with a different essential type category.
- The expression is assigned to an object with a narrower essential type.

## Check Information

**Group:** The Essential Type Model
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 10.4` | `MISRA C:2012 Rule 10.5` | `MISRA C:2012 Rule 10.6`

## Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 10.4

Both operands of an operator in which the usual arithmetic conversions are performed shall have the same essential type category

## Description

### Rule Definition

*Both operands of an operator in which the usual arithmetic conversions are performed shall have the same essential type category.*

### Rationale

The use of implicit conversions between types can lead to unintended results, including possible loss of value, sign, or precision.

For information on essential types, see `MISRA C:2012 Rule 10.1`.

### Polyspace Specification

Polyspace does not produce a violation of this rule:

- If one of the operands is the constant zero.
- If one of the operands is a signed constant and the other operand is unsigned, and the signed constant has the same representation as its unsigned equivalent.

  For instance, the statement `u8b = u8a + 3;`, where `u8a` and `u8b` are `unsigned char` variables, does not violate the rule because the constants `3` and `3U` have the same representation.

### Message in Report

Operands of *`operator_name`* operator shall have the same essential type category.

## Check Information

**Group:** The Essential Type Model
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 10.3` | `MISRA C:2012 Rule 10.7`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 10.5

The value of an expression should not be cast to an inappropriate essential type

## Description

### Rule Definition

*The value of an expression should not be cast to an inappropriate essential type.*

### Rationale

#### Converting Between Variable Types

| | | From | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Boolean** | **character** | **enum** | **signed** | **unsigned** | **floating** |
| To | **Boolean** | | Avoid | Avoid | Avoid | Avoid | Avoid |
| | **character** | Avoid | | | | | Avoid |
| | **enum** | Avoid | Avoid | Avoid | Avoid | Avoid | Avoid |
| | **signed** | Avoid | | | | | |
| | **unsigned** | Avoid | | | | | |
| | **floating** | Avoid | Avoid | | | | |

Some inappropriate explicit casts are:

- In C99, the result of a cast of assignment to `_Bool` is always 0 or 1. This result is not necessarily the case when casting to another type which is defined as essentially Boolean.
- A cast to an essential enum type may result in a value that does not lie within the set of enumeration constants for that type.
- A cast from essential Boolean to any other type is unlikely to be meaningful.
- Converting between floating and character types is not meaningful as there is no precise mapping between the two representations.

Some acceptable explicit casts are:

- To change the type in which a subsequent arithmetic operation is performed.
- To truncate a value deliberately.
- To make a type conversion explicit in the interests of clarity.

For more information on essential types, see `MISRA C:2012 Rule 10.1`.

### Message in Report

The value of an expression should not be cast to an inappropriate essential type.

## Check Information

**Group:** The Essential Type Model
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 10.3` | `MISRA C:2012 Rule 10.8`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 10.6

The value of a composite expression shall not be assigned to an object with wider essential type

## Description

### Rule Definition

*The value of a composite expression shall not be assigned to an object with wider essential type.*

### Rationale

A *composite expression* is a nonconstant expression using a composite operator. In the Essential Type Model, composite operators are:

- Multiplicative (`*`, `/`, `%`)
- Additive (binary `+`, binary `-`)
- Bitwise (`&`, `|`, `^`)
- Shift (`<<`, `>>`)
- Conditional (`?`, `:`)

If you assign the result of a composite expression to a larger type, the implicit conversion can result in loss of value, sign, precision, or layout.

For information on essential types, see `MISRA C:2012 Rule 10.1`.

### Message in Report

The composite expression is assigned to an object with a wider essential type.

## Check Information

**Group:** The Essential Type Model
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 10.3` | `MISRA C:2012 Rule 10.7`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 10.7

If a composite expression is used as one operand of an operator in which the usual arithmetic conversions are performed then the other operand shall not have wider essential type

## Description

### Rule Definition

*If a composite expression is used as one operand of an operator in which the usual arithmetic conversions are performed, then the other operand shall not have wider essential type.*

### Rationale

A *composite expression* is a nonconstant expression using a composite operator. In the Essential Type Model, composite operators are:

- Multiplicative (`*`, `/`, `%`)
- Additive (binary +, binary −)
- Bitwise (`&`, `|`, `^`)
- Shift (<<, >>)
- Conditional (`?`, `:`)

Restricting implicit conversion on composite expressions mean that sequences of arithmetic operations within expressions must use the same essential type. This restriction reduces confusion and avoids loss of value, sign, precision, or layout. However, this rule does not imply that all operands in an expression are of the same essential type.

For information on essential types, see `MISRA C:2012 Rule 10.1`.

### Message in Report

- The right operand shall not have wider essential type than the left operand which is a composite expression.
- The left operand shall not have wider essential type than the right operand which is a composite expression.

## Check Information

**Group:** The Essential Type Model
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 10.8

The value of a composite expression shall not be cast to a different essential type category or a wider essential type

## Description

### Rule Definition

*The value of a composite expression shall not be cast to a different essential type category or a wider essential type.*

### Rationale

A *composite expression* is a non-constant expression using a composite operator. In the Essential Type Model, composite operators are:

- Multiplicative (`*`, `/`, `%`)
- Additive (binary `+`, binary `-`)
- Bitwise (`&`, `|`, `^`)
- Shift (<<, >>)
- Conditional (`?`, `:`)

Casting to a wider type is not permitted because the result may vary between implementations. Consider this expression:

```
(uint32_t) (u16a +u16b);
```

On a 16-bit machine the addition is performed in 16 bits. The result is wrapped before it is cast to 32 bits. On a 32-bit machine, the addition takes place in 32 bits and preserves high-order bits that are lost on a 16-bit machine. Casting to a narrower type with the same essential type category is acceptable as the explicit truncation of the results always leads to the same loss of information.

For information on essential types, see `MISRA C:2012 Rule 10.1`.

## Message in Report

- The value of a composite expression shall not be cast to a different essential type category.
- The value of a composite expression shall not be cast to a wider essential type.

# Examples

## Casting to Different or Wider Essential Type

```
extern unsigned short ru16a, u16a, u16b;
extern unsigned int   u32a, ru32a;
extern signed int     s32a, s32b;

void foo(void)
{
  ru16a  = (unsigned short) (u32a + u32a);/* Compliant                          */
  ru16a += (unsigned short) s32a + s32b;
                                     /* Noncompliant - different essential type  */
  ru16a += (unsigned short) s32a;    /* Compliant - s32a is not composite       */
  ru32a  = (unsigned int) (u16a + u16b);  /* Noncompliant - wider essential type */
}
```

In this example, rule 10.8 is violated in the following cases:

- `s32a` and `s32b` are essentially `signed` variables. However, the result `( s32a + s32b )` is cast to an essentially `unsigned` type.
- `u16a` and `u16b` are essentially `unsigned short` variables. However, the result `( s32a + s32b )` is cast to a wider essential type, `unsigned int`.

# Check Information

**Group:** The Essential Type Model
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 10.5`

## Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 11.1

Conversions shall not be performed between a pointer to a function and any other type

## Description

### Rule Definition

*Conversions shall not be performed between a pointer to a function and any other type.*

### Rationale

The rule forbids the following two conversions:

- Conversion from a function pointer to any other type. This conversion causes undefined behavior.
- Conversion from a function pointer to another function pointer, if the function pointers have different argument and return types.

  The conversion is forbidden because calling a function through a pointer with incompatible type results in undefined behavior.

### Polyspace Specification

Polyspace considers both explicit and implicit casts when checking this rule. However, casts from `NULL` or `(void*)0` do not violate this rule.

### Message in Report

Conversions shall not be performed between a pointer to a function and any other type.

# Examples

## Cast between two function pointers

```
typedef void (*fp16) (short n);
typedef void (*fp32) (int n);

#include <stdlib.h>                     /* To obtain macro  NULL */

void func(void) {   /* Exception 1 - Can convert a null pointer 
                     * constant into a pointer to a function */
  fp16 fp1 = NULL;                 /* Compliant - exception  */
  fp16 fp2 = (fp16) fp1;           /* Compliant */
  fp32 fp3 = (fp32) fp1;           /* Non-compliant */
  if (fp2 != NULL) {}              /* Compliant - exception  */
  fp16 fp4 = (fp16) 0x8000;        /* Non-compliant - integer to 
                                    * function pointer */}
```

In this example, the rule is violated when:

- The pointer `fp1` of type `fp16` is cast to type `fp32`. The function pointer types `fp16` and `fp32` have different argument types.
- An integer is cast to type `fp16`.

The rule is not violated when function pointers `fp1` and `fp2` are cast to `NULL`.

# Check Information

**Group:** Pointer Type Conversions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

# See Also

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 11.2

Conversions shall not be performed between a pointer to an incomplete type and any other type

## Description

### Rule Definition

*Conversions shall not be performed between a pointer to an incomplete type and any other type.*

### Rationale

An incomplete type is a type that does not contain sufficient information to determine its size. For example, the statement `struct s;` describes an incomplete type because the fields of `s` are not defined. The size of a variable of type `s` cannot be determined.

Conversions to or from a pointer to an incomplete type result in undefined behavior. Typically, a pointer to an incomplete type is used to hide the full representation of an object. This encapsulation is broken if another pointer is implicitly or explicitly cast to such a pointer.

### Message in Report

Conversions shall not be performed between a pointer to an incomplete type and any other type.

## Examples

### Casts from incomplete type

```
struct s *sp;
struct t *tp;
```

```
short  *ip;
struct ct *ctp1;
struct ct *ctp2;


void foo(void) {

    ip = (short *) sp;            /* Non-compliant */
    sp = (struct s *) 1234;       /* Non-compliant */
    tp = (struct t *) sp;         /* Non-compliant */
    ctp1 = (struct ct *) ctp2;    /* Compliant */

    /* You can convert a null pointer constant to
     * a pointer to an incomplete type */
    sp = NULL;                    /* Compliant - exception  */

    /* A pointer to an incomplete type may be converted into void */
    struct s *f(void);
    (void) f();                   /* Compliant - exception  */

}
```

In this example, types `s`, `t` and `ct` are incomplete. The rule is violated when:

- The variable `sp` with an incomplete type is cast to a basic type.
- The variable `sp` with an incomplete type is cast to a different incomplete type `t`.

The rule is not violated when:

- The variable `ctp2` with an incomplete type is cast to the same incomplete type.
- The `NULL` pointer is cast to the variable `sp` with an incomplete type.
- The return value of `f` with incomplete type is cast to `void`.

## Check Information

**Group:** Pointer Type Conversions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 11.5`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 11.3

A cast shall not be performed between a pointer to object type and a pointer to a different object type

## Description

### Rule Definition

*A cast shall not be performed between a pointer to object type and a pointer to a different object type.*

### Rationale

If a pointer to an object is cast into a pointer to a different object, the resulting pointer can be incorrectly aligned. The incorrect alignment causes undefined behavior.

Even if the conversion produces a pointer that is correctly aligned, the behavior can be undefined if the pointer is used to access an object.

Exception: You can convert a pointer to object type into a pointer to one of the following types:

- `char`
- `signed char`
- `unsigned char`

### Message in Report

A cast shall not be performed between a pointer to object type and a pointer to a different object type.

# Examples

## Noncompliant: Cast to Pointer Pointing to Object of Wider Type

```
signed   char *p1;
unsigned int *p2;

void foo(void){
  p2 = ( unsigned int * ) p1;     /* Non-compliant */
}
```

In this example, p1 can point to a signed char object. However, p1 is cast to a pointer that points to an object of wider type, unsigned int.

## Noncompliant: Cast to Pointer Pointing to Object of Narrower Type

```
extern unsigned int read_value ( void );
extern void display ( unsigned int n );

void foo ( void ){
  unsigned int u = read_value ( );
  unsigned short *hi_p = ( unsigned short * ) &u;    /* Non-compliant  */
  *hi_p = 0;
  display ( u );
}
```

In this example, u is an unsigned int variable. &u is cast to a pointer that points to an object of narrower type, unsigned short.

On a big-endian machine, the statement *hi_p = 0 attempts to clear the high bits of the memory location that &u points to. But, from the result of display(u), you might find that the high bits have not been cleared.

## Compliant: Cast Adding a Type Qualifier

```
const short *p;
const volatile short *q;
void foo (void){
  q = ( const volatile short * ) p;  /* Compliant */
}
```

In this example, both `p` and `q` can point to `short` objects. The cast between them adds a `volatile` qualifier only and is therefore compliant.

## Check Information

**Group:** Pointer Type Conversions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 11.4` | `MISRA C:2012 Rule 11.5` | `MISRA C:2012 Rule 11.8`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 11.4

A conversion should not be performed between a pointer to object and an integer type

## Description

### Rule Definition

*A conversion should not be performed between a pointer to object and an integer type.*

### Rationale

Conversion between integers and pointers can cause errors or undefined behavior.

- If an integer is cast to a pointer, the resulting pointer can be incorrectly aligned. The incorrect alignment causes undefined behavior.
- If a pointer is cast to an integer, the resulting value can be outside the allowed range for the integer type.

### Polyspace Specification

Casts or implicit conversions from `NULL` or `(void*)0` do not generate a warning.

### Message in Report

A conversion should not be performed between a pointer to object and an integer type.

## Examples

### Casts between pointer and integer

```
#include <stdbool.h>

typedef unsigned char       uint8_t;
typedef          char      char_t;
typedef unsigned short     uint16_t;
typedef signed   int       int32_t;

typedef _Bool bool_t;
uint8_t *PORTA = (uint8_t *) 0x0002;           /* Non-compliant */

void foo(void) {

    char_t c = 1;
    char_t *pc = &c;                               /* Compliant */


    uint16_t ui16   = 7U;
    uint16_t *pui16 = &ui16;                       /* Compliant */
    pui16 = (uint16_t *) ui16;                     /* Non-compliant */


    uint16_t *p;
    int32_t addr = (int32_t) p;                   /* Non-compliant */
    bool_t b = (bool_t) p;                        /* Non-compliant */
    enum etag { A, B } e = ( enum etag ) p;       /* Non-compliant */
}
```

In this example, the rule is violated when:

- The integer `0x0002` is cast to a pointer.

  If the integer defines an absolute address, it is more common to assign the address to a pointer in a header file. To avoid the assignment being flagged, you can then exclude headers files from coding rules checking. For more information, see `Do not generate results for (-do-not-generate-results-for)`.
- The pointer `p` is cast to integer types such as `int32_t`, `bool_t` or `enum etag`.

The rule is not violated when the address `&ui16` is assigned to a pointer.

## Check Information

**Group:** Pointer Type Conversions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 11.3` | `MISRA C:2012 Rule 11.7` | `MISRA C:2012 Rule 11.9`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 11.5

A conversion should not be performed from pointer to void into pointer to object

## Description

### Rule Definition

*A conversion should not be performed from pointer to void into pointer to object.*

### Rationale

If a pointer to `void` is cast into a pointer to an object, the resulting pointer can be incorrectly aligned. The incorrect alignment causes undefined behavior. However, such a cast can sometimes be necessary, for example, when using memory allocation functions.

### Polyspace Specification

Casts or implicit conversions from `NULL` or `(void*)0` do not generate a warning.

### Message in Report

A conversion should not be performed from pointer to void into pointer to object.

## Examples

### Cast from Pointer to `void`

```
void foo(void) {

    unsigned int  u32a = 0;
    unsigned int  *p32 = &u32a;
    void          *p;
    unsigned int  *p16;
    p   = p32;                /* Compliant - pointer to uint32_t
                               *            into pointer to void */
    p16 = p;                  /* Non-compliant */

    p   = (void *) p16;       /* Compliant */
    p32 = (unsigned int *) p; /* Non-compliant */
}
```

In this example, the rule is violated when the pointer `p` of type `void*` is cast to pointers to other types.

The rule is not violated when `p16` and `p32`, which are pointers to non-`void` types, are cast to `void*`.

## Check Information

**Group:** Pointer Type Conversions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 11.2` | `MISRA C:2012 Rule 11.3`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

**Introduced in R2014b**

# MISRA C:2012 Rule 11.6

A cast shall not be performed between pointer to void and an arithmetic type

## Description

### Rule Definition

*A cast shall not be performed between pointer to void and an arithmetic type.*

### Rationale

Conversion between integer types and pointers to `void` can cause errors or undefined behavior.

- If an integer type is cast to a pointer, the resulting pointer can be incorrectly aligned. The incorrect alignment causes undefined behavior.
- If a pointer is cast to an arithmetic type, the resulting value can be outside the allowed range for the type.

Conversion between non-integer arithmetic types and pointers to `void` is undefined.

### Polyspace Specification

Casts or implicit conversions from `NULL` or `(void*)0` do not generate a warning.

### Message in Report

A cast shall not be performed between pointer to void and an arithmetic type.

# Examples

## Casts Between Pointer to **void** and Arithmetic Types

```
void foo(void) {

    void           *p;
    unsigned int   u;
    unsigned short r;

    p = (void *) 0x1234u;             /* Non-compliant - undefined */
    u = (unsigned int) p;             /* Non-compliant - undefined */

    p = (void *) 0;                   /* Compliant - Exception */

}
```

In this example, `p` is a pointer to `void`. The rule is violated when:

- An integer value is cast to `p`.
- `p` is cast to an `unsigned int` type.

The rule is not violated if an integer constant with value 0 is cast to a pointer to `void`.

# Check Information

**Group:** Pointer Type Conversions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

# See Also

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 11.7

A cast shall not be performed between pointer to object and a non-integer arithmetic type

## Description

### Rule Definition

*A cast shall not be performed between pointer to object and a non-integer arithmetic type.*

### Rationale

This rule covers types that are essentially Boolean, character, enum or floating.

- If an essentially Boolean, character or enum variable is cast to a pointer, the resulting pointer can be incorrectly aligned. The incorrect alignment causes undefined behavior. If a pointer is cast to one of those types, the resulting value can be outside the allowed range for the type.
- Casts to or from a pointer to a floating type results in undefined behavior.

### Message in Report

A cast shall not be performed between pointer to object and a non-integer arithmetic type.

## Examples

### Casts from Pointer to Non-Integer Arithmetic Types

```
int foo(void) {

    short *p;
    float  f;
    long  *l;
    f = (float)   p;              /* Non-compliant */
    p = (short *) f;              /* Non-compliant */

    l = (long *)  p;              /* Compliant */
}
```

In this example, the rule is violated when:

- The pointer p is cast to float.
- A float variable is cast to a pointer to short.

The rule is not violated when the pointer p is cast to long*.

## Check Information

**Group:** Pointer Type Conversions<br>
**Category:** Required<br>
**AGC Category:** Required<br>
**Language:** C90, C99

## See Also

MISRA C:2012 Rule 11.4

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 11.8

A cast shall not remove any const or volatile qualification from the type pointed to by a pointer

## Description

### Rule Definition

*A cast shall not remove any const or volatile qualification from the type pointed to by a pointer.*

### Rationale

This rule forbids:

- Casts from a pointer to a `const` object to a pointer that does not point to a `const` object.
- Casts from a pointer to a `volatile` object to a pointer that does not point to a `volatile` object.

Such casts violate type qualification. For example, the `const` qualifier indicates the read-only status of an object. If a cast removes the qualifier, the object is no longer read-only.

### Polyspace Specification

Polyspace flags both implicit and explicit conversions that violate this rule.

### Message in Report

A cast shall not remove any const or volatile qualification from the type pointed to by a pointer.

# Examples

## Casts That Remove Qualifiers

```
void foo(void) {

    /* Cast on simple type */
    unsigned short           x;
    unsigned short * const   cpi = &x;  /* const pointer */
    unsigned short * const  *pcpi;   /* pointer to const pointer */
    unsigned short **ppi;
    const unsigned short    *pci;    /* pointer to const */
    volatile unsigned short *pvi;    /* pointer to volatile  */
    unsigned short          *pi;

    pi = cpi;                        /* Compliant - no cast required */
    pi  = (unsigned short *)  pci;   /* Non-compliant */
    pi  = (unsigned short *)  pvi;   /* Non-compliant */
    ppi = (unsigned short **)pcpi;   /* Non-compliant */
}
```

In this example:

- The variables pci and pcpi have the const qualifier in their type. The rule is violated when the variables are cast to types that do not have the const qualifier.
- The variable pvi has a volatile qualifier in its type. The rule is violated when the variable is cast to a type that does not have the volatile qualifier.

Even though cpi has a const qualifier in its type, the rule is not violated in the statement p=cpi;. The assignment does not cause a type conversion because both p and cpi have type unsigned short.

# Check Information

**Group:** Pointer Type Conversions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 11.3`

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 11.9

The macro NULL shall be the only permitted form of integer null pointer constant

## Description

### Rule Definition

*The macro NULL shall be the only permitted form of integer null pointer constant.*

### Rationale

The following expressions require the use of a null pointer constant:

- Assignment to a pointer
- The == or != operation, where one operand is a pointer
- The ?: operation, where one of the operands on either side of : is a pointer

Using NULL rather than 0 makes it clear that a null pointer constant was intended.

### Message in Report

The macro NULL shall be the only permitted form of integer null pointer constant.

## Examples

### Using 0 for Pointer Assignments and Comparisons

```
void main(void) {

    int *p1 = 0;               /* Non-compliant */
    int *p2 = ( void * ) 0;    /* Compliant     */

#define MY_NULL_1 0
#define MY_NULL_2 ( void * ) 0

    if ( p1 == MY_NULL_1 )    /* Non-compliant */
    { }
    if ( p2 == MY_NULL_2 )    /* Compliant     */
    { }

}
```

In this example, the rule is violated when the constant 0 is used instead of `(void*) 0` for pointer assignments and comparisons.

## Check Information

**Group:** Pointer Type Conversions
**Category:** Required
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 11.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 12.1

The precedence of operators within expressions should be made explicit

## Description

### Rule Definition

*The precedence of operators within expressions should be made explicit.*

### Rationale

The C language has a large number of operators and their precedence is not intuitive. Inexperienced programmers can easily make mistakes. Remove any ambiguity by using parentheses to explicitly define operator precedence.

The following table list the MISRA C definition of operator precedence for this rule.

| Description | Operator and Operand | Precedence |
|---|---|---|
| Primary | identifier, constant, string literal, (expression) | 16 |
| Postfix | [] () (function call) . -> ++(post-increment) --(post-decrement) () {}(C99: compound literals) | 15 |
| Unary | ++(post-increment) --(post-decrement) & * + - ~ ! sizeof defined (preprocessor) | 14 |
| Cast | () | 13 |
| Multiplicative | * / % | 12 |
| Additive | + - | 11 |
| Bitwise shift | << >> | 10 |
| Relational | <> <= >= | 9 |
| Equality | == != | 8 |
| Bitwise AND | & | 7 |

| Description | Operator and Operand | Precedence |
|---|---|---|
| Bitwise XOR | `^` | 6 |
| Bitwise OR | `\|` | 5 |
| Logical AND | `&&` | 4 |
| Logical OR | `\|\|` | 3 |
| Conditional | `?:` | 2 |
| Assignment | `= *= /= += -= <<= >>= &= ^= \|=` | 1 |
| Comma | `,` | 0 |

## Message in Report

Operand of logical %s is not a primary expression. The precedence of operators within expressions should be made explicit.

# Examples

## Ambiguous Precedence in Multi-Operation Expressions

```
int a, b, c, d, x;

void foo(void) {
  x = sizeof a + b;                     /* Non-compliant - MISRA-12.1 */

  x = a == b ? a : a - b;               /* Non-compliant - MISRA-12.1 */

  x = a <<  b + c ;                     /* Non-compliant - MISRA-12.1 */

  if (a || b && c) { }                  /* Non-compliant - MISRA-12.1 */

  if ( (a>x) && (b>x) || (c>x) )   { }  /* Non-compliant - MISRA-12.1 */
}
```

This example shows various violations of MISRA rule 12.1. In each violation, if you do not know the order of operations, the code could execute unexpectedly.

To comply with this MISRA rule, add parentheses around individual operations in the expressions. One possible solution is shown here.

```
int a, b, c, d, x;

void foo(void) {
  x = sizeof(a) + b;

  x = ( a == b ) ? a : ( a - b );

  x = a << ( b + c );

  if ( ( a || b ) && c) { }

  if ( ((a>x) && (b>x)) || (c>x) ) { }
}
```

## Ambiguous Precedence In Preprocessing Expressions

```
# if defined X && X + Y > Z    /* Non-compliant - MISRA-12.1 */
# endif

# if ! defined X && defined Y  /* Non-compliant - MISRA-12.1 */
# endif
```

In this example, two violations of MISRA rule 12.1 are shown in preprocessing code. In each violation, if you do not know the correct order of operations, the results can be unexpected and cause problems.

To comply with this MISRA rule, add parentheses around individual operations in the expressions. One possible solution is shown here.

```
# if defined (X) && ( (X + Y) > Z )
# endif

# if ! defined (X) && defined (Y)
# endif
```

## Compliant Expressions Without Parentheses

```
int a, b, c, x;
struct {int a; } s, *ps, *pp[2];
```

```
void foo(void) {
  ps = &s

  pp[i]-> a;          /* Compliant - no need to write (pp[i])->a */
  *ps++;              /* Compliant - no need to write *( p++ ) */

  x = f ( a + b, c ); /* Compliant - no need to write f ( (a+b),c) */

  x = a, b;           /* Compliant - parsed as ( x = a ), b */

  if (a && b && c ){  /* Compliant - all operators have
                       * the same precedence */
}
```

In this example, the expressions shown have multiple operations. However, these expressions are compliant because operator precedence is already clear.

## Check Information

**Group:** Expressions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 12.2` | `MISRA C:2012 Rule 12.3` | `MISRA C:2012 Rule 12.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 12.2

The right hand operand of a shift operator shall lie in the range zero to one less than the width in bits of the essential type of the left hand operand

## Description

### Rule Definition

*The right hand operand of a shift operator shall lie in the range zero to one less than the width in bits of the essential type of the left hand operand.*

### Rationale

Consider the following statement:

```
var = abc << num;
```

If `abc` is a 16-bit integer, then `num` must be in the range 0–15, (nonnegative and less than 16). If `num` is negative or greater than 16, then the shift behavior is undefined.

### Polyspace Specification

In Polyspace, the numbers that are manipulated in preprocessing directives are 64 bits wide. The valid shift range is between 0 and 63. When bitfields are within a complex expression, Polyspace extends this check onto the bitfield field width or the width of the base type.

### Message in Report

- Shift amount is bigger than *`size`*.
- Shift amount is negative.
- The right operand of a shift operator shall lie in the range zero to one less than the width in bits of the essential type of the left operand.

## Check Information

**Group:** Expressions
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 12.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 12.3

The comma operator should not be used

## Description

### Rule Definition

*The comma operator should not be used.*

### Rationale

The comma operator can be detrimental to readability. You can often write the same code in another form.

### Message in Report

The comma operator should not be used.

## Examples

### Comma Usage in C Code

```
typedef signed int abc, xyz, jkl;

static void func1 ( abc, xyz, jkl );       /* Compliant - case 1 */

int foo(void)
{
    volatile int rd = 1;                   /* Compliant - case 2*/
    int var=0, foo=0, k=0, n=2, p, t[10];  /* Compliant - case 3*/

    int abc = 0, xyz = abc + 1;            /* Compliant - case 4*/
    int jkl = ( abc + xyz, abc + xyz );    /* Not compliant - case 1*/
    var = 1, foo += var, kkk = 3;           /* Not compliant - case 2*/
    var = (kkk = 1, foo = 2);               /* Not compliant - case 3*/

    for ( var = 0, ptr = &t[ 0 ]; var < num; ++var, ++ptr){}
                                            /* Not compliant - case 4*/

    if ((abc,xyz)<0) { return 1; }          /* Not compliant - case 5*/
}
```

In this example, the code shows various uses of commas in C code.

| Case | Reason for noncompliance |
|---|---|
| 1 | When reading the code, it is not immediately obvious what `jkl` is initialized to. For example, you could infer that `jkl` has a value `abc+xyz`, `(abc+xyz)*(abc+xyz)`, `f((abc+xyz),(abc+xyz))`, and so on. |
| 2 | When reading the code, it is not immediately obvious whether `foo` has a value 0 or 1 after the statement. |
| 3 | When reading the code, it is not immediately obvious what value is assigned to `var`. |
| 4 | When reading the code, it is not immediately obvious which values control the `for` loop. |
| 5 | When reading the code, it is not immediately obvious whether the `if` statement depends on `abc`, `xyz`, or both. |

| Case | Reason for compliance |
|---|---|
| 1 | Using commas to call functions with variables is allowed. |
| 2 | Comma operator is not used. |
| 3 & 4 | When using the comma for initialization, the variables and their values are immediately obvious. |

## Check Information

**Group:** Expressions
**Category:** Advisory
**AGC Category:** Advisory

**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 12.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 12.4

Evaluation of constant expressions should not lead to unsigned integer wrap-around

## Description

### Rule Definition

*Evaluation of constant expressions should not lead to unsigned integer wrap-around.*

### Rationale

Unsigned integer expressions do not strictly overflow, but instead wraparound. Although there may be good reasons to use modulo arithmetic at run time, intentional use at compile time is less likely.

### Message in Report

Evaluation of constant expressions should not lead to unsigned integer wrap-around.

## Check Information

**Group:** Expressions
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 12.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 12.5

The `sizeof` operator shall not have an operand which is a function parameter declared as “array of type”

## Description

### Rule Definition

*The `sizeof` operator shall not have an operand which is a function parameter declared as “array of type”.*

### Rationale

The `sizeof` operator acting on an array normally returns the array size in bytes. For instance, in the following code, `sizeof(arr)` returns the size of `arr` in bytes.

```
int32_t arr[4];
size_t numberOfElements = sizeof (arr) / sizeof(arr[0]);
```

However, when the array is a function parameter, it degenerates to a pointer. The `sizeof` operator acting on the array returns the corresponding pointer size and not the array size.

The use of `sizeof` operator on an array that is a function parameter typically indicates an unintended programming error.

### Message in Report

The `sizeof` operator shall not have an operand which is a function parameter declared as “array of type”.

# Examples

## Incorrect Use of `sizeof` Operator

```
int32_t glbA[] = { 1, 2, 3, 4, 5 };
void f (int32_t A[4])
{
         uint32_t numElements = sizeof(A) / sizeof(int32_t);  /* Non-compliant */
        uint32_t numElements_glbA = sizeof(glbA) / sizeof(glbA[0]);  /* Compliant */
}
```

In this example, the variable `numElements` always has the same value of 1, irrespective of the number of members that appear to be in the array (4 in this case), because `A` has type `int32_t *` and not `int32_t[4]`.

The variable `numElements_glbA` has the expected vale of 5 because the `sizeof` operator acts on the global array `glbA`.

# Check Information

**Group:** Expressions
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

# See Also

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 13.1

Initializer lists shall not contain persistent side effects

## Description

### Rule Definition

*Initializer lists shall not contain persistent side effects.*

### Rationale

C99 permits initializer lists with expressions that can be evaluated only at run-time. However, the order in which elements of the list are evaluated is not defined. If one element of the list modifies the value of a variable which is used in another element, the ambiguity in order of evaluation causes undefined values. Therefore, this rule requires that expressions occurring in an initializer list cannot modify the variables used in them.

### Message in Report

Initializer lists shall not contain persistent side effects.

## Examples

### Initializers with Persistent Side Effect

```
volatile int v;
int x;
int y;

void f(void) {
    int arr[2] = {x+y,x-y};  /* Compliant */
    int arr2[2] = {v,0};      /* Non-compliant */
    int arr3[2] = {x++,y};    /* Non-compliant */
}
```

In this example, the rule is not violated in the first initialization because the initializer does not modify either `x` or `y`. The rule is violated in the other initializations.

- In the second initialization, because `v` is volatile, the initializer can modify `v`.
- In the third initialization, the initializer modifies the variable `x`.

## Check Information

**Group:** Side Effects
**Category:** Required
**AGC Category:** Required
**Language:** C99

## See Also

`MISRA C:2012 Rule 13.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 13.2

The value of an expression and its persistent side effects shall be the same under all permitted evaluation orders

## Description

### Rule Definition

*The value of an expression and its persistent side effects shall be the same under all permitted evaluation orders.*

### Rationale

An expression can have different values under the following conditions:

- The same variable is modified more than once in the expression, or is both read and written.
- The expression allows more than one order of evaluation.

Therefore, this rule forbids expressions where a variable is modified more than once and can cause different results under different orders of evaluation.

### Message in Report

The value of 'XX' depends on the order of evaluation. The value of volatile 'XX' depends on the order of evaluation because of multiple accesses.

## Examples

### Variable Modified More Than Once in Expression

```
int a[10], b[10];
#define COPY_ELEMENT(index) (a[(index)]=b[(index)])
```

```
void main () {
    int i=0, k=0;

    COPY_ELEMENT (k);         /* Compliant */
    COPY_ELEMENT (i++);       /* Non-compliant  */
}
```

In this example, the rule is violated by the statement `COPY_ELEMENT(i++)` because `i++` occurs twice and the order of evaluation of the two expressions is unspecified.

### Variable Modified and Used in Multiple Function Arguments

```
void f (unsigned int param1, unsigned int param2) {}

void main () {
    unsigned int i=0;
    f ( i++, i );                 /* Non-compliant */
}
```

In this example, the rule is violated because it is unspecified whether the operation `i++` occurs before or after the second argument is passed to `f`. The call `f(i++,i)` can translate to either `f(0,0)` or `f(0,1)`.

## Check Information

**Group:** Side Effects
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Dir 4.9` | `MISRA C:2012 Rule 13.1` | `MISRA C:2012 Rule 13.3` | `MISRA C:2012 Rule 13.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 13.3

A full expression containing an increment (++) or decrement (--) operator should have no other potential side effects other than that caused by the increment or decrement operator

## Description

### Rule Definition

*A full expression containing an increment (++) or decrement (--) operator should have no other potential side effects other than that caused by the increment or decrement operator.*

### Rationale

The rule is violated if the following happens in the same line of code:

- The increment or decrement operator acts on a variable.
- Another read or write operation is performed on the variable.

For example, the line `y=x++` violates this rule. The `++` and `=` operator both act on `x`.

Although the operator precedence rules determine the order of evaluation, placing the `++` and another operator in the same line can reduce the readability of the code.

### Message in Report

A full expression containing an increment (++) or decrement (--) operator should have no other potential side effects other than that caused by the increment or decrement operator.

## Examples

### Increment Operator Used in Expression with Other Side Effects

```
int input(void);
int choice(void);
int operation(int, int);

int func() {
    int x = input(), y = input(), res;
    int ch = choice();
    if (choice == -1)
        return(x++);
    if (choice == 0) {
        res = x++ + y++;
        return(res);           /* Non-compliant */
    }
    else if (choice == 1) {
        x++;                   /* Compliant */
        y++;                   /* Compliant */
        return (x+y);
    }
    else {
        res = operation(x++,y);
        return(res);           /* Non-compliant */
    }
}
```

In this example, the rule is violated when the expressions containing the ++ operator have side effects other than that caused by the operator. For example, in the expression `return(x++)`, the other side-effect is the `return` operation.

## Check Information

**Group:** Side Effects
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 13.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 13.4

The result of an assignment operator should not be used

## Description

### Rule Definition

*The result of an assignment operator should not be used.*

### Rationale

The rule is violated if the following happens in the same line of code:

- The assignment operator acts on a variable.
- Another read or operation is performed on the result of the assignment.

For example, the line `a[x]=a[x=y];` violates this rule. The `[]` operator acts on the result of the assignment `x=y`.

### Message in Report

The result of an assignment operator should not be used.

## Examples

### Result of Assignment Used

```
int x, y, b, c, d;
int a[10];
unsigned int bool_var, false=0, true=1;

int foo(void) {

    x = y;            /* Compliant - x is not used */
    a[x] = a[x = y];  /* Non-compliant - Value of x=y is used */

    if ( bool_var = false ) {}
                     /* Non-compliant - bool_var=false is used */

    if ( bool_var == false ) {}   /* Compliant */

    if ( ( 0u == 0u ) || ( bool_var = true ) ) {}
    /* Non-compliant - even though (bool_var=true) is not evaluated */

    if ( ( x = f () ) != 0 ) {}
                   /* Non-compliant - value of x=f() is used */

    a[b += c] = a[b];
                   /* Non-compliant - value of b += c is used */

    b = c = d = 0; /* Non-compliant - value of d=0 and c=d=0 are used */

}
```

In this example, the rule is violated when the result of an assignment is used.

## Check Information

**Group:** Side Effects
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 13.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 13.5

The right hand operand of a logical && or || operator shall not contain persistent side effects

## Description

### Rule Definition

*The right hand operand of a logical && or || operator shall not contain persistent side effects.*

### Rationale

The right operand of an `||` operator is not evaluated if the left operand is true. The right operand of an `&&` operator is not evaluated if the left operand is false. In these cases, if the right operand modifies the value of a variable, the modification does not take place. Following the operation, if you expect a modified value of the variable, the modification might not always happen.

### Polyspace Specification

- For this rule, Polyspace considers that all function calls have a persistent side effect.
- If the right operand is a volatile variable, Polyspace does not flag this as a rule violation.

### Message in Report

The right hand operand of a && operator shall not contain side effects. The right hand operand of a || operator shall not contain side effects.

# Examples

## Right Operand of Logical Operator with Persistent Side Effects

```
int check (int arg) {
    static int count;
    if(arg > 0) {
        count++;                  /* Persistent side effect */
        return 1;
    }
    else
        return 0;
}

int getSwitch(void);
int getVal(void);

void main(void) {
    int val = getVal();
    int mySwitch = getSwitch();
    int checkResult;

    if(mySwitch && check(val)) {   /* Non-compliant */
    }

    checkResult = check(val);
    if(checkResult && mySwitch) {  /* Compliant */
    }

    if(check(val) && mySwitch) {   /* Compliant */
    }
}
```

In this example, the rule is violated when the right operand of the `&&` operation contains a function call. The function call has a persistent side effect because the static variable `count` is modified in the function body. Depending on `mySwitch`, this modification might or might not happen.

The rule is not violated when the left operand contains a function call. Alternatively, to avoid the rule violation, assign the result of the function call to a variable. Use this variable in the logical operation in place of the function call.

In this example, the function call has the side effect of modifying a `static` variable. Polyspace flags all function calls when used on the right-hand side of a logical `&&` or `||` operator, even when the function does not have a side effect. Manually inspect your function body to see if it has side effects. If the function does not have side effects, add a comment and justification in your Polyspace result explaining why you retained your code.

## Check Information

**Group:** Side Effects
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 13.6

The operand of the sizeof operator shall not contain any expression which has potential side effects

## Description

### Rule Definition

*The operand of the sizeof operator shall not contain any expression which has potential side effects.*

### Rationale

The argument of a `sizeof` operator is usually not evaluated at run time. If the argument is an expression, you might wrongly expect that the expression is evaluated.

### Polyspace Specification

The rule is not violated if the argument is a `volatile` variable.

### Message in Report

The operand of the sizeof operator shall not contain any expression which has potential side effects.

## Examples

### Expressions in `sizeof` Operator

```
#include <stddef.h>
int x;
int y[40];
struct S {
    int a;
    int b;
};
struct S myStruct;

void main() {
    size_t sizeOfType;
    sizeOfType = sizeof(x);          /* Compliant */
    sizeOfType = sizeof(y);          /* Compliant */
    sizeOfType = sizeof(myStruct);   /* Compliant */
    sizeOfType = sizeof(x++);        /* Non-compliant */
}
```

In this example, the rule is violated when the expression `x++` is used as argument of `sizeof` operator.

## Check Information

**Group:** Side Effects
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 18.8`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

#### Introduced in R2014b

# MISRA C:2012 Rule 14.1

A loop counter shall not have essentially floating type

## Description

### Rule Definition

*A loop counter shall not have essentially floating type.*

### Rationale

When using a floating-point loop counter, accumulation of rounding errors can result in a mismatch between the expected and actual number of iterations. This rounding error can happen when a loop step that is not a power of the floating point radix is rounded to a value that can be represented by a float.

Even if a loop with a floating-point loop counter appears to behave correctly on one implementation, it can give a different number of iteration on another implementation.

### Polyspace Specification

If the `for` index is a variable symbol, Polyspace checks that it is not a float.

### Message in Report

A loop counter shall not have essentially floating type.

## Examples

### `for` Loop Counters

```
int main(void){
    unsigned int counter = 0u;
    int result = 0;
    float foo;

    // Float loop counters
    for(float foo = 0.0f; foo < 1.0f; foo +=0.001f){
        /* Non-compliant - counter = 1000 at the end of the loop */
        ++counter;
    }

    float fff = 0.0f;
    for(fff = 0.0f; fff <12.0f; fff += 1.0f){    /* Non-compliant*/
        result++;
    }

    // Integer loop count
    for(unsigned int count = 0u; count < 1000u; ++count){ /* Compliant */
        foo = (float) count * 0.001f;
    }
}
```

In this example, the three `for` loops show three different loop counters. The first and second `for` loops use float variables as loop counters, and therefore are not compliant. The third loop uses the integer `count` as the loop counter. Even though `count` is used as a float inside the loop, the variable remains an integer when acting as the loop index. Therefore, this `for` loop is compliant.

## `while` Loop Counters

```
int main(void){
    unsigned int u32a;
    float foo;

    foo = 0.0f;
    while (foo < 1.0f){
        foo += 0.001f;  /* Non-compliant - foo used as a loop counter */
    }

    foo = read_float32();
    do{
        u32a = read_u32();
    }while( ((float)u32a - foo) > 10.0f );
                        /* Compliant - foo doesn't change in the loop */
                        /*  so cannot be a counter */
    return 1;
}
```

This example shows two `while` loops both of which use `foo` in the `while`-loop conditions.

The first `while` loop uses `foo` in the condition and inside the loop. Because `foo` changes, floating-point rounding errors can cause unexpected behavior.

The second `while` loop does not use `foo` inside the loop, but does use `foo` inside the `while`-condition. So `foo` is not the loop counter. The integer `u32a` is the loop counter because it changes inside the loop and is part of the while condition. Because `u32a` is an integer, the rounding error issue is not a concern, making this `while` loop compliant.

## Check Information

**Group:** Control Statement Expressions
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 14.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 14.2

A for loop shall be well-formed

## Description

### Rule Definition

*A for loop shall be well-formed.*

### Rationale

The `for` statement provides a general-purpose looping facility. Using a restricted form of loop makes code easier to review and to analyze.

### Polyspace Specification

Polyspace checks that:

- The `for` loop index (`V`) is a variable symbol.
- `V` is the last assigned variable in the first expression (if present).
- If the first expression exists, it contains an assignment of `V`.
- If the second expression exists, it is a comparison of `V`.
- If the third expression exists, it is an assignment of `V`.
- There are no direct assignments of the `for` loop index.

### Message in Report

- 1st expression should be an assignment. The following kinds of for loops are allowed:
  - all three expressions shall be present;
  - the 2nd and 3rd expressions shall be present with prior initialization of the loop counter;

  - all three expressions shall be empty for a deliberate infinite loop.
- 3rd expression should be an assignment of a loop counter.
- 3rd expression : assigned variable should be the loop counter (*counter*).
- 3rd expression should be an assignment of loop counter (*counter*) only.
- 2nd expression should contain a comparison with loop counter (*counter*).
- Loop counter (*counter*) should not be modified in the body of the loop.
- Bad type for loop counter (*counter*).

## Examples

### Altering the Loop Counter Inside the Loop

```
void foo(void){

    for(short index=0; index < 5; index++){  /* Non-compliant */
        index = index + 3;       /* Altering the loop counter */
    }
}
```

In this example, the loop counter `index` changes inside the `for` loop. It is hard to determine when the loop terminates.

One possible correction is to use an extra flag to terminate the loop early.

In this correction, the second clause of the `for` loop depends on the counter value, `index < 5`, and upon an additional flag, `!flag`. With the additional flag, the for loop definition and counter remain readable, and you can escape the loop early.

```
#define FALSE 0
#define TRUE  1

void foo(void){

    int flag = FALSE;

    for(short index=0; (index < 5) && !flag; index++){ /* Compliant */
        if((index % 4) == 0){
            flag = TRUE;        /* allows early termination of loop */
        }
    }
}
```

### for Loops With Empty Clauses

```
void foo(void)
    for(short index = 0; ; index++) {}   /* Non-compliant */

    for(short index = 0; index < 10;) {} /* Non-compliant */

    short index;
    for(; index < 10;) {}     /* Non-compliant */

    for(; index < 10; i++) {} /* Compliant */

    for(;;){}
          /* Compliant - Exception all three clauses can be empty */
}
```

This example shows `for` loops definitions with a variety of missing clauses. To be compliant, initialize the first clause variable before the `for` loop (line 9). However, you cannot have a `for` loop without the second or third clause.

The one exception is a `for` loop with all three clauses empty, so as to allow for infinite loops.

## Check Information

**Group:** Control Statement Expressions
**Category:** Required
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 14.1` | `MISRA C:2012 Rule 14.3` | `MISRA C:2012 Rule 14.4`

## Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 14.3

Controlling expressions shall not be invariant

## Description

### Rule Definition

*Controlling expressions shall not be invariant.*

### Rationale

If the controlling expression, for example an `if` condition, has a constant value, the non-changing value can point to a programming error.

### Polyspace Specification

Polyspace Bug Finder and Polyspace Code Prover check this coding rule differently. The analyses can produce different results.

Polyspace Bug Finder flags some violations of MISRA C 14.3 through the `Dead code` and `Useless if` checkers.

Polyspace Code Prover does not use gray code to flag MISRA C 14.3 violations.

### Message in Report

- Boolean operations whose results are invariant shall not be permitted.
- Expression is always true.
- Boolean operations whose results are invariant shall not be permitted.
- Expression is always false.
- Controlling expressions shall not be invariant.

## Check Information

**Group:** Control Statement Expressions<br>
**Category:** Required<br>
**AGC Category:** Required<br>
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 2.1` | `MISRA C:2012 Rule 14.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 14.4

The controlling expression of an if statement and the controlling expression of an iteration-statement shall have essentially Boolean type

## Description

### Rule Definition

*The controlling expression of an if statement and the controlling expression of an iteration-statement shall have essentially Boolean type*

### Rationale

Strong typing requires the controlling expression on an `if` statement or iteration statement to have *essentially Boolean* type.

### Polyspace Specification

Polyspace does not flag integer constants, for example `if(2)`.

If your configuration includes the option `-boolean-types`, the number of warnings can increase or decrease.

### Message in Report

The controlling expression of an if statement and the controlling expression of an iteration-statement shall have essentially Boolean type.

## Examples

### Controlling Expression in **`if`**, **`while`**, and **`for`**

```
#include <stdbool.h>
#include <stdlib.h>
```

```
#define TRUE = 1

typedef _Bool bool_t;
extern bool_t flag;

void foo(void){
    int *p = 1;
    int *q = 0;
    int i = 0;
    while(p){}           /* Non-compliant - p is a pointer */

    while(q != NULL){}   /* Compliant */

    while(TRUE){}        /* Compliant */

    while(flag){}        /* Compliant */

    if(i){}              /* Non-compliant - int32_t is not boolean */

    if(i != 0){}         /* Compliant */

    for(int i=-10; i;i++){}   /* Non-compliant - int32_t is not boolean */

    for(int i=0; i<10;i++){}  /* Compliant */
}
```

This example shows various controlling expressions in `while`, `if`, and `for` statements.

The noncompliant statements (the first `while`, `if`, and `for` examples), use a single non-Boolean variable. If you use a single variable as the controlling statement, it must be essentially Boolean (lines 17 and 19). Boolean expressions are also compliant with MISRA.

## Check Information

**Group:** Control Statement Expressions
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 14.2` | `MISRA C:2012 Rule 20.8`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 15.1

The goto statement should not be used

## Description

### Rule Definition

*The goto statement should not be used.*

### Rationale

Unrestricted use of goto statements makes the program unstructured and difficult to understand.

### Message in Report

The goto statement should not be used.

## Examples

### Use of goto Statements

```
void foo(void) {
    int i = 0, result = 0;

label1:
    for ( i; i < 5; i++ ) {
        if (i > 2) goto label2;      /* Non-compliant */
    }

label2: {
        result++;
        goto label1;                 /* Non-compliant */
    }
}
```

In this example, the rule is violated when `goto` statements are used.

## Check Information

**Group:** Control Flow
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.2` | `MISRA C:2012 Rule 15.3` | `MISRA C:2012 Rule 15.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 15.2

The goto statement shall jump to a label declared later in the same function

## Description

### Rule Definition

*The goto statement shall jump to a label declared later in the same function.*

### Rationale

Unrestricted use of `goto` statements makes the program unstructured and difficult to understand. You can use a forward `goto` statement together with a backward one to implement iterations. Restricting backward `goto` statements ensures that you use only iteration statements provided by the language such as `for` or `while` to implement iterations. This restriction reduces visual complexity of the code.

### Message in Report

The goto statement shall jump to a label declared later in the same function.

## Examples

### Use of Backward `goto` Statements

```
void foo(void) {
    int i = 0, result = 0;

label1:
    for ( i; i < 5; i++ ) {
        if (i > 2) goto label2;    /* Compliant */
    }

label2: {
        result++;
        goto label1;                /* Non-compliant */
    }
}
```

In this example, the rule is violated when a `goto` statement causes a backward jump to `label1`.

The rule is not violated when a `goto` statement causes a forward jump to `label2`.

## Check Information

**Group:** Control Flow
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.1` | `MISRA C:2012 Rule 15.3` | `MISRA C:2012 Rule 15.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 15.3

Any label referenced by a goto statement shall be declared in the same block, or in any block enclosing the goto statement

## Description

### Rule Definition

*Any label referenced by a goto statement shall be declared in the same block, or in any block enclosing the goto statement.*

### Rationale

Unrestricted use of `goto` statements makes the program unstructured and difficult to understand. Restricting use of `goto` statements to jump between blocks or into nested blocks reduces visual code complexity.

### Message in Report

Any label referenced by a goto statement shall be declared in the same block, or in any block enclosing the goto statement.

## Examples

### `goto` Statements Jump Inside Block

```
void f1(int a) {
    if(a <= 0) {
        goto L2;        /* Non-compliant - L2 in different block*/
    }

    goto L1;            /* Compliant - L1 in same block*/

    if(a == 0) {
        goto L1;        /* Compliant - L1 in outer block*/
    }

    goto L2;            /* Non-compliant - L2 in inner block*/

    L1: if(a > 0) {
            L2:;
    }
}
```

In this example, `goto` statements cause jumps to different labels. The rule is violated when:

- The label occurs in a block different from the block containing the `goto` statement.

  The block containing the label neither encloses nor is enclosed by the current block.
- The label occurs in a block enclosed by the block containing the `goto` statement.

The rule is not violated when:

- The label occurs in the same block as the block containing the `goto` statement..
- The label occurs in a block that encloses the block containing the `goto` statement..

## `goto` Statements in `switch` Block

```
void f2 ( int x, int z ) {
    int y = 0;

    switch(x) {
    case 0:
        if(x == y) {
            goto L1;  /* Non-compliant - switch-clauses are treated as blocks */
        }
        break;
    case 1:
        y = x;
        L1: ++x;
        break;
    default:
        break;
    }

}
```

In this example, the label for the `goto` statement appears to occur in a block that encloses the block containing the `goto` statement. However, for the purposes of this rule, the software considers that each `case` statement begins a new block. Therefore, the `goto` statement violates the rule.

## Check Information

**Group:** Control Flow
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.1` | `MISRA C:2012 Rule 15.2` | `MISRA C:2012 Rule 15.4` | `MISRA C:2012 Rule 16.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 15.4

There should be no more than one break or goto statement used to terminate any iteration statement

## Description

### Rule Definition

*There should be no more than one break or goto statement used to terminate any iteration statement.*

### Rationale

If you use one `break` or `goto` statement in your loop, you have one secondary exit point from the loop. Restricting number of exits from a loop in this way reduces visual complexity of your code.

### Message in Report

There should be no more than one break or goto statement used to terminate any iteration statement.

## Examples

### `break` Statements in Inner and Outer Loops

```
volatile int stop;

int func(int *arr, int size, int sat) {
    int i,j;
    int sum = 0;
    for (i=0; i< size; i++) {   /* Compliant  */
        if(sum >= sat)
            break;
        for (j=0; j< i; j++) {  /* Compliant */
            if(stop)
                break;
            sum += arr[j];
        }
    }
}
```

In this example, the rule is not violated in both the inner and outer loop because both loops have one `break` statement each.

### `break` and `goto` Statements in Loop

```
volatile int stop;

void displayStopMessage();

int func(int *arr, int size, int sat) {
    int i;
    int sum = 0;
    for (i=0; i< size; i++) {   /* Non-compliant  */
        if(sum >= sat)
            break;
        if(stop)
            goto L1;
        sum += arr[i];
    }

    L1: displayStopMessage();
}
```

In this example, the rule is violated because the `for` loop has one `break` statement and one `goto` statement.

### `goto` Statement in Inner Loop and `break` Statement in Outer Loop

```
volatile int stop;

void displayMessage();

int func(int *arr, int size, int sat) {
    int i,j;
    int sum = 0;
    for (i=0; i< size; i++) {  /* Non-compliant */
        if(sum >= sat)
            break;
        for (j=0; j< i; j++) { /* Compliant */
            if(stop)
                goto L1;
            sum += arr[i];
        }
    }

    L1: displayMessage();
}
```

In this example, the rule is not violated in the inner loop because you can exit the loop only through the one `goto` statement. However, the rule is violated in the outer loop because you can exit the loop through either the `break` statement or the `goto` statement in the inner loop.

## Check Information

**Group:** Control Flow
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.1` | `MISRA C:2012 Rule 15.2` | `MISRA C:2012 Rule 15.3`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

#### Introduced in R2014b

# MISRA C:2012 Rule 15.5

A function should have a single point of exit at the end

## Description

### Rule Definition

*A function should have a single point of exit at the end.*

### Rationale

This rule requires that a `return` statement must occur as the last statement in the function body. Otherwise, the following issues can occur:

- Code following a `return` statement can be unintentionally omitted.
- If a function that modifies some of its arguments has early `return` statements, when reading the code, it is not immediately clear which modifications actually occur.

### Message in Report

A function should have a single point of exit at the end.

## Examples

### More Than One `return` Statement in Function

```
#define MAX ((unsigned int)2147483647)
#define NULL (void*)0

typedef unsigned int bool_t;
bool_t false = 0;
bool_t true = 1;
bool_t f1(unsigned short n, char *p) {          /* Non-compliant */
    if(n > MAX) {
        return false;
    }

    if(p == NULL) {
        return false;
    }

    return true;
}
```

In this example, the rule is violated because there are three `return` statements.

One possible correction is to store the return value in a variable and return this variable just before the function ends.

```
#define MAX ((unsigned int)2147483647)
#define NULL (void*)0

typedef unsigned int bool_t;
bool_t false = 0;
bool_t true = 1;
bool_t return_value;

bool_t f2 (unsigned short n, char *p) {         /* Compliant */
    return_value = true;
    if(n > MAX) {
        return_value = false;
    }

    if(p == NULL) {
        return_value = false;
    }

    return return_value;
}
```

## Check Information

**Group:** Control Flow
**Category:** Advisory

**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 17.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 15.6

The body of an iteration-statement or a selection-statement shall be a compound statement

## Description

### Rule Definition

*The body of an iteration-statement or a selection-statement shall be a compound-statement.*

### Rationale

The rule applies to:

- Iteration statements such as `while`, `do ... while` or `for`.
- Selection statements such as `if ... else` or `switch`.

If the block of code associated with an iteration or selection statement is not contained in braces, you can make mistakes about the association. For example:

- You can wrongly associate a line of code with an iteration or selection statement because of its indentation.
- You can accidentally place a semicolon following the iteration or selection statement. Because of the semicolon, the line following the statement is no longer associated with the statement even though you intended otherwise.

### Message in Report

- The else keyword shall be followed by either a compound statement, or another if statement.
- An if (expression) construct shall be followed by a compound statement.
- The statement forming the body of a while statement shall be a compound statement.

- The statement forming the body of a do ... while statement shall be a compound statement.
- The statement forming the body of a for statement shall be a compound statement.
- The statement forming the body of a switch statement shall be a compound statement.

# Examples

## Iteration Block

```
int data_available = 1;
void f1(void) {
    while(data_available)                 /* Non-compliant */
        process_data();

    while(data_available) {               /* Compliant */
        process_data();
    }
}
```

In this example, the second `while` block is enclosed in braces and does not violate the rule.

## Nested Selection Statements

```
void f1(void) {
    if(flag_1)                            /* Non-compliant */
        if(flag_2)                        /* Non-compliant */
            action_1();
    else                                  /* Non-compliant */
            action_2();
}
```

In this example, the rule is violated because the `if` or `else` blocks are not enclosed in braces. Unless indented as above, it is easy to associate the `else` statement with the inner `if`.

One possible correction is to enclose each block associated with an `if` or `else` statement in braces.

```
void f1(void) {
    if(flag_1) {                          /* Compliant */
        if(flag_2) {                        /* Compliant */
            action_1();
        }
    }
    else {                                /* Compliant */
        action_2();
    }
}
```

### Spurious Semicolon After Iteration Statement

```
void f1(void) {
    while(flag_1);                        /* Non-compliant */
    {
        flag_1 = action_1();
    }
}
```

In this example, the rule is violated even though the `while` statement is followed by a block in braces. The semicolon following the `while` statement causes the block to dissociated from the `while` statement.

The rule helps detect such spurious semicolons.

## Check Information

**Group:** Control Flow
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 15.7

All if … else if constructs shall be terminated with an else statement

## Description

### Rule Definition

*All if … else if constructs shall be terminated with an else statement.*

### Rationale

Unless there is a terminating `else` statement in an `if...elseif...else` construct, during code review, it is difficult to tell if you considered all possible results for the `if` condition.

### Message in Report

All if … else if constructs shall be terminated with an else statement.

## Examples

### Missing `else` Block

```
int get_flag_1(void);
int get_flag_2(void);
void action_1(void);
void action_2(void);

void f1(void) {
    int flag_1 = get_flag_1(), flag_2 = get_flag_2();
    if(flag_1) {
        action_1();
    }
    else if(flag_2) {
        /* Non-compliant */
        action_2();
    }
}
```

In this example, the rule is violated because the `if ... else if` construct does not have a terminating `else` block.

To avoid the rule violation, add a terminating `else` block. The block can be empty.

```
int get_flag_1(void);
int get_flag_2(void);
void action_1(void);
void action_2(void);

void f1(void) {
    int flag_1 = get_flag_1(), flag_2 = get_flag_2();
    if(flag_1) {
        action_1();
    }
    else if(flag_2) {
        /* Non-compliant */
        action_2();
    }
    else {
        /* No statement required */
        /* ; is optional */
    }

}
```

## Check Information

**Group:** Control Flow
**Category:** Required
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 16.5`

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 16.1

All switch statements shall be well-formed

## Description

### Rule Definition

*All switch statements shall be well-formed*

### Rationale

The syntax for switch statements in C is not particularly rigorous and can allow complex, unstructured behavior. This rule and other rules impose a simple consistent structure on the `switch` statement.

### Polyspace Specification

Following the MISRA specifications, the coding rules checker also raises a violation of rule 16.1 if a `switch` statement violates one of these rules: 16.2, 16.3, 16.4, 16.5 or 16.6.

### Message in Report

All messages in report file begin with "MISRA-C switch statements syntax normative restriction."

- Initializers shall not be used in switch clauses.
- The child statement of a switch shall be a compound statement.
- All switch clauses shall appear at the same level.
- A switch clause shall only contain switch labels and switch clauses, and no other code.
- A switch statement shall only contain switch labels and switch clauses, and no other code.

## Check Information

**Group:** Switch Statements
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.3` | `MISRA C:2012 Rule 16.2` | `MISRA C:2012 Rule 16.3` | `MISRA C:2012 Rule 16.4` | `MISRA C:2012 Rule 16.5` | `MISRA C:2012 Rule 16.6`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 16.2

A switch label shall only be used when the most closely-enclosing compound statement is the body of a switch statement

## Description

### Rule Definition

*A switch label shall only be used when the most closely-enclosing compound statement is the body of a switch statement*

### Rationale

The C Standard permits placing a switch label (for instance, `case` or `default`) before any statement contained in the body of a switch statement. This flexibility can lead to unstructured code. To prevent unstructured code, make sure a switch label appears only at the outermost level of the body of a switch statement.

### Message in Report

All messages in report file begin with "MISRA-C switch statements syntax normative restriction."

- Initializers shall not be used in switch clauses.
- The child statement of a switch shall be a compound statement.
- All switch clauses shall appear at the same level.
- A switch clause shall only contain switch labels and switch clauses, and no other code.
- A switch statement shall only contain switch labels and switch clauses, and no other code.

## Check Information

**Group:** Switch Statements

**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 16.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 16.3

An unconditional break statement shall terminate every switch-clause

## Description

### Rule Definition

*An unconditional break statement shall terminate every switch-clause*

### Rationale

A *switch-clause* is a case containing at least one statement. Two consecutive labels without an intervening statement is compliant with MISRA.

If you fail to end your switch-clauses with a break statement, then control flow "falls" into the next statement. This next statement can be another switch-clause, or the end of the switch. This behavior is sometimes intentional, but more often it is an error. If you add additional cases later, an unterminated switch-clause can cause problems.

### Polyspace Specification

Polyspace raises a warning for each noncompliant `case` clause.

### Message in Report

An unconditional break statement shall terminate every switch-clause.

## Check Information

**Group:** Switch Statements
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 16.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 16.4

Every switch statement shall have a default label

## Description

### Rule Definition

*Every switch statement shall have a default label*

### Rationale

The requirement for a `default` label is defensive programming. Even if your switch covers all possible values, there is no guarantee that the input takes one of these values. Statements following the `default` label take some appropriate action. If the `default` label requires no action, use comments to describe why there are no specific actions.

### Message in Report

Every switch statement shall have a default label.

## Examples

### Switch Statement Without **`default`**

```
short func1(short xyz){

    switch(xyz){       /* Non-compliant - default label is required */
        case 0:
            ++xyz;
            break;
        case 1:
        case 2:
            break;
    }
    return xyz;
}
```

In this example, the switch statement does not include a `default` label, and is therefore noncompliant.

One possible correction is to use the `default` label to flag input errors. If your switch-clauses cover all expected input, then the default cases flags any input errors.

```
short func1(short xyz){

    switch(xyz){      /* Compliant */
        case 0:
            ++xyz;
            break;
        case 1:
        case 2:
            break;
        default:
            errorflag = 1;
            break;
    }
    if (errorflag == 1)
        return errorflag;
    else
        return xyz;
}
```

## Switch Statement for Enumerated Inputs

```
enum Colors{
    RED, GREEN, BLUE
};

enum Colors func2(enum Colors color){
    enum Colors next;

    switch(color){      /* Non-compliant - default label is required */
        case RED:
            next = GREEN;
            break;
        case GREEN:
            next = BLUE;
            break;
        case BLUE:
            next = RED;
            break;
    }
    return next;
}
```

In this example, the switch statement does not include a `default` label, and is therefore noncompliant. Even though this switch statement handles all values of the enumeration, there is no guarantee that color takes one of the those values.

To be compliant, add the `default` label to the end of your switch. You can use this case to flag unexpected inputs.

```
enum Colors{
    RED, GREEN, BLUE, ERROR
};

enum Colors func2(enum Colors color){
    enum Colors next;

    switch(color){      /* Compliant */
        case RED:
            next = GREEN;
            break;
        case GREEN:
            next = BLUE;
            break;
        case BLUE:
            next = RED;
            break;
        default:
            next = ERROR;
            break;
    }

    return next;
}
```

## Check Information

**Group:** Switch Statements
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 2.1` | `MISRA C:2012 Rule 16.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 16.5

A default label shall appear as either the first or the last switch label of a switch statement

## Description

### Rule Definition

*A default label shall appear as either the first or the last switch label of a switch statement.*

### Rationale

Using this rule, you can easily locate the `default` label within a `switch` statement.

### Message in Report

A default label shall appear as either the first or the last switch label of a switch statement.

## Examples

### Default Case in **`switch`** Statements

```
void foo(int var){

    switch(var){
        default:   /* Compliant - default is the first label */
        case 0:
            ++var;
            break;
        case 1:
        case 2:
            break;
    }

    switch(var){
        case 0:
            ++var;
            break;
        default:    /* Non-compliant - default is mixed with the case labels */
        case 1:
        case 2:
            break;
    }

    switch(var){
        case 0:
            ++var;
            break;
        case 1:
        case 2:
        default:     /* Compliant - default is the last label */
            break;
    }

    switch(var){
        case 0:
            ++var;
            break;
        case 1:
        case 2:
            break;
        default:      /* Compliant - default is the last label */
            var = 0;
            break;
    }
}
```

This example shows the same switch statement several times, each with `default` in a different place. As the first, third, and fourth switch statements show, `default` must be the first or last label. `default` can be part of a compound switch-clause (for instance, the third `switch` example), but it must be the last listed.

# Check Information

**Group:** Switch Statements

**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.7` | `MISRA C:2012 Rule 16.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 16.6

Every switch statement shall have at least two switch-clauses

## Description

### Rule Definition

*Every switch statement shall have at least two switch-clauses.*

### Rationale

A switch statement with a single path is redundant and can indicate a programming error.

### Message in Report

Every switch statement shall have at least two switch-clauses.

## Check Information

**Group:** Switch Statements<br>
**Category:** Required<br>
**AGC Category:** Advisory<br>
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 16.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 16.7

A switch-expression shall not have essentially Boolean type

## Description

### Rule Definition

*A switch-expression shall not have essentially Boolean type*

### Rationale

The C Standard requires the controlling expression to a `switch` statement to have an integer type. Because C implements Boolean values with integer types, it is possible to have a Boolean expression control a `switch` statement. For controlling flow with Boolean types, an `if-else` construction is more appropriate.

### Polyspace Specification

If your configuration uses the `-boolean-types` option, the number of reported violations can increase.

### Message in Report

A switch-expression shall not have essentially Boolean type.

## Check Information

**Group:** Switch Statements
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 17.1

The features of <starg.h> shall not be used

## Description

### Rule Definition

*The features of <stdarg.h> shall not be used..*

### Rationale

The rule forbids use of `va_list`, `va_arg`, `va_start`, `va_end`, and `va_copy`.

You can use these features in ways where the behavior is not defined in the Standard. For instance:

- You invoke `va_start` in a function but do not invoke the corresponding `va_end` before the function block ends.
- You invoke `va_arg` in different functions on the same variable of type `va_list`.
- `va_arg` has the syntax `type va_arg (va_list ap, type)`.

  You invoke `va_arg` with a `type` that is incompatible with the actual type of the argument retrieved from `ap`.

### Message in Report

The features of <stdarg.h> shall not be used.

## Examples

### Use of **`va_start`**, **`va_list`**, **`va_arg`**, and **`va_end`**

```
#include<stdarg.h>
void f2(int n, ...) {
    int i;
    double val;
    va_list vl;                           /* Non-compliant */

    va_start(vl, n);                      /* Non-compliant */

    for(i = 0; i < n; i++)
    {
        val = va_arg(vl, double);           /* Non-compliant */
    }

    va_end(vl);                           /* Non-compliant */
}
```

In this example, the rule is violated because va_start, va_list, va_arg and va_end are used.

## Undefined Behavior of va_arg

```
#include <stdarg.h>
void h(va_list ap) {                      /* Non-compliant */
    double y;

    y = va_arg(ap, double );                /* Non-compliant */
}

void g(unsigned short n, ...) {
    unsigned int x;
    va_list ap;                           /* Non-compliant */

    va_start(ap, n);                      /* Non-compliant */
    x = va_arg(ap, unsigned int);         /* Non-compliant */

    h(ap);

    /* Undefined - ap is indeterminate because va_arg used in h () */
    x = va_arg(ap, unsigned int);         /* Non-compliant */

}

void f(void) {
    /* undefined - uint32_t:double type mismatch when g uses va_arg () */
    g(1, 2.0, 3.0);
}
```

In this example, va_arg is used on the same variable ap of type va_list in both functions g and h. In g, the second argument is unsigned int and in h, the second argument is double. This type mismatch causes undefined behavior.

## Check Information

**Group:** Function
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 17.2

Functions shall not call themselves, either directly or indirectly

## Description

### Rule Definition

*Functions shall not call themselves, either directly or indirectly.*

### Rationale

Variables local to a function are stored in the call stack. If a function calls itself directly or indirectly several times, the available stack space can be exceeded, causing serious failure. Unless the recursion is tightly controlled, it is difficult to determine the maximum stack space required.

### Message in Report

**Message in Report:** Function XX shall not call itself either directly or indirectly. Function XX is called indirectly by YY.

## Examples

### Direct and Indirect Recursion

```
void foo1( void ) {      /* Non-compliant - Indirect recursion foo1->foo2->foo1... */
    foo2();
    foo1();               /* Non-compliant - Direct recursion */
}

void foo2( void ) {
    foo1();
}
```

In this example, the rule is violated because of:

- Direct recursion `foo1` → `foo1`.
- Indirect recursion `foo1` → `foo2` → `foo1`.

## Check Information

**Group:** Function
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Polyspace Results

`Number of Recursions` | `Number of Direct Recursions`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 17.3

A function shall not be declared implicitly

## Description

### Rule Definition

*A function shall not be declared implicitly.*

### Rationale

An implicit declaration occurs when you call a function before declaring or defining it. When you declare a function explicitly before calling it, the compiler can match the argument and return types with the parameter types in the declaration. If an implicit declaration occurs, the compiler makes assumptions about the argument and return types. For instance, it assumes a return type of `int`. The assumptions might not agree with what you expect and cause undesired type conversions.

### Message in Report

Function 'XX' has no complete visible prototype at call.

## Examples

### Function Not Declared Before Call

```
#include <math.h>

extern double power3 (double val, int exponent);
int getChoice(void);

double func() {
    double res;
    int ch = getChoice();
    if(ch == 0) {
        res = power(2.0, 10);    /* Non-compliant */
    }
    else if( ch==1) {
        res = power2(2.0, 10);   /* Non-compliant */
    }
    else {
        res = power3(2.0, 10);   /* Compliant */
        return res;
    }
}

double power2 (double val, int exponent) {
    return (pow(val, exponent));
}
```

In this example, the rule is violated when a function that is not declared is called in the code. Even if a function definition exists later in the code, the rule violation occurs.

The rule is not violated when the function is declared before it is called in the code. If the function definition exists in another file and is available only during the link phase, you can declare the function in one of the following ways:

- Declare the function with the `extern` keyword in the current file.
- Declare the function in a header file and include the header file in the current file.

## Check Information

**Group:** Function
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90

## See Also

`MISRA C:2012 Rule 8.2` | `MISRA C:2012 Rule 8.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 17.4

All exit paths from a function with non-void return type shall have an explicit return statement with an expression

## Description

### Rule Definition

*All exit paths from a function with non-void return type shall have an explicit return statement with an expression.*

### Rationale

If a non-`void` function does not explicitly return a value but the calling function uses the return value, the behavior is undefined. To prevent this behavior:

1. You must provide `return` statements with an explicit expression.
2. You must ensure that during run time, at least one `return` statement executes.

### Message in Report

Missing return value for non-void function 'XX'.

## Examples

### Missing Return Statement Along Certain Execution Paths

```
int absolute(int v) {
    if(v < 0) {
        return v;
    }
}
```

In this example, the rule is violated because a `return` statement does not exist on all execution paths. If `v >= 0`, then the control returns to the calling function without an explicit return value.

### Return Statement Without Explicit Expression

```
#define SIZE 10
int table[SIZE];

unsigned short lookup(unsigned short v) {
    if((v < 0) || (v > SIZE)) {
        return;
    }
    return table[v];
}
```

In this example, the rule is violated because the `return` statement in the `if` block does not have an explicit expression.

## Check Information

**Group:** Function
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 15.5`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

#### Introduced in R2014b

# MISRA C:2012 Rule 17.5

The function argument corresponding to a parameter declared to have an array type shall have an appropriate number of elements

## Description

### Rule Definition

*The function argument corresponding to a parameter declared to have an array type shall have an appropriate number of elements.*

### Rationale

If you use an array declarator for a function parameter instead of a pointer, the function interface is clearer because you can state the minimum expected array size. If you do not state a size, the expectation is that the function can handle an array of any size. In such cases, the size value is typically another parameter of the function, or the array is terminated with a sentinel value.

However, it is legal in C to specify an array size but pass an array of smaller size. This rule prevents you from passing an array of size smaller than the size you declared.

### Message in Report

The function argument corresponding to a parameter declared to have an array type shall have an appropriate number of elements.

The argument type has `actual_size` elements whereas the parameter type expects `expected_size` elements.

# Examples

## Incorrect Array Size Passed to Function

```
void func(int arr[4]);

int main() {
    int arrSmall[3] = {1,2,3};
    int arr[4] = {1,2,3,4};
    int arrLarge[5] ={1,2,3,4,5};

    func(arrSmall);      /* Non-compliant */
    func(arr);           /* Compliant */
    func(arrLarge);      /* Compliant */

    return 0;
}
```

In this example, the rule is violated when `arrSmall`, which has size 3, is passed to `func`, which expects at least 4 elements.

# Check Information

**Group:** Functions
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90. C99

# See Also

`MISRA C:2012 Rule 17.6`

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Rule 17.6

The declaration of an array parameter shall not contain the static keyword between the [ ]

## Description

### Rule Definition

*The declaration of an array parameter shall not contain the static keyword between the [ ].*

### Rationale

If you use the `static` keyword within `[]` for an array parameter of a function, you can inform a C99 compiler that the array contains a minimum number of elements. The compiler can use this information to generate efficient code for certain processors. However, in your function call, if you provide less than the specified minimum number, the behavior is not defined.

### Message in Report

The declaration of an array parameter shall not contain the static keyword between the [ ].

## Examples

### Use of `static` Keyword Within `[]` in Array Parameter

```
extern int arr1[20];
extern int arr2[10];

/* Non-compliant: static keyword used in array declarator */
unsigned int total (unsigned int n, unsigned int arr[static 20]) {
    unsigned int i;
    unsigned int sum = 0;
    for (i=0U; i < n; i++) {
        sum+= arr[i];
    }

    return sum;
}

void func (void) {
    int res, res2;
    res = total (10U, arr1);  /* Non-compliant - behavior not defined */
    res2 = total (20U, arr2); /* Non-compliant, even if behavior is defined */
}
```

In this example, the rule is violated when the `static` keyword is used within `[]` in the array parameter of function `total`. Even if you call `total` with array arguments where the behavior is well-defined, the rule violation occurs.

## Check Information

**Group:** Function<br>
**Category:** Mandatory<br>
**AGC Category:** Mandatory<br>
**Language:** C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 17.7

The value returned by a function having non-void return type shall be used

## Description

### Rule Definition

*The value returned by a function having non-void return type shall be used.*

### Rationale

You can unintentionally call a function with a non-`void` return type but not use the return value. Because the compiler allows the call, you might not catch the omission. This rule forbids calls to a non-`void` function where the return value is not used. If you do not intend to use the return value of a function, explicitly cast the return value to `void`.

### Message in Report

The value returned by a function having non-void return type shall be used.

## Examples

### Used and Unused Return Values

```
unsigned int cutOff(unsigned int val) {
    if (val > 10 && val < 100) {
        return val;
    }
    else {
        return 0;
    }
}
```

```
unsigned int getVal(void);

void func2(void) {
    unsigned int val = getVal(), res;
    cutOff(val);           /* Non-compliant */
    res = cutOff(val);     /* Compliant */
    (void)cutOff(val);     /* Compliant */
}
```

In this example, the rule is violated when the return value of `cutOff` is not used subsequently.

The rule is not violated when the return value is:

- Assigned to another variable.
- Explicitly cast to `void`.

## Check Information

**Group:** Function
**Category:** Required
**AGC Category:** Readability
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 2.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 17.8

A function parameter should not be modified

## Description

### Rule Definition

*A function parameter should not be modified.*

### Rationale

When you modify a parameter, the function argument corresponding to the parameter is not modified. However, you or another programmer unfamiliar with C can expect by mistake that the argument is also modified when you modify the parameter.

### Message in Report

A function parameter should not be modified.

## Examples

### Function Parameter Modified

```
int input(void);

void func(int param1, int* param2) {

    param1 = input();   /* Non-compliant */
    *param2 = input();  /* Compliant */
}
```

In this example, the rule is violated when the parameter `param1` is modified.

The rule is not violated when the parameter is a pointer `param2` and `*param2` is modified.

## Check Information

**Group:** Functions
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Rule 18.1

A pointer resulting from arithmetic on a pointer operand shall address an element of the same array as that pointer operand

## Description

### Rule Definition

*A pointer resulting from arithmetic on a pointer operand shall address an element of the same array as that pointer operand.*

### Rationale

Using an invalid array subscript can lead to erroneous behavior of the program. Run-time derived array subscripts are especially troublesome because they cannot be easily checked by manual review or static analysis.

The C Standard defines the creation of a pointer to one beyond the end of the array. The rule permits the C Standard. Dereferencing a pointer to one beyond the end of an array causes undefined behavior and is noncompliant.

### Polyspace Specification

Polyspace flags this rule during the analysis as:

- Bug Finder — `Array access out-of-bounds` and `Pointer access out-of-bounds`
- Code Prover — `Illegally dereferenced pointer` and `Out of bounds array index`

### Message in Report

A pointer resulting from arithmetic on a pointer operand shall address an element of the same array as that pointer operand.

## Check Information

**Group:** Pointers and Arrays
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Dir 4.1` | `MISRA C:2012 Rule 18.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 18.2

Subtraction between pointers shall only be applied to pointers that address elements of the same array

## Description

### Rule Definition

*Subtraction between pointers shall only be applied to pointers that address elements of the same array.*

### Rationale

This rule applies to expressions of the form `pointer_expression1 - pointer_expression2`. The behavior is undefined if `pointer_expression1` and `pointer_expression2`:

- Do not point to elements of the same array,
- Or do not point to the element one beyond the end of the array.

### Polyspace Specification

This rule is raised whenever the analysis detects a `Subtraction or comparison between pointers to different arrays`.

### Message in Report

Subtraction between pointers shall only be applied to pointers that address elements of the same array.

# Examples

## Subtracting Pointers

```
#include <stddef.h>

void f1 (int32_t *ptr)
{
    int32_t a1[10];
    int32_t a2[10];
    int32_t *p1 = &a1[ 1];
    int32_t *p2 = &a2[10];
    ptrdiff_t diff1, diff2, diff3;

    diff1 =  p1 - a1;   // Compliant
    diff2 =  p2 - a2;   // Compliant
    diff3 =  p1 - p2;   // Non-compliant
}
```

In this example, the three subtraction expressions show the difference between compliant and noncompliant pointer subtractions. The `diff1` and `diff2` subtractions are compliant because the pointers point to the same array. The `diff3` subtraction is not compliant because `p1` and `p2` point to different arrays.

# Check Information

**Group:** Pointers and Arrays
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

# See Also

`MISRA C:2012 Dir 4.1` | `MISRA C:2012 Rule 18.4`

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 18.3

The relational operators >, >=, < and <= shall not be applied to objects of pointer type except where they point into the same object

## Description

### Rule Definition

*The relational operators >, >=, <, and <= shall not be applied to objects of pointer type except where they point into the same object.*

### Rationale

If two pointers do not point to the same object, comparisons between the pointers produces undefined behavior.

You can address the element beyond the end of an array, but you cannot access this element.

### Message in Report

The relational operators >, >=, < and <= shall not be applied to objects of pointer type except where they point into the same object.

## Examples

### Pointer and Array Comparisons

```
void f1(void){
    int arr1[10];
    int arr2[10];
    int *ptr1 = arr1;

    if(ptr1 < arr2){}    /* Non-compliant */
    if(ptr1 < arr1){}    /* Compliant */
}
```

In this example, ptr1 is a pointer to arr1. To be compliant with rule 18.3, you can compare only ptr1 with arr1. Therefore, the comparison between ptr1 and arr2 is noncompliant.

### Structure Comparisons

```
struct limits{
  int lower_bound;
  int upper_bound;
};

void func2(void){
    struct limits lim_1 = { 2, 5 };
    struct limits lim_2 = { 10, 5 };

    if(&lim_1.lower_bound <= &lim_2.upper_bound){}  /* Non-compliant *
    if(&lim_1.lower_bound <= &lim_1.upper_bound){}  /* Compliant */
}
```

This example defines two limits structures, lim1 and lim2, and compares the elements. To be compliant with rule 18.3, you can compare only the structure elements within a structure. The first comparison compares the lower_bound of lim1 and the upper_bound of lim2. This comparison is noncompliant because the lim_1.lower_bound and lim_2.upper_bound are elements of two different structures.

## Check Information

**Group:** Pointers and Arrays
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

MISRA C:2012 Dir 4.1

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 18.4

The +, -, += and -= operators should not be applied to an expression of pointer type

## Description

### Rule Definition

*The +, -, += and -= operators should not be applied to an expression of pointer type.*

### Rationale

The preferred form of pointer arithmetic is using the array subscript syntax `ptr[expr]`. This syntax is clear and less prone to error than pointer manipulation. With pointer manipulation, any explicitly calculated pointer value has the potential to access unintended or invalid memory addresses. Array indexing can also access unintended or invalid memory, but it is easier to review.

To a new C programmer, the expression `ptr+1` can be mistakenly interpreted as one plus the address of `ptr`. However, the new memory address depends on the size, in bytes, of the pointer's target. This confusion can lead to unexpected behavior.

When used with caution, pointer manipulation using ++ can be more natural (for instance, sequentially accessing locations during a memory test).

### Polyspace Specification

Polyspace flags operations on pointers, for example, `Pointer + Integer`, `Integer + Pointer`, `Pointer - Integer`.

### Message in Report

The +, -, += and -= operators should not be applied to an expression of pointer type.

# Examples

## Pointers and Array Expressions

```
void fun1(void){
    unsigned char arr[10];
    unsigned char *ptr;
    unsigned char index = 0U;

    index = index + 1U;   /* Compliant - rule only applies to pointers */

    arr[index] = 0U;      /* Compliant */
    ptr = &arr[5];        /* Compliant */
    ptr = arr;
    ptr++;                /* Compliant - increment operator not + */
    *(ptr + 5) = 0U;      /* Non-compliant */
    ptr[5] = 0U;          /* Compliant */
}
```

This example shows various operations with pointers and arrays. The only operation in this example that is noncompliant is using the + operator directly with a pointer (line 12).

## Adding Array Elements Inside a `for` Loop

```
void fun2(void){
    unsigned char array_2_2[2][2] = {{1U, 2U}, {4U, 5U}};
    unsigned char i = 0U;
    unsigned char j = 0U;
    unsigned char sum = 0U;

    for(i = 0u; i < 2U; i++){
        unsigned char *row = array_2_2[ i ];

        for(j = 0u; j < 2U; j++){
            sum += row[ j ];                   /* Compliant */
        }
    }
}
```

In this example, the second `for` loop uses the array pointer `row` in an arithmetic expression. However, this usage is compliant because it uses the array index form.

### Pointers and Array Expressions

```
void fun3(unsigned char *ptr1, unsigned char ptr2[ ]){
    ptr1++;                /* Compliant */
    ptr1 = ptr1 - 5;       /* Non-compliant */
    ptr1 -= 5;             /* Non-compliant */
    ptr1[2] = 0U;          /* Compliant */

    ptr2++;                /* Compliant */
    ptr2 = ptr2 + 3;       /* Non-compliant */
    ptr2 += 3;             /* Non-compliant */
    ptr2[3] = 0U;          /* Compliant */
}
```

This example shows the offending operators used on pointers and arrays. Notice that the same types of expressions are compliant and noncompliant for both pointers and arrays.

If `ptr1` does not point to an array with at least six elements, and `ptr2` does not point to an array with at least 4 elements, this example violates rule 18.1.

## Check Information

**Group:** Pointers and Arrays
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 18.1` | `MISRA C:2012 Rule 18.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 18.5

Declarations should contain no more than two levels of pointer nesting

## Description

### Rule Definition

*Declarations should contain no more than two levels of pointer nesting.*

### Rationale

The use of more than two levels of pointer nesting can seriously impair the ability to understand the behavior of the code. Avoid this usage.

### Message in Report

Declarations should contain no more than two levels of pointer nesting.

## Examples

### Pointer Nesting

```
typedef char *INTPTR;

void function(char ** arrPar[ ])    /* Non-compliant - 3 levels */
{
    char   **  obj2;             /* Compliant */
    char   *** obj3;             /* Non-compliant */
    INTPTR *   obj4;             /* Compliant */
    INTPTR * const * const obj5;    /* Non-compliant */
    char   ** arr[10];             /* Compliant */
    char   ** (*parr)[10];         /* Compliant */
    char   *  (**pparr)[10];         /* Compliant */
}
```

```
struct s{
    char *   s1;                /* Compliant */
    char **  s2;                /* Compliant */
    char *** s3;                /* Non-compliant */
};

struct s *   ps1;            /* Compliant */
struct s **  ps2;            /* Compliant */
struct s *** ps3;            /* Non-compliant */

char **  (  *pfunc1)(void);        /* Compliant */
char **  ( **pfunc2)(void);        /* Compliant */
char **  (***pfunc3)(void);        /* Non-compliant */
char *** ( **pfunc4)(void);        /* Non-compliant */
```

This example shows various pointer declarations and nesting levels. Any pointer with more than two levels of nesting is considered noncompliant.

## Check Information

**Group:** Pointers and Arrays
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 18.6

The address of an object with automatic storage shall not be copied to another object that persists after the first object has ceased to exist

## Description

### Rule Definition

*The address of an object with automatic storage shall not be copied to another object that persists after the first object has ceased to exist.*

### Rationale

The address of an object becomes indeterminate when the lifetime of that object expires. Any use of an indeterminate address results in undefined behavior.

### Polyspace Specification

Polyspace flags a violation when assigning an address to a global variable, returning a local variable address, or returning a parameter address.

### Message in Report

The address of an object with automatic storage shall not be copied to another object that persists after the first object has ceased to exist.

## Examples

### Address of Local Variables

```
char *func(void){
    char local_auto;
    return &local_auto  /* Non-compliant
```

```
                         * &local_auto is indeterminate */
}
```

In this example, because `local_auto` is a local variable, after the function returns, the address of `local_auto` is indeterminate.

### Copying Pointer Addresses to Local Variables

```
char *sp;

void f(unsigned short u){
    g(&u);
}

void g(unsigned short *p){
    sp = p;  /* Non-compliant
              * the parameter u from f is copied to static sp */
}

void h(void){
    static unsigned short *q;

    unsigned short x =0u;
    q = &x;  /* Non-compliant -
              * &x stored in object with greater lifetime */
}
```

In this example, the function `g` stores a copy of its pointer parameter `p`. If `p` always points to an object with static storage duration, then the code is compliant with this rule. However, in this example, `p` points to an object with automatic storage duration. In such a case, copying the parameter `p` is noncompliant.

## Check Information

**Group:** Pointers and Arrays
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 18.7

Flexible array members shall not be declared

## Description

### Rule Definition

*Flexible array members shall not be declared.*

### Rationale

Flexible array members are usually used with dynamic memory allocation. Dynamic memory allocation is banned by Directive 4.12 and Rule 21.3 on page 5-340.

### Message in Report

Flexible array members shall not be declared.

## Check Information

**Group:** Pointers and Arrays
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 21.3`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 18.8

Variable-length array types shall not be used

## Description

### Rule Definition

*Variable-length array types shall not be used.*

### Rationale

When the size of an array declared in a block or function prototype is not an integer constant expression, you specify variable array types. Variable array types are typically implemented as a variable size object stored on the stack. Using variable type arrays can make it impossible to determine statistically the amount of memory for the stack requires.

If the size of a variable-length array is negative or zero, the behavior is undefined.

If a variable-length array must be compatible with another array type, then the size of the array types must be identical and positive integers. If your array does not meet these requirements, the behavior is undefined.

If you use a variable-length array type in a `sizeof`, it is uncertain if the array size is evaluated or not.

### Message in Report

Variable-length array types shall not be used.

## Check Information

**Group:** Pointers and Arrays
**Category:** Required

**AGC Category:** Required
**Language:** C99

## See Also

`MISRA C:2012 Rule 13.6`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 19.1

An object shall not be assigned or copied to an overlapping object

## Description

### Rule Definition

*An object shall not be assigned or copied to an overlapping object.*

### Rationale

When you assign an object to another object with overlapping memory, the behavior is undefined. The exceptions are:

- You assign an object to another object with exactly overlapping memory and compatible type.
- You copy one object to another using `memmove`.

### Message in Report

- An object shall not be assigned or copied to an overlapping object.
- Destination and source of XX overlap, the behavior is undefined.

## Examples

### Assignment of Unions

```
void func (void) {
    union {
        short i;
        int j;
    } a = {0}, b = {1};
    a.j = a.i;   /* Non-compliant */
    a = b;       /* Compliant */
}
```

In this example, the rule is violated when `a.i` is assigned to `a.j` because the two variables have overlapping regions of memory.

### Assignment of Array Segments

```
#include <string.h>

int arr[10];

void func(void) {
    memcpy (&arr[5], &arr[4], 2u * sizeof(arr[0]));    /* Non-compliant */
    memcpy (&arr[5], &arr[4], sizeof(arr[0]));         /* Compliant */
    memcpy (&arr[1], &arr[4], 2u * sizeof(arr[0]));    /* Compliant */
}
```

In this example, memory equal to twice `sizeof(arr[0])` is the memory space taken up by two array elements. If that memory space begins from `&a[4]` and `&a[5]`, the two memory regions overlap. The rule is violated when the `memcpy` function is used to copy the contents of these two overlapping memory regions.

## Check Information

**Group:** Overlapping Storage
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 19.2`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 19.2

The union keyword should not be used

## Description

### Rule Definition

*The union keyword should not be used.*

### Rationale

If you write to a union member and read the same union member, the behavior is well-defined. But if you read a different member, the behavior depends on the relative sizes of the members. For instance:

- If you read a union member with wider memory size, the value you read is unspecified.
- Otherwise, the value is implementation-dependant.

### Message in Report

The union keyword should not be used.

## Examples

### Possible Problems with `union` Keyword

```
unsigned int zext(unsigned int s)
{
    union                 /* Non-compliant */
    {
        unsigned int ul;
        unsigned short us;
    } tmp;

    tmp.us = s;
    return tmp.ul;        /* Unspecified value */
}
```

In this example, the 16-bit `short` field `tmp.us` is written but the wider 32-bit `int` field `tmp.ul` is read. Using the `union` keyword can cause such unspecified behavior. Therefore, the rule forbids using the `union` keyword.

## Check Information

**Group:** Overlapping Storage
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 19.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2014b**

# MISRA C:2012 Rule 20.1

#include directives should only be preceded by preprocessor directives or comments

## Description

### Rule Definition

*#include directives should only be preceded by preprocessor directives or comments.*

### Rationale

For better code readability, group all `#include` directives in a file at the top of the file. Undefined behavior can occur if you use `#include` to include a standard header file within a declaration or definition, or if you use part of the Standard Library before including the related standard header files.

### Polyspace Specification

Polyspace flags text that precedes a `#include` directive. Polyspace ignores preprocessor directives, comments, spaces, or "new lines".

### Message in Report

#include directives should only be preceded by preprocessor directives or comments.

## Check Information

**Group:** Preprocessing Directives
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.2

The ', " or \ characters and the /* or // character sequences shall not occur in a header file name

## Description

### Rule Definition

*The ', " or \ characters and the /* or // character sequences shall not occur in a header file name.*

### Rationale

The program's behavior is undefined if:

- You use `'`, `"`, `\`, `/*` or `//` between `<` `>` delimiters in a header name preprocessing token.
- You use `'`, `\`, `/*` or `//` between `"` delimiters in a header name preprocessing token.

Although `\` results in undefined behavior, many implementations accept `/` in its place.

### Polyspace Specification

Polyspace flags the characters `'`, `"`, `\`, `/*` or `//` between < and > in `#include <filename>`.

Polyspace flags the characters `'`, `\`, `/*` or `//` between `"` and `"` in `#include "filename"`.

### Message in Report

The ', "or \ characters and the /* or // character sequences shall not occur in a header file name.

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.3

The #include directive shall be followed by either a <filename> or \"filename\" sequence

## Description

### Rule Definition

*The #include directive shall be followed by either a <filename> or "filename" sequence.*

### Rationale

This rule applies only after macro replacement.

The behavior is undefined if an `#include` directive does not use one of the following forms:

- `#include <filename>`
- `#include "filename"`

### Message in Report

- '#include' expects \"FILENAME\" or <FILENAME>
- '#include_next' expects \"FILENAME\" or <FILENAME>
- '#include' does not expect string concatenation.
- '#include_next' does not expect string concatenation.

## Check Information

**Group:** Preprocessing Directives<br>
**Category:** Required<br>
**AGC Category:** Required<br>
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.4

A macro shall not be defined with the same name as a keyword

## Description

### Rule Definition

*A macro shall not be defined with the same name as a keyword.*

### Rationale

Using macros to change the meaning of keywords can be confusing. The behavior is undefined if you include a standard header while a macro is defined with the same name as a keyword.

### Message in Report

- The macro *macro_name* shall not be redefined.
- The macro *macro_name* shall not be undefined.

## Examples

### Redefining `int` keyword

```
#define int some_other_type
          /* Non-compliant - int keyword behavior altered */
#include <stdlib.h>
...
```

In this example, the `#define` violates Rule 20.4 because it alters the behavior of the `int` keyword. The inclusion of the standard header results in undefined behavior.

One possible correction is to use a different keyword:

```
#define int_mine some_other_type
#include <stdlib.h>
...
```

### Redefining keywords versus statements

```
#define while(E) for ( ; (E) ; )  /* Non-compliant - while redefined*/
#define unless(E) if ( !(E) )     /* Compliant*/

#define seq(S1, S2) do{ S1; S2;} while(false)  /* Compliant*/
#define compound(S) {S;}                       /* Compliant*/
...
```

In this example, it is noncompliant to redefine the keyword `while`, but it is compliant to define a macro that expands to statements.

### Redefining keywords in different standards

```
#define inline
```

In this example, redefining `inline` is compliant in C90, but not in C99 because `inline` is not a keyword in C90.

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Languages:** C90, C99

## See Also

`MISRA C:2012 Rule 21.1`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.5

#undef should not be used

## Description

### Rule Definition

*#undef should not be used.*

### Rationale

`#undef` can make the software unclear which macros exist at a particular point within a translation unit.

### Message in Report

#undef shall not be used.

## Check Information

**Group:** Preprocessing Directives
**Category:** Advisory
**AGC Category:** Readability
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.6

Tokens that look like a preprocessing directive shall not occur within a macro argument

## Description

### Rule Definition

*Tokens that look like a preprocessing directive shall not occur within a macro argument.*

### Rationale

An argument containing sequences of tokens that otherwise act as preprocessing directives leads to undefined behavior.

### Polyspace Specification

Polyspace looks for the # character in a macro arguments (outside a string or character constant).

### Message in Report

Macro argument shall not look like a preprocessing directive.

## Examples

### Macro Expansion Causing Non-Compliance

```
#define M( A ) printf ( #A )

#include <stdio.h>

void foo(void){
    M(
#ifdef SW         /* Non-compliant */
    "Message 1"
#else
    "Message 2"   /* Compliant - SW not defined */
#endif            /* Non-compliant */
    );
}
```

This example shows a macro definition and the macro usage. `#ifdef SW` and `#endif` are noncompliant because they look like a preprocessing directive. Polyspace does not flag `#else "Message 2"` because after macro expansion, Polyspace knows `SW` is not defined. The expanded macro is `printf ("\"Message 2\"");`

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.7

Expressions resulting from the expansion of macro parameters shall be enclosed in parentheses

## Description

### Rule Definition

*Expressions resulting from the expansion of macro parameters shall be enclosed in parentheses.*

### Rationale

If you do not use parentheses, then it is possible that operator precedence does not give the results that you want when macro substitution occurs.

If you are not using a macro parameter as an expression, then the parentheses are not necessary because no operators are involved in the macro.

### Message in Report

Expanded macro parameter *param* shall be enclosed in parentheses.

## Examples

### Macro Expressions

```
#define mac1(x, y) (x * y)
#define mac2(x, y) ((x) * (y))

void foo(void){
    int r;

    r = mac1(1 + 2, 3 + 4);       /* Non-compliant */
    r = mac1((1 + 2), (3 + 4));    /* Compliant */

    r = mac2(1 + 2, 3 + 4);        /* Compliant */
}
```

In this example, `mac1` and `mac2` are two defined macro expressions. The definition of `mac1` does not enclose the arguments in parentheses. In line 7, the macro expands to `r = (1 + 2 * 3 + 4);` This expression can be `(1 + (2 * 3) + 4)` or `(1 + 2) * (3 + 4)`. However, without parentheses, the program does not know the intended expression. Line 8 uses parentheses, so the line expands to `(1 + 2) * (3 + 4)`. This macro expression is compliant.

The definition of `mac2` does enclose the argument in parentheses. Line 10 (the same macro arguments in line 7) expands to `(1 + 2) * (3 + 4)`. This macro and macro expression are compliant.

## Check Information

**Group:** Preprocessing Directives<br>
**Category:** Required<br>
**AGC Category:** Required<br>
**Language:** C90, C99

## See Also

`MISRA C:2012 Dir 4.9`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.8

The controlling expression of a #if or #elif preprocessing directive shall evaluate to 0 or 1

## Description

### Rule Definition

*The controlling expression of a #if or #elif preprocessing directive shall evaluate to 0 or 1.*

### Rationale

Strong typing requires that conditional inclusion preprocessing directives, `#if` or `#elif`, have a controlling expression that evaluates to a Boolean value.

### Message in Report

The controlling expression of a #if or #elif preprocessing directive shall evaluate to 0 or 1.

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 14.4`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 20.9

All identifiers used in the controlling expression of #if or #elif preprocessing directives shall be #define'd before evaluation

## Description

### Rule Definition

*All identifiers used in the controlling expression of #if or #elif preprocessing directives shall be #define'd before evaluation.*

### Rationale

If attempt to use a macro identifier in a preprocessing directive, and you have not defined that identifier, then the preprocessor assumes that it has a value of zero. This value might not meet developer expectations.

### Message in Report

`Identifier` is not defined.

## Examples

### Macro Identifiers

```
#if M == 0                    /* Non-compliant - Not defined */
#endif

#if defined (M)               /* Compliant - M is not evaluate */
#if M == 0                    /* Compliant - M is known to be defined */
#endif
#endif

#if defined (M) && (M == 0)   /* Compliant
```

```
                                            * if M defined, M evaluated in ( M == 0 ) */
#endif
```

This example shows various uses of `M` in preprocessing directives. The second and third `#if` clauses check to see if the software defines `M` before evaluating `M`. The first `#if` clause does not check to see if `M` is defined, and because `M` is not defined, the statement is noncompliant.

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Dir 4.9`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.10

The # and ## preprocessor operators should not be used

## Description

### Rule Definition

*The # and ## preprocessor operators should not be used.*

### Rationale

The order of evaluation associated with multiple `#`, multiple `##`, or a mix of `#` and `##` preprocessor operators is unspecified. In some cases, it is therefore not possible to predict the result of macro expansion.

The use of `##` can result in obscured code.

### Message in Report

The # and ## preprocessor operators should not be used.

## Check Information

**Group:** Preprocessing Directives
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 1.3` | `MISRA C:2012 Rule 20.11`

### Topics

"Activate Coding Rules Checker"

“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 20.11

A macro parameter immediately following a # operator shall not immediately be followed by a ## operator

## Description

### Rule Definition

*A macro parameter immediately following a # operator shall not immediately be followed by a ## operator.*

### Rationale

The order of evaluation associated with multiple #, multiple ##, or a mix of # and ## preprocessor operators, is unspecified. Rule 20.10 discourages the use of # and ##. The result of a # operator is a string literal. It is extremely unlikely that pasting this result to any other preprocessing token results in a valid token.

### Message in Report

The ## preprocessor operator shall not follow a macro parameter following a # preprocessor operator.

## Examples

### Use of # and ##

```
#define A( x )    #x             /* Compliant */
#define B( x, y ) x ## y         /* Compliant */
#define C( x, y ) #x ## y     /* Non-compliant */
```

In this example, you can see three uses of the # and ## operators. You can use these preprocessing operators alone (line 1 and line 2), but using # then ## is noncompliant (line 3).

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 20.10`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.12

A macro parameter used as an operand to the # or ## operators, which is itself subject to further macro replacement, shall only be used as an operand to these operators

## Description

### Rule Definition

*A macro parameter used as an operand to the # or ## operators, which is itself subject to further macro replacement, shall only be used as an operand to these operators.*

### Rationale

The parameter to `#` or `##` is not expanded prior to being used. The same parameter appearing elsewhere in the replacement text is expanded. If the macro parameter is itself subject to macro replacement, its use in mixed contexts within a macro replacement might not meet developer expectations.

### Message in Report

Expanded macro parameter *`param1`* is also an operand of *`op`* operator.

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"

“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 20.13

A line whose first token is # shall be a valid preprocessing directive

## Description

### Rule Definition

*A line whose first token is # shall be a valid preprocessing directive*

### Rationale

You typically use a preprocessing directive to conditionally exclude source code until a corresponding `#else`, `#elif`, or `#endif` directive is encountered. If your compiler does not detect a preprocessing directive because it is malformed or invalid, you can end up excluding more code than you intended.

If all preprocessing directives are syntactically valid, even in excluded code, this unintended code exclusion cannot happen.

### Message in Report

Directive is not syntactically meaningful.

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

# See Also

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

# MISRA C:2012 Rule 20.14

All #else, #elif and #endif preprocessor directives shall reside in the same file as the #if, #ifdef or #ifndef directive to which they are related

## Description

### Rule Definition

*All #else, #elif and #endif preprocessor directives shall reside in the same file as the #if, #ifdef or #ifndef directive to which they are related.*

### Rationale

When conditional compilation directives include or exclude blocks of code and are spread over multiple files, confusion arises. If you terminate an `#if` directive within the same file, you reduce the visual complexity of the code and the chances of an error.

If you terminate `#if` directives within the same file, you can use `#if` directives in included files

### Message in Report

- '#else' not within a conditional.
- '#elsif' not within a conditional.
- '#endif' not within a conditional. unterminated conditional directive.

## Check Information

**Group:** Preprocessing Directives
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

# See Also

## Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

# MISRA C:2012 Rule 21.1

#define and #undef shall not be used on a reserved identifier or reserved macro name

## Description

### Rule Definition

*#define and #undef shall not be used on a reserved identifier or reserved macro name.*

### Rationale

Reserved identifiers and reserved macro names are intended for use by the implementation. Removing or changing the meaning of a reserved macro can result in undefined behavior. This rule applies to the following:

- Identifiers or macro names beginning with an underscore
- Identifiers in file scope described in the C Standard Library (ISO/IEC 9899:1999, Section 7, "Library")
- Macro names described in the C Standard Library as being defined in a standard header (ISO/IEC 9899:1999, Section 7, "Library").

### Message in Report

- The macro *macro_name* shall not be redefined.
- The macro *macro_name* shall not be undefined.
- The macro *macro_name* shall not be defined.

## Examples

### Defining or Undefining Reserved Identifiers

```
#undef __LINE__              /* Non-compliant - begins with _ */
#define _Guard_H 1           /* Non-compliant - begins with _ */
```

```
#undef _ BUILTIN_sqrt        /* Non-compliant - implementation may
                               * use _BUILTIN_sqrt for other purposes,
                               * e.g. generating a sqrt instruction */
#define defined               /* Non-compliant - reserved identifier */
#define errno my_errno        /* Non-compliant - library identifier */
#define isneg(x) ( (x) < 0 )  /* Compliant - rule doesn't include
                               * future library directions   */
```

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Languages:** C90, C99

## See Also

MISRA C:2012 Rule 20.4

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 21.2

A reserved identifier or macro name shall not be declared

## Description

### Rule Definition

*A reserved identifier or macro name shall not be declared.*

### Rationale

The Standard allows implementations to treat reserved identifiers specially. If you reuse reserved identifiers, you can cause undefined behavior.

### Polyspace Specification

- If you define a macro name that corresponds to a standard library macro, object, or function, rule 21.1 is violated.
- The rule considers tentative definitions as definitions.

### Message in Report

Identifier 'XX' shall not be reused.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 21.3

The memory allocation and deallocation functions of <stdlib.h> shall not be used

## Description

### Rule Definition

*The memory allocation and deallocation functions of <stdlib.h> shall not be used.*

### Rationale

Using memory allocation and deallocation routines can cause undefined behavior. For instance:

- You free memory that you had not allocated dynamically.
- You use a pointer that points to a freed memory location.

### Polyspace Specification

If you use names of dynamic heap memory allocation functions for macros, and you expand the macros in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro <name> shall not be used.
- Identifier XX should not be used.

## Examples

### Use of `malloc`, `calloc`, `realloc` and `free`

```
#include <stdlib.h>
```

```
static int foo(void);

typedef struct struct_1 {
    int a;
    char c;
} S_1;

static int foo(void) {

    _S_1 * ad_1;
    int  * ad_2;
    int  * ad_3;

    ad_1 = (S_1*)calloc(100U, sizeof(S_1));        /* Non-compliant */
    ad_2 = malloc(100U * sizeof(int));             /* Non-compliant */
    ad_3 = realloc(ad_3, 60U * sizeof(long));      /* Non-compliant */

    free(ad_1);                                    /* Non-compliant */
    free(ad_2);                                    /* Non-compliant */
    free(ad_3);                                    /* Non-compliant */

    return 1;
}
```

In this example, the rule is violated when the functions `malloc`, `calloc`, `realloc` and `free` are used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 18.7`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 21.4

The standard header file <setjmp.h> shall not be used

## Description

### Rule Definition

*The standard header file <setjmp.h> shall not be used.*

### Rationale

Using `setjmp` and `longjmp`, you can bypass normal function call mechanisms and cause undefined behavior.

### Polyspace Specification

If the `longjmp` function is a macro and the macro is expanded in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 21.5

The standard header file <signal.h> shall not be used

## Description

### Rule Definition

*The standard header file <signal.h> shall not be used.*

### Rationale

Using signal handling functions can cause implementation-defined and undefined behavior.

### Polyspace Specification

If the signal function is a macro and the macro is expanded in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 21.6

The Standard Library input/output functions shall not be used

## Description

### Rule Definition

*The Standard Library input/output functions shall not be used.*

### Rationale

This rule applies to the functions that are provided by `<stdio.h>` and in C99, their character-wide equivalents provided by `<wchar.h>`. Using these functions can cause unspecified, undefined and implementation-defined behavior.

### Polyspace Specification

If the Standard Library function is a macro and the macro is expanded in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 21.7

The `atof`, `atoi`, `atol`, and `atoll` functions of `<stdlib.h>` shall not be used

## Description

### Rule Definition

*The atof, atoi, atol, and atoll functions of <stdlib.h> shall not be used.*

### Rationale

When a string cannot be converted, the behavior of these functions can be undefined.

### Polyspace Specification

If the function is a macro and the macro is expanded in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

**Introduced in R2014b**

# MISRA C:2012 Rule 21.8

The library functions abort, exit, getenv and system of <stdlib.h> shall not be used

## Description

### Rule Definition

*The library functions abort, exit, getenv and system of <stdlib.h> shall not be used.*

### Rationale

Using these functions can cause undefined and implementation-defined behaviors.

### Polyspace Specification

In case the abort, exit, getenv, and system functions are actually macros, and the macros are expanded in the code, this rule is detected as violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 21.9

The library functions bsearch and qsort of <stdlib.h> shall not be used

## Description

### Rule Definition

*The library functions bsearch and qsort of <stdlib.h> shall not be used.*

### Rationale

The comparison function in these library functions can behave inconsistently when the elements being compared are equal. Also, the implementation of `qsort` can be recursive and place unknown demands on the call stack.

### Polyspace Specification

If the function is a macro and the macro is expanded in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2014b

# MISRA C:2012 Rule 21.10

The Standard Library time and date functions shall not be used

## Description

### Rule Definition

*The Standard Library time and date functions shall not be used.*

### Rationale

Using these functions can cause unspecified, undefined and implementation-defined behavior.

### Polyspace Specification

If the function is a macro and the macro is expanded in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 21.11

The standard header file <tgmath.h> shall not be used

## Description

### Rule Definition

*The standard header file <tgmath.h> shall not be used.*

### Rationale

Using the facilities of this header file can cause undefined behavior.

### Polyspace Specification

If the function is a macro and the macro is expanded in the code, this rule is violated. It is assumed that rule 21.2 is not violated.

### Message in Report

- The macro '<name> shall not be used.
- Identifier XX should not be used.

## Examples

### Use of Function in **`tgmath.h`**

```
#include <tgmath.h>

float f1,res;


void func(void) {
    res = sqrt(f1); /* Non-compliant */
}
```

In this example, the rule is violated when the `sqrt` macro defined in `tgmath.h` is used.

For this example, one possible correction is to use the function `sqrtf` defined in `math.h` for `float` arguments.

```
#include <math.h>

float f1, res;


void func(void) {
 res = sqrtf(f1);
}
```

## Check Information

**Group:** Standard Libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2014b

# MISRA C:2012 Rule 21.12

The exception handling features of `<fenv.h>` should not be used

## Description

### Rule Definition

*The exception handling features of* `<fenv.h>` *should not be used.*

### Rationale

In some cases, the values of the floating-point status flags are unspecified. Attempts to access them can cause undefined behavior.

### Message in Report

The exception handling features of `<fenv.h>` should not be used

## Examples

### Use of Features in `<fenv.h>`

```
#include <fenv.h>

void func(float x, float y) {
    float z;

    feclearexcept(FE_DIVBYZERO);              /* Non-compliant */
    z = x/y;

    if(fetestexcept (FE_DIVBYZERO))  {        /* Non-compliant */
    }
    else {
#pragma STDC FENV_ACCESS ON
```

```
        z=x*y;
        if(z>x) {
#pragma STDC FENV_ACCESS OFF
            if(fetestexcept (FE_OVERFLOW)) {  /* Non-compliant */
            }
        }
    }
}
```

In this example, the rule is violated when the identifiers `feclearexcept` and `fetestexcept`, and the macros `FE_DIVBYZERO` and `FE_OVERFLOW` are used.

## Check Information

**Group:** Standard libraries
**Category:** Advisory
**AGC Category:** Advisory
**Language:** C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2015b**

# MISRA C:2012 Rule 21.13

Any value passed to a function in `<ctype.h>` shall be representable as an `unsigned char` or be the value EOF

## Description

### Rule Definition

*Any value passed to a function in `<ctype.h>` shall be representable as an `unsigned char` or be the value EOF.*

### Rationale

Functions in `<ctype.h>` have a well-defined behavior only for `int` arguments whose value is within the range of `unsigned char` or the negative value equivalent of `EOF`. The use of other values results in undefined behavior.

### Polyspace Specification

Polyspace considers that the negative value equivalent of EOF is -1 and does not raise a violation if you pass -1 as argument to a function in `ctype.h`.

### Message in Report

Any value passed to a function in `<ctype.h>` shall be representable as an `unsigned char` or be the value `EOF`.

## Examples

### Invalid Arguments for Functions from `<ctype.h>`

```
bool_t f (uint8_t a)
{
    return (         isdigit ((int32_t) a  )      /* Compliant     */
                &&  isalpha ((int32_t) 'b')      /* Compliant     */
                &&  islower (         EOF)      /* Compliant     */
                &&  isalpha (         256));    /* Non-compliant */
}
```

In this example, the rule is violated when `256`, which is an neither an `unsigned char` or the value `EOF`, is passed as an input argument to the `isalpha` function.

**Note** The `int` casts in the above example are required to comply with Rule 10.3 on page 5-150.

# Check Information

**Group:** Standard libraries
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

# See Also

`MISRA C:2012 Rule 10.3`

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

### Introduced in R2017a

# MISRA C:2012 Rule 21.14

The Standard Library function `memcmp` shall not be used to compare null terminated strings

## Description

### Rule Definition

*The Standard Library function* `memcmp` *shall not be used to compare null terminated strings.*

### Rationale

If `memcmp` is used to compare two strings and the length of either string is less than the number of bytes compared, the strings can appear different even when they are logically the same. The characters after the null terminator are compared even though they do not form part of the string.

For instance:

```
memcmp(string1, string2, sizeof(string1))
```

can compare bytes after the null terminator if `string1` is longer than `string2`.

### Message in Report

The Standard Library function `memcmp` shall not be used to compare null terminated strings.

## Examples

### Using **`memcmp`** for String Comparison

```
extern char buffer1[ 12 ];
extern char buffer2[ 12 ];
```

```
void f1 ( void )
{
    ( void ) strcpy ( buffer1, "abc" );
    ( void ) strcpy ( buffer2, "abc" );
    if ( memcmp ( buffer1, buffer2, sizeof ( buffer1 ) ) != 0 )
    {
        /* Non-compliant */
    }
}
```

In this example, the comparison in the `if` statement is noncompliant. The strings stored in `buffer1` and `buffer2` can be reported different, but this difference comes from uninitialized characters after the null terminators.

## Check Information

**Group:** Standard libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 21.15` | `MISRA C:2012 Rule 21.16`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 21.15

The pointer arguments to the Standard Library functions memcpy, memmove and memcmp shall be pointers to qualified or unqualified versions of compatible types

## Description

### Rule Definition

*The pointer arguments to the Standard Library functions memcpy, memmove and memcmp shall be pointers to qualified or unqualified versions of compatible types.*

### Rationale

The functions

```
memcpy( arg1, arg2, num_bytes );
memmove( arg1, arg2, num_bytes );
memcmp( arg1, arg2, num_bytes );
```

perform a byte-by-byte copy, move or comparison between the memory locations that arg1 and arg2 point to. A byte-by-byte copy, move or comparison is meaningful only if arg1 and arg2 have compatible types.

Using pointers to different data types for arg1 and arg2 typically indicates a coding error.

### Message in Report

The pointer arguments to the Standard Library functions memcpy, memmove and memcmp shall be pointers to qualified or unqualified versions of compatible types.

## Examples

### Incompatible Argument Types for **memcpy**

```
void f ( uint8_t s1[ 8 ], uint16_t s2[ 8 ] )
{
    ( void ) memcpy ( s1, s2, 8 ); /* Non-compliant */
}
```

In this example, `s1` and `s2` are pointers to different data types. The `memcpy` statement copies eight bytes from one buffer to another.

Eight bytes represent the entire span of the buffer that `s1` points to, but only part of the buffer that `s2` points to. Therefore, the `memcpy` statement copies only part of `s2` to `s1`, which might be unintended.

## Check Information

**Group:** Standard libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 21.14` | `MISRA C:2012 Rule 21.16`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 21.16

The pointer arguments to the Standard Library function `memcmp` shall point to either a pointer type, an essentially signed type, an essentially unsigned type, an essentially Boolean type or an essentially enum type

## Description

### Rule Definition

*The pointer arguments to the Standard Library function `memcmp` shall point to either a pointer type, an essentially signed type, an essentially unsigned type, an essentially Boolean type or an essentially enum type.*

### Rationale

The Standard Library function

```
memcmp ( lhs, rhs, num );
```

performs a byte-by-byte comparison of the first `num` bytes of the two objects that `lhs` and `rhs` point to.

Do not use `memcmp` for a byte-by-byte comparison of the following.

| Type | Rationale |
|---|---|
| Structures | If members of a structure have different data types, your compiler introduces additional padding for data alignment in memory. The content of these extra padding bytes is meaningless. If you perform a byte-by-byte comparison of structures with `memcmp`, you compare even the meaningless data stored in the padding. You might reach the false conclusion that two data structures are not equal, even if their corresponding members have the same value. |

| Type | Rationale |
|---|---|
| Objects with essentially floating type | The same floating point value can be stored using different representations. If you perform a byte-by-byte comparison of two variables with `memcmp`, you can reach the false conclusion that the variables are unequal even when they have the same value. The reason is that the values are stored using two different representations. |
| Essentially char arrays | Essentially char arrays are typically used to store strings. In strings, the content in bytes after the null terminator is meaningless. If you perform a byte-by-byte comparison of two strings with `memcmp`, you might reach the false conclusion that two strings are not equal, even if the bytes before the null terminator store the same value. |

## Message in Report

The pointer arguments to the Standard Library function `memcmp` shall point to either a pointer type, an *essentially signed* type, an *essentially unsigned* type, an *essentially Boolean* type or an *essentially enum* type.

# Examples

## Using `memcmp` for Comparison of Structures, Unions, and *essentially char* Arrays

```
struct S;
bool_t f1 ( struct S *s1, struct S *s2 )
{
        return ( memcmp ( s1, s2, sizeof ( struct S ) ) != 0 ); /* Non-compliant */
}

union U
{
uint32_t range;
uint32_t height;
};
bool_t f2 ( union U *u1, union U *u2 )
{
        return ( memcmp ( u1, u2, sizeof ( union U ) ) != 0 ); /* Non-compliant */
}
```

```
const char a[ 6 ] = "task";
bool_t f3 ( const char b[ 6 ] )
{
        return ( memcmp ( a, b, 6 ) != 0 ); /* Non-compliant */
}
```

In this example:

- Structures `s1` and `s2` are compared in the `bool_t f1` function. The return value of this function might indicate that `s1` and `s2` are different due to padding. This comparison is noncompliant.
- Unions `u1` and `u2` are compared in the `bool_t f2` function. The return value of this function might indicate that `u1` and `u2` are the same due to unintentional comparison of `u1.range` and `u2.height`, or `u1.height` and `u2.range`. This comparison is noncompliant.
- Essentially char arrays `a` and `b` are compared in the `bool_t f3` function. The return value of this function might incorrectly indicate that the strings are different because the length of `a` (four) is less than the number of bytes compared (six). This comparison is noncompliant.

## Check Information

**Group:** Standard libraries
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 21.14` | `MISRA C:2012 Rule 21.15`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 21.17

Use of the string handling function from `<string.h>` shall not result in accesses beyond the bounds of the objects referenced by their pointer parameters

## Description

### Rule Definition

*Use of the string handling function from `<string.h>` shall not result in accesses beyond the bounds of the objects referenced by their pointer parameters.*

### Rationale

Incorrect use of a string handling function might result in a read or write access beyond the bounds of the function arguments, resulting in undefined behavior.

### Message in Report

Use of the string handling function from `<string.h>` shall not result in accesses beyond the bounds of the objects referenced by their pointer parameters.

## Examples

### Pointer Access Out of Bounds from **`strcpy`** Usage

```
char string[] = "Short";
void f1 ( const char *str )
{
        ( void ) strcpy ( string, "Too long to fit" );              /* Non-compliant */
        if ( strlen ( str ) < ( sizeof ( string ) - 1u ) )
        {
            ( void ) strcpy ( string, str );                         /* Compliant */
        }
}
```

```
size_t f2 ( void )
{
        char text[ 5 ] = "Token";
        return strlen ( text );                                     /* Non-compliant */
}
```

In this example:

- The first use of `strcpy` is noncompliant because it attempts to write beyond the end of its destination argument `string`.
- The second use of `strcpy` is compliant because it attempts to write to the destination argument `string` only if the source argument `str` fits.
- The use of `strlen` is noncompliant. `strlen` computes the length of a string up to the null terminator. The character array `text` has no null terminator.

# Check Information

**Group:** Standard libraries<br>
**Category:** Mandatory<br>
**AGC Category:** Mandatory<br>
**Language:** C90, C99

# See Also

`MISRA C:2012 Rule 21.18`

## Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 21.18

The `size_t` argument passed to any function in `<string.h>` shall have an appropriate value

## Description

### Rule Definition

*The `size_t` argument passed to any function in `<string.h>` shall have an appropriate value.*

### Rationale

The value must be positive and not greater than the size of the smallest object passed by pointer to the function. For instance, suppose you use the `strncmp` function to compare two strings `lhs_string` and `rhs_string` as follows:

```
strncmp (lhs_string, rhs_string, num)
```

The third argument `num` must be positive and must not be greater than the size of `lhs_string` or `rhs_string`, whichever is smaller.

Otherwise, using the function can result in read or write access beyond the bounds of the function argument.

### Message in Report

The `size_t` argument passed to any function in `<string.h>` shall have an appropriate value.

## Examples

### Incorrect `size_t` Argument for `memcmp`

```
char buf1[ 5 ] = "12345";
char buf2[ 10 ] = "1234567890";

void f ( void )
{
        if ( memcmp ( buf1, buf2, 5 ) == 0 )
        {
            /* Compliant */
        }
        if ( memcmp ( buf1, buf2, 6 ) == 0 )
        {
            /* Non-compliant */
        }
}
```

In this example, the first `if` statement is compliant. The `size_t` argument is five, which is same as the size of the smaller string, `buf1`.

By the same reasoning, the second `if` statement is noncompliant.

## Check Information

**Group:** Standard libraries<br>
**Category:** Mandatory<br>
**AGC Category:** Mandatory<br>
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 21.17`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"

“Software Quality Objective Subsets (C:2012)”

Introduced in R2017a

# MISRA C:2012 Rule 21.19

The pointers returned by the Standard Library functions `localeconv`, `getenv`, `setlocale` or `strerror` shall only be used as if they have pointer to `const`-qualified type

## Description

### Rule Definition

*The pointers returned by the Standard Library functions `localeconv`, `getenv`, `setlocale` or `strerror` shall only be used as if they have pointer to `const`-qualified type.*

### Rationale

The C99 Standard states that if the program modifies the structure pointed to by the value returned by `localeconv`, or the strings returned by `getenv`, `setlocale` or `strerro`, undefined behavior occurs. Treating the pointers returned by the various functions as if they were `const`-qualified allows an analysis tool to detect any attempt to modify an object through one of the pointers. Assigning the return values of the functions to `const`-qualified pointers results in the compiler issuing a diagnostic if an attempt is made to modify an object.

### Message in Report

The pointers returned by the Standard Library functions `localeconv`, `getenv`, `setlocale` or `strerror` shall only be used as if they have pointer to `const`-qualified type.

## Examples

### Returning Pointers from`setlocale` and `localeconv`

```
void f1 ( void )
{
        char *s1 = setlocale ( LC_ALL, 0 ); /* Non-compliant */
        struct lconv *conv = localeconv (); /* Non-compliant */
        s1[ 1 ] = 'A'; /* Undefined behavior */
        conv->decimal_point = "^"; /* Undefined behavior */
}

void f2 ( void )
{
        char str[128];
        (void) strcpy (str, setlocale ( LC_ALL,0 ) ); /* Compliant */
        const struct lconv *conv = localeconv ();     /* Compliant */
        conv->decimanl_point = "^"                    /* Constraint violation */
}

void f3 ( void )
{
const struct lconv *conv = localeconv (); /* Compliant */
conv->grouping[ 2 ] = 'x';                /* Non-compliant */
}
```

In the above example:

- The usage of `setlocale` and `localeconv` in the function `f1` are non-compliant as the returned pointers are assigned to non-`const`—qualified pointers.

  **Note** The usage of `setlocale` and `localeconv` above are not constraint violations and will therefore not be reported by a compiler. However, an analysis tool will be able to report a violation.

- The usage of `setlocale` in the function `f2` is compliant as `strcpy` takes a `const char *` as its second parameter. The usage of `localeconv` in the function `f2` is compliant as the returned pointers are assigned to a `const`-qualified pointer. Any attempt to modify an object through a pointer will be reported by a compiler or analysis tool as this is a constraint violation.

- The usage of a `const`-qualified pointer in the function `f3` gives compile time protection of the value returned by `localeconv` but the same is not true for the strings it references. Modification of these strings can be detected by an analysis tool.

## Check Information

**Group:** Standard libraries
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 7.4` | `MISRA C:2012 Rule 11.8` | `MISRA C:2012 Rule 21.8`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 21.20

The pointer returned by the Standard Library functions `asctime`, `ctime`, `gmtime`, `localtime`, `localeconv`, `getenv`, `setlocale` or `strerror` shall not be used following a subsequent call to the same function

## Description

### Rule Definition

*The pointer returned by the Standard Library functions `asctime`, `ctime`, `gmtime`, `localtime`, `localeconv`, `getenv`, `setlocale` or `strerror` shall not be used following a subsequent call to the same function.*

### Rationale

The preceding functions return a pointer to an object within the Standard Library. Implementation for this object can use a static buffer that can be modified by a second call to the same function. Therefore the value accessed through a pointer before a subsequent call to the same function can change unexpectedly.

### Message in Report

The pointer returned by the Standard Library functions `asctime`, `ctime`, `gmtime`, `localtime`, `localeconv`, `getenv`, `setlocale` or `strerror` shall not be used following a subsequent call to the same function.

## Examples

### Use of Return Value from **`getenv`** After Another Call to **`getenv`**

```
void f1( void )
{
        const char *res1;
        const char *res2;
        char copy[ 128 ];
        res1 = setlocale ( LC_ALL, 0 );
        ( void ) strcpy ( copy, res1 );
        res2 = setlocale ( LC_MONETARY, "French" );
        printf ( "%s\n", res1 ); /* Non-compliant */
        printf ( "%s\n", copy ); /* Compliant */
        printf ( "%s\n", res2 ); /* Compliant */
}
```

In this example:

- The first `printf` statement is non-compliant because the pointer returned by `setlocale` is used following a subsequent call to it when `res2` is assigned.
- The second `printf` statement is compliant because the copy operation performed by `strcpy` is made before a subsequent call to `setlocale` function is made.
- The third `printf` statement is compliant because there is no subsequent call to the `setlocale` function is made before use.

## Check Information

**Group:** Standard libraries
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 22.1

All resources obtained dynamically by means of Standard Library functions shall be explicitly released

## Description

### Rule Definition

*All resources obtained dynamically by means of Standard Library functions shall be explicitly released.*

### Rationale

Resources are something that you must return to the system once you have used them. Examples include dynamically allocated memory and file descriptors.

If you do not release resources explicitly as soon as possible, then a failure can occur due to exhaustion of resources.

### Message in Report

All resources obtained dynamically by means of Standard Library functions shall be explicitly released.

## Examples

### Dynamic Memory

```
#include<stdlib.h>


void performOperation(int);

int func1(int num) {
    int *arr1 = (int*) malloc(num * sizeof(int));

    return 0;
}            /* Non-compliant - memory allocated to arr1 is not released */

int func2(int num) {
    int *arr2 = (int*) malloc(num * sizeof(int));

    free(arr2);
    return 0;
}           /* Compliant - memory allocated to arr2 is released */
```

In this example, the rule is violated when memory dynamically allocated using the `malloc` function is not freed using the `free` function before the end of scope.

## File Pointers

```
#include <stdio.h>
void func1( void ) {
    FILE *fp1;
    fp1 = fopen ( "data1.txt", "w" );
    fprintf ( fp1, "*" );

    fp1 = fopen ( "data2.txt", "w" );              /* Non-compliant */
    fprintf ( fp1, "!" );
    fclose ( fp1 );
}

void func2( void ) {
    FILE *fp2;
    fp2 = fopen ( "data1.txt", "w" );
    fprintf ( fp2, "*" );
    fclose(fp2);

    fp2 = fopen ( "data2.txt", "w" );              /* Compliant */
    fprintf ( fp2, "!" );
    fclose ( fp2 );
}
```

In this example, the file pointer `fp1` is pointing to a file `data1.txt`. Before `fp1` is explicitly dissociated from the file stream of `data1.txt`, it is used to access another file `data2.txt`. Therefore, the rule 22.1 is violated.

The rule is not violated in `func2` because file `data1.txt` is closed and the file pointer `fp2` is explicitly dissociated from `data1.txt` before it is reused.

## Check Information

**Group:** Resources
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Directive 4.13` | `MISRA C:2012 Rule 21.3` | `MISRA C:2012 Rule 21.6` | `Resource leak`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Rule 22.2

A block of memory shall only be freed if it was allocated by means of a Standard Library function

## Description

### Rule Definition

*A block of memory shall only be freed if it was allocated by means of a Standard Library function.*

### Rationale

The Standard Library functions that allocate memory are `malloc`, `calloc` and `realloc`.

You free a block of memory when you pass its address to the `free` or `realloc` function. The following causes undefined behavior:

- You free a block of memory that you did not allocate.
- You free a block of memory that have already freed before.

### Message in Report

A block of memory shall only be freed if it was allocated by means of a Standard Library function.

## Examples

### Memory Not Allocated Is Freed

```
#include <stdlib.h>
```

```
void func1(void) {
    int x=0;
    int *ptr=&x;

    free(ptr);
   /* Non-compliant: ptr is not dynamically allocated */
}
```

In this example, the rule is violated because the `free` function operates on a pointer that does not point to dynamically allocated memory.

### Memory Freed Twice

```
#include <stdlib.h>

void func(int arrSize) {
    int *ptr = (int*) malloc(arrSize* sizeof(int));

    free(ptr);   /* Block of memory freed once */
    free(ptr);   /* Non-compliant - Block of memory freed twice */
}
```

In this example, the rule is violated when the `free` function operates on `ptr` twice without a reallocation in between.

## Check Information

**Group:** Resources
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`Deallocation of previously deallocated pointer` | `Invalid free of pointer` | `MISRA C:2012 Directive 4.13` | `MISRA C:2012 Rule 21.3`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Rule 22.3

The same file shall not be open for read and write access at the same time on different streams

## Description

### Rule Definition

*The same file shall not be open for read and write access at the same time on different streams.*

### Rationale

If a file is both written and read via different streams, the behavior can be undefined.

### Message in Report

The same file shall not be open for read and write access at the same time on different streams.

## Examples

### Opening File That Is Open in Another Stream

```
#include <stdio.h>

void func(void) {
    FILE *fw = fopen("tmp.txt", "r+");
    FILE *fr = fopen("tmp.txt", "r");   /* Non-compliant: File open in stream fw*/
}
```

In this example, the rule is violated when the same file `tmp.txt` is opened in two streams. The `FILE` pointers `fw` and `fr` point to two different streams here.

## Check Information

**Group:** Resources<br>
**Category:** Required<br>
**AGC Category:** Required<br>
**Language:** C

## See Also

`MISRA C:2012 Rule 21.6` | `Resource leak`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

# MISRA C:2012 Rule 22.4

There shall be no attempt to write to a stream which has been opened as read-only

## Description

### Rule Definition

*There shall be no attempt to write to a stream which has been opened as read-only.*

### Rationale

The Standard does not specify the behavior if an attempt is made to write to a read-only stream.

### Message in Report

There shall be no attempt to write to a stream which has been opened as read-only.

## Examples

### Writing to File Opened as Read-Only

```
#include <stdio.h>

void func1(void) {
    FILE *fp1 = fopen("tmp.txt", "r");
    (void) fprintf(fp1, "Some text"); /* Non-compliant: Read-only stream */
    (void) fclose(fp1);
}

void func2(void) {
    FILE *fp2 = fopen("tmp.txt", "r+");
    (void) fprintf(fp2, "Some text"); /* Compliant */
    (void) fclose(fp2);
}
```

In this example, the file stream associated with `fp1` is opened as read-only. The rule is violated when the stream is written.

## Check Information

**Group:** Resources
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 21.6` | `Writing to read-only resource`

### Topics

“Activate Coding Rules Checker”
“Review Coding Rule Violations”
“Polyspace MISRA C:2012 Checker”
“Software Quality Objective Subsets (C:2012)”

Introduced in R2015b

# MISRA C:2012 Rule 22.5

A pointer to a FILE object shall not be dereferenced

## Description

### Rule Definition

*A pointer to a* FILE *object shall not be dereferenced.*

### Rationale

The Standard states that the address of a FILE object used to control a stream can be significant. Copying that object might not give the same behavior. This rule ensures that you cannot perform such a copy.

Directly manipulating a FILE object might be incompatible with its use as a stream designator.

### Message in Report

A pointer to a FILE object shall not be dereferenced

## Examples

### **FILE*** Pointer Dereferenced

```
#include <stdio.h>

void func(void) {
    FILE *pf1;
    FILE *pf2;
    FILE f3;

    pf2 = pf1;        /* Compliant */
    f3 = *pf2;         /* Non-compliant */
    pf2->_flags=0;     /* Non-compliant */
 }
```

In this example, the rule is violated when the `FILE*` pointer `pf2` is dereferenced.

## Check Information

**Group:** Resources
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 21.6`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2015b**

# MISRA C:2012 Rule 22.6

The value of a pointer to a FILE shall not be used after the associated stream has been closed

## Description

### Rule Definition

*The value of a pointer to a* FILE *shall not be used after the associated stream has been closed.*

### Rationale

The Standard states that the value of a FILE* pointer is indeterminate after you close the stream associated with it.

### Message in Report

The value of a pointer to a FILE shall not be used after the associated stream has been closed.

## Examples

### Use of **FILE** Pointer After Closing Stream

```
#include <stdio.h>

void func(void) {
    FILE *fp;
    void *ptr;

    fp = fopen("tmp","w");
    if(fp != NULL) {
        fclose(fp);
        fprintf(fp,"text");
    }
}
```

In this example, the stream associated with the `FILE*` pointer `fp` is closed with the `fclose` function. The rule is violated `FILE*` pointer `fp` is used before the stream is re-opened.

## Check Information

**Group:** Resources
**Category:** Mandatory
**AGC Category:** Mandatory
**Language:** C90, C99

## See Also

`MISRA C:2012 Directive 4.13` | `MISRA C:2012 Rule 21.6` | `Use of previously closed resource`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2015b**

# MISRA C:2012 Rule 22.7

The macro EOF shall only be compared with the unmodified return value from any Standard Library function capable of returning EOF

## Description

### Rule Definition

*The macro `EOF` shall only be compared with the unmodified return value from any Standard Library function capable of returning `EOF`.*

### Rationale

The `EOF` value may become indistinguishable from a valid character code if the value returned is converted to another type. In such cases, testing the converted value against `EOF` will not reliably identify if the end of the file has been reached or if an error has occurred.

### Message in Report

The macro `EOF` shall only be compared with the unmodified return value from any Standard Library function capable of returning `EOF`.

## Examples

### Possibly Misleading Results from Comparison with **`EOF`**

```
void f1 ( void )
{
    char ch;
    ch = ( char ) getchar ();
    if ( EOF != ( int32_t ) ch )  /* Non-compliant */
    {
    }
}

void f2 ( void )
{
    char ch;
    ch = ( char ) getchar ();
    if ( !feof ( stdin ) )        /* Compliant */
    {
    }
}

void f3 ( void )
{
    int32_t i_ch;
    i_ch = getchar ();
    if ( EOF != i_ch )            /* Compliant */
     {
        char ch;
        ch = ( char ) i_ch;
    }
}
```

In this example:

- The test in the `f1` function is non-compliant. It will not be reliable as the return value is cast to a narrower type before checking for `EOF`.
- The test in the `f2` function is compliant. It shows how *`feof()`* can be used to check for `EOF` when the return value from *`getchar()`* has been subjected to type conversion.
- The test in the `f3` function is compliant. It is reliable as the unconverted return value is used when checking for `EOF`.

## Check Information

**Group:** Resources
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 22.8

The value of `errno` shall be set to zero prior to a call to an `errno`-setting-function

## Description

### Rule Definition

*The value of `errno` shall be set to zero prior to a call to an `errno`-setting-function.*

### Rationale

If an error occurs during a call to an `errno`-setting-function, the function writes a nonzero value to `errno`. Otherwise, `errno` is not modified.

If you do not explicitly set `errno` to zero before a function call, it can contain values from a previous call. Checking `errno` for nonzero values after the function call can give the false impression that an error occurred.

`Errno`-setting functions include:

- `ftell`, `fgetpos`, `fgetwc` and related functions.
- `strtoimax`, `strtol` and related functions.

  The wide-character equivalents such as `wcstoimax` and `wcstol` are also covered.

### Message in Report

The value of `errno` shall be set to zero prior to a call to an *`errno`-setting-function*.

# Examples

## `errno` Not Reset Before Use

```
#include <stdlib.h>
#include <errno.h>

double val = 0.0;

void f ( void )
{
    val = strtod("1.0",NULL); /* Non-compliant */
    if ( 0 == errno ) /* Check errno for nonzero values */
    {
        val = strtod("1.0",NULL); /* Compliant - case 1*/
        if ( 0 == errno ) /* Check errno for nonzero values */
        {
        }
    }
    else
    {
        errno = 0;
        val = strtod("1.0",NULL); /* Compliant - case 2*/
        if ( 0 == errno ) /* Check errno for nonzero values */
        {
        }
    }
}
```

In this example, the rule is violated when `strtod` is called but `errno` is not reset prior to the call.

The rule is not violated in the following cases:

- Case 1: `errno` is compared against zero and then `strtod` is called in the `if( 0 == errno )` branch.
- Case 2: `errno` is explicitly set to zero and then `strtod` is called.

# Check Information

**Group:** Resources

**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 22.9` | `MISRA C:2012 Rule 22.10`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 22.9

The value of errno shall be tested against zero after calling an errno-setting function

## Description

### Rule Definition

*The value of errno shall be tested against zero after calling an errno-setting function.*

### Rationale

If an error occurs during a call to an errno-setting-function, the function writes a nonzero value to errno. Otherwise, errno is not modified.

When errno is nonzero, the function return value is not likely to be correct. Before using this return value, you must test errno for nonzero values.

Errno-setting functions include:

- ftell, fgetpos, fgetwc and related functions.
- strtoimax, strtol and related functions.

  The wide-character equivalents such as wcstoimax and wcstol are also covered.

### Message in Report

The value of errno shall be tested against zero after calling an *errno-setting function*.

## Examples

### **errno** Not Tested After Function Call

```
#include <stdlib.h>
#include <errno.h>
```

```
void func(void);
double val = 0.0;

void f1 ( void )
{
  errno = 0;
  val = strtod ( "1.0", NULL ); /* Non-compliant */
  func ();

  if ( 0 != errno )
    {
    }

  errno = 0;
  val = strtod ( "1.0", NULL ); /* Compliant */
  if ( 0 == errno )
    {
      func();
    }
}
```

In this example, the rule is violated when `errno` is not checked immediately after the first call to `strtod`. Instead, a second function `func` is called. `func` might use the value in the global variable `val`. The value can be incorrect if an error has occurred during the call to `strtod`.

The rule is not violated when `errno` is checked before operations that potentially use the return value of `strtod`.

## Check Information

**Group:** Resources
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 22.8` | `MISRA C:2012 Rule 22.10`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"

"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

Introduced in R2017a

# MISRA C:2012 Rule 22.10

The value of errno shall only be tested when the last function to be called was an errno-setting function

## Description

### Rule Definition

*The value of errno shall only be tested when the last function to be called was an errno-setting function.*

### Rationale

Besides the errno-setting functions, the Standard does not enforce that other functions set errno on errors. Whether these functions set errno or not is implementation-dependent.

To detect errors, if you check errno alone, the validity of this check also becomes implementation-dependent. On implementations that do not require errno setting, even if you check errno alone, you can overlook error conditions.

For a list of errno-setting functions, see MISRA C:2012 Rule 22.8.

### Message in Report

The value of errno shall only be tested when the last function to be called was an errno-setting function.

## Examples

### Incorrect Test of **errno**

```
void f ( void )
{
    float64_t f64;
    errno = 0;
    f64 = atof ( "A.12" );
    if ( 0 == errno ) /* Non-compliant */
    {
    }
    errno = 0;
    f64 = strtod ( "A.12", NULL );
    if ( 0 == errno ) /* Compliant */
    {
    }
}
```

In this example:

- The first `if` statement is noncompliant because `atof` may or may not set `errno` when an error is detected. `f64` may not have a valid value within this `if` statement.
- The second `if` statement is compliant because `strtod` is an *`errno`-setting function*. `f64` will have a valid value within this `if` statement.

## Check Information

**Group:** Resources
**Category:** Required
**AGC Category:** Required
**Language:** C90, C99

## See Also

`MISRA C:2012 Rule 22.8` | `MISRA C:2012 Rule 22.9`

### Topics

"Activate Coding Rules Checker"
"Review Coding Rule Violations"
"Polyspace MISRA C:2012 Checker"
"Software Quality Objective Subsets (C:2012)"

**Introduced in R2017a**

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# Custom Coding Rules

# Group 1: Files

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 1.1 | All source file names must follow the specified pattern. | The source file name “file_name” does not match the specified pattern. | Only the base name is checked. A source file is a file that is not included. |
| 1.2 | All source folder names must follow the specified pattern. | The source dir name “dir_name” does not match the specified pattern. | Only the folder name is checked. A source file is a file that is not included. |
| 1.3 | All include file names must follow the specified pattern. | The include file name “file_name” does not match the specified pattern. | Only the base name is checked. An include file is a file that is included. |
| 1.4 | All include folder names must follow the specified pattern. | The include dir name “dir_name” does not match the specified pattern. | Only the folder name is checked. An include file is a file that is included. |

# Group 2: Preprocessing

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 2.1 | All macros must follow the specified pattern. | The macro “macro_name” does not match the specified pattern. | Macro names are checked before preprocessing. |
| 2.2 | All macro parameters must follow the specified pattern. | The macro parameter “param_name” does not match the specified pattern. | Macro parameters are checked before preprocessing. |

## Group 3: Type definitions

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 3.1 | All integer types must follow the specified pattern. | The integer type “type_name” does not match the specified pattern. | Applies to integer types specified by `typedef` statements. Does not apply to enumeration types. For example: `typedef signed int int32_t;` |
| 3.2 | All float types must follow the specified pattern. | The float type “type_name” does not match the specified pattern. | Applies to float types specified by `typedef` statements. For example: `typedef float f32_t;` |
| 3.3 | All pointer types must follow the specified pattern. | The pointer type “type_name” does not match the specified pattern. | Applies to pointer types specified by `typedef` statements. For example: `typedef int* p_int;` |
| 3.4 | All array types must follow the specified pattern. | The array type “type_name” does not match the specified pattern. | Applies to array types specified by `typedef` statements. For example: `typedef int[3] a_int_3;` |
| 3.5 | All function pointer types must follow the specified pattern. | The function pointer type “type_name” does not match the specified pattern. | Applies to function pointer types specified by `typedef` statements. For example: `typedef void (*pf_callback) (int);` |

# Group 4: Structures

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 4.1 | All `struct` tags must follow the specified pattern. | The struct tag “tag_name” does not match the specified pattern. | |
| 4.2 | All `struct` types must follow the specified pattern. | The struct type “type_name” does not match the specified pattern. | This is the `typedef` name. |
| 4.3 | All `struct` fields must follow the specified pattern. | The struct field “field_name” does not match the specified pattern. | |
| 4.4 | All `struct` bit fields must follow the specified pattern. | The struct bit field “field_name” does not match the specified pattern. | |

## Group 5: Classes (C++)

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 5.1 | All class names must follow the specified pattern. | The class tag "tag_name" does not match the specified pattern. | |
| 5.2 | All class types must follow the specified pattern. | The class type "type_name" does not match the specified pattern. | This is the `typedef` name. |
| 5.3 | All data members must follow the specified pattern. | The data member "member_name" does not match the specified pattern. | |
| 5.4 | All function members must follow the specified pattern. | The function member "member_name" does not match the specified pattern. | |
| 5.5 | All static data members must follow the specified pattern. | The static data member "member_name" does not match the specified pattern. | |
| 5.6 | All static function members must follow the specified pattern. | The static function member "member_name" does not match the specified pattern. | |
| 5.7 | All bitfield members must follow the specified pattern. | The bitfield "member_name" does not match the specified pattern. | |

# Group 6: Enumerations

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 6.1 | All enumeration tags must follow the specified pattern. | The enumeration tag "tag_name" does not match the specified pattern. | |
| 6.2 | All enumeration types must follow the specified pattern. | The enumeration type "type_name" does not match the specified pattern. | This is the typedef name. |
| 6.3 | All enumeration constants must follow the specified pattern. | The enumeration constant "constant_name" does not match the specified pattern. | |

## Group 7: Functions

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 7.1 | All global functions must follow the specified pattern. | The global function “function_name” does not match the specified pattern. | A global function is a function with external linkage. |
| 7.2 | All static functions must follow the specified pattern. | The static function “function_name” does not match the specified pattern. | A static function is a function with internal linkage. |
| 7.3 | All function parameters must follow the specified pattern. | The function parameter “param_name” does not match the specified pattern. | In C++, applies to non-member functions. |

# Group 8: Constants

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 8.1 | All global constants must follow the specified pattern. | The global constant "constant_name" does not match the specified pattern. | A global constant is a constant with external linkage. |
| 8.2 | All static constants must follow the specified pattern. | The static constant "constant_name" does not match the specified pattern. | A static constant is a constant with internal linkage. |
| 8.3 | All local constants must follow the specified pattern. | The local constant "constant_name" does not match the specified pattern. | A local constant is a constant without linkage. |
| 8.4 | All static local constants must follow the specified pattern. | The static local constant "constant_name" does not match the specified pattern. | A static local constant is a constant declared static in a function. |

## Group 9: Variables

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 9.1 | All global variables must follow the specified pattern. | The global variable “var_name” does not match the specified pattern. | A global variable is a variable with external linkage. |
| 9.2 | All static variables must follow the specified pattern. | The static variable “var_name” does not match the specified pattern. | A static variable is a variable with internal linkage. |
| 9.3 | All local variables must follow the specified pattern. | The local variable “var_name” does not match the specified pattern. | A local variable is a variable without linkage. |
| 9.4 | All static local variables must follow the specified pattern. | The static local variable “var_name” does not match the specified pattern. | A static local variable is a variable declared static in a function. |

# Group 10: Name spaces (C++)

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 10.1 | All names paces must follow the specified pattern. | The name space “name space_name” does not match the specified pattern. | |

## Group 11: Class templates (C++)

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 11.1 | All class templates must follow the specified pattern. | The class template “template_name” does not match the specified pattern. | |
| 11.2 | All class template parameters must follow the specified pattern. | The class template parameter “param_name” does not match the specified pattern. | |

## Group 12: Function templates (C++)

| Number | Rule Applied | Message generated if rule is violated | Other details |
|---|---|---|---|
| 12.1 | All function templates must follow the specified pattern. | The function template “template_name” does not match the specified pattern. | Applies to non-member functions. |
| 12.2 | All function template parameters must follow the specified pattern. | The function template parameter “param_name” does not match the specified pattern. | Applies to non-member functions. |
| 12.3 | All function template members must follow the specified pattern. | The function template member “member_name” does not match the specified pattern. | |

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# Code Metrics

# Comment Density

Ratio of number of comments to number of statements

## Description

The metric specifies the ratio of comments to statements expressed as a percentage.

Multi-line comments are counted as one comment. A statement typically ends with a semi-colon with some exceptions. Exceptions include semi-colons in `for` loops or structure field declarations.

The recommended lower limit for this metric is 20. For better readability of your code, try to place at least one comment for every five statements.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Comment Density Calculation

```
struct record {
    char name[40];
    long double salary;
    int isEmployed;
};

struct record dataBase[100];

struct record fetch(void);
void remove(int);

void maintenanceRoutines() {
// This function implements
// regular maintenance on an internal database
    int i;
    struct record tempRecord;
    for(i=0; i <100; i++) {
        tempRecord = fetch(); // This function fetches a record
        // from the database
        if(tempRecord.isEmployed == 0)
            remove(i);         // Remove employee record
        //from the database
    }
}
```

In this example, the comment density is 38. The calculation is done as follows:

| Code | Running Total of Comments | Running Total of Statements |
|---|---|---|
| `struct record {`<br>`    char name[40];`<br>`    long double salary;`<br>`    int isEmployed;`<br>`};` | 0 | 1 |
| `struct record dataBase[100];`<br>`struct record fetch(void);`<br>`void remove(int);` | 0 | 4 |
| `void maintenanceRoutines() {` | 0 | 4 |
| `// This function implements`<br>`// regular maintenance on an internal database` | 1 | 4 |
| `int i;`<br>`struct record tempRecord;` | 1 | 6 |
| `for(i=0; i <100; i++) {` | 1 | 6 |
| ` tempRecord = fetch(); // This`<br>`      function fetches a record`<br>`        // from the database` | 2 | 7 |
| `if(tempRecord.isEmployed == 0)`<br>`            remove(i);`<br>`        // Remove employee record`<br>`        //from the database`<br>`  }`<br>`}` | 3 | 8 |

There are 3 comments and 8 statements. The comment density is 3/8*100 = 38.

## Metric Information

**Group**: File
**Acronym**: `COMF`
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Cyclomatic Complexity

Number of linearly independent paths in function body

## Description

This metric calculates the number of decision points in a function and adds one to the total. A decision point is a statement that causes your program to branch into two paths.

The recommended upper limit for this metric is 10. If the cyclomatic complexity is high, the code is both difficult to read and can cause more orange checks. Therefore, try to limit the value of this metric.

To enforce limits on metrics, see “Review Code Metrics”.

### Computation Details

The metric calculation uses the following rules to identify decision points:

- An `if` statement is one decision point.
- The statements `for` and `while` count as one decision point, even when no condition is evaluated, for example, in infinite loops.
- Boolean combinations `(&&, ||)` do not count as decision points.
- `case` statements do not count as decision points unless they are followed by a `break` statement. For instance, this code has a cyclomatic complexity of two:

```
switch(num) {
        case 0:
        case 1:
        case 2:
            break;
        case 3:
        case 4:
    }
```

- The calculation is done after preprocessing:

- Macros are expanded.
- Conditional compilation is applied. The blocks hidden by preprocessing directives are ignored.

## Examples

### Function with Nested `if` Statements

```
int foo(int x,int y)
{
    int flag;
    if (x <= 0)
        /* Decision point 1*/
        flag = 1;
    else
    {
        if (x < y )
            /* Decision point 2*/
            flag = 1;
        else if (x==y)
            /* Decision point 3*/
            flag = 0;
        else
            flag = -1;
    }
    return flag;
}
```

In this example, the cyclomatic complexity of `foo` is 4.

### Function with `?` Operator

```
int foo (int x, int y) {
    if((x <0) ||(y < 0))
        /* Decision point 1*/
        return 0;
    else
        return (x > y ? x: y);
        /* Decision point 2*/
}
```

In this example, the cyclomatic complexity of `foo` is 3. The `?` operator is the second decision point.

## Function with `switch` Statement

```
#include <stdio.h>

int foo(int x,int y, int ch)
{
    int val = 0;
    switch(ch) {
    case 1:
        /* Decision point 1*/
        val = x + y;
        break;
    case 2:
        /* Decision point 2*/
        val = x - y;
        break;
    default:
        printf("Invalid choice.");
    }
    return val;
}
```

In this example, the cyclomatic complexity of `foo` is 3.

## Function with Nesting of Different Control-Flow Statements

```
int foo(int x,int y, int bound)
{
    int count = 0;
    if (x <= y)
        /* Decision point 1*/
        count = 1;
    else
        while(x>y) {
            /* Decision point 2*/
            x--;
            if(count< bound) {
                /* Decision point 3*/
                count++;
            }
        }
    return count;
}
```

In this example, the cyclomatic complexity of `foo` is 4.

## Metric Information

**Group**: Function<br>
**Acronym**: `VG`<br>
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Higher Estimate of Local Variable Size

Total size of all local variables in function

## Description

This metric provides a conservative estimate of the total size of local variables in a function. The metric is the sum of the following sizes in bytes:

- Size of function return value
- Sizes of function parameters
- Sizes of local variables
- Additional padding introduced for memory alignment

Your actual stack usage due to local variables can be different from the metric value.

- Some of the variables are stored in registers instead of on the stack.
- Your compiler performs variable liveness analysis to enable certain memory optimizations. For instance, compilers store the address to which the execution returns following the function call. When computing this metric, Polyspace does not consider these optimizations.
- Your compiler uses additional memory during a function call. When computing this metric, Polyspace does not consider this hidden memory usage.
- (C++ only) Destructors and `try-catch` statements can introduce hidden contributions to the metric value.

However, the metric provides a reasonable estimate of the stack usage due to local variables.

To determine the sizes of basic types, the software uses your specifications for `Target processor type (-target)`. The metric also takes into account `#pragma pack` directives in your code.

# Examples

## All Variables of Same Type

```
int flag();

int func(int param) {
  int var_1;
  int var_2;
  if (flag()) {
      int var_3;
      int var_4;
    } else {
      int var_5;
    }
}
```

In this example, assuming 4 bytes for `int`, the higher estimate of local variable size is 28. The breakup of the size is shown in this table.

| Variable | Size (in Bytes) | Running Total |
|---|---|---|
| Return value | 4 | 4 |
| Parameter `param` | 4 | 8 |
| Local variables `var_1` and `var_2` | `4+4=8` | 16 |
| Local variables defined in the `if` condition | `(4+4)+4=12`<br>The size of variables in the first branch is eight bytes. The size in the second branch is four bytes. The sum of the two branches is 12 bytes. | 28 |

No padding is introduced for memory alignment because all the variables involved have the same type.

## Variables of Different Types

```
char func(char param) {
  int var_1;
  char var_2;
  double var_3;
}
```

In this example, assuming one byte for char, four bytes for int and eight bytes for double and four bytes for alignment, the higher estimate of local variable size is 20. The alignment is usually the word size on your platform. In your Polyspace project, you specify the alignment through your target processor. For more information, see the Alignment column in Target processor type (-target). The breakup of the size is shown in this table.

| Variable | Size (in Bytes) | Running Total |
|---|---|---|
| Return value | 1 | 1 |
| Additional padding introduced before param is stored | 0<br>No memory alignment is required because the next variable param has the same size. | 1 |
| Parameter param | 1 | 2 |
| Additional padding introduced before var_1 is stored | 2<br>Memory must be aligned using padding because the next variable var_1 requires four bytes. The storage must start from a memory address at a multiple of four. | 4 |
| var_1 | 4 | 8 |
| Additional padding introduced before var_2 is stored | 0<br>No memory alignment is required because the next variable var_2 has smaller size. | 8 |
| var_2 | 1 | 9 |

| Variable | Size (in Bytes) | Running Total |
|---|---|---|
| Additional padding introduced before var_3 is stored | 3<br>Memory must be aligned using padding because the next variable var_3 has eight bytes. The storage must start from a memory address at a multiple of the alignment, four bytes. | 12 |
| var_3 | 8 | 20 |

The rules for the amount of padding are:

- If the next variable stored has the same or smaller size, no padding is required.
- If the next variable has a greater size:
  - If the variable size is the same as or less than the alignment on the platform, the amount of padding must be sufficient so that the storage address is a multiple of its size.
  - If the variable size is greater than the alignment on the platform, the amount of padding must be sufficient so that the storage address is a multiple of the alignment.

## C++ Methods and Objects

```
class MySimpleClass {
  public:
    MySimpleClass() {};
    MySimpleClass(int) {};
    ~MySimpleClass() {};
};

int main() {
  MySimpleClass c;
  return 0;
}
```

In this example, the estimated local variable sizes are:

- Constructor `MySimpleClass::MySimpleClass()`: Four bytes.

  The size comes from the `this` pointer, which is an implicit argument to the constructor. You specify the pointer size using the option `Target processor type (-target)`.
- Constructor `MySimpleClass::MySimpleClass(int)`: Eight bytes.

  The size comes from the `this` pointer and the `int` argument.
- Destructor `MySimpleClass::~MySimpleClass()`: Eight bytes.

  The size comes from the `this` pointer and a hidden contribution from an internal variable.
- `main()`: Five bytes.

  The size comes from the `int` return value and the size of object `c`. The minimum size of an object is the alignment that you specify using the option `Target processor type (-target)`.

## C++ Functions with Object Arguments

```
class MyClass {
  public:
    MyClass() {};
    MyClass(int) {};
    ~MyClass() {};
  private:
    int i[10];
};
void func1(const MyClass& c) {
}

void func2() {
  func1(4);
}
```

In this example, the estimated local variable size for `func2()` is 40 bytes. When `func2()` calls `func1()`, a temporary object of the class `MyClass` is created. The object has ten `int` variables, each with a size of four bytes.

## Metric Information

**Group:** Function
**Acronym:** `LOCAL_VARS_MAX`
**HIS Metric**: No

## See Also

`Lower Estimate of Local Variable Size` | `Calculate code metrics (-code-metrics)`

Introduced in R2016b

# Language Scope

Language scope

## Description

This metric measures the cost of maintaining or changing a function. It is calculated as:

```
(N1 + N2)/(n1 + n2)
```

Here:

- `N1` is the number of occurrences of operators.
- `N2` is the number of occurrences of operands.
- `n1` is the number of distinct operators.
- `n2` is the number of distinct operands.

The recommended upper limit for this metric is 4. For lower maintenance cost for a function, try to enforce an upper limit on this metric. For instance, if the same operand occurs many times, to change the operand name, you have to make many substitutions.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Language Scope Calculation

```
int f(int i)
{
    if (i == 1)
        return i;
    else
        return i * g(i-1);
}
```

In this example:

- `N1` = 17.
- `N2` = 9.
- `n1` = 12.

  The distinct operators are `int`, `(`, `)`, `{`, `if`, `==`, `return`, `else`, `*`, `-`, `;`, `}`.
- `n2` = 4.

  The distinct operands are `f`, `i`, `1` and `g`.

The language scope of `f` is (17 + 9) / (12 + 4) = 1.8.

## Metric Information

**Group**: Function
**Acronym**: `VOCF`
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Lower Estimate of Local Variable Size

Total size of local variables in function taking nested scopes into account

## Description

This metric provides an optimistic estimate of the total size of local variables in a function. The metric is the sum of the following sizes in bytes:

- Size of function return value
- Sizes of function parameters
- Sizes of local variables

  Suppose that the function has variable definitions in nested scopes as follows:

  ```
  type func (type param_1, ...) {

    {
      /* Scope 1 */
      type var_1, ...;
    }
    {
      /* Scope 2 */
      type var_2, ...;
    }
  }
  ```

  The software computes the total variable size in each scope and uses whichever total is greatest. For instance, if a conditional statement has variable definitions, the software computes the total variable size in each branch, and then uses whichever total is greatest. If a nested scope itself has further nested scopes, the same process is repeated for the inner scopes.

  A variable defined in a nested scope is not visible outside the scope. Therefore, some compilers reuse stack space for variables defined in separate scopes. This metric provides a more accurate estimate of stack usage for such compilers. Otherwise, use the metric `Higher Estimate of Local Variable Size`. This metric adds the size of all local variables, whether or not they are defined in nested scopes.

- Additional padding introduced for memory alignment

Your actual stack usage due to local variables can be different from the metric value.

- Some of the variables are stored in registers instead of on the stack.
- Your compiler performs variable liveness analysis to enable certain memory optimizations. When computing this metric, Polyspace does not consider these optimizations.
- Your compiler uses additional memory during a function call. For instance, compilers store the address to which the execution returns following the function call. When computing this metric, Polyspace does not consider this hidden memory usage.
- (C++ only) Destructors and `try-catch` statements can introduce hidden contributions to the metric value.

However, the metric provides a reasonable estimate of the stack usage due to local variables.

To determine the sizes of basic types, the software uses your specifications for `Target processor type (-target)`. The metric also takes into account `#pragma pack` directives in your code.

## Examples

### All Variables of Same Type

```
int flag();

int func(int param) {
  int var_1;
  int var_2;
  if (flag()) {
      int var_3;
      int var_4;
    } else {
      int var_5;
    }
}
```

In this example, assuming four bytes for `int`, the lower estimate of local variable size is 24. The breakup of the metric is shown in this table.

| Variable | Size (in Bytes) | Running Total |
|---|---|---|
| Return value | 4 | 4 |
| Parameter `param` | 4 | 8 |
| Local variables `var_1` and `var_2` | `4+4=8` | 16 |
| Local variables defined in the `if` condition | `max(4+4,4)= 8`<br>The size of variables in the first branch is eight bytes. The size in the second branch is four bytes. The maximum of the two branches is eight bytes. | 24 |

No padding is introduced for memory alignment because all the variables involved have the same type.

## Variables of Different Types

```
char func(char param) {
  int var_1;
  char var_2;
  double var_3;
}
```

In this example, assuming one byte for `char`, four bytes for `int`, eight bytes for `double` and four bytes for alignment, the lower estimate of local variable size is 20. The alignment is usually the word size on your platform. In your Polyspace project, you specify the alignment through your target processor. For more information, see the Alignment column in `Target processor type (-target)`. The breakup of the size is shown in this table.

| Variable | Size (in Bytes) | Running Total |
|---|---|---|
| Return value | 1 | 1 |

| Variable | Size (in Bytes) | Running Total |
|---|---|---|
| Additional padding introduced before param is stored | 0<br>No memory alignment is required because the next variable param has the same size. | 1 |
| Parameter param | 1 | 2 |
| Additional padding introduced before var_1 is stored | 2<br>Memory must be aligned using padding because the next variable var_1 requires four bytes. The storage must start from a memory address at a multiple of four. | 4 |
| var_1 | 4 | 8 |
| Additional padding introduced before var_2 is stored | 0<br>No memory alignment is required because the next variable var_2 has smaller size. | 8 |
| var_2 | 1 | 9 |
| Additional padding introduced before var_3 is stored | 3<br>Memory must be aligned using padding because the next variable var_3 requires eight bytes. The storage must start from a memory address at a multiple of the alignment, four bytes. | 12 |
| var_3 | 8 | 20 |

The rules for the amount of padding are:

- If the next variable stored has the same or smaller size, no padding is required.
- If the next variable has a greater size:
  - If the variable size is the same as or less than the alignment on the platform, the amount of padding must be sufficient so that the storage address is a multiple of its size.
  - If the variable size is greater than the alignment on the platform, the amount of padding must be sufficient so that the storage address is a multiple of the alignment.

## C++ Methods and Objects

```
class MySimpleClass {
  public:
    MySimpleClass() {};
    MySimpleClass(int) {};
    ~MySimpleClass() {};
};

int main() {
  MySimpleClass c;
  return 0;
}
```

In this example, the estimated local variable sizes are:

- Constructor `MySimpleClass::MySimpleClass()`: Four bytes.

  The size comes from the `this` pointer, which is an implicit argument to the constructor. You specify the pointer size using the option `Target processor type (-target)`.
- Constructor `MySimpleClass::MySimpleClass(int)`: Eight bytes.

  The size comes from the `this` pointer and the `int` argument.
- Destructor `MySimpleClass::~MySimpleClass()`: Eight bytes.

  The size comes from the `this` pointer and a hidden contribution from an internal variable.

- main(): Five bytes.

  The size comes from the int return value and the size of object c. The minimum size of an object is the alignment that you specify using the option Target processor type (-target).

### C++ Functions with Object Arguments

```
class MyClass {
  public:
    MyClass() {};
    MyClass(int) {};
    ~MyClass() {};
  private:
    int i[10];
};
void func1(const MyClass& c) {
}

void func2() {
  func1(4);
}
```

In this example, the estimated local variable size for func2() is 40 bytes. When func2() calls func1(), a temporary object of the class MyClass is created. The object has ten int variables, each with a size of four bytes.

## Metric Information

**Group:** Function
**Acronym:** LOCAL_VARS_MIN
**HIS Metric**: No

## See Also

Higher Estimate of Local Variable Size | Calculate code metrics (-code-metrics)

**Introduced in R2016b**

# Estimated Function Coupling

Measure of complexity between levels of call tree

## Description

This metric provides an approximate measure of complexity between different levels of the call tree. The metric is defined as:

*number of call occurrences – number of function definitions* + *1*

If there are more function definitions than function calls, the estimated function coupling result is negative.

This metric:

- Counts function calls and function definitions in the current file only.

  It does not count function definitions in a header file included in the current file.
- Treats `static` and `inline` functions like any other function.

## Examples

### Same Function Called Multiple Times

```
void checkBounds(int *);
int getUnboundedValue();

int getBoundedValue(void) {
    int num = getUnboundedValue();
    checkBounds(&num);
    return num;
}

void main() {
    int input1=getBoundedValue(), input2= getBoundedValue(), prod;
    prod = input1 * input2;
    checkBounds(&prod);
}
```

In this example, there are:

- 5 call occurrences. Both `getBoundedValue` and `checkBounds` are called twice and `getUnboundedValue` is called once.
- 2 function definitions. `main` and `getBoundedValue` are defined.

Therefore, the Estimated function coupling is `5 - 2 + 1 = 4`.

### Negative Estimated Function Coupling

```
int foobar(int a, int b){
    return a+b;
}

int bar(int b){
    return b+2;
}

int foo(int a){
    return a<<2;
}

int main(int x){
    foobar(x,x+2);
    return 0;
}
```

This example shows how you can get a negative estimated function coupling result. In this example, you see:

- 1 function call in `main`.
- 4 defined functions: `foobar`, `bar`, `foo`, and `main`.

Therefore, the estimated function coupling is `1 - 4 + 1 = -2`.

## Metric Information

**Group**: File

**Acronym**: `FCO`
**HIS Metric**: No

## See Also

`Number of Call Occurrences` | `Calculate code metrics (-code-metrics)`

# Number of Call Levels

Maximum depth of nesting of control flow structures

## Description

This metric specifies the maximum nesting depth of control flow statements such as `if`, `switch`, `for`, or `while` in a function. A function without control-flow statements has a call level 1.

The recommended upper limit for this metric is 4. For better readability of your code, try to enforce an upper limit for this metric.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Function with Nested `if` Statements

```
int foo(int x,int y)
{
    int flag = 0;
    if (x <= 0)
        /* Call level 1*/
        flag = 1;
    else
    {
        if (x <= y )
            /* Call level 2*/
            flag = 1;
        else
            flag = -1;
    }
    return flag;
}
```

In this example, the number of call levels of `foo` is 2.

### Function with Nesting of Different Control-Flow Statements

```
int foo(int x,int y, int bound)
{
    int count = 0;
    if (x <= y)
        /* Call level 1*/
        count = 1;
    else
        while(x>y) {
            /* Call level 2*/
            x--;
            if(count< bound) {
                /* Call level 3*/
                count++;
            }
        }
    return count;
}
```

In this example, the number of call levels of `foo` is 3.

## Metric Information

**Group**: Function
**Acronym**: `LEVEL`
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Number of Call Occurrences

Number of calls in function body

## Description

This metric specifies the number of function calls in the body of a function.

Calls through a function pointer are not counted. Calls in unreachable code and calls to standard library functions are counted. `assert` is considered as a macro and not a function, so it is not counted.

## Examples

### Same Function Called Multiple Times

```
int func1(void);
int func2(void);

int foo() {
    return (func1() + func1()*func1() + 2*func2());
}
```

In this example, the number of call occurrences in `foo` is 4.

### Function Called in a Loop

```
#include<stdio.h>

void fillArraySize10(int *arr) {
    for(int i=0; i<10; i++)
        arr[i]=getVal();
}

int getVal(void) {
    int val;
    printf("Enter a value:");
    scanf("%d", &val);
    return val;
}
```

In this example, the number of call occurrences in `fillArraySize10` is 1.

### Recursive Function

```
#include <stdio.h>

void main() {
 int count;
 printf("How many numbers ?");
 scanf("%d",&count);
 fibonacci(count);
}

int fibonacci(int num)
{
   if ( num == 0 )
      return 0;
   else if ( num == 1 )
      return 1;
   else
      return ( fibonacci(num-1) + fibonacci(num-2) );
}
```

In this example, the number of call occurrences in `fibonacci` is 2.

## Metric Information

**Group**: Function
**Acronym**: `NCALLS`
**HIS Metric**: No

## See Also

`Number of Called Functions` | `Calculate code metrics (-code-metrics)`

# Number of Called Functions

Number of callees of a function

## Description

This metric specifies the number of callees of a function.

Calls through a function pointer are not counted. Calls in unreachable code and calls to standard library functions are counted. `assert` is considered as a macro and not a function, so it is not counted. For C++ templates, the first instantiation of the template is used to calculate this metric.

The recommended upper limit for this metric is 7. For more self-contained code, try to enforce an upper limit on this metric.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Same Function Called Multiple Times

```
int func1(void);
int func2(void);

int foo() {
    return (func1() + func1()*func1() + 2*func2());
}
```

In this example, the number of called functions in `foo` is 2. The called functions are `func1` and `func2`.

### Recursive Function

```
#include <stdio.h>
```

```
void main() {
 int count;
 printf("How many numbers ?");
 scanf("%d",&count);
 fibonacci(count);
}

int fibonacci(int num)
{
   if ( num == 0 )
      return 0;
   else if ( num == 1 )
      return 1;
   else
      return ( fibonacci(num-1) + fibonacci(num-2) );
}
```

In this example, the number of called functions in `fibonacci` is 1. The called function is `fibonacci` itself.

## Metric Information

**Group**: Function
**Acronym**: `CALLS`
**HIS Metric**: Yes

## See Also

`Number of Call Occurrences` | `Number of Calling Functions` | `Calculate code metrics (-code-metrics)`

# Number of Calling Functions

Number of distinct callers of a function

## Description

This metric measures the number of distinct callers of a function.

Calls through a function pointer are not counted. Calls in unreachable code are counted. Even if a caller calls a function more than once, it is counted only once when this metric is calculated. For C++ templates, the first instantiation of the template is used to calculate this metric.

The recommended upper limit for this metric is 5. For more self-contained code, try to enforce an upper limit on this metric.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Same Function Calling a Function Multiple Times

```
#include <stdio.h>

int getVal() {
    int myVal;
    printf("Enter a value:");
    scanf("%d", &myVal);
    return myVal;
}

int func() {
    int val=getVal();
    if(val<0)
        return 0;
    else
        return val;
}
```

```
int func2() {
    int val=getVal();
    while(val<0)
        val=getVal();
    return val;
}
```

In this example, the number of calling functions for `getVal` is 2. The calling functions are `func` and `func2`.

## Recursive Function

```
#include <stdio.h>

void main() {
 int count;
 printf("How many numbers ?");
 scanf("%d",&count);
 fibonacci(count);
}

int fibonacci(int num)
{
   if ( num == 0 )
      return 0;
   else if ( num == 1 )
      return 1;
   else
      return ( fibonacci(num-1) + fibonacci(num-2) );
}
```

In this example, the number of calling functions for `fibonacci` is 2. The calling functions are `main` and `fibonacci` itself.

# Metric Information

**Group**: Function
**Acronym**: `CALLING`
**HIS Metric**: Yes

## See Also

Number of Called Functions | Calculate code metrics (-code-metrics)

# Number of Direct Recursions

Number of instances of a function calling itself directly

## Description

This metric specifies the number of direct recursions in your project.

A direct recursion is a recursion where a function calls itself in its own body. If indirect recursions do not occur, the number of direct recursions is equal to the number of recursive functions.

The recommended upper limit for this metric is 0. To avoid the possibility of exceeding available stack space, do not use recursions in your code. To detect use of recursions, check for violations of `MISRA C:2012 Rule 17.2`.

## Examples

### Direct Recursion

```
int getVal(void);

void main() {
    int count = getVal(), total;
    assert(count > 0 && count <100);
    total = sum(count);
}

int sum(int val) {
    if(val<0)
        return 0;
    else
        return (val + sum(val-1));
}
```

In this example, the number of direct recursions is 1.

## Metric Information

**Group**: Project
**Acronym**: `AP_CG_DIRECT_CYCLE`
**HIS Metric**: Yes

## See Also

`MISRA C:2012 Rule 17.2` | `Calculate code metrics (-code-metrics)`

# Number of Executable Lines

Number of executable lines in function body

## Description

This metric measures the number of executable lines in a function body. When calculating the value of this metric, Polyspace excludes declarations without static initializers, comments, blank lines, braces or preprocessing directives.

If the function body contains a `#include` directive, the included file source code is also calculated as part of this metric.

This metric is not calculated for C++ templates.

## Examples

### Function with Declarations, Braces and Comments

```
void func(int);

int getSign(int arg) {
    int sign;
    if(arg<0) {
        sign=-1;
        func(-arg);
        /* func takes positive arguments */
    }
    else if(arg==0)
        sign=0;
    else {
        sign=1;
        func(arg);
    }
    return sign;
}
```

In this example, the number of executable lines of `getSign` is 9. The calculation excludes:

- The declaration `int sign;`.
- The comment `/* ... */`.
- The two lines with braces only.

## Metric Information

**Group**: Function
**Acronym**: `FXLN`
**HIS Metric**: No

## See Also

`Number of Lines Within Body` | `Number of Instructions` | `Calculate code metrics (-code-metrics)`

# Number of Files

Number of source files

## Description

This metric calculates the number of source files in your project.

## Metric Information

**Group**: Project<br>
**Acronym**: `FILES`<br>
**HIS Metric**: No

## See Also

`Number of Header Files` | `Calculate code metrics (-code-metrics)`

# Number of Function Parameters

Number of function arguments

## Description

This metric measures the number of function arguments.

If ellipsis is used to denote variable number of arguments, when calculating this metric, the ellipsis is not counted.

The recommended upper limit for this metric is 5. For less dependency between functions and fewer side effects, try to enforce an upper limit on this metric.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Function with Fixed Arguments

```
int initializeArray(int* arr, int size) {
}
```

In this example, `initializeArray` has two parameters.

### Function with Type Definition in Arguments

```
int getValueInLoc(struct {int* arr; int size;}myArray, int loc) {
}
```

In this example, `getValueInLoc` has two parameters.

### Function with Variable Arguments

```
double average ( int num, ... )
{
    va_list arg;
    double sum = 0;

    va_start ( arg, num );

    for ( int x = 0; x < num; x++ )
    {
        sum += va_arg ( arg, double );
    }
    va_end ( arg);

    return sum / num;
}
```

In this example, `average` has one parameter. The ellipsis denoting variable number of arguments is not counted.

## Metric Information

**Group**: Function
**Acronym**: `PARAM`
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Number of Goto Statements

Number of goto statements

## Description

This metric measures the number of goto statements in a function.

break and continue statements are not counted.

The recommended upper limit on this metric is 0. For better readability of your code, avoid goto statements in your code. To detect use of goto statements, check for violations of MISRA C:2012 Rule 15.1.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Function with goto Statements

```
#define SIZE 10
int initialize(int **arr, int loc);
void printString(char *);
void printErrorMessage(void);
void printExecutionMessage(void);

int main()
{
    int *arrayOfStrings[SIZE],len[SIZE],i;
    for ( i = 0; i < SIZE; i++ )
    {
        len[i] = initialize(arrayOfStrings,i);
    }

    for ( i = 0; i < SIZE; i++ )
    {
        if(len[i] == 0)
```

```
            goto emptyString;
        else
            goto nonEmptyString;
        loop: printExecutionMessage();
    }

emptyString:
    printErrorMessage();
    goto loop;
nonEmptyString:
    printString(arrayOfStrings[i]);
    goto loop;
}
```

In this example, the function `main` has 4 `goto` statements.

## Metric Information

**Group**: Function<br>
**Acronym**: `GOTO`<br>
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Number of Header Files

Number of included header files

## Description

This metric measures the number of header files in the project. Both directly and indirectly included header files are counted.

The metric gives a slightly higher number than the actual number of header files that you use because Polyspace® internal header files and header files included by those files are also counted. For the same reason, the metric can vary slightly even if you do not explicitly include new header files or remove inclusion of header files from your code. For instance, the number of Polyspace® internal header files can vary if you change your analysis options.

## Metric Information

**Group**: Project
**Acronym**: `INCLUDES`
**HIS Metric**: No

## See Also

`Number of Files` | `Calculate code metrics (-code-metrics)`

# Number of Instructions

Number of instructions per function

## Description

This metric measures the number of instructions in a function body.

The recommended upper limit for this metric is 50. For more modular code, try to enforce an upper limit for this metric.

To enforce limits on metrics, see “Review Code Metrics”.

### Computation Details

The metric is calculated using the following rules:

- A simple statement ending with a `;` is one instruction.

  If the statement is empty, it does not count as an instruction.
- A variable declaration counts as one instruction only if the variable is also initialized.
- Control flow statements such as `if`, `for`, `break`, `goto`, `return`, `switch`, `while`, `do-while` count as one instruction.
- The following do not count as instructions by themselves:

  - Beginning of a block of code

    For instance, the following counts as one instruction:

    ```
    {
        var = 1;
    }
    ```
  - Labels

    For instance, the following counts as two instructions. The `case` labels do not count as instructions.

```
 switch (1) {  // Instruction 1: switch
     case 0:
     case 1:
     case 2:
     default:
     break;    // Instruction 2: break
  }
```

# Examples

## Calculation of Number of Instructions

```
int func(int* arr, int size) {
    int i, countPos=0, countNeg=0, countZero = 0;
    for(i=0; i<size; i++) {
        if(arr[i] >0)
            countPos++;
        else if(arr[i] ==0)
            countZero++;
        else
            countNeg++;
    }
}
```

In this example, the number of instructions in `func` is 9. The instructions are:

1. `countPos=0`
2. `countNeg=0`
3. `countZero=0`
4. `for(i=0;i<size;i++) { ... }`
5. `if(arr[i] >=0)`
6. `countPos++`
7. `else if(arr[i]==0)`

   The ending `else` is counted as part of the `if-else` instruction.
8. `countZero++`
9. `countNeg++`

**Note** This metric is different from the number of executable lines. For instance:

- `for(i=0;i<size;i++)` has 1 instruction and 1 executable line.
- The following code has 1 instruction but 3 executable lines.

```
for(i=0;
    i<size;
    i++)
```

## Metric Information

**Group**: Function<br>
**Acronym**: `STMT`<br>
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Number of Lines

Total number of lines in a file

## Description

This metric calculates the number of lines in a file. When calculating the value of this metric, Polyspace includes comments and blank lines.

This metric is calculated for source files and header files in the same folders as source files. If you want:

- The metric reported for other header files, change the default value of the option `Generate results for sources and (-generate-results-for)`.
- The metric not reported for header files at all, change the value of the option `Do not generate results for (-do-not-generate-results-for)` to `all-headers`.

## Metric Information

**Group**: File
**Acronym**: `TOTAL_LINES`
**HIS Metric**: No

## See Also

`Number of Lines Without Comment` | `Calculate code metrics (-code-metrics)`

# Number of Lines Within Body

Number of lines in function body

## Description

This metric calculates the number of lines in function body. When calculating the value of this metric, Polyspace includes declarations, comments, blank lines, braces and preprocessing directives.

If the function body contains a `#include` directive, the included file source code is also calculated as part of this metric.

This metric is not calculated for C++ templates.

## Examples

### Function with Declarations, Braces and Comments

```
void func(int);

int getSign(int arg) {
    int sign;
    if(arg<0) {
        sign=-1;
        func(-arg);
        /* func takes positive arguments */
    }
    else if(arg==0)
        sign=0;
    else {
        sign=1;
        func(arg);
    }
    return sign;
}
```

In this example, the number of executable lines of `getSign` is 13. The calculation includes:

- The declaration `int sign;`.
- The comment `/* ... */`.
- The two lines with braces only.

## Metric Information

**Group**: Function
**Acronym**: `FLIN`
**HIS Metric**: No

## See Also

`Number of Executable Lines` | `Calculate code metrics (-code-metrics)`

# Number of Lines Without Comment

Number of lines of code excluding comments

## Description

This metric calculates the number of lines in a file. When calculating the value of this metric, Polyspace excludes comments and blank lines.

This metric is calculated for source files and header files in the same folders as source files. If you want:

- The metric reported for other header files, change the default value of the option `Generate results for sources and (-generate-results-for)`.
- The metric not reported for header files at all, change the value of the option `Do not generate results for (-do-not-generate-results-for)` to `all-headers`.

## Metric Information

**Group**: File
**Acronym**: `LINES_WITHOUT_CMT`
**HIS Metric**: No

## See Also

`Number of Lines` | `Calculate code metrics (-code-metrics)`

# Number of Local Non-Static Variables

Total number of local variables in function

## Description

This metric provides the number of local variables in a function.

The metric excludes static variables. To find number of static variables, use the metric `Number of Local Static Variables`.

## Examples

### Non-Structured Variables

```
int flag();

int func(int param) {
  int var_1;
  int var_2;
  if (flag()) {
      int var_3;
      int var_4;
    } else {
      int var_5;
    }
}
```

In this example, the number of local non-static variables in `func` is 5. The number does not include the function arguments and return value.

### Arrays and Structured Variables

```
typedef struct myStruct{
   char  arr1[50];
   char  arr2[50];
   int   val;
} myStruct;

void func(void) {
  myStruct var;
  char localArr[50];
}
```

In this example, the number of local non-static variables in `func` is 2: the structured variable `var` and the array `localArr`.

### Variables in Class Methods

```
class Rectangle {
    int width, height;
  public:
    void set (int,int);
    int area (void);
} rect;

int Rectangle::area (void) {
    int temp;
    temp = width * height;
    return(temp);
}
```

In this example, the number of local non-static variables in `Rectangle::area` is 1: the variable `temp`.

## Metric Information

**Group:** Function<br>
**Acronym:** `LOCAL_VARS`<br>
**HIS Metric**: No

## See Also

`Number of Local Static Variables` | `Higher Estimate of Local Variable Size` | `Lower Estimate of Local Variable Size` | `Calculate code metrics (-code-metrics)`

Introduced in R2017a

# Number of Local Static Variables

Total number of local static variables in function

## Description

This metric provides the number of local static variables in a function.

## Examples

### Number of Static Variables

```
void func(void) {
  static int var_1 = 0;
  int var_2;
}
```

In this example, the number of static variables in `func` is 1. For examples of different types of variables, see `Number of Local Non-Static Variables`.

## Metric Information

**Group:** Function
**Acronym:** `LOCAL_STATIC_VARS`
**HIS Metric**: No

## See Also

`Higher Estimate of Local Variable Size` | `Number of Local Non-Static Variables` | `Calculate code metrics (-code-metrics)`

Introduced in R2017a

# Number of Paths

Estimated static path count

## Description

This metric measures the number of paths in a function.

If `goto` statements are present in your code, Polyspace cannot calculate the number of paths. The software displays a metric value of -1.

The recommended upper limit for this metric is 80. If the number of paths is high, the code is difficult to read and can cause more orange checks. Try to limit the value of this metric.

To enforce limits on metrics, see “Review Code Metrics”.

### Computation Details

The number of paths is calculated according to these rules:

- If the statements in a function do not break the control flow, the number of paths is one.

  Even an empty statement such as `;` or empty block such as `{}` counts as one path.
- The number of paths for a control flow statement is calculated as follows:

  - `if-else if-else`: The number of paths is the sum of paths calculated in the `if` block, each `else if` block, and the concluding `else` block. When the concluding `else` block is omitted, the path count is increased by 1.

    For instance, the statement `if(..) {} else if(..) {} else {}` counts as three paths. The statement `if() {}` counts as two paths, one for the `if` block and one for the omitted `else` block.
  - `switch-case`: Every `case` with `break` statement adds one to the path count. The `default` statement counts as one path, even if it is omitted.

  For instance, the statement `switch (var) { case 1: .. break; case 2: .. break; default: .. }` counts as three paths.

  - `for`, `while`, and `do-while`: The number of paths is equal to the number of paths in the loop body + 1.

    For instance, the statement `while(0) {;}` counts as two paths.

- If more than one control flow statement are present in a sequence, the number of paths is the product of the path count for each control flow statement.

  For instance, if a function has three `for` loops and two `if-else` statements, the number of paths is 2 × 2 × 2 × 2 × 2 = 32.

  If many control flow statements are present in a function, the number of paths can be large. Nested control flow statements reduce the number of paths at the cost of increasing the depth of nesting. For an example, see “Function with Nested Control Flow Statements” on page 7-58.

# Examples

## Function with One Path

```
void func(int ch) {
    switch (ch)
    {
    case 1:
    case 2:
    case 3:
    case 4:
    default:
    }
}
```

In this example, `func` has one path.

## Function with Control Flow Statement Causing Multiple Paths

```
void func(int ch) {
    switch (ch)
    {
```

```
    case 1:
        break;
    case 2:
        break;
    case 3:
        break;
    case 4:
        break;
    default:
    }
}
```

In this example, `func` has five paths. Apart from the path that goes through the `cases` and `default`, each `break` causes the creation of a new path.

## Function with Nested Control Flow Statements

```
void func()
{
    int i = 0, j = 0, k = 0;
    for (i=0; i<10; i++)
    {
        for (j=0; j<10; j++)
        {
            for (k=0; k<10; k++)
            {
                if (i < 2 )
                    ;
                else
                {
                    if (i > 5)
                        ;
                    else
                        ;
                }
            }
        }
    }
}
```

In this example, `func` has six paths. The number is calculated as follows:

- The innermost `if-else` block counts as two paths.

- The outer `if-else` block counts as three paths, one path for the `if` block and the previous two paths for the `else` block.
- The innermost `for` loop counts as four paths, one path for the loop and the previous three paths for the `if-else` blocks.
- The next two outer loops add one path each.

Therefore, the number of paths in `func` is six.

## Metric Information

**Group**: Function
**Acronym**: `PATH`
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

# Number of Return Statements

Number of `return` statements in a function

## Description

This metric measures the number of `return` statements in a function.

The recommended upper limit for this metric is 1. If one return statement is present, when reading the code, you can easily identify what the function returns.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Function with Return Points

```
int getSign (int arg) {
    if(arg <0)
        return -1;
    else if(arg > 0)
        return 1;
    return 0;
}
```

In this example, `getSign` has 3 `return` statements.

## Metric Information

**Group**: Function
**Acronym**: `RETURN`
**HIS Metric**: Yes

## See Also

`Calculate code metrics (-code-metrics)`

## Topics

“Review Code Metrics” (Polyspace Code Prover)
“Compare Metrics Against Software Quality Objectives” (Polyspace Code Prover)

# Number of Recursions

Number of call graph cycles over one or more functions

## Description

This metric specifies the number of recursions in your project. Even if more than one function is involved in one recursive cycle, the number of recursions is counted as one.

Calls through a function pointer are not considered.

The recommended upper limit for this metric is 0. To avoid the possibility of exceeding available stack space, do not use recursions in your code. To detect use of recursions, check for violations of `MISRA C:2012 Rule 17.2`.

To enforce limits on metrics, see “Review Code Metrics”.

## Examples

### Direct Recursion

```
int getVal(void);

void main() {
    int count = getVal(), total;
    assert(count > 0 && count <100);
    total = sum(count);
}

int sum(int val) {
    if(val<0)
        return 0;
    else
        return (val + sum(val-1));
}
```

In this example, the number of recursions is 1.

A direct recursion is a recursion where a function calls itself in its own body. For direct recursions, the number of recursions is equal to the number of recursive functions.

## Indirect Recursion with One Call Graph Cycle

```
volatile int signal;

void operation1() {
    int stop = signal%2;
    if(!stop)
        operation2();
}

void operation2() {
    operation1();
}

void main() {
    operation1();
}
```

In this example, the number of recursions is 1. Although two functions `operation1` and `operation2` indirectly call themselves, they are involved in the same call graph cycle `operation1` → `operation2` → `operation1`.

An indirect function is a recursion where a function calls itself through other functions. For indirect recursions, the number of recursions can be different from the number of recursive functions.

## Indirect Recursion with Two Call Graph Cycles

```
volatile int signal;

void operation1() {
    int stop = signal%3;
    if(stop==1)
        operation2();
    else if(stop==2)
        operation3();
}

void operation2() {
    operation1();
}

void operation3() {
    operation3();
}

void main() {
    operation1();
}
```

In this example, the number of recursions is 2.

There are two call graph cycles:

- operation1 → operation2 → operation1
- operation1 → operation3 → operation1

## Same Function Called in Direct and Indirect Recursion

```
volatile int signal;

void operation1() {
    int stop = signal%3;
    if(stop==1)
        operation1();
    else if(stop==2)
        operation2();
}

void operation2() {
    operation1();
}

void main() {
    operation1();
}
```

In this example, the number of call graph cycles is 1.

If the same function calls itself both directly and indirectly, the two cycles are counted as 1.

## Metric Information

**Group**: Project
**Acronym**: `AP_CG_CYCLE`
**HIS Metric**: Yes

## See Also

`MISRA C:2012 Rule 17.2` | `Calculate code metrics (-code-metrics)`

# Polyspace Report Components — Alphabetical List

# Acronym Definitions

Create table of Polyspace acronyms used in report and their full forms

## Description

This component creates a table containing the acronyms used in the report and their full forms. Aronyms are used for Polyspace Code Prover checks and Polyspace result status.

## See Also

### Topics

"Customize Existing Report Template"

# Call Hierarchy

Create table showing call graph in source code

## Description

This component creates a table showing the call hierarchy in your source code. For each function call in your source code, the table displays the following information:

- Level of call hierarchy, where the function is called.

  Each level is denoted by `|`. If a function call appears in the table as `|||-> *file_name.function_name*`, the function call occurs at the third level of the hierarchy. Beginning from `main` or an entry point, there are three function calls leading to the current call.
- File containing the function call.

  In addition, the line and column is also displayed.
- File containing the function definition.

  In addition, the line and column where the function definition begins is also displayed.

In addition, the table also displays uncalled functions.

This table captures the information available on the **Call Hierarchy** pane in the Polyspace user interface.

## See Also

### Topics

"Customize Existing Report Template"

# Code and Verification Information

Create table of verification times and code characteristics

## Description

This component creates tables containing verification times and code characteristics such as number of lines.

## Properties

### Include Verification Time Information

If you select this option, the report contains verification times broken down by phase.

- For Polyspace Bug Finder, the phases are `compilation`, `pass0`, `pass1`, etc.
- For Polyspace Code Prover, the phases are `compilation`, `global`, `function`, etc.

### Include Code Details

If you select this option, the report contains the following code characteristics:

- Number of files
- Number of lines
- Number of lines without comment

## See Also

### Topics

"Customize Existing Report Template"

# Code Metrics Details

Create table of Polyspace metrics broken down by file and function

## Description

This component creates a table containing metrics from a Polyspace project. The metrics appear broken down by file and function.

## Properties

### Project Metrics

If you select this option, the report contains the following metrics about the project:

- Number of direct recursions
- Number of files
- Number of headers
- Number of protected and unprotected shared variables

### File Metrics

If you select this option, the report contains the following metrics about each file in the project:

- Estimated function coupling
- Lines without comment
- Comment density
- Total lines

### Function Metrics

If you select this option, the report contains the following metrics about each function in the project:

- Cyclomatic complexity
- Language scope
- Lower and higher estimates of local variable size
- Number of lines within body
- Number of executable lines
- Number of `goto` statements
- Number of call levels
- Number of called functions
- Number of call occurrences
- Number of function parameters
- Number of paths
- Number of `return` statements
- Number of instructions
- Number of calling functions

## See Also

### Topics

"Customize Existing Report Template"

# Code Metrics Summary

Create table of Polyspace metrics

## Description

This component creates a table containing metrics from a Polyspace project. The metrics are the same as those displayed under `Code Metrics Details`. However, the file and function metrics are not broken down by individual files and functions. Instead, the table provides the minimum and maximum value of a file metric over all files and a function metric over all functions.

## See Also

### Topics

"Customize Existing Report Template"

# Code Verification Summary

Create table of Polyspace analysis results

## Description

This component creates tables containing the following results:

- Number of results
- Number of coding rule violations for each coding rule type such as MISRA C
- Number of defects, for Polyspace Bug Finder results
- Number of checks of each color, for Polyspace Code Prover results
- Whether the project passed or failed the software quality objective

## Properties

### Include Checks from Polyspace Standard Library Stub Functions

Unless you deselect this option, the tables contain Polyspace Code Prover checks that appear in Polyspace stubs for the standard library functions.

## See Also

### Topics

“Customize Existing Report Template”

# Coding Rules Details

Create table of coding rule violations broken down by file

## Description

This component creates tables containing coding rule violations broken down by each file in the Polyspace project. For each rule violation, the table contains the following information:

- Rule number
- Rule description
- Function containing the violation
- Line and column number
- Review information such as classification, status and comments

## Properties

### Select Coding Rules Type

Using this option, you can choose which coding rule violations to display. You can display violations for the following set of coding rules:

- MISRA C rules
- MISRA AC AGC rules
- MISRA C++ rules
- JSF C++ rules
- Custom coding rules

### Display by

Using this option, you can break down the display of coding rule violations by file.

## See Also

### Topics

“Customize Existing Report Template”

# Coding Rules Summary

Create table with number of coding rule violations

## Description

This component creates a table containing the number of coding rule violations. You can choose whether to break this information down by rule number or file.

## Properties

### Select Coding Rules Type

Using this option, you can choose which coding rule violations to display. You can display violations for the following set of coding rules:

- MISRA C rules
- MISRA AC AGC rules
- MISRA C++ rules
- JSF C++ rules
- Custom coding rules

### Include Files/Rules with No Problems Detected

If you select this option, the table displays:

- Files that do not contain coding rule violations
- Rules that your code does not violate

### Display by

Using this option, you can break down the display of coding rule violations by:

- Rule number
- File

# See Also

## Topics

"Customize Existing Report Template"

# Configuration Parameters

Create table of analysis options, assumptions and coding rules configuration

## Description

This component creates the following tables:

- *Polyspace settings*: The analysis options that you used to obtain your results. The table lists command-line version of the options along with their values.
- *Analysis assumptions*: The assumptions used to obtain your Code Prover results. The table lists only the modifiable assumptions. For assumptions that you cannot change, see the Polyspace documentation.
- *Coding rules configuration*: The coding rules whose violations you checked for. The table lists the rule number, rule description and other information about the rules.
- *Files with compilation errors*: If your project has source files with compilation errors, these files are listed.

## See Also

### Topics

"Customize Existing Report Template"

# Defects Summary

Create table of Polyspace Bug Finder defects

## Description

This component creates a table of Polyspace Bug Finder defects. From this table, you can see the number of defects of each type.

## Properties

### Include Checkers with No Defects Detected

If you select this option, the table includes all defect types that Polyspace Bug Finder can detect, including those that do not occur in your code.

## See Also

### Topics

"Customize Existing Report Template"

# Global Variable Checks

Create table of Polyspace Code Prover global variables

## Description

This component creates a table of Polyspace Code Prover global variables. From this table, you can see the number of global variables of each type.

## See Also

### Topics

"Customize Existing Report Template"

# Recursive Functions

Create table of recursive functions

## Description

This component creates a table containing the recursive functions in your source code. For each recursive function, the table lists its immediate caller.

## See Also

### Topics

"Customize Existing Report Template"

# Report Customization (Filtering)

Create filters that apply to your Polyspace reports

## Description

This component allows you to filter unwanted information from existing Polyspace report templates. To apply global filters, place this component immediately below the node representing the report name.

## Properties

### Code Metrics Filters

The properties in table below apply to the inclusion of code metrics in your report.

| Property | Purpose | User Action |
|---|---|---|
| **Include Project Metrics** | Choose whether to include metrics about your Polyspace project. | Select the check box to include project metrics. |
| **Project metrics to include** | Specify project metrics to include or exclude from report. | Enter a regular MATLAB expression. |
| **Include File Metrics** | Choose whether to include per file metrics in report. | Select the check box to include per file metrics. |
| **File Metrics > Files to include** | Specify files to include or exclude when reporting file metrics. | Enter a regular MATLAB expression. |
| **File metrics to include** | Specify file metrics to include or exclude from report. | Enter a regular MATLAB expression. |

| Property | Purpose | User Action |
|---|---|---|
| **Include Function Metrics** | Choose whether to include per function metrics in report. | Select the check box to include per function metrics. |
| **Function Metrics > Files to include** | Specify files to include or exclude when reporting function metrics. | Enter a regular MATLAB expression. |
| **Functions to include** | Specify functions to include or exclude when reporting function metrics. | Enter a regular MATLAB expression. |
| **Function metrics to include** | Specify function metrics to include or exclude from report. | Enter a regular MATLAB expression. |

## Coding Rules Filters

The properties in table below apply to the inclusion of coding rule violations in your report.

| Property | Purpose | User Action |
|---|---|---|
| **Files to include** | Specify files to include or exclude when reporting coding rule violations. | Enter a regular MATLAB expression. |
| **Coding rule numbers to include** | Specify coding rules to include or exclude when reporting coding rule violations. | Enter a regular MATLAB expression. |
| **Classifications to include** | Specify classifications to include or exclude when reporting coding rule violations. | Enter a regular MATLAB expression. |
| **Status types to include** | Specify statuses to include or exclude when reporting coding rule violations. | Enter a regular MATLAB expression. |

## Run-time Check Filters

The properties in table below apply to the inclusion of Polyspace Code Prover checks in your report.

| Property | Purpose |
|---|---|
| **Red Checks** | Specify whether to include red checks in your report. Red checks indicate proven run-time errors. |
| **Gray Checks** | Specify whether to include gray checks in your report. Gray checks indicate unreachable code. |
| **Orange Checks** | Specify whether to include orange checks in your report. Orange checks indicate possible run-time errors. |
| **Green Checks** | Specify whether to include green checks in your report. Green checks indicate that an operation does not contain a specific run-time error. |
| **Inspection Point Checks** | Specify whether to include inspection point checks in your report. These checks allow an user to find the values that a variable can take at a certain point in the code. |
| **Unreachable Functions** | Specify whether to include unreachable functions in your report. |

## Advanced Filters

The properties in table below apply to the inclusion of metrics, coding rule violations and Polyspace Code Prover checks in your report.

| Property | Purpose | User Action |
|---|---|---|
| **Justification status** | Choose whether to report only justified checks, only unjustified checks or all checks. | Choose an option from the dropdown list. |

| Property | Purpose | User Action |
|---|---|---|
| **Files to include** | Specify files to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Check types to include** | Specify Polyspace Code Prover checks to include in your report. | Enter a regular MATLAB expression. |
| **Function names to include** | Specify functions to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Classification types to include** | Specify classifications to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Status types to include** | Specify statuses to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Comments to include** | Specify comments to include or exclude from your report. | Enter a regular MATLAB expression. |

## See Also

### Topics

"Customize Existing Report Template"
"Regular Expressions" (MATLAB)

# Run-time Checks Details Ordered by Color/File

Create overrides for global filters in Polyspace reports

## Description

This component adds detailed information about the run-time checks to your report. This component can also be used to override global filters in specific chapters of your report. Use the following workflow when using filters in your report:

1. To create filters that apply to all chapters of your report, use the **Report Customization (Filtering)** component. For more information, see `Report Customization (Filtering)`.
2. To override some of the filters in individual chapters, use the **Run-time Checks Details Ordered by Color/File** component. Select the **Override Global Report filter** box.

## Properties

### Categories To Include

The properties in table below apply to the inclusion of Polyspace Code Prover checks in your report.

| Property | Purpose |
|---|---|
| **Red Checks** | Specify whether to include red checks in your report. Red checks indicate proven run-time errors. |
| **Gray Checks** | Specify whether to include gray checks in your report. Gray checks indicate unreachable code. |
| **Orange Checks** | Specify whether to include orange checks in your report. Orange checks indicate possible run-time errors. |

| Property | Purpose |
|---|---|
| **Green Checks** | Specify whether to include green checks in your report. Green checks indicate that an operation does not contain a specific run-time error. |
| **Inspection Point Checks** | Specify whether to include inspection point checks in your report. These checks allow an user to find the values that a variable can take at a certain point in the code. |
| **Unreachable Functions** | Specify whether to include unreachable functions in your report. |

## Advanced Filters

The properties in table below apply to the inclusion of metrics, coding rule violations and Polyspace Code Prover checks in your report.

| Property | Purpose | User Action |
|---|---|---|
| **Justification status** | Choose whether to report only justified checks, only unjustified checks or all checks. | Choose an option from the dropdown list. |
| **Files to include** | Specify files to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Check types to include** | Specify Polyspace Code Prover checks to include in your report. | Enter a regular MATLAB expression. |
| **Function names to include** | Specify functions to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Classification types to include** | Specify classifications to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Status types to include** | Specify statuses to include or exclude from your report. | Enter a regular MATLAB expression. |
| **Comments to include** | Specify comments to include or exclude from your report. | Enter a regular MATLAB expression. |

## See Also

### Topics

"Customize Existing Report Template"

# Run-time Checks Details Ordered by Review Information

Create table with Polyspace Code Prover checks ordered by review information

## Description

This component creates tables displaying the Polyspace Code Prover checks in your code. All checks with same combination of **Severity** and **Status** appear in the same table.

## See Also

### Topics

"Customize Existing Report Template"

# Run-time Checks Summary Ordered by File

Create table with Polyspace Code Prover checks ordered by file

## Description

This component creates a table displaying the number of Polyspace Code Prover checks per file in your code.

## Properties

### Sort the data

Use this option to sort the rows in the table alphabetically by filename or by percentage of unproven code.

### Display as

Use this option to display the number of checks in a table or in bar charts.

### Display ratio of checks in a file

Select this option to display the number of checks of a certain color as a ratio of total number of checks in the file.

### Include checks from Polyspace standard library stub functions

Select this option to include the checks from Polyspace standard library stub functions in your display.

## See Also

### Topics

"Customize Existing Report Template"

# Software Quality Objectives - Coding Rules Summary

Create table of coding rule violations in results downloaded from Polyspace Metrics

## Description

This component creates a table containing coding rule violations in results downloaded from Polyspace Metrics.

## See Also

### Topics

"Customize Existing Report Template"

# Software Quality Objectives - Run-time Checks Details

Create table of run-time check distribution in results downloaded from Polyspace Metrics

## Description

This component creates tables showing run-time checks in results downloaded from Polyspace Metrics.

The component `Software Quality Objectives - Run-time Checks Summary` shows the distribution of run-time checks. This component shows individual instances of run-time checks. Each file has a dedicated table showing the run-time checks in the file.

## See Also

### Topics

"Customize Existing Report Template"

# Software Quality Objectives - Run-time Checks Summary

Create table of run-time check distribution in results downloaded from Polyspace Metrics

## Description

This component creates a table showing the distribution of run-time checks in results downloaded from Polyspace Metrics.

This component shows the distribution of run-time checks. The component `Software Quality Objectives - Run-time Checks Details` shows the individual instances of run-time checks.

## See Also

### Topics

"Customize Existing Report Template"

# Summary By File

Create table showing summary of Polyspace results by file

## Description

This component creates a table showing a breakdown of Polyspace results by file.

## See Also

### Topics

"Customize Existing Report Template"

# Variable Access

Create table showing global variable access in source code

## Description

This component creates a table showing the global variable access in your source code. For each global variable, the table displays the following information:

- Variable name.

  The entry for each variable is denoted by `|`.
- Type of the variable.
- Number of read and write operations on the variable.
- Details of read and write operations. For each read or write operation, the table displays the following information:

  - File and function containing the operation in the form *`file_name.function_name`*.

    The entry for each read or write operation is denoted by `||`. Write operations are denoted by < and read operations by >.
  - Line and column number of the operation.

This table captures the information available on the **Variable Access** pane in the Polyspace user interface.

## See Also

### Topics

"Customize Existing Report Template"

# Variable Checks Details Ordered By Review Information

Create table with Polyspace Code Prover global variable results ordered by review information

## Description

This component creates tables displaying the Polyspace Code Prover global variable results in your code. All checks with same combination of **Severity** and **Status** appear in the same table.

## See Also

### Topics

"Customize Existing Report Template"

# Configuration Parameters

# Product mode

Select type of Polyspace code analysis to run.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `Code Prover`

`Code Prover`

Run a Polyspace Code Prover verification.

`Bug Finder`

Run a Polyspace Bug Finder analysis.

## Dependency

You see only the products for which you have a license. If you do not have a Polyspace Code Prover license, the default product mode is `Bug Finder`.

## Command-Line Information

Use the `pslinkoptions` property `VerificationMode`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Run Analysis for Embedded Coder"

# Settings from (C)

Select settings for the analysis configuration. You can quickly activate coding rules checking for generated C code

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `Project configuration`

`Project configuration`

Run Polyspace with the options specified in the "Project configuration" on page 9-8 or "Use custom project file" on page 9-7.

You do not check coding rules unless you select a rule set in the configuration.

`Project configuration and MISRA AC AGC checking`

Run Polyspace with the options specified in the **Project configuration** plus MISRA AC-AGC obligatory and recommended rules.

`Project configuration and MISRA C 2004 checking`

Run Polyspace with the options specified in the **Project configuration** plus all MISRA C 2004 rules.

`Project configuration and MISRA C 2012 checking`

Run Polyspace with the options specified in the **Project configuration** plus all MISRA C 2012 rules. This option automatically applies the rule categories for generated code. See `Use generated code requirements (-misra3-agc-mode)`.

`MISRA AC AGC checking`

Check compliance with the MISRA AC-AGC obligatory and recommended rules. After rules checking, Polyspace stops.

`MISRA C 2004 checking`

Check compliance with all MISRA C 2004 rules. After rules checking, Polyspace stops.

`MISRA C 2012 checking`

Check compliance with all MISRA C 2012 rules. This option automatically applies the rule categories for generated code. See `Use generated code requirements (-misra3-agc-mode)`. After rules checking, Polyspace stops.

## Dependency

This setting overrides custom configuration settings in “Project configuration” on page 9-8 and “Use custom project file” on page 9-7. If you want to use your custom coding rule settings, select the `Project configuration` option.

## Command-Line Information

Use the `pslinkoptions` property `VerificationSettings`.

# See Also

pslinkoptions | `pslinkoptions`

## Related Examples

- “Specify Type of Analysis to Perform”

# Settings from (C++)

Select settings for the analysis configuration. This option allows you to quickly activate coding rules checking for generated C++ code.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `Project configuration`

`Project configuration`

Run Polyspace with the options specified in the “Project configuration” on page 9-8 or “Use custom project file” on page 9-7.

You do not check coding rules unless you select a rule set in the configuration.

`Project configuration and MISRA C++ checking`

Run Polyspace with the options specified in the **Project configuration** plus MISRA C++ required rules.

`Project configuration and JSF C++ checking`

Run Polyspace with the options specified in the **Project configuration** plus JSF C++ shall rules.

`MISRA C++ checking`

Check compliance with the MISRA C++: 2008 required rules. After rules checking, Polyspace stops.

`JSF C++ checking`

Check compliance with the JSF C++ shall rules. After rules checking, Polyspace stops.

## Dependency

This setting overrides custom configuration settings in “Project configuration” on page 9-8 and “Use custom project file” on page 9-7. If you want to use your custom coding rule settings, select the `Project configuration` option.

### Command-Line Information

Use the `pslinkoptions` property `CxxVerificationSettings`.

## See Also

`pslinkoptions` | pslinkoptions

### Related Examples

- “Specify Type of Analysis to Perform”

# Use custom project file

Set Polyspace configuration options with a custom `.psprj` file

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** Off □

Off □

Analysis uses configuration options from **Project configuration** on page 9-8 parameters.

On ☑

Analysis uses configuration options from the specified `.psprj` project file.

## Dependency

The **Settings from** parameter overrides custom configuration settings for coding rules. If you want to use your custom coding rule settings, set **Settings from** > **Project configuration**.

## Command-Line Information

Use the `pslinkoptions` properties `EnablePrjConfigFile` and `PrjConfigFile`. For details, see pslinkoptionspslinkoptions.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- “Configure Advanced Polyspace Analysis Options”

# Project configuration

Set advanced configuration options to customize the analysis.

## Settings

Open the Polyspace Configuration window by using the **Configure** button. Customize additional settings in this window and save your project configuration. If you added a custom project file in the parameter “Use custom project file” on page 9-7, that project file configuration is shown. Otherwise, the default project template is used.

For details about the advanced options, see “Analysis Options”.

## Dependency

The **Settings from** parameter overrides custom configuration settings for coding rules. If you want to use your custom coding rule settings, set **Settings from** > **Project configuration**.

## Command-Line Information

Use `polyspace.ModelLinkBugFinderOptions` with the `pslinkoptions` properties `EnablePrjConfigFile` and `PrjConfigFile`.

# See Also

`polyspace.ModelLinkBugFinderOptions` | `pslinkoptions` | pslinkoptions

## Related Examples

- “Configure Advanced Polyspace Analysis Options”

## More About

- “Analysis Options”

# Enable additional file list

Add additional supporting code files to the analysis.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** Off □

Off □

The analysis includes no additional files.

On ☑

Polyspace analyzes the specified C/C++ files with the generated code. Use the **Select files** button to specify these additional files.

## Command-Line Information

Use the `pslinkoptions` properties `EnableAdditionalFileList` and `AdditionalFileList`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Include Handwritten Code"

# Stub lookup tables

Specify that the verification must stub auto-generated functions that use certain kinds of lookup tables in their body. The lookup tables in these functions use linear interpolation and do not allow extrapolation. That is, the result of using the lookup table always lies between the lower and upper bounds of the table.

If you use this option, the verification is more precise and has fewer orange checks. The verification of lookup table functions is usually imprecise. The software has to make certain assumptions about these functions. To avoid missing a run-time error, the verification assumes that the result of using the lookup table is within the full range allowed by the result data type. This assumption can cause many unproven results (orange checks) when a lookup table function is called. By using this option, you narrow down the assumption. For functions using lookup tables with linear interpolation and no extrapolation, the result is at least within the bounds of the table.

The option is relevant only if your model uses Lookup Table blocks.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** On ☑

On ☑

For autogenerated functions that use lookup tables with linear interpolation and no extrapolation, the verification:

- Does not check for run-time errors in the function body.
- Calls a function stub instead of the actual function at the function call sites. The stub ensures that the result of using the lookup table is within the bounds of the table.

To identify if the lookup table in the function uses linear interpolation and no extrapolation, the verification uses information provided by the code generation product. For instance, if you use Embedded Coder to generate code, the lookup table functions with linear interpolation and no extrapolation follow specific naming conventions.

Off □

The verification does not stub autogenerated functions that use lookup tables.

## Tips

- The option applies only to autogenerated functions. If you integrate your own C/C++ S-Function using lookup tables with the model, the option does not cause them to be stubbed.
- The option is on by default. For certification purposes, if you want your verification tool to be independent of the code generation tool, turn off the option.

## Command-Line Information

Use the `pslinkoptions` property `AutoStubLUT`.

# See Also

`pslinkoptions` | pslinkoptions

# Input

Choose whether to constrain input block variables.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `Use specified minimum and maximum values`

`Use specified minimum and maximum values`

Analysis assumes minimum and maximum values for input variables. These values are specified in the input block dialog box. Use this value to reduce the number of false positive results.

`Unbounded inputs`

Analysis assumes full range for input variables. Use this value to run a robust analysis that includes values outside the expected range.

## Command-Line Information

Use the `pslinkoptions` property `InputRangeMode`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Specify Signal Ranges"

# Tunable parameters

Choose how to treat tunable parameter values during the analysis. Treat values as either constants or a range of values.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `Use calibration data`

`Use calibration data`

Analysis assumes constant values for tunable parameters. Use this value to run a contextual analysis. This option can reduce the number of false positive results.

`Use specified minimum and maximum values`

Analysis assumes a range of values for the tunable parameter variables. Specify maximum and minimum values in the model. Use this option to run a robust analysis that includes values outside the expected parameter value.

## Command-Line Information

Use the `pslinkoptions` property `ParamRangeMode`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Specify Signal Ranges"

# Output

Choose whether to verify output values.

Code Prover option only. Bug Finder cannot check output values.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `No verification`

`No verification`

Polyspace does not verify output values.

`Verify outputs are within minimum and maximum values`

Polyspace checks to see if the output variable values are within the expected minimum and maximum values. Specify the minimum and maximum values in the output block dialog boxes.

## Command-Line Information

Use the `pslinkoptions` property `OutputRangeMode`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- “Specify Signal Ranges”

# Model reference verification depth

Only for models that use Embedded Coder generated code. Indicate how deep into the model hierarchy to analyze.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `Current model only`

`Current model only`

Polyspace analyzes only the current model

`1`

Polyspace analyzes the current model and the referenced models that are one level below the current model.

`2`

Polyspace analyzes the current model and the referenced models that are up to two levels below the current model.

`3`

Polyspace analyzes the current model and the referenced models that are up to three levels below the current model.

`All`

Polyspace analyzes the current model and all referenced models.

## Command-Line Information

Use the `pslinkoptions` property `ModelRefVerifDepth`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Configure Analysis Depth for Referenced Models"

# Model by model verification

Only for models that use Embedded Coder generated code. Analyze each model or referenced model individually. If you have a large project, this option can help modularize your analysis .

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** Off □

Off □

Polyspace analyzes your models together. Model interactions are analyzed.

On ☑

Polyspace analyzes your model and each of its referenced models in isolation. This option does not analyze model interactions.

## Command-Line Information

Use the `pslinkoptions` property `ModelRefByModelRefVerif`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Configure Analysis Depth for Referenced Models"

# Output folder

Specify the location and folder name for your analysis results.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `results_$ModelName$`

Enter a path for your results folder. If you do not use a full path, the results folder is relative to your current MATLAB folder.

If you select “Add results to current Simulink project” on page 9-20, the results folder is relative to the Simulink project folder.

By default, the software stores your results in *`Current Folder`* `\results_`*`model_name`*.

## Command-Line Information

Use the `pslinkoptions` property `ResultDir`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- “Manage Results”

# Make output folder name unique by adding a suffix

Add a unique suffix to the results folder for every run to avoid overwriting previous results.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** Off □

Off □

Every time you rerun your analysis, your results are overwritten.

On ☑

For each run of the analysis, Polyspace specifies a new location for the results folder by appending a unique number to the folder name.

## Command-Line Information

Use the `pslinkoptions` property `AddSuffixToResultDir`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Manage Results"

# Add results to current Simulink project

Add your Polyspace results to the current Simulink project. To use this option, you must have a Simulink project open.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** Off □

Off □

Results are saved to the current folder.

On ☑

Results are saved to the currently open Simulink project.

## Dependencies

You must have a Simulink project open to use this option.

## Command-Line Information

Use the `pslinkoptions` property `AddToSimulinkProject`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- “Manage Results”

# Open results automatically after verification

Decide whether to open your results in the Polyspace interface after running analysis from Simulink.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** On ☑

On ☑

After you run an analysis, your results open automatically in the Polyspace interface.

Off □

You must manually open your results after running an analysis.

## Command-Line Information

Use the `pslinkoptions` property `OpenProjectManager`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Manage Results"

# Check configuration before verification

Check whether model and code configurations are optimal for code analysis.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** `On (proceed with warnings)`

`On (proceed with warnings)`

The process stops for errors, but continues the code analysis if the configuration has only warnings.

`On (stop for warnings)`

If the configuration has errors or warnings, the process stops.

`Off`

The software does not check the configuration.

## Command-Line Information

Use the `pslinkoptions` property `CheckConfigBeforeAnalysis`. For details, see pslinkoptions.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Check Simulink Model Settings"

# Verify all occurrences

For S-Function analyses only. Run an analysis on all instances of the selected S-Function.

**Model Configuration Parameters Category**: Polyspace

## Settings

**Default:** Off □

Off □

Analyze only the selected S-Function block. The analysis includes only information from the selected S-Function block.

On ☑

Analyze all occurrences of the S-function in the model. If the S-Function is included in the model multiple times, information from all occurrences is included in the analysis.

## Command-Line Information

Use the `pslinkoptions` property `VerifALLSFcnInstances`.

# See Also

`pslinkoptions` | pslinkoptions

## Related Examples

- "Verify S-Function Code"

10

# Approximations Used During Bug Finder Analysis

## Inputs in Polyspace Bug Finder

A Bug Finder analysis does not return a defect caused by a special value of an unknown input, unless the input is bounded. Polyspace makes no assumption about the value of unbounded inputs when your source code is incomplete. For example, in the following code Bug Finder detects a **division by zero** in `foo_1()`, but not in `foo_2()`:

```
int foo_1(int p)
{
  int x = 0;
  if ( p > -10 && p < 10 )  /* p is bounded by if statement */
      x = 100/p;    /* Division by zero detected */

  return x;
}

int foo_2(int p)    /* p is unbounded */
{
  int x = 0;
  x = 100/p;    /* Division by zero not detected */


  return x;
}
```

**Note** To set bounds on your input, add constraints in your code such as `assert` or `if`.

### See Also

"Global Variables in Polyspace Bug Finder" on page 10-3 | "Bug Finder Analysis Assumptions"

# Global Variables in Polyspace Bug Finder

When you run a Bug Finder analysis, Polyspace makes certain assumptions about the initialization of global variables. These assumptions depend on how you declare and define global variables. For example, in this code

```
int foo(void) {
    return 1/gvar;
}
```

Bug Finder detects a **division by zero** defect with the variable `gvar` in these cases:

- You define `int gvar;` in the source code and provide a `main` function that calls `foo`. Bug Finder follows ANSI standards that state the variable is initialized to zero.
- You define `int gvar;` or declare `extern int gvar;` in the source code. Another function calls `foo` and sets `gvar=0`. Otherwise, when your source files are incomplete and do not contain a `main` function, Bug Finder makes no assumption about the initialization of `gvar`.
- You declare `const int gvar;`. Bug Finder assumes `gvar` is initialized to zero due to the `const` keyword.

## See Also

"Inputs in Polyspace Bug Finder" on page 10-2 | "Bug Finder Analysis Assumptions"