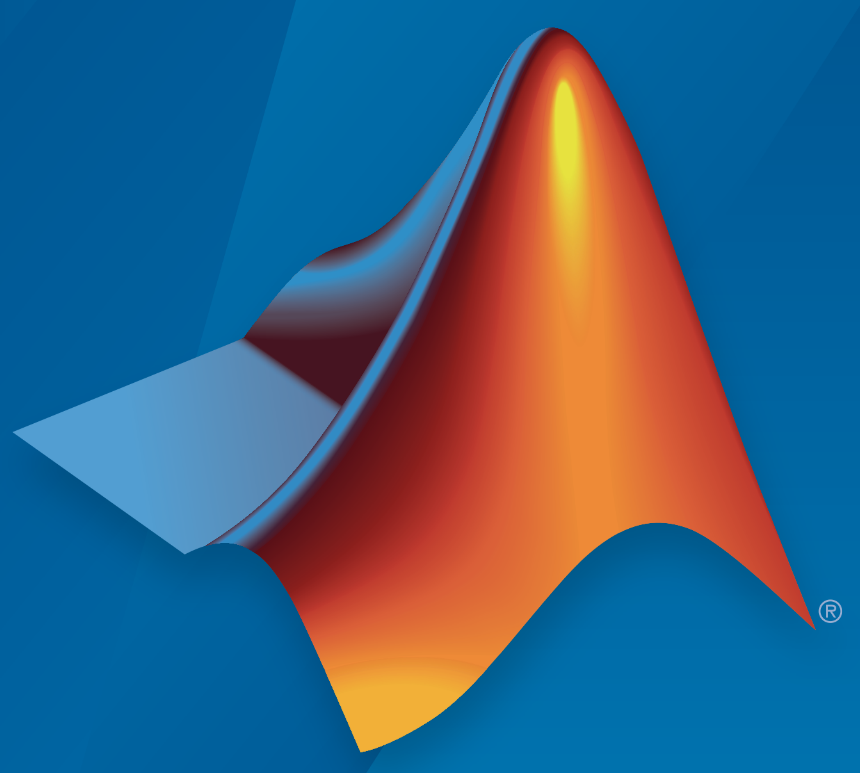
Polyspace® Bug Finder™

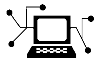
Reference



MATLAB® & SIMULINK®

R2015b

How to Contact MathWorks



Latest news: www.mathworks.com

Sales and services: www.mathworks.com/sales_and_services

User community: www.mathworks.com/matlabcentral

Technical support: www.mathworks.com/support/contact_us

Phone: 508-647-7000

The MathWorks, Inc.
3 Apple Hill Drive
Natick, MA 01760-2098

Polyspace® Bug Finder™ Reference

© COPYRIGHT 2013–2015 by The MathWorks, Inc.

The software described in this document is furnished under a license agreement. The software may be used or copied only under the terms of the license agreement. No part of this manual may be photocopied or reproduced in any form without prior written consent from The MathWorks, Inc.

FEDERAL ACQUISITION: This provision applies to all acquisitions of the Program and Documentation by, for, or through the federal government of the United States. By accepting delivery of the Program or Documentation, the government hereby agrees that this software or documentation qualifies as commercial computer software or commercial computer software documentation as such terms are used or defined in FAR 12.212, DFARS Part 227.72, and DFARS 252.227-7014. Accordingly, the terms and conditions of this Agreement and only those rights specified in this Agreement, shall pertain to and govern the use, modification, reproduction, release, performance, display, and disclosure of the Program and Documentation by the federal government (or other entity acquiring for or through the federal government) and shall supersede any conflicting contractual terms or conditions. If this License fails to meet the government's needs or is inconsistent in any respect with federal procurement law, the government agrees to return the Program and Documentation, unused, to The MathWorks, Inc.

Trademarks

MATLAB and Simulink are registered trademarks of The MathWorks, Inc. See www.mathworks.com/trademarks for a list of additional trademarks. Other product or brand names may be trademarks or registered trademarks of their respective holders.

Patents

MathWorks products are protected by one or more U.S. patents. Please see www.mathworks.com/patents for more information.

Revision History

September 2013	Online only	New for Version 1.0 (Release 2013b)
March 2014	Online only	Revised for Version 1.1 (Release 2014a)
October 2014	Online only	Revised for Version 1.2 (Release 2014b)
March 2015	Online only	Revised for Version 1.3 (Release 2015a)
September 2015	Online only	Revised for Version 2.0 (Release 2015b)

Contents

1 Option Descriptions

Target operating system (C/C++) **1-3**
Settings **1-3**
Dependencies **1-4**
Command-Line Information **1-4**

Target processor type (C/C++) **1-5**
Settings: **1-5**
Tips **1-6**
Command-Line Information **1-6**

Generic target options (C/C++) **1-7**
Command-Line Options **1-7**

Dialect (C) **1-12**
Settings **1-12**
Dependency **1-13**
Limitations **1-13**
Command-Line Information **1-14**

Respect C90 standard (C) **1-15**
Settings **1-15**
Dependencies **1-15**
Command-Line Information **1-15**

Sfr type support (C) **1-16**
Settings **1-16**
Dependency **1-16**
Command-Line Information **1-16**

Division round down (C/C++) **1-17**
Settings **1-17**
Command-Line Information **1-17**

Enum type definition (C/C++) **1-18**
Settings **1-18**
Command-Line Information **1-18**

Signed right shift (C/C++) **1-19**
Settings **1-19**
Limitation **1-19**
Command-Line Information **1-20**

Preprocessor definitions (C/C++) **1-21**
Settings **1-21**
Tips **1-21**
Command-Line Information **1-22**

Disabled preprocessor definitions (C/C++) **1-23**
Settings **1-23**
Command-Line Information **1-23**

Code from DOS or Windows file system (C/C++) **1-24**
Settings **1-24**
Command-Line Information **1-24**

Command/script to apply to preprocessed files (C/C++) . . . **1-25**
Settings **1-25**
Tips **1-25**
Command-Line Information **1-26**

Include (C/C++) **1-28**
Settings **1-28**
Tips **1-28**
Command-Line Information **1-28**

Include folders (C/C++) **1-29**
Settings **1-29**
Command-Line Information **1-29**

Constraint setup (C/C++) **1-30**
Settings **1-30**
Command-Line Information **1-30**

Functions to stub (C) **1-31**
Settings **1-31**
Command-Line Information **1-31**

Disable automatic concurrency detection (C/C++) **1-32**
Settings **1-32**
Command-Line Information **1-32**

Configure multitasking manually (C/C++) **1-34**
Settings **1-34**
Command-Line Information **1-34**

Entry points (C/C++) **1-35**
Settings **1-35**
Dependencies **1-35**
Tips **1-35**
Command-Line Information **1-35**

Critical section details (C/C++) **1-37**
Settings **1-37**
Dependencies **1-37**
Tips **1-37**
Command-Line Information **1-37**

Temporally exclusive tasks (C/C++) **1-39**
Settings **1-39**
Dependencies **1-39**
Command-Line Information **1-39**

Check MISRA C:2004 . . . . **1-41**
Settings **1-41**
Dependency **1-42**
Tips **1-42**
Command-Line Information **1-42**

Check MISRA AC AGC **1-44**
Settings **1-44**
Dependency **1-45**
Tips **1-45**
Command-Line Information **1-45**

Check MISRA C:2012 . . . . **1-47**
Settings **1-47**
Dependency **1-48**
Tips **1-48**
Command-Line Information **1-48**

Use generated code requirements (C) **1-50**
Settings **1-50**
Dependency **1-51**
Command-Line Information **1-51**

Check custom rules (C/C++) **1-52**
Settings **1-52**
Command-Line Information **1-54**

Files and folders to ignore (C) **1-55**
Settings **1-55**
Command-Line Information **1-55**

Effective boolean types (C) **1-56**
Settings **1-57**
Dependencies **1-57**
Command-Line Information **1-57**

Allowed pragmas (C) **1-59**
Settings **1-59**
Dependencies **1-59**
Command-Line Information **1-59**

Find defects (C/C++) **1-60**
Settings **1-60**
Command-Line Information **1-60**

Generate report (C/C++) **1-62**
Settings **1-62**
Tips **1-62**
Command-Line Information **1-62**

Report template (C/C++) **1-64**
Settings **1-64**
Dependencies **1-65**
Command-Line Information **1-65**

Output format (C/C++) **1-67**
Settings **1-67**
Tips **1-67**
Dependencies **1-67**
Command-Line Information **1-67**

Batch (C/C++) **1-69**
Settings **1-69**
Command-Line Information **1-70**

Add to results repository (C/C++) **1-71**
Settings **1-71**
Dependency **1-71**
Command-Line Information **1-71**

Calculate Code Metrics (C/C++) **1-72**
Settings **1-72**
Command-Line Information **1-72**

Command/script to apply after the end of the code verification (C/C++) **1-73**
Settings **1-73**
Command-Line Information **1-73**

Other (C) **1-74**
`-extra-flags` **1-74**
`-c-extra-flags` **1-74**
`-cfe-extra-flags` **1-75**
`-il-extra-flags` **1-75**

Termination functions (C) **1-76**
Settings **1-76**
Command-Line Information **1-76**

Initialization functions (C) **1-77**
Settings **1-77**
Command-Line Information **1-77**

Step functions (C) **1-78**
Settings **1-78**
Tips **1-78**
Command-Line Information **1-79**

Parameters (C) **1-80**
Settings **1-80**
Command-Line Information **1-80**

Inputs (C) **1-82**
Settings **1-82**

Command-Line Information **1-82**

Verify module (C) **1-84**
Settings **1-84**
Command-Line Information **1-84**

2 Option Descriptions for C++ Code

Dialect (C++) **2-2**
Settings **2-2**
Dependencies **2-3**
Limitations **2-4**
Command-Line Information **2-5**

C++11 Extensions (C++) **2-7**
Settings **2-7**
Dependencies **2-7**
Command-Line Information **2-7**

Source code language (C++) **2-8**
Settings **2-8**
Command-Line Information **2-8**

Block char16/32_t types (C++) **2-9**
Settings **2-9**
Dependencies **2-9**
Command-Line Information **2-9**

Pack alignment value (C++) **2-10**
Settings **2-10**
Dependencies **2-10**
Command-Line Information **2-10**

Import folder (C++) **2-11**
Settings **2-11**
Dependencies **2-11**
Command-Line Information **2-11**

Ignore pragma pack directives (C++) **2-12**
Settings **2-12**
Dependencies **2-12**
Command-Line Information **2-12**

Management of scope of 'for loop' variable index (C++) . . . **2-13**
Settings **2-13**
Command-Line Information **2-13**

Management of wchar_t (C++) **2-14**
Settings **2-14**
Command-Line Information **2-14**

Set wchar_t to unsigned long (C++) **2-15**
Settings **2-15**
Command-Line Information **2-15**

Set size_t to unsigned long (C++) **2-16**
Settings **2-16**
Command-Line Information **2-16**

Ignore link errors (C++) **2-17**
Settings **2-17**
Command-Line Information **2-17**

Functions to stub (C++) **2-18**
Settings **2-18**
Command-Line Information **2-18**

Check MISRA C++ rules **2-20**
Settings **2-20**
Command-Line Information **2-21**

Check JSF C++ rules **2-22**
Settings **2-22**
Tips **2-23**
Command-Line Information **2-23**

Files and folders to ignore (C++) **2-24**
Settings **2-24**
Command-Line Information **2-24**

Other (C++) **2-25**
-cpp-extra-flags flag **2-25**
-il-extra-flags flag **2-25**

Termination functions (C++) **2-26**
Settings **2-26**
Tips **2-26**
Command-Line Information **2-26**

Initialization functions (C++) **2-28**
Settings **2-28**
Command-Line Information **2-28**

Step functions (C++) **2-29**
Settings **2-29**
Tips **2-29**
Command-Line Information **2-29**

Parameters (C++) **2-31**
Settings **2-31**
Command-Line Information **2-31**

Inputs (C++) **2-33**
Settings **2-33**
Command-Line Information **2-33**

Verify module (C++) **2-35**
Settings **2-35**
Command-Line Information **2-35**

3 Polyspace Command-Line Options

4 Checks

5 Functions, Properties, and Apps

6 MISRA C 2012

7 Custom Coding Rules

Group 1: Files 7-2

Group 2: Preprocessing 7-3

Group 3: Type definitions 7-4

Group 4: Structures 7-5

Group 5: Classes (C++) 7-6

Group 6: Enumerations 7-7

Group 7: Functions 7-8

Group 8: Constants 7-9

Group 9: Variables 7-10

Group 10: Name spaces (C++) 7-11

Group 11: Class templates (C++) 7-12

Group 12: Function templates (C++) 7-13

8 Code Metrics

1

Option Descriptions

- “Target operating system (C/C++)” on page 1-3
- “Target processor type (C/C++)” on page 1-5
- “Generic target options (C/C++)” on page 1-7
- “Dialect (C)” on page 1-12
- “Respect C90 standard (C)” on page 1-15
- “Sfr type support (C)” on page 1-16
- “Division round down (C/C++)” on page 1-17
- “Enum type definition (C/C++)” on page 1-18
- “Signed right shift (C/C++)” on page 1-19
- “Preprocessor definitions (C/C++)” on page 1-21
- “Disabled preprocessor definitions (C/C++)” on page 1-23
- “Code from DOS or Windows file system (C/C++)” on page 1-24
- “Command/script to apply to preprocessed files (C/C++)” on page 1-25
- “Include (C/C++)” on page 1-28
- “Include folders (C/C++)” on page 1-29
- “Constraint setup (C/C++)” on page 1-30
- “Functions to stub (C)” on page 1-31
- “Disable automatic concurrency detection (C/C++)” on page 1-32
- “Configure multitasking manually (C/C++)” on page 1-34
- “Entry points (C/C++)” on page 1-35
- “Critical section details (C/C++)” on page 1-37
- “Temporally exclusive tasks (C/C++)” on page 1-39
- “Check MISRA C:2004” on page 1-41
- “Check MISRA AC AGC” on page 1-44
- “Check MISRA C:2012” on page 1-47

- “Use generated code requirements (C)” on page 1-50
- “Check custom rules (C/C++)” on page 1-52
- “Files and folders to ignore (C)” on page 1-55
- “Effective boolean types (C)” on page 1-56
- “Allowed pragmas (C)” on page 1-59
- “Find defects (C/C++)” on page 1-60
- “Generate report (C/C++)” on page 1-62
- “Report template (C/C++)” on page 1-64
- “Output format (C/C++)” on page 1-67
- “Batch (C/C++)” on page 1-69
- “Add to results repository (C/C++)” on page 1-71
- “Calculate Code Metrics (C/C++)” on page 1-72
- “Command/script to apply after the end of the code verification (C/C++)” on page 1-73
- “Other (C)” on page 1-74
- “Termination functions (C)” on page 1-76
- “Initialization functions (C)” on page 1-77
- “Step functions (C)” on page 1-78
- “Parameters (C)” on page 1-80
- “Inputs (C)” on page 1-82
- “Verify module (C)” on page 1-84

Target operating system (C/C++)

Specify the operating system of your target application. This option is available on the **Target & Compiler** node in the **Configuration** pane.

This information allows the corresponding system definitions to be used during preprocessing to analyze the included files properly.

A generic set of includes is provided with Polyspace®. These are automatically included when the operating system is set to `no-predefined-OS` or `Linux`. For projects developed for other operating systems, analyze these projects using the corresponding include files for that operating system.

Settings

Default: `no-predefined-OS`

`no-predefined-OS`

Analyzes with a general operating system set up. Use with preprocessor macros (`-U` or `-D`) to specify the system flags at compilation time.

`Linux`

Analyzes with the Linux® system definitions.

`Solaris`

Analyzes with the Solaris™ system definitions.

This option requires you to add a path to the Solaris include folder in your project, or use the `-I` option at the command line.

`VxWorks`

Analyzes with the VxWorks® system definitions.

This option requires you to add a path to the VxWorks include folder in your project, or use the `-I` option at the command line.

`Visual`

Analyzes with the Visual Studio® system definitions. Used for Microsoft® Windows® systems.

This option requires you to add a path to the Visual Studio include folder in your project, or use the `-I` option at the command line.

Dependencies

Setting this parameter changes the available **Dialect** options. All options are available with the `no-predefined-OS` option. The other operating systems only show usable dialects for that system.

Command-Line Information

Parameter: `-OS-target`
Value: `no-predefined-OS | Linux | Solaris | VxWorks | Visual`
Default: `no-predefined-OS`
Example: `polyspace-bug-finder-nodesktop -OS-target Linux`

See Also

"Target processor type (C/C++)" on page 1-5 | "Dialect (C)" on page 1-12 | "Dialect (C++)" on page 2-2

Related Examples

- "Specify Analysis Options"

More About

- "Compile Operating System-Dependent Code"

Target processor type (C/C++)

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

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

Settings:

Default: `i386`

You can modify some default attributes by selecting the browse button to the right of the **Target processor type** drop-down menu. The optional settings for each target are shown in [brackets] in the table.

Target	char	short	int	long	long long	float	double	long double	ptr	sign of char	endian	align
`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 / ColdFire`[a]	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	40[b]	32	signed	Little	32
`sharc21x61`	32	32	32	32	64	32	32 [64]	32 [64]	32	signed	Little	32
`NEC-V850`	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]
`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]

Target	char	short	int	long	long long	float	double	long double	ptr	sign of char	endian	align
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)	8 [16]	8 [16]	16 [32]	32	32 [64]	32	32 [64]	32 [64]	16 [32]	signed	Little	32 [16, 8]

a. The M68k family (68000, 68020, etc.) includes the "ColdFire" processor
b. Operations on long double values will be imprecise.
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.
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 (C/C++)" on page 1-7.

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 processor described above, contact MathWorks® technical support for advice.

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 -lang c -target m68k`

Related Examples

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

Generic target options (C/C++)

The **Generic target options** dialog box is only available when you select a mcpu target for **Target processor type**. The **Target processor type** option is available on the **Target & Compiler** node in the **Configuration** pane.

Allows the specification of a generic “Micro Controller/Processor Unit" target. Use the dialog box to specify the name of a new mcpu target — e.g., *MyTarget*.

The generic target option is incompatible with either:

- **Target operating system** set to Visual
- **Dialect** set to visual*

That new target is added to the **Target processor type** option list. The default characteristics of the new target are (using the *type [size, alignment]* format):

- *char [8, 8]*
- *short [16, 16]*
- *int [16, 16]*
- *long [32, 32]*
- *long long [32, 32]*
- *float [32, 32]*
- *double [32, 32]*
- *long double [32, 32]*
- *pointer [16, 16]*
- *char is signed*
- *little-endian*

Changing the genetic target has consequences for:

- Detection of overflow
- Computation of sizeof objects

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. 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
-big-endian	Big-endian architectures are Most Significant byte First (MSF). For example: SPARC, m68k. 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

Option	Description	Available With	Example
-default-sign-of-char [signed | unsigned]	Specify default sign of char. signed: Specifies that char is signed, overriding target's default. 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 Incompatible with -short-is-8bits and -align 8	mcpu	polyspace-bug-finder-nodesktop -target mcpu -char-is-16bits
-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. If your project sets int to 64 bits, you cannot use this option.	All targets	polyspace-bug-finder-nodesktop -target mcpu -long-is-32bits

<table>
<tr><th>Option</th><th>Description</th><th>Available With</th><th>Example</th></tr>
<tr><td>-long-long-is-64bits</td><td>Define long long as 64 bits, regardless of sign. Alignment is also set to 64 bits.</td><td>mcpu</td><td>polyspace-bug-finder-nodesktop -target mcpu -long-long-is-64bits</td></tr>
<tr><td>-double-is-64bits</td><td>Define double and long double as 64 bits, regardless of sign.</td><td>mcpu, sharc21x61, hc08, hc12, mpc5xx</td><td>polyspace-bug-finder-nodesktop -target mcpu -double-is-64bits</td></tr>
<tr><td>-pointer-is-24bits</td><td>Define pointer as 24 bits, regardless of sign.</td><td>c18</td><td>polyspace-bug-finder-nodesktop -target c18 -pointer-is-24bits</td></tr>
<tr><td>-pointer-is-32bits</td><td>Define pointer as 32 bits, regardless of sign.</td><td>mcpu</td><td>polyspace-bug-finder-nodesktop -target mcpu -pointer-is-32bits</td></tr>
<tr><td>-align [32|16|8]</td><td>Specifies the largest alignment of struct or array objects to the 32, 16 or 8 bit boundaries.

Consequently, the array or struct storage is strictly determined by the size of the individual data objects without member and end padding.</td><td>mcpu,

Only 16 or 32 bits for: hc08, hc12, mpc5xx</td><td>polyspace-bug-finder-nodesktop -target mcpu -align 16</td></tr>
</table>

See Also

"Target processor type (C/C++)" on page 1-5

Related Examples

- "Specify Generic Target Processors"

More About

- "Common Generic Targets"

Dialect (C)

Allow syntax associated with C language extensions. This option is available on the **Target & Compiler** node in the **Configuration** pane.

Using this option allows additional structure types as keywords of the language, such as `sfr`, `sbit`, and `bit`. These structures and associated semantics are part of the compiler that extends the ANSI® C language.

Settings

Default: `none`

`none`

Analysis allows only ANSI C standard syntax.

`gnu4.6`

Analysis allows GCC 4.6 dialect syntax.

`gnu4.7`

Analysis allows GCC 4.7 dialect syntax.

For more information, see “Limitations” on page 1-13.

`gnu4.8`

Analysis allows GCC 4.8 dialect syntax.

For more information, see “Limitations” on page 1-13.

`gnu4.9`

Analysis allows GCC 4.9 dialect syntax.

For more information, see “Limitations” on page 1-13.

`clang3.5`

Analysis allows Clang 3.5 dialect syntax.

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

`visual10`

Analysis allows Microsoft Visual C++® 2010 syntax.

`visual11.0`

Analysis allows Microsoft Visual C++ 2012 syntax.

`visual12.0`

Analysis allows Microsoft Visual C++ 2013 syntax.

`keil`

Analysis allows non-ANSI C syntax and semantics associated with the Keil™ 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).

Dependency

This parameter is dependent on the value of **Target operating system**. The dialect options work only with the applicable operating systems. You can use every dialect with the **Target operating system** option, `no-predefined-OS`.

Limitations

Polyspace does not support certain aspects of the GNU® dialects 4.7 and later. These limitations can cause compilation errors, incomplete results, or false positives.

- **Vector types and attributes** — Not supported, ignored.

  Workaround: To reduce compilation issues

  - At the command line, use the option `-D _EMMINTRIN_H_INCLUDED -D _XMMINTRIN_H_INCLUDED`.
  - In the Polyspace environment, in **Macros** > **Preprocessor definitions**, add two rows: `_EMMINTRIN_H_INCLUDED` and `_XMMINTRIN_H_INCLUDED`.
- **Visibility attributes** — Not supported, ignored.

  Workaround: Remove all attributes during preprocessing,

  - At the command line, use the option `-D __attribute__(x)=`.
  - In the Polyspace environment, in **Macros** > **Preprocessor definitions**, add a row: `__attribute__(x)=`.

- **Complex types** — Only floating complex types supported, integral complex types cause an error.
- **Using built-in library function on complex types** — Not supported, stubbed during analysis. Calls to these functions return variables with full ranges.

  Workaround: To make the analysis more precise, add an include file that defines the functions for complex variables.
- **Computed `goto`** — Not supported.

  Bug Finder ignores the `goto`.
- **Nested functions** — Not supported, causes an error.
- **Using built-in library functions on atomic operators** — Not supported, Polyspace stubs the functions. This limitation can cause imprecise results.
- **IEEE® floating point library functions** — Not supported, causes compilation error.

  This limitation includes `isnan`, `isnanf`, `isnanl`, `isinf`, `isinff`, `isinfl`, `isnormal`, and `isfinite`.

Command-Line Information

Parameter: `-dialect`
Value: `none | gnu4.6 | gnu4.7 | gnu4.8 | gnu4.9 | clang3.5 | visual10 | visual11.0 | visual12.0 | keil | iar`
Default: `none`
Example: `polyspace-bug-finder-nodesktop -lang c -sources "file1.c,file2.c" -OS-target Linux -dialect gnu4.6`

See Also

"Target operating system (C/C++)" on page 1-3 | "Target processor type (C/C++)" on page 1-5

Related Examples

- "Analyze Keil or IAR Dialects"

Respect C90 standard (C)

Restrict the analysis to the C language specified in the ANSI C standard (ISO/IEC 9899:1990). Any language extensions added after the C90 standard will generate compilation errors.

Settings

Default: Off

Off

Allow C99 language extensions.

On

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

Dependencies

If you enable this option, the **Dialect** settings `keil` and `iar` are disabled.

Command-Line Information

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

Sfr type support (C)

Specify the `sfr` types. This option is available on the **Target & Compiler** node in the **Configuration** pane.

If the code uses `sfr` keywords, you must declare each `sfr` type using this option.

Settings

No Default

List each sfr name and its size in bits.

Dependency

Setting **Dialect** to `keil` or `iar` enables this parameter.

Command-Line Information

Parameter: `-sfr-types` *`sfr_name=size_in_bits`*`,...`
No Default
Name Value: an sfr name
Size Value: `8 | 16 | 32`
Example: `polyspace-bug-finder-nodesktop -lang c -dialect iar -sfr-types sfr=8,sfr32=32,sfrb=16 ...`

Division round down (C/C++)

Specify how division and modulus of a negative numbers is interpreted by the analysis. This option is available on the **Target & Compiler** node in the **Configuration** pane.

The ANSI 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*".

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

Settings

Default: Off

☐ Off

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

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

☑ On

If either operand `/` or `%` is negative, the result of the `/` operator is the largest integer less or equal than 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.

Command-Line Information

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

Enum type definition (C/C++)

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.

Settings

Default: `defined-by-standard`

`defined-by-standard`

Uses the signed integer type for all dialects except gnu.

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

`auto-signed-first`

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

`auto-unsigned-first`

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

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

Command-Line Information

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

Signed right shift (C/C++)

Choose between arithmetical and logical computation. This option is available on the **Target & Compiler** node in the **Configuration** pane.

This option does not modify compile-time expressions. For more details, see “Limitation” on page 1-19.

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 statements 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`
Example: `polyspace-bug-finder-nodesktop -logical-signed-right-shift`

Preprocessor definitions (C/C++)

Define macro compiler flags. This option is available on the **Macros** node in the **Configuration** pane.

Depending on your **Target operating system**, some compiler flags are defined by default. Use this option to define flags that are not already defined.

Settings

No Default

Using the button, add a row for the macro flag you want to define. The flag must be in the format `Flag=Value`. If you want Polyspace to ignore the flag, 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.

Tips

Sometimes, your source code contains non-ANSI extension keywords. Although your compiler supports the keywords, Polyspace does not support them. To avoid compilation errors caused by an unsupported keyword, 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 example, 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;
```

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 (C/C++)" on page 1-23

Disabled preprocessor definitions (C/C++)

Disable macro compiler flags. This option is available on the **Macros** node in the **Configuration** pane.

Some **Target operating system** settings enable macro compilation flags by default. This option allows you disable these macros.

Settings

No Default

Using the button, add a new row for each macro flag being disabled.

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: *`flag`*
Example: `polyspace-bug-finder-nodesktop -U HAVE_MYLIB -U USE_COM1`

See Also

"Preprocessor definitions (C/C++)" on page 1-21

Code from DOS or Windows file system (C/C++)

Specify that DOS or Windows files are in analysis. This option is available on the **Environment Settings** node in the **Configuration** pane.

Use this options if the contents of the **Include** or **Source** folder come from a DOS or Windows file system. It deals with upper/lower case sensitivity and control character issues.

Settings

Default: On

☑ On

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`

Command/script to apply to preprocessed files (C/C++)

Specify a command or script to run on each source file after the preprocessing phase. This option is available on the **Environment Settings** node in the **Configuration** pane.

The command must be designed to process the standard output from preprocessing and produce its results in accordance with that standard output. Additionally, It is important to preserve the number of lines in the preprocessed file. Adding a line or removing one could result in some unpredictable behavior on the location of checks and macros in the Polyspace user interface.

Note: The Compilation Assistant is automatically disabled when you specify this option.

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 will be executed.

Tips

- 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.

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 (C/C++)" on page 1-73

Related Examples

- "Specify Analysis Options"

Include (C/C++)

Specify files to be included by each C file involved in the analysis. This option is available on the **Environment Settings** node in the **Configuration** pane

Settings

No Default

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

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

Tips

If you have compilation problems because Polyspace does not recognize certain keywords specific to your compiler, you can define the keywords in a header file and provide the header file with this option.

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`

Include folders (C/C++)

View the include folders used for verification.

- 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 (C/C++)” on page 1-28

Constraint setup (C/C++)

Specify range for global variables, function inputs and return values of stubbed functions using a **Data Range Specifications** template file. The template file can be either a text or an XML file. This option is available on the **Inputs & Stubbing** node in the **Configuration** pane.

Settings

No Default

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

Command-Line Information

Parameter: `-data-range-specifications`
Value: *`file`*
No Default
Example: `polyspace-code-prover-nodesktop -sources` *`file_name`* `-data-range-specifications "C:\DRS\range.txt"`

See Also

"Functions to stub (C)" on page 1-31 | "Ignore default initialization of global variables (C/C++)"

Related Examples

- "Specify Analysis Options"
- "Specify Constraints"

More About

- "Constraints"

Functions to stub (C)

Specify functions that you want the software to stub. This option is available on the **Inputs & Stubbing** node in the **Configuration** pane.

Settings

No Default

Click to add a field. Enter function name.

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`

Related Examples

- "Specify Analysis Options"

Disable automatic concurrency detection (C/C++)

Deactivate the automatic concurrency detection for POSIX and VxWorks threading functions. This option turns off the automatic multitasking detection. If you want to manually model your multitasking program, see "Configure multitasking manually (C/C++)" on page 1-34.

This option is on the **Multitasking** node in the **Configuration** pane.

Settings

Default: Off

Off

Use pthread primitives to automatically detect your program's multitasking model. Supported pthread primitives are:

POSIX®

- `pthread_create`
- `pthread_mutex_lock`
- `pthread_mutex_unlock`

VxWorks

- `taskSpawn`
- `semTake`
- `semGive`

On

Do not detect multitasking in your code.

If you want to manually configure your multitasking model, see "Configure multitasking manually (C/C++)" on page 1-34.

Command-Line Information

Parameter: `-disable-concurrency-detection`

Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-disable-concurrency-detection`

See Also

"Entry points (C/C++)" on page 1-35 | "Critical section details (C/C++)" on page 1-37 | "Temporally exclusive tasks (C/C++)" on page 1-39

Related Examples

- "Modeling Multitasking Code"
- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

Configure multitasking manually (C/C++)

Specify whether your code is a multitasking application. This option allows you to manually configure the multitasking structure for Polyspace. If you use POSIX or VxWorks `pthread` primitives, Polyspace can detect the multitasking. See "Disable automatic concurrency detection (C/C++)" on page 1-32.

This option is on the **Multitasking** node in the **Configuration** pane.

Settings

Default: Off

On

The code is intended for a multitasking application.

Off

The code is not intended for a multitasking application.

Command-Line Information

There is nosingle command-line option to turn on multitasking verification. By using the `-entry-points` option, you turn on multitasking verification.

See Also

"Disable automatic concurrency detection (C/C++)" on page 1-32 | "Entry points (C/C++)" on page 1-35 | "Critical section details (C/C++)" on page 1-37 | "Temporally exclusive tasks (C/C++)" on page 1-39

Related Examples

- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

Entry points (C/C++)

Specify functions that serve as entry points to your code. Use this option when your code is intended for multitasking. This option is available on the **Multitasking** node in the **Configuration** pane.

Settings

No Default

Click [+] to add a field. Enter function name.

Dependencies

This option is enabled only if you select the **Multitasking** box.

Tips

- If a function `func` models cyclic tasks or interrupts that can run zero or more times, to specify the multiple cycles for Polyspace:

  1. Create a new function `newFunc` of the form

     ```
     void newFunc (void)
     ```

  2. In the body of `newFunc`, call `func` inside a loop with unspecified number of runs. Make the loop control variable `volatile int`. For example:

     ```
     void newFunc(void) {
       volatile int randomValue = 0;
       while(randomValue) {
          func();
        }
     }
     ```

  3. Specify `newFunc` as 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 (C/C++)" on page 1-37 | "Temporally exclusive tasks (C/C++)" on page 1-39

Related Examples

- "Specify Analysis Options"
- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

Critical section details (C/C++)

When verifying multitasking code, Polyspace considers that a critical section lies between calls to a lock function and an unlock function. Specify the two function names. This option is available on the **Multitasking** node in the **Configuration** pane.

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.

Settings

No Default

Click [+] to add a field.

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

Dependencies

This option is enabled only if you select the **Multitasking** box.

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.

<table>
<tr><td>Starting procedure: <code>func_begin</code></td><td>Starting procedure: <code>func_begin</code></td></tr>
<tr><td>Ending procedure: <code>func_end</code></td><td>Ending procedure: <code>func_end</code></td></tr>
<tr><td><pre>void my_task() {
   my_lock(1);
   /* Critical section code */
   my_unlock(1);
}</pre></td><td><pre>void my_task() {
   my_lock(2);
   /* Critical section code */
   my_unlock(2);
}</pre></td></tr>
</table>

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

Polyspace Analysis Options

"Configure multitasking manually (C/C++)" on page 1-34 | "Entry points (C/C++)" on page 1-35 | "Temporally exclusive tasks (C/C++)" on page 1-39

Polyspace Results

Data race | Data race including atomic operations

Related Examples

- "Specify Analysis Options"
- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

Temporally exclusive tasks (C/C++)

Specify functions that cannot execute concurrently. The execution of the functions cannot overlap with each other. Use this option to implement temporal exclusion in multitasking code. This option is available on the **Multitasking** node in the **Configuration** pane.

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.

Dependencies

This option is enabled only if you select the **Multitasking** box.

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

Polyspace Analysis Options

“Configure multitasking manually (C/C++)” on page 1-34 | “Entry points (C/C++)” on page 1-35 | “Critical section details (C/C++)” on page 1-37

Polyspace Results

Data race | Data race including atomic operations

Related Examples

- "Specify Analysis Options"
- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

Check MISRA C:2004

Specify whether to check for violation of MISRA C®:2004 rules. Each value of the option corresponds to a subset of rules to check. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane. For projects with mixed C and C++ code, the MISRA C:2004 checker analyzes only `.c` files.

After analysis, the **Results Summary** 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
```

Dependency

For C++ projects that contain `.c` and `.cpp` files, you can only select this option if you have set **Source code language** > **C-CPP**.

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.

- Checking for certain coding rules can cause the analysis to run longer than usual. To check these rules, Polyspace Bug Finder™ must check for certain defects, too. For faster analysis, you can disable the checking of these rules if you want.

  For more information, see “Rules to Disable for Faster Analysis”.

Command-Line Information

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

See Also

“Files and folders to ignore (C)” on page 1-55

Related Examples

- “Specify Analysis Options”

- “Activate Coding Rules Checker”
- “Select Specific MISRA or JSF Coding Rules”

More About

- “Polyspace MISRA C 2004 and MISRA AC AGC Checkers”
- “Software Quality Objective Subsets (C:2004)”

Check MISRA AC AGC

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. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane. For projects with mixed C and C++ code, the MISRA AC AGC checker analyzes only `.c` files.

After analysis, the **Results Summary** pane lists the coding rule violations. On the **Source** pane, for every coding rule violation, 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 [folder icon] 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
```

Dependency

For C++ projects that contain `.c` and `.cpp` files, you can only select this option if you have set **Source code language** > **C-CPP**.

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.
- Checking for certain coding rules can cause the analysis to run longer than usual. To check these rules, Polyspace Bug Finder must check for certain defects, too. For faster analysis, you can disable the checking of these rules if you want.

  For more information, see “Rules to Disable for Faster Analysis”.

Command-Line Information

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

Related Examples

- “Specify Analysis Options”
- “Activate Coding Rules Checker”
- “Select Specific MISRA or JSF Coding Rules”

More About

- “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

Specify whether to check for violations of MISRA C:2012 guidelines. Each value of the option corresponds to a subset of guidelines to check. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane. For projects with mixed C and C++ code, the MISRA C:2012 checker analyzes only `.c` files.

After analysis, the **Results Summary** 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 mandatory and required guidelines.

`mandatory`

Check mandatory guidelines.

`all`

Check mandatory, required, and advisory guidelines.

`SQO-subset1`

Check 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 a subset of guidelines, `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 [folder icon] 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
  ```

Dependency

For C++ projects that contain `.c` and `.cpp` files, you can only select this option if you have set **Source code language** > **C-CPP**.

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.
- Checking for certain coding rules can cause the analysis to run longer than usual. To check these rules, Polyspace Bug Finder must check for certain defects, too. For faster analysis, you can disable the checking of these rules if you want.

  For more information, see “Rules to Disable for Faster Analysis”.

Command-Line Information

Parameter: `-misra3`
Value: `mandatory | mandatory-required | all | SQO-subset1 | SQO-subset2 | `*`file`*
Default: `mandatory-required`
Example: `polyspace-bug-finder-nodesktop -lang c -sources `*`file_name`*` -misra3 mandatory-required`

See Also

“Files and folders to ignore (C)” on page 1-55

Related Examples

- “Specify Analysis Options”
- “Activate Coding Rules Checker”
- “Select Specific MISRA or JSF Coding Rules”

More About

- “Polyspace MISRA C:2012 Checker”
- “Software Quality Objective Subsets (C:2012)”

Use generated code requirements (C)

Specify whether to use the MISRA C:2012 categories for automatically generated code. This option changes which rules are mandatory, required, or advisory. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane.

Settings

Default: Off (On for analyses started from the Simulink® plug-in.)

☐ Off

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

☑ On

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** 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

"Files and folders to ignore (C)" on page 1-55 | "Check MISRA C:2012" on page 1-47

Related Examples

- "Specify Analysis Options"
- "Activate Coding Rules Checker"

More About

- "Polyspace MISRA C:2012 Checker"

Check custom rules (C/C++)

Define naming conventions for identifiers and check your code against them. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane.

After analysis, the **Results Summary** 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

Default: Off

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 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

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"`

Related Examples

- "Specify Analysis Options"
- "Activate Coding Rules Checker"
- "Create Custom Coding Rules"

More About

- "Format of Custom Coding Rules File"
- "Custom Coding Rules"

Files and folders to ignore (C)

Specify files and folders to ignore during coding rules checking and during Bug Finder defect checking. This option is available on the **Inputs & Stubbing** node in the **Configuration** pane.

Settings

Default: `all-headers`

`all-headers`

Ignore included `.h` files

`all`

Ignore all files in include folders

`custom`

Ignore include files and folders that you specify in the **File/Folder** view. To add files to the custom **File/Folder** list, select [folder icon] to choose the files and folders to exclude. To remove a file or folder from the list of excluded files and folders, select the row. Then click [delete icon].

Command-Line Information

Parameter: `-includes-to-ignore`
Value: `all-headers` | `all` | *`file1`*`[,`*`file2`*`[,...]]` | *`folder1`*`[,`*`folder2`*`[,...]]`
Default: `all-headers`
Example: `polyspace-bug-finder-nodesktop -lang c -sources` *`file_name`* `-misra2 required-rules -includes-to-ignore "C:\usr\include"`

Related Examples

- "Specify Analysis Options"
- "Activate Coding Rules Checker"

Effective boolean types (C)

Specify data types that you want Polyspace to treat as Boolean. You can specify a data type only if you have defined it through a `typedef` statement in your source code. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane.

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
MISRA C:2012 Rule 10.1	Operands shall not be of an inappropriate essential type
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
MISRA C:2012 Rule 10.5	The value of an expression should not be cast to an inappropriate essential type
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.

Rule Number	Rule Statement
MISRA C:2012 Rule 16.7	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 enabled only if you select one of the options **Check MISRA C:2004**, **Check MISRA AC AGC** or **Check MISRA C:2012**.

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`

Related Examples

- "Activate Coding Rules Checker"
- "Specify Boolean Types"

More About

- "MISRA C:2004 and MISRA AC AGC Coding Rules"

Allowed pragmas (C)

Specify pragma directives for which MISRA C rule 3.4 should not be applied. MISRA C or MISRA AC AGC rule 3.4 requires checking that all pragma directives are documented within the documentation of the compiler. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane.

Settings

No Default

Click to add a field. Enter the pragma name that you want Polyspace to ignore during MISRA C checking .

Dependencies

This option is enabled only if you select one of the options **Check MISRA C:2004** or **Check MISRA AC AGC**.

Command-Line Information

Parameter: `-allowed-pragmas`
Value: `*pragma1*[,*pragma2*[,...]]`
No Default
Example: `polyspace-bug-finder-nodesktop -sources *filename* -misra2 required-rules -allowed-pragmas pragma_01,pragma_02`

Related Examples

- "Activate Coding Rules Checker"

More About

- "MISRA C:2004 and MISRA AC AGC Coding Rules"

Find defects (C/C++)

Enable or disable defect checking. Activate different defect checkers. This option is available on the **Bug Finder Analysis** node in the **Configuration** pane.

Settings

Default: `default`

`default`

A list of default defects defined by the software. For information on which defects are default, refer to the individual defect reference pages.

`all`

All defects.

`custom`

Choose the defects you want to find by selecting categories of checkers or specific defects.

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` | group | defect parameter
Default: `default`
Parameter: `-disable-checkers`
Value: group | defect parameter
Example: `polyspace-bug-finder-nodesktop -sources` *`filename`* `-checkers numerical,dataflow -disable-checkers FLOAT_ZERO_DIV`
Example: `polyspace-bug-finder-nodesktop -sources` *`filename`* `-checkers default -disable-checkers concurrency,dead_code`

See Also

"Defects"

Related Examples

- "Specify Analysis Options"

More About

- "Bug Finder Defect Groups"

Generate report (C/C++)

Specify whether to generate a report after the analysis. This option is available on the **Reporting** node in the **Configuration** pane.

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.

Settings

Default: Off

On

Polyspace generates an analysis report using the template and format you specify.

Off

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

"Report template (C/C++)" on page 1-64 | "Output format (C/C++)" on page 1-67

Related Examples

- "Specify Analysis Options"

- “Generate Reports”

Report template (C/C++)

Specify template for generating analysis report. This option is available on the **Reporting** node in the **Configuration** pane.

`.rpt` files for the report templates are available in *`MATLAB_Install`*`\polyspace\toolbox\psrptgen\templates\bug_finder`.

Settings

Default: `BugFinderSummary`

`BugFinderSummary`

The report lists:

- **Polyspace Bug Finder Summary**: Number of result sets and number of defects in the source code.
- **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 result sets and number of defects in the source code.
- **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 for C" or "Analysis Options for C++".

  If you check for coding rules, an additional **Coding Rules Configuration** section states all 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.

Dependencies

This option is available only if you select the **Generate report** box.

Command-Line Information

Parameter: `-report-template`
Value: Name of template with extension `.rpt`
Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-report-template BugFinder.rpt`

See Also

"Generate report (C/C++)" on page 1-62 | "Output format (C/C++)" on page 1-67

Related Examples

- "Generate Reports"

Output format (C/C++)

Specify output format of generated report. This option is available on the **Reporting** node in the **Configuration** pane.

Settings

Default: `Word`

`HTML`

Generate report in `.html` format

`PDF`

Generate report in `.pdf` format

`Word`

Generate report in `.docx` format. Not available on UNIX® platforms.

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

"Output format (C/C++)" on page 1-67 | "Report template (C/C++)" on page 1-64

Related Examples

- “Specify Analysis Options”
- “Generate Reports”

Batch (C/C++)

Enable or disable batch remote analysis. This option is available on the **Distributed Computing** node in the **Configuration** pane.

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

Settings

Default: Off

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 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

Do not run batch analysis on a remote computer.

Command-Line Information

To run a remote verification 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-bug-finder-nodesktop -batch -scheduler NodeHost`
`polyspace-bug-finder-nodesktop -batch -scheduler MJSName@NodeHost`

See Also

"Add to results repository (C/C++)" on page 1-71 | `-scheduler`

Related Examples

- "Specify Analysis Options"
- "Set Up Server for Metrics and Remote Analysis"

Add to results repository (C/C++)

Specify upload of analysis results to the Polyspace Metrics results repository, allowing Web-based reporting of results and code metrics. This option is available on the **Distributed Computing** node in the **Configuration** pane.

Settings

Default: Off

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

Analysis results are stored locally.

Dependency

This option is only available for remote verifications. For local verification, you can manually upload your results to Polyspace Metrics by right-clicking on your results file and selecting **Upload to Metrics**.

Command-Line Information

Parameter: `-add-to-results-repository`
Default: Off
Example: `polyspace-bug-finder-nodesktop -batch -scheduler NodeHost -add-to-results-repository`

See Also

“Set Up Server for Metrics and Remote Analysis” | “Set Up Polyspace Metrics” | “Batch (C/C++)” on page 1-69

Related Examples

- “Run Remote Batch Analysis”

Calculate Code Metrics (C/C++)

Specify that Polyspace must compute and display code complexity metrics for your source code. For more information, see “Code Metrics”.

Settings

Default: Off

On

Polyspace computes and displays code complexity metrics on the **Results Summary** pane.

Off

Polyspace does not compute complexity metrics.

Command-Line Information

Parameter: `-code-metrics`
Default: Off
Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-code-metrics`

Command/script to apply after the end of the code verification (C/C++)

Specify a command or script to be executed after the verification. This option is available on the **Advanced Settings** node in the **Configuration** pane.

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 will be 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 verification 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.

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 (C/C++)" on page 1-25

Related Examples

- "Specify Analysis Options"

Other (C)

In this section...
"`-extra-flags`" on page 1-74
"`-c-extra-flags`" on page 1-74
"`-cfe-extra-flags`" on page 1-75
"`-il-extra-flags`" on page 1-75

This option is available on the **Advanced Settings** node in the **Configuration** pane.

-extra-flags

This dialog box is for adding nonofficial or expert options to the analyzer. Each word of the option (even the parameters) must be preceded by *-extra-flags*.

These flags will be given to you by MathWorks if required.

No Default

Example Shell Script Entry:

```
 polyspace-bug-finder-nodesktop -extra-flags -param1 -extra-flags -
param2 \

  -extra-flags 10 ...
```

-c-extra-flags

This option is used to specify an expert option to be added to an analysis. Each word of the option (even the parameters) must be preceded by *-c-extra-flags*.

These flags will be given to you by MathWorks if required.

No Default

Example Shell Script Entry:

```
polyspace-bug-finder-nodesktop -c-extra-flags -param1 -c-extra-flags
-param2 -c-extra-flags 10
```

-cfe-extra-flags

This option is used to specify an expert option for an analysis.

These flags will be given to you by MathWorks if required.

No Default

Example Shell Script Entry:

```
polyspace-bug-finder-nodesktop -cfe-extra-flags -param1 -cfe-extra-
flags -param2
```

-il-extra-flags

This option is used to specify an expert option to be added to an analysis. Each word of the option (even the parameters) must be preceded by *-il-extra-flags*.

These flags will be given to you by MathWorks if required.

No Default

Example Shell Script Entry:

```
polyspace-bug-finder-nodesktop -il-extra-flags -param1 -il-extra-
flags -param2 -il-extra-flags 10
```

Termination functions (C)

This option is available only for model-generated code.

Specify functions that the generated `main` must call after the cyclic code ends. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

No Default

Click [+] to add a field. Enter function name.

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 (C)" on page 1-80 | "Inputs (C)" on page 1-82 | "Initialization functions (C)" on page 1-77 | "Step functions (C)" on page 1-78

Related Examples

- "Specify Analysis Options"
- "Configure Simulink Model"

More About

- "Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
- "Main Generation for Model Analysis"

Initialization functions (C)

This option is available only for model-generated code.

Specify functions that the generated `main` must call before the cyclic code begins. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

No Default

Click [+] to add a field. Enter function name.

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 (C)" on page 1-80 | "Inputs (C)" on page 1-82 | "Step functions (C)" on page 1-78 | "Termination functions (C)" on page 1-76

Related Examples

- "Specify Analysis Options"
- "Configure Simulink Model"

More About

- "Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
- "Main Generation for Model Analysis"

Step functions (C)

This option is available only for model-generated code.

Specify functions that the generated `main` must call in each cycle of the cyclic code. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

Default: `unused`

`none`

The generated `main` does not call functions in the cyclic code.

`unused`

The generated `main` calls all functions that are not called elsewhere in the code. In particular, 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. It also does not call inlined functions.

`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.

Tips

- When you select `unused`, the generated `main` does not call a function if it is called elsewhere. However, this rule does not apply to calls through function pointers. The generated `main` calls a function even when it is called elsewhere through a function pointer.
- 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` | `unused` | `all` | `custom=`*`function1`*`[,`*`function2`*`[,...]]`
Default: `unused`
Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator -functions-called-in-loop all`

See Also

“Parameters (C)” on page 1-80 | “Inputs (C)” on page 1-82 | “Initialization functions (C)” on page 1-77 | “Step functions (C)” on page 1-78 | “Termination functions (C)” on page 1-76

Related Examples

- “Specify Analysis Options”
- “Configure Simulink Model”

More About

- “Recommended Polyspace Bug Finder Options for Analyzing Generated Code”
- “Main Generation for Model Analysis”

Parameters (C)

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. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

Default: `public`

`public`

The generated `main` initializes all variables except those declared with keywords `static` and `const`.

`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.

Command-Line Information

Parameter: `-variables-written-before-loop`
Value: `none | public | all | custom=variable1[,variable2[,...]]`
Default: `public`
Example: `polyspace-bug-finder-nodesktop -sources file_name -main-generator -variables-written-before-loop all`

See Also

"Inputs (C)" on page 1-82 | "Initialization functions (C)" on page 1-77 | "Step functions (C)" on page 1-78 | "Termination functions (C)" on page 1-76

Related Examples

- "Specify Analysis Options"
- "Configure Simulink Model"

More About

- "Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
- "Main Generation for Model Analysis"

Inputs (C)

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. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

Default: `public`

`public`

The generated `main` initializes all variables except those declared with keywords `static` and `const`.

`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.

Command-Line Information

Parameter: `-variables-written-in-loop`
Value: `none | public | all | custom=`*`variable1`*`[,`*`variable2`*`[,...]]`
Default: `public`
Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator -variables-written-in-loop all`

See Also

"Parameters (C)" on page 1-80 | "Initialization functions (C)" on page 1-77 | "Step functions (C)" on page 1-78 | "Termination functions (C)" on page 1-76

Related Examples

- “Specify Analysis Options”
- “Configure Simulink Model”

More About

- “Recommended Polyspace Bug Finder Options for Analyzing Generated Code”
- “Main Generation for Model Analysis”

Verify module (C)

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. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

Default: On

On

Polyspace generates a `main` function if it does not find one in the source files. The generated `main`:

- Initializes variables that you specify using **Variables to initialize**.
- Calls functions that you specify using **Initialization functions** ahead of other functions.
- Calls functions that you specify using **Functions to call** in arbitrary order.

If you do not specify the above options explicitly, the generated `main`:

- Initializes all global variables except those declared with keywords `const` and `static`.
- Calls in arbitrary order 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 verification if a `main` function is not present in the source files.

Command-Line Information

Parameter: `-main-generator`
Default: Off
Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator ...`

See Also

“Parameters (C)” on page 1-80 | “Inputs (C)” on page 1-82 | “Initialization functions (C)” on page 1-77 | “Step functions (C)” on page 1-78 | “Termination functions (C)” on page 1-76

Related Examples

- “Specify Analysis Options”
- “Configure Simulink Model”

More About

- “Main Generation for Model Analysis”

Option Descriptions for C++ Code

- "Dialect (C++)" on page 2-2
- "C++11 Extensions (C++)" on page 2-7
- "Source code language (C++)" on page 2-8
- "Block char16/32_t types (C++)" on page 2-9
- "Pack alignment value (C++)" on page 2-10
- "Import folder (C++)" on page 2-11
- "Ignore pragma pack directives (C++)" on page 2-12
- "Management of scope of 'for loop' variable index (C++)" on page 2-13
- "Management of wchar_t (C++)" on page 2-14
- "Set wchar_t to unsigned long (C++)" on page 2-15
- "Set size_t to unsigned long (C++)" on page 2-16
- "Ignore link errors (C++)" on page 2-17
- "Functions to stub (C++)" on page 2-18
- "Check MISRA C++ rules" on page 2-20
- "Check JSF C++ rules" on page 2-22
- "Files and folders to ignore (C++)" on page 2-24
- "Other (C++)" on page 2-25
- "Termination functions (C++)" on page 2-26
- "Initialization functions (C++)" on page 2-28
- "Step functions (C++)" on page 2-29
- "Parameters (C++)" on page 2-31
- "Inputs (C++)" on page 2-33
- "Verify module (C++)" on page 2-35

Dialect (C++)

Allow syntax associated with C++ language extensions. This option is available on the **Target & Compiler** node in the **Configuration** pane.

Settings

Default: `none`

`none`

Analysis allows for ISO®/IEC 14882:2003 C++ (C++ 2003) syntax.

If you want to allow ISO/IEC 14882:2011 C++ (C++ 2011) syntax, also select **C++ 11 extensions**.

`gnu3.4`

Analysis allows GCC 3.4 dialect syntax.

`gnu4.6`

Analysis allows GCC 4.6 dialect syntax.

`gnu4.7`

Analysis allows GCC 4.7 dialect syntax.

For more information, see “Limitations” on page 2-4.

`gnu4.8`

Analysis allows GCC 4.8 dialect syntax.

For more information, see “Limitations” on page 2-4.

`gnu4.9`

Analysis allows GCC 4.9 dialect syntax.

For more information, see “Limitations” on page 2-4.

`clang3.5`

Analysis allows Clang 3.5 dialect syntax.

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

`iso`

Analysis allows for ISO/IEC 14882:2003 C++ (C++ 2003) syntax.

If you want to allow ISO/IEC 14882:2011 C++ (C++ 2011) syntax, also select **C++ 11 extensions**.

`visual`

Analysis allows Microsoft Visual C++ .NET 2003 syntax.

`visual6`

Analysis allows Microsoft Visual C++ 6.0 (VC6) syntax.

`visual7.0`

Analysis allows Microsoft Visual C++ .NET 2002 syntax.

`visual7.1`

Analysis allows Microsoft Visual C++ .NET 2003 syntax.

`visual8`

Analysis allows Microsoft Visual C++ 2005 syntax.

`visual9.0`

Analysis allows Microsoft Visual C++ 2008 syntax.

`visual10`

Analysis allows Microsoft Visual C++ 2010 syntax.

This option automatically adds the option `-no-stl-stubs`.

`visual11.0`

Analysis allows Microsoft Visual C++ 2012 syntax.

This option automatically adds the option `-no-stl-stubs`.

`visual12.0`

Analysis allows Microsoft Visual C++ 2013 syntax.

This option automatically adds the option `-no-stl-stubs`.

Dependencies

This parameter depends on the value of **Target operating system**. The dialect options work only with the applicable operating systems. You can use every dialect with the **Target operating system** option, `no-predefined-OS`.

If you enable **Check JSF C++ Rules** with a dialect other than `iso` or `none`, Polyspace cannot completely check some JSF® coding rules. For example, AV Rule 8: “All code shall conform to ISO/IEC 14882:2002(E) standard C++.”

Limitations

Polyspace does not support certain aspects of the GNU dialects 4.7 and later. These limitations can cause compilation errors, incomplete results, or false positives.

- **Priority attributes** — Not supported, ignores priorities and uses standard initialization instead.

  ### Example

  ```
  #include <stdio.h>
  struct A{
      int a;
      A():a(1) {
         fprintf(stderr, "A constructor\n");
      }
  };

  struct B{
      int b;

      B():b(1) {
         fprintf(stderr, "B constructor\n");
      }
  };

  A a __attribute__((init_priority (100)));
  B b __attribute__((init_priority (50)));
  ```

  The expected output from the above code is:

  ```
  B constructor
  A constructor
  ```

  However, Polyspace preserves the standard initialization. So the actual output is:

  ```
  A constructor
  B constructor
  ```

  Workaround: To use the desired priority, change the order of the declarations to match the desired order.

- **Vector types and attributes** — Limited support.

  If you encounter compilation issues:

  - At the command line, use the option `-D _EMMINTRIN_H_INCLUDED -D _XMMINTRIN_H_INCLUDED`.
  - In the Polyspace environment, in **Macros** > **Preprocessor definitions**, add two rows: `_EMMINTRIN_H_INCLUDED` and `_XMMINTRIN_H_INCLUDED`.
- **Visibility attributes** — Not supported, ignored.

  Workaround: Remove all attributes during preprocessing,

  - At the command line, use the option `-D __attribute__(x)=`.
  - In the Polyspace environment, in **Macros** > **Preprocessor definitions**, add a row: `__attribute__(x)=`.
- **Complex types** — Only floating complex types supported, integral complex types cause an error.
- **Using built-in library function on complex types** — Not supported, stubbed during analysis. Calls to these functions return variables with full ranges.

  Workaround: To make the analysis more precise, add an include file that defines the functions for complex variables.
- **Computed `goto`** — Not supported.

  Bug Finder ignores the `goto`.
- **Nested functions** — Not supported, causes an error.
- **Using built-in library functions on atomic operators** — Not supported, Polyspace stubs the functions. This limitation can cause imprecise results.
- **IEEE floating point library functions** — Limited support, can cause imprecise results.

  This limitation includes `isnan`, `isnanf`, `isnanl`, `isinf`, `isinff`, `isinfl`, `isnormal`, and `isfinite`.

Command-Line Information

Parameter: `-dialect`
Value: `none | gnu3.4 | gnu4.6 | gnu4.7 | gnu4.8 | gnu4.9 | iso | clang3.5 | visual | visual6 | visual7.0 | visual7.1 | visual8 | visual9.0 | visual10 | visual11.0 | visual12.0`
Default: `none`

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

See Also

"Target operating system (C/C++)" on page 1-3 | "Target processor type (C/C++)" on page 1-5 | "C++11 Extensions (C++)" on page 2-7 | "Block char16/32_t types (C++)" on page 2-9

More About

- "Supported C++ 2011 Extensions"

C++11 Extensions (C++)

Allow for C++11 language extensions. This option is available on the **Target & Compiler** node in the **Configuration** pane.

If your code uses any C++11 language constructs, select this option to allow this syntax during your analysis.

Settings

Default: Off

☐ Off

The analysis does not allow C++11 syntax.

☑ On

The analysis allows C++11 syntax.

Dependencies

You can only select this option when the **Dialect** option is `none`, `gnu4.6`, or `gnu4.7`.

Command-Line Information

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

See Also

“Dialect (C++)” on page 2-2 | “Block char16/32_t types (C++)” on page 2-9

More About

- “Supported C++ 2011 Extensions”

Source code language (C++)

Specify the language of your source files. Polyspace can usually determine the project language from the source files in your project. However, you must specify the language manually for some situations. For example, if you include only C++ source files in your Polyspace project, but your larger programming project is actually C and C++, specify the `C-CPP` setting.

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

Settings

Default: `CPP`

`CPP`

If your project contains only `.cpp` 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 `.cpp` 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.

Command-Line Information

See `-lang`.

Block char16/32_t types (C++)

The analysis does not allow `char16_t` or `char32_t` types. This option is available on the **Target & Compiler** node in the **Configuration** pane.

If you have defined `char16_t` and/or `char32_t` through a `typedef` statement or using includes, this option allows you to turn off the standard Polyspace definition of `char16_t` and `char32_t`.

Settings

Default: Off

☐ Off

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

☑ On

The analysis does not allow `char16_t` and `char32_t` types.

Dependencies

You can only select this option when the **Dialect** option is either `none` or a `gnu` dialect.

Command-Line Information

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

See Also

"Dialect (C++)" on page 2-2 | "C++11 Extensions (C++)" on page 2-7

More About

- "Supported C++ 2011 Extensions"

Pack alignment value (C++)

Specify the default packing alignment for an analysis. This option is available on the **Target & Compiler** node in the **Configuration** pane.

If an invalid value is given, analysis will halt and display an error message. with a bad value or if this option is used in non visual mode (**Target operating system** `Visual` or **Dialect** `visual*`).

Settings

Default: 8

- 1
- 2
- 4
- 8
- 16

Dependencies

This analysis option is available only when,

- **Target operating system** is set to `no-predefined-OS` or `Visual`.
- and **Dialect** is set to one of the `visual*` options.

Command-Line Information

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

Import folder (C++)

Specifies a single directory to be included by `#import` directive. This option is available on the **Target & Compiler** node in the **Configuration** pane.

Settings

No default

Give the location of `*.tlh` files generated by a Visual Studio compiler when encountering `#import` directive on `*.tlb` files.

Dependencies

This analysis option is available only when,

- **Target operating system** is set to `no-predefined-OS` or `Visual`.
- and **Dialect** is set to one of the `visual*` options.

Command-Line Information

Parameter: `-import-dir`
Value: File location
Example: `polyspace-bug-finder-nodesktop -OS-target Visual -dialect visual8 -import-dir /com1/inc`

Ignore pragma pack directives (C++)

Specifies C++ `#pragma` packing alignment for structure, union, and class members. This option is available on the **Target & Compiler** node in the **Configuration** pane.

Settings

Default: Off

☐ Off

Keeps C++ `#pragma` directives in the analysis

☑ On

Allows C++ `#pragma` directives to be ignored in order to prevent link errors

Analysis will halt and display an error message with a bad value or if this option is used in non visual mode (**Target operating system** `Visual` or **Dialect** `visual*`).

Dependencies

This analysis option is available only when,

- **Target operating system** is set to `no-predefined-OS` or `Visual`.
- and **Dialect** is set to one of the `visual*` options.

Command-Line Information

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

Management of scope of 'for loop' variable index (C++)

Specify the scope of the index variable declared within a `for` loop. This option is available on the **Target & Compiler** node in the **Configuration** pane.

For example:

```
for (int index=0; ...){};
index++; // At this point, index variable is usable (out) or not (in)
```

This option allows the default behavior implied by the Polyspace `-dialect` option to be overridden.

This option is equivalent to the Visual C++ options `/Zc:forScope` and `Zc:forScope-`.

Settings

Default: `defined-by-dialect`

`defined-by-dialect`

Default behavior specified by selected dialect

`out`

The index variable is usable outside the scope of the for loop.

Default behavior for the dialect options `visual6`, `visual7` and `visual 7.1`

`in`

The index variable is not usable outside the scope of the for loop.

Default behavior for all other dialects, including `visual8`. The C++ standard specifies that the index is treated as `in`.

Command-Line Information

Parameter: `-for-loop-index-scope`
Value: `defined-by-dialect | out | in`
Default: `defined-by-dialect`
Example: `polyspace-bug-finder-nodesktop -lang cpp -for-loop-index-scope in`

Management of wchar_t (C++)

Specify how to treat `wchar_t`. This option is available on the **Target & Compiler** node in the **Configuration** pane.

This option is equivalent to the Visual C++ options `/Zc:wchar` and `/Zc:wchar-`.

Settings

Default: `defined-by-dialect`

`defined-by-dialect`

Default behavior specified by selected dialect

`typedef`

Use according to `typedef` statement specified by Microsoft Visual C++ `6.0/7.0/7.1` dialects.

Default behavior for the dialect options `visual6`, `visual7.0` and `visual7.1`

`keyword`

Use as a keyword as given by the C++ standard

Default behavior for all other dialects, including `visual8`.

Command-Line Information

Parameter: `-wchar-t-is`
Value: `defined-by-dialect | typedef | keyword`
Default: `defined-by-dialect`
Example: `polyspace-bug-finder-nodesktop -for-loop-index-scope keyword`

Set wchar_t to unsigned long (C++)

Specify the underlying type of `wchar_t` to be unsigned long. This option is available on the **Target & Compiler** node in the **Configuration** pane.

Settings

Default: Off

Off

Use the default underlying type of `wchar_t` as defined by the dialect or the **Management of wchar_t** option.

On

Set the type of `size_t` to unsigned long, as defined in the C++ standard.

For example, `sizeof(L'W')` will have the value of `sizeof(unsigned long)` and the `wchar_t` field will be aligned in the same way as the unsigned long field.

Command-Line Information

Parameter: `-wchar-t-is-unsigned-long`
Default: off
Example: `polyspace-bug-finder-nodesktop -lang cpp -wchar-t-is-unsigned-long`

Set size_t to unsigned long (C++)

Force the underlying type of `size_t` to be `unsigned long`. This option is available on the **Target & Compiler** node in the **Configuration** pane. If you use this option, you can only redefine `size_t` with a `typedef` statement to `unsigned long`.

For example, Polyspace applies the following `typedef` statement because the type is `unsigned long`:

```
typedef unsigned long size_t;
```

However, Polyspace ignores this `typedef` statement, because the **Set size_t to unsigned long** option allows only `unsigned long`.

```
typedef unsigned int size_t;
```

Settings

Default: Off

☐ Off

Use the default underlying type of `size_t`, unsigned int

☑ On

Set the type of `size_t` to unsigned long

Command-Line Information

Parameter: `-size-t-is-unsigned-long`
Default: off
Example: `polyspace-bug-finder-nodesktop -lang cpp -size-t-is-unsigned-long`

Ignore link errors (C++)

Ignore linkage errors. This option is available on the **Environment Settings** node in the **Configuration** pane.

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

Default: Off

☐ Off

Stop analysis for linkage errors.

☑ On

Ignore the linkage errors if possible.

Command-Line Information

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

Functions to stub (C++)

Specify functions to stub during verification. This option is available on the **Inputs & Stubbing** node in the **Configuration** pane.

For these 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.

Settings

No Default

Click to enter function name.

When entering function names, use one of the following syntaxes:

- Basic syntax, with extensions for classes and templates:

Function Type	Syntax
Simple function	`test`
Class method	`A::test`
Template method	`A<T>::test`

- Syntax with function arguments, to differentiate overloaded functions. Function arguments are separated with semicolons:

Function Type	Syntax
Simple function	`test()`
Class method	`A::test(int;int)`
Template method	`A<T>::test<T>::test(T;T)`

Command-Line Information

Parameter: `-functions-to-stub`
No Default

Value: `function1[,function2[,...]]`
Example: `polyspace-code-prover-nodesktop -sources file_name -functions-to-stub function_1,function_2`

Check MISRA C++ rules

Specify whether to check for violation of MISRA C++ rules. Each value of the option corresponds to a subset of rules to check. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane. For projects with mixed C and C++ code, the MISRA C++ checker analyzes only `.cpp` files.

After analysis, the **Results Summary** 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 [folder icon] 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
```

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`

Related Examples

- "Specify Analysis Options"
- "Activate Coding Rules Checker"
- "Select Specific MISRA or JSF Coding Rules"

More About

- "Polyspace MISRA C++ Checker"
- "Software Quality Objective Subsets (C++)"
- "MISRA C++ Coding Rules"

Check JSF C++ rules

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. This option is available on the **Coding Rules & Code Metrics** node in the **Configuration** pane. For projects with mixed C and C++ code, the JSF C++ checker analyzes only `.cpp` files.

After analysis, the **Results Summary** 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 dialect other than ISO, some rules might not be completely checked. For example, AV Rule 8: "All code shall conform to ISO/IEC 14882:2002(E) standard C++."

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`

Related Examples

- "Specify Analysis Options"
- "Activate Coding Rules Checker"
- "Select Specific MISRA or JSF Coding Rules"

More About

- "Polyspace JSF C++ Checker"
- "JSF C++ Coding Rules"

Files and folders to ignore (C++)

Specify files and folders to ignore during coding rules checking and during Bug Finder defect checking. This option is available on the **Inputs & Stubbing** node in the **Configuration** pane.

Settings

Default: `all-headers`

`all-headers`

Ignores `.h` or `.hpp` files

`all`

Ignores all files in include folders

`custom`

Ignore include files and folders that you specify in the **File/Folder** view. To add files to the custom **File/Folder** list, select [folder icon] to choose the files and folders to exclude. To remove a file or folder from the list of excluded files and folders, select the row. Then click [delete icon].

Command-Line Information

Parameter: `-includes-to-ignore`
Value: `all-headers` | `all` | *`file1`*`[,`*`file2`*`[,...]]` | *`folder1`*`[,`*`folder2`*`[,...]]`
Default: `all-headers`
Example: `polyspace-bug-finder-nodesktop -lang cpp -sources` *`file_name`* `-jsf-coding-rules required-rules -includes-to-ignore "C:\usr\include"`

See Also

"Check MISRA C++ rules" | "Check JSF C++ rules"

Related Examples

- "Specify Analysis Options"
- "Activate Coding Rules Checker"

Other (C++)

This option is for adding nonofficial or expert options to the analyzer. This option is available on the **Advanced Settings** node in the **Configuration** pane. Each word of the option (even the parameters) must be preceded by `-extra-flags`.

These flags will be given to you by MathWorks if required.

No Default

Example Shell Script Entry:

```
polyspace-bug-finder-nodesktop -extra-flags -param1 -extra-flags -
param2
```

-cpp-extra-flags flag

It specifies an expert option to be added to a C++ analysis. Each word of the option (even the parameters) must be preceded by `-cpp-extra-flags`.

These flags will be given to you by MathWorks if required.

No Default

Example Shell Script Entry:

```
polyspace-bug-finder-nodesktop -cpp-extra-flags -stubbed-new-may-
return-null
```

-il-extra-flags flag

It specifies an expert option to be added to a C++ analysis. Each word of the option (even the parameters) must be preceded by `-il-extra-flags`.

These flags will be given to you by MathWorks if required.

No Default

Example Shell Script Entry:

```
polyspace-bug-finder-nodesktop -il-extra-flags flag
```

Termination functions (C++)

This option is available only for model-generated code.

Specify functions that the generated `main` must call after the cyclic code loop. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

No Default

Click [+] to add a field. Enter function name. For class methods, use the syntax `className::functionName`.

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 (C++)" on page 2-31 | "Inputs (C++)" on page 2-33 | "Initialization functions (C++)" on page 2-28 | "Step functions (C++)" on page 2-29

Related Examples

- "Specify Analysis Options"
- "Configure Simulink Model"

More About

- "Recommended Polyspace Bug Finder Options for Analyzing Generated Code"

- “Main Generation for Model Analysis”

Initialization functions (C++)

This option is available only for model-generated code.

Specify functions that the generated `main` must call before the cyclic code begins. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

No Default

Click to add a field. Enter function name. For class methods, use the syntax `className::functionName`.

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 (C++)” on page 2-31 | “Inputs (C++)” on page 2-33 | “Step functions (C++)” on page 2-29 | “Termination functions (C++)” on page 2-26

Related Examples

- “Specify Analysis Options”
- “Configure Simulink Model”

More About

- “Recommended Polyspace Bug Finder Options for Analyzing Generated Code”
- “Main Generation for Model Analysis”

Step functions (C++)

This option is available only for model-generated code.

Specify functions that the generated `main` must call in each cycle of the cyclic code. This option is available on the **Main Generator** node in the **Configuration** pane.

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.

`custom`

The generated `main` calls functions that you specify. Click [+] to add a field. Enter function name. For class methods, use the syntax `className::functionName`.

Tips

- If you specify a function for the option **Initialization functions** or **Termination functions**, you cannot specify it for **Step functions**.

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 (C++)" on page 2-31 | "Inputs (C++)" on page 2-33 | "Initialization functions (C++)" on page 2-28 | "Termination functions (C++)" on page 2-26

Related Examples

- "Specify Analysis Options"
- "Configure Simulink Model"

More About

- "Recommended Polyspace Bug Finder Options for Analyzing Generated Code"
- "Main Generation for Model Analysis"

Parameters (C++)

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. This option is available on the **Main Generator** node in the **Configuration** pane.

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 class members, use the syntax `className::variableName`.

Command-Line Information

Parameter: `-variables-written-before-loop`
Value: `none | all | custom=`*`variable1`*`[,`*`variable2`*`[,...]]`
Default: `none`
Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator -variables-written-before-loop all`

See Also

"Inputs (C++)" on page 2-33 | "Initialization functions (C++)" on page 2-28 | "Step functions (C++)" on page 2-29 | "Termination functions (C++)" on page 2-26

Related Examples

- "Specify Analysis Options"

- “Configure Simulink Model”

More About

- “Recommended Polyspace Bug Finder Options for Analyzing Generated Code”
- “Main Generation for Model Analysis”

Inputs (C++)

This option is available only for model-generated code.

Specify variables that the generated `main` must write to, at the beginning of every iteration of the cyclic code loop. At the beginning of every loop iteration, Polyspace considers these variables to have any value allowed by their type. This option is available on the **Main Generator** node in the **Configuration** pane.

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 class members, use the syntax `className::variableName`.

Command-Line Information

Parameter: `-variables-written-in-loop`
Value: `none | all | custom=`*`variable1`*`[,`*`variable2`*`[,...]]`
Default: `public`
Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator -variables-written-in-loop all`

See Also

"Parameters (C++)" on page 2-31 | "Initialization functions (C++)" on page 2-28 | "Step functions (C++)" on page 2-29 | "Termination functions (C++)" on page 2-26

Related Examples

- "Specify Analysis Options"

- “Configure Simulink Model”

More About

- “Recommended Polyspace Bug Finder Options for Analyzing Generated Code”
- “Main Generation for Model Analysis”

Verify module (C++)

This option is available only for model-generated code.

Specify that Polyspace must generate a `main` function during verification if it does not find one in the source files. This option is available on the **Main Generator** node in the **Configuration** pane.

Settings

Default: On

On

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**.
2. Calls functions specified by **Initialization functions** ahead of other functions.
3. Calls functions specified by **Functions to call** in arbitrary order.
4. Calls class methods specified by **Class** and **Functions to call within the specified classes**.

If you do not specify the above options explicitly, the generated `main`:

- Initializes all global variables except those declared with keywords `const` and `static`.
- Calls in arbitrary order all functions and class methods that are not called anywhere in the source files. Polyspace considers that global variables can be written between two consecutive function or methods calls. Therefore, in each called function or method, global variables initially have the full range of values allowed by their type.

Off

Polyspace stops verification if it does not find a `main` function in the source files.

Command-Line Information

Parameter: `-main-generator`
Default: Off

Example: `polyspace-bug-finder-nodesktop -sources` *`file_name`* `-main-generator ...`

See Also

"Initialization functions (C++)" on page 2-28

Related Examples

- "Specify Analysis Options"
- "Configure Simulink Model"

More About

- "Main Generation for Model Analysis"

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.

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`.

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`

-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`.

Note: In the Polyspace environment, select [icon] 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`

-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`

-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`

-I

Specify include folder for compilation

Syntax

`-I folder`

Description

`-I folder` specifies the name of a folder that you must include when compiling C sources. You can specify only one folder for each instance of `-I`. However, you can specify this option multiple times.

Polyspace software 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`

-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.

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`

-lang

Specify code language for the project

Syntax

`-lang [c|cpp|c-cpp]`

Description

`-lang [c|cpp|c-cpp]` specifies the source code language for the project, either `c` for C code only, `cpp` for C++ code only, or `c-cpp` for a mix of C and C++ code.

If you do not specify a language, Polyspace tries to detect the language from the source files.

Note: In the Polyspace user interface, specify the project language when you create a new project. For more information, see "Create New Project".

Examples

Define the language of your Polyspace project as C++.

```
polyspace-bug-finder-nodesktop -lang cpp -sources...
```

See Also

"Source code language (C++)" on page 2-8 | `polyspaceBugFinder`

-max-processes

Specify the maximum number of processes that can run simultaneously on a multicore system.

Syntax

`-max-processes` *`num`*

Description

`-max-processes` *`num`* specifies the maximum number of processes that can run simultaneously on a multicore system. The valid range of *`num`* is 1 to 128. The default is the maximum number of available CPUs.

Examples

Disable parallel processing during the analysis.

```
polyspace-bug-finder-nodesktop -max-processes 1
```

See Also

`polyspaceBugFinder`

-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
-dialect none
-dos
-misra2 required-rules
-includes-to-ignore 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`

-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`

-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`.

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 (C/C++)" on page 1-67 | "Report template (C/C++)" on page 1-64 |
`polyspaceBugFinder`

-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. In the user interface, the default location is `C:Polyspace_Results`.

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`

-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`

-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. The list must be in quotations and separated by commas. 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`

-sources-list-file

Specify file containing list of sources

Syntax

`-sources-list-file "*filename*"`

Description

`-sources-list-file "filename"` specifies 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`

-support-FX-option-results

Allow partial translation of sources with managed extensions

Syntax

`-support-FX-option-results`

Description

`-support-FX-option-results` allows the analysis of a project containing translated sources obtained by compilation of a Visual project using the /FX Visual option.

Visual C++ /FX option allows the partial translation of sources making use of managed extensions to Visual C++ sources without managed extensions.

Using /FX, the translated files are generated in place of the original ones in the project, but the names are changed from `foo.ext` to `foo.mrg.ext`.

These extensions are currently not taken into account by Polyspace analysis and can be considered as a limitation to analyze this kind of code. Managed files need to be located in the same folder as the original ones and Polyspace software will analyze managed files instead of the original ones without intrusion, and will permit you to remove part of the limitations due to specific extensions.

Dependencies

This analysis option is available only when your configuration includes both,

- `-OS-target` set to `no-predefined-OS` or `Visual`.
- `-dialect` set to *`visual*`*, where *`visual*`* is one of the Visual C++ dialect options.

Examples

Assign a project author to your Polyspace Project.

```
polyspace-bug-finder-nodesktop -lang cpp
     -OS-target Visual
     -dialect visual10
    -support-FX-option-results
```

See Also

`-date` | `-prog` | "Target operating system (C/C++)" on page 1-3 | "Dialect (C++)" on page 2-2 | `polyspaceBugFinder`

-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.

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`

-tmp-dir-in-results-dir

Keep temporary files in results folder

Syntax

```
-tmp-dir-in-results-dir
```

Description

`-tmp-dir-in-results-dir` keeps temporary files in the results folder. By default, temporary files are stored in the standard `/temp` or `C:\Temp` folder. This option stores the temporary files in a subfolder of the results folder. Use this option only when the temporary folder partition does not have enough disk space. If the results folder is mounted on a network drive, this option can slow down your processor.

Examples

Store temporary files in the results folder.

```
polyspace-bug-finder-nodesktop -tmp-dir-in-results-dir
```

See Also

`polyspaceBugFinder`

-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`

4

Checks

*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 4-3.

- 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` • The `if` block does not execute.	• The statement `(r1 = r0).isOk()` returns `r0.m_b` which has value `true` • The `if` block executes.

Correction — Return `*this`

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

Category: Object oriented
Language: C++
Default: Off
Command-Line Syntax: `return_not_ref_to_this`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2015b

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++`.

Correction — Avoid NULL Pointer Arithmetic

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Null pointer

More About

- "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`.

Correction — Keep Array Index Within Array Bounds

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Pointer access out of bounds

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-119: Improper Restriction of Operations within the Bounds of a Memory Buffer
- CWE-466: Return of Pointer Value Outside of Expected Range

Introduced in R2013b

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

```
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.

Correction — Change Assert Expression

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.

```
void asserting_x(unsigned int theta) {

    theta =+ 5;
    assert(theta > 0);
}
```

Correction — Fix Code

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.

```
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 (C/C++)" on page 1-60

More About

- "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. According to the ANSI C standard, the valid access modes for `fopen` are: • `r`,`r+` • `w`,`w+` • `a`,`a+` • `rb`, `wb`, `ab` • `r+b`, `w+b`, `a+b` • `rb+`, `wb+`, `ab+`	`fopen` has undefined behavior for invalid access modes. Some implementations allow extension of the access mode such as: • GNU: `rb +cmxe,ccs=utf` • Visual C++: `a+t`, where `t` specifies a text mode. However, your access mode string must begin with one of the valid sequences.	Pass a valid access mode to `fopen`.
You pass the status flag `O_APPEND` to the `open` function without combining	`O_APPEND` indicates that you intend to add new content at the end of a	Pass either `O_APPEND|O_WRONLY` or `O_APPEND|O_RDWR` as access mode.

Situation	Risk	Fix
it with either O_WRONLY or O_RDWR.	file. However, without O_WRONLY or O_RDWR, you cannot write to the file. The open function does not return -1 for this logical error.	
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. 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.

Correction — Use Either `r` or `w` as Access Mode

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

Category: Programming
Language: C/C++
Default: Off
Command-Line Syntax: `bad_file_access_mode_status`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE 628: Function Call with Incorrectly Specified Arguments
- CWE 686: Function Call with Incorrect Argument Type

Introduced in R2015b

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**.

Correction — Call Base Class Copy Assignment Operator

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

Category: Object oriented
Language: C++
Default: On

Command-Line Syntax: `missing_base_assign_op_call`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

`Copy constructor not called in initialization list`

More About

- "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.

Correction — Make Base Class Destructor Virtual

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

Category: Object oriented
Language: C++
Default: On
Command-Line Syntax: `dtor_not_virtual`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CERT C++ Coding Standard: OOP52-CPP — Do not delete a polymorphic object without a virtual destructor

Introduced in R2015b

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.

Correction — Use Smaller Precision in Format Specifier

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

Category: Static memory
Language: C/C++
Default: On
Command-Line Syntax: `str_format_buffer_overflow`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–124: Buffer Underwrite (Buffer Underflow)
- CWE–125: Out-of-bounds Read
- CWE–126: Buffer Over-read
- CWE–127: Buffer Under-read

Introduced in R2015b

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.
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. For instance, replace `memset(a, -13,`

Issue	Risk	Possible Fix
		`sizeof(a))` with `memset(a, (-13) & 0xFF, sizeof(a))`.

Examples

Value Cannot Be Represented in a Byte

```
#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.

Correction — Apply Cast

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.

```
#define SIZE 32
void func(void) {
    char buf[SIZE   ];
    int c = -2;
    memset(buf, (unsigned char)c, sizeof(buf));
}
```

Result Information

Category: Programming
Language: C/C++
Default: Off
Command-Line Syntax: `memset_invalid_value`
Impact: Low

See Also

Polyspace Analysis Options
"Find defects (C/C++)" on page 1-60

Polyspace Results
Use of memset with size argument zero

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-665: Improper Initialization

Introduced in R2015b

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.

Correction — Remove Close Operation

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

Category: Resource management
Language: C/C++
Default: On
Command-Line Syntax: `double_resource_close`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE 672: Operation on a Resource after Expiration or Release

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.

Correction — Change `#if 0` to `#if 1`

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 (C/C++)" on page 1-60

Polyspace Results
`Dead code` | `Unreachable code` | `Useless if`

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2013b

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**.

Correction — Call Base Class Copy Constructor

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

Category: Object oriented
Language: C++
Default: On
Command-Line Syntax: `missing_copy_ctor_call`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

`Base class assignment operator not called`

More About

- "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

Category: Programming
Language: C/C++
Default: Off
Command-Line Syntax: `overlapping_copy`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Overlapping assignment

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-475: Undefined Behavior for Input to API
- CWE-628: Function Call with Incorrectly Specified Arguments
- CWE-687: Function Call with Incorrectly Specified Argument Value

Introduced in R2015b

Data race

Multiple tasks perform unprotected non-atomic operations on shared variables

Description

Data race occurs when:

- Multiple tasks perform unprotected operations on a shared variable.
- At least one task performs a read operation and another task performs a write operation.
- 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**.

Examples

Multiple Tasks Call the Same Function

```
int var;
void begin_critical_section();
void end_critical_section();

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:

<table>
<tr><th>Option</th><th colspan="2">Specification</th></tr>
<tr><td>Configure multitasking manually</td><td colspan="2"></td></tr>
<tr><td>Entry points</td><td colspan="2"><code>task1</code>

<code>task2</code>

<code>task3</code></td></tr>
<tr><td rowspan="2">Critical section details</td><td>Starting procedure</td><td>Ending procedure</td></tr>
<tr><td><code>begin_critical_section</code></td><td><code>end_critical_section</code></td></tr>
</table>

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.

Correction — Place Critical Section Inside Function Call

One possible correction is to place the operation 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 end_critical_section();
void increment(void) {
      begin_critical_section();
      var++;
      end_critical_section();
}

void task1(void)  {
      increment();
}

void task2(void)  {
      increment();
}

void task3(void)  {
      increment();
}
```

Correction — Place Critical Section Outside Function Call

Another possible correction is to call `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 end_critical_section();
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();
}
```

Correction — Make Tasks Temporally Exclusive

Another possible correction is to make the tasks `task1` and `task2` temporally exclusive. Temporally exclusive tasks cannot execute concurrently.

On the **Configuration** pane:

1. Select **Multitasking**.
2. For **Temporally exclusive tasks**, enter `task1 task2`.

Check Information

Group: Concurrency
Language: C | C++
Default: On
Command-Line Syntax: `data_race`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60 | "Target processor type (C/C++)" on page 1-5 | "Configure multitasking manually (C/C++)" on page 1-34 | "Entry points (C/C++)" on page 1-35

Polyspace Results

Data race including atomic operations | Deadlock | Double lock | Double unlock | Missing lock | Missing unlock

More About

- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

External Websites

- CWE-366: Race Condition within a Thread

Introduced in R2014b

Data race including atomic operations

Multiple tasks perform unprotected operations on shared variables

Description

Data race occurs when:

- Multiple tasks perform unprotected operations on a shared variable.
- At least one task performs a read operation and another task performs a write operation.

The operations can be either atomic or non-atomic. For data race on non-atomic operations alone, see 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

Data Race on Atomic Access

```
#include<stdio.h>

int var;
void begin_critical_section();
void end_critical_section();

void task1(void) {
    var = 1;
}

void task2(void) {
    int local_var;
    local_var = var;
    printf("%d", local_var);
}

void task3(void) {
```

```
    begin_critical_section();
    var++;
    end_critical_section();
}
```

In this example, to emulate multitasking behavior, specify the following options:

<table>
<tr><th>Option</th><th colspan="2">Specification</th></tr>
<tr><td>Configure multitasking manually</td><td colspan="2">☑</td></tr>
<tr><td>Entry points</td><td colspan="2"><code>task1</code>

<code>task2</code>

<code>task3</code></td></tr>
<tr><td rowspan="2">Critical section details</td><td>Starting procedure</td><td>Ending procedure</td></tr>
<tr><td><code>begin_critical_section</code></td><td><code>end_critical_section</code></td></tr>
</table>

In this example, the write operation `var=1;` in task `task1` executes concurrently with the read operation `local_var=var;` in task `task2`.

Correction — Use Critical Sections

One possible correction is to place the operations

- `var=1;` in `task1`
- `local_var=var;` in `task2`

in the same critical section. 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, 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();
    var++;
    end_critical_section();
}
```

Correction — Make Tasks Temporally Exclusive

Another possible correction is to make the tasks `task1` and `task2` temporally exclusive. Temporally exclusive tasks cannot execute concurrently.

On the **Configuration** pane:

1. Select **Multitasking**.
2. For **Temporally exclusive tasks**, enter `task1 task2`.

Check Information

Group: Concurrency
Language: C | C++
Default: Off
Command-Line Syntax: `data_race_all`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60 | "Configure multitasking manually (C/C++)" on page 1-34 | "Entry points (C/C++)" on page 1-35

Polyspace Results

Data race | Deadlock | Double lock | Double unlock | Missing lock | Missing unlock

More About

- “Set Up Multitasking Analysis Manually”
- “Review Concurrency Defects”

External Websites

- CWE-366: Race Condition within a Thread

Introduced in R2014b

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`
	
	`task2`	

Critical section details	**Starting procedure**	**Ending procedure**
	`begin_critical_section_`	`end_critical_section_1`
	`begin_critical_section_`	`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`.

Correction-Follow Same Locking Sequence in Both Tasks

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`
	`task2`
	`task3`	

Critical section details	**Starting procedure**	**Ending procedure**
	`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`.

Correction — Break Cyclic Order

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`.

```
void performTaskCycle();

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60 | "Configure multitasking manually (C/C++)" on page 1-34 | "Entry points (C/C++)" on page 1-35 | "Critical section details (C/C++)" on page 1-37 | "Temporally exclusive tasks (C/C++)" on page 1-39

Polyspace Results

Data race including atomic operations | Data race | Double lock | Double unlock | Missing lock | Missing unlock

More About

- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

External Websites

- CWE-833: Deadlock

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){
         return 0;  /*Defect: Condition always false */
    }
    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.

Correction — Remove Dead Code

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, 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.

Correction — Change Condition

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, 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

See Also

Polyspace Analysis Options
“Find defects (C/C++)” on page 1-60

Polyspace Results
`Code deactivated by constant false condition` | `Unreachable code` | `Useless if`

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-561: Dead Code

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.

Correction — Remove Duplicate Deallocation

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Use of previously freed pointer

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-415: Double Free

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*.

Correction — Align the Function Return Values

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

<table>
<tr>
<td>

test1.c

```
#include "square.h"
#include "circle.h"
struct aCircle circle;
struct aSquare square;

int main(){
    square.side=1;
    circle.radius=1;
    return 0;
}
```

</td>
<td>

test2.c

```
#include "circle.h"
#include "square.h"
struct aCircle circle;
struct aSquare square;

int main(){
    square.side=1;
    circle.radius=1;
    return 0;
}
```

</td>
</tr>
<tr>
<td>

circle.h

```
#pragma pack(1)

extern struct aCircle{
    int radius;
} circle;
```

</td>
<td>

square.h

```
extern struct aSquare {
    unsigned int side:1;
} square;
```

</td>
</tr>
</table>

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.

Correction — Close Packing Statements

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	*test2.c*

`#include "square.h"`
`#include "circle.h"`
`struct aCircle circle;`
`struct aSquare square;`
 	
`int main(){`
`    square.side=1;`
`    circle.radius=1;`
`    return 0;`
`}`
	`#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.

Correction — Use the `Ignore pragma pack directives` Option

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60 | "Ignore pragma pack directives (C++)" on page 2-12

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-685: Function Call With Incorrect Number of Arguments
- CWE-686: Function Call With Incorrect Argument Type

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.

Correction — Cast `void*` Pointer to `MyClass*`

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

Category: Good practice
Language: C++
Default: Off
Command-Line Syntax: `delete_of_void_ptr`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "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.

Correction — Use `snprintf` Instead of `sprintf`

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

Category: Static memory
Language: C/C++
Default: On
Command-Line Syntax: `strlib_buffer_overflow`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Destination buffer underflow in string manipulation

More About

- "Navigate to Root Cause of Defect"

- "Review and Fix Results"

External Websites

- CWE–121: Stack-based Buffer Overflow
- CWE–125: Out-of-bounds Read
- CWE–251: Often Misused: String Management
- CWE–787: Out-of-bounds Write

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 overflow 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`.

Correction — Change Pointer Decrementer

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Destination buffer overflow in string manipulation

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–124: Buffer Underwrite ('Buffer Underflow')
- CWE–786: Access of Memory Location Before Start of Buffer
- CWE–787: Out-of-bounds Write

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 `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, 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 BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    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	☑	
Entry points	my_task	
Critical section details	**Starting procedure**	**Ending procedure**
	BEGIN_CRITICAL_SECTION	END_CRITICAL_SECTION

`my_task` enters a critical section through the call `BEGIN_CRITICAL_SECTION();`. `my_task` calls `BEGIN_CRITICAL_SECTION` again before it leaves the critical section through the call `END_CRITICAL_SECTION();`.

Correction — Remove First Lock

If you want the first `global_var+=1;` to be outside the critical section, one possible correction is to remove the first call to `BEGIN_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 my_task(void)
{
    global_var += 1;
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

Correction — Remove Second Lock

If you want the first `global_var+=1;` to be inside the critical section, one possible correction is to remove the second call to `BEGIN_CRITICAL_SECTION`.

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void my_task(void)
{
```

```
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

Correction — Add Another Unlock

If you want the second `global_var+=1;` to be inside a critical section, another possible correction is to add another call to `END_CRITICAL_SECTION`.

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

Double Lock with Function Call

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void performOperation(void) {
  BEGIN_CRITICAL_SECTION();
  global_var++;
}

void my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    performOperation();
    END_CRITICAL_SECTION();
```

```
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

Option	Specification	
Configure multitasking manually	☑	
Entry points	`my_task`	
Critical section details	**Starting procedure**	**Ending procedure**
	`BEGIN_CRITICAL_SECTION`	`END_CRITICAL_SECTION`

`my_task` enters a critical section through the call `BEGIN_CRITICAL_SECTION();`. `my_task` calls the function `performOperation`. In `performOperation`, `BEGIN_CRITICAL_SECTION` is called again even though `my_task` has not left the critical section through the call `END_CRITICAL_SECTION();`.

Correction — Remove Second Lock

One possible correction is to remove the call to `BEGIN_CRITICAL_SECTION` in `my_task`.

```
int global_var;

void BEGIN_CRITICAL_SECTION(void);
void END_CRITICAL_SECTION(void);

void performOperation(void) {
  global_var++;
}

void my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    performOperation();
    END_CRITICAL_SECTION();
}
```

Check Information

Group: Concurrency

Language: C | C++
Default: On
Command-Line Syntax: `double_lock`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60 | "Configure multitasking manually (C/C++)" on page 1-34 | "Entry points (C/C++)" on page 1-35 | "Critical section details (C/C++)" on page 1-37 | "Temporally exclusive tasks (C/C++)" on page 1-39

Polyspace Results

Data race including atomic operations | Data race | Deadlock | Double unlock | Missing lock | Missing unlock

More About

- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

External Websites

- CWE-764: Multiple Locks of a Critical Resource

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 `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, 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 my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_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	☑	
Entry points	my_task	
Critical section details	**Starting procedure**	**Ending procedure**
	BEGIN_CRITICAL_SECTION	END_CRITICAL_SECTION

my_task enters a critical section through the call BEGIN_CRITICAL_SECTION();. my_task leaves the critical section through the call END_CRITICAL_SECTION();. my_task calls END_CRITICAL_SECTION again without an intermediate call to BEGIN_CRITICAL_SECTION.

Correction — Remove Second Unlock

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 my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
    global_var += 1;
}
```

Correction — Remove First Unlock

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 my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    global_var += 1;
    END_CRITICAL_SECTION();
}
```

Correction — Add Another Lock

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 my_task(void)
{
    BEGIN_CRITICAL_SECTION();
    global_var += 1;
    END_CRITICAL_SECTION();
    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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60 | "Configure multitasking manually (C/C++)" on page 1-34 | "Entry points (C/C++)" on page 1-35 | "Critical section details (C/C++)" on page 1-37 | "Temporally exclusive tasks (C/C++)" on page 1-39

Polyspace Results

Data race including atomic operations | Data race | Deadlock | Double lock | Missing lock | Missing unlock

More About

- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

External Websites

- CWE-765: Multiple Unlocks of a Critical Resource

Introduced in R2014b

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.

Correction: Catch Exception by Reference

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.

Correction — Catch Exceptions by Reference

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

Category: Programming
Language: C++
Default: On
Command-Line Syntax: `excp_caught_by_value`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "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.

Correction — Reorder `catch` Statement

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

Category: Programming
Language: C++
Default: On
Command-Line Syntax: `excp_handler_hidden`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-755: Improper Handling of Exceptional Conditions

Introduced in R2015b

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 (C/C++)” on page 1-5.

Examples

Multiplication of Floats

```
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.

Correction — Different Storage Type

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.

```
double square(void) {
    float val = FLT_MAX;

    return val * val;
}
```

Check Information

Group: Numerical

Language: C | C++
Default: Off
Command-Line Syntax: `float_ovfl`
Impact: Low

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Integer overflow | Unsigned integer overflow

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-682: Incorrect Calculation
- CWE-873: CERT C++ Secure Coding Section 05 - Floating Point Arithmetic (FLP)

Introduced in R2013b

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 (C/C++)" on page 1-5.

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

See Also

Polyspace Analysis Options
"Find defects (C/C++)" on page 1-60

Polyspace Results
Integer conversion overflow | Unsigned integer conversion overflow | Sign change integer conversion overflow

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-197: Numeric Truncation Error
- CWE-681: Incorrect Conversion between Numeric Types

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.

Correction — Check Before Division

```
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.

Correction — Change Denominator

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

Category: Numerical
Language: C | C++
Default: On
Command-Line Syntax: `float_zero_div`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Integer division by zero

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-369: Divide By Zero

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

```
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`.

Correction — Use an Unsigned Long Format Specifier

One possible correction is to use the `%lu` format specifier. This specifier matches the `unsigned` integer type and `long` size of `fst`.

```
void string_format(void) {

    unsigned long fst = 1;

    printf("%lu\n", fst);
}
```

Correction — Use an Integer Argument

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`.

```
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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Invalid use of standard library string routine

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- Standard library output functions
- CWE-685: Function Call With Incorrect Number of Arguments
- CWE-686: Function Call With Incorrect Argument Type

Introduced in R2013b

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

Hardcoded buffer size causes the following issues:

- Hardcoded 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 hardcoded 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

Hardcoded 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.

Correction — Use Symbolic Name

One possible correction is to replace the hardcoded 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

Category: Good practice
Language: C/C++
Default: Off
Command-Line Syntax: `hard_coded_buffer_size`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–547: Use of Hard-coded, Security-relevant Constants

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

Hardcoded loop boundary causes the following issues:

- Hardcoded loop boundary makes the code vulnerable to denial of service attacks when the loop involves time-consuming computation or resource allocation.
- Hardcoded 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 hardcoded 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.

Correction — Use Symbolic Name

One possible correction is to replace the hardcoded 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

Category: Good practice
Language: C/C++
Default: Off
Command-Line Syntax: `hard_coded_loop_boundary`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–547: Use of Hard-coded, Security-relevant Constants

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. Unused array initializer elements indicate a possible coding error.	Place braces correctly.
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.

Issue	Risk	Possible Fix
In your designated initializer, you initialize an element twice.	The first initialization is overridden. 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

```
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}`.

Correction — Place Braces Correctly

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.

Correction — Explicitly Initialize All Elements

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.

Correction — Fix Redundant Initialization

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.

Correction — Use Only Designated Initializers

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

Category: Programming
Language: C/C++
Default: On
Command-Line Syntax: `improper_array_init`
Impact: Medium

See Also

“Find defects (C/C++)” on page 1-60

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE–665: Improper Initialization

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.

Correction — Unhide Base Class Method

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`.

Correction — Add `const` Qualifier to Derived Class Method

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`.

Correction — Use Reference for Parameter of Derived Class Method

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

Category: Object oriented
Language: C++
Default: On
Command-Line Syntax: `virtual_func_hiding`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "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. 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.

For more information, see CERT C Coding Standard: EXP08-C— Ensure pointer arithmetic is used correctly.

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.

Correction — Remove `sizeof` Operator

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.

Correction — Apply Cast Before Pointer Arithmetic

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

Category: Programming
Language: C/C++
Default: On
Command-Line Syntax: `bad_ptr_scaling`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE 468: Incorrect Pointer Scaling

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 (C/C++)” on page 1-5.

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.

Correction — Change Conversion Type

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

See Also

Float conversion overflow | Unsigned integer conversion overflow | Sign change integer conversion overflow | “Find defects (C/C++)” on page 1-60

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-190: Integer Overflow or Wraparound
- CWE-191: Integer Underflow (Wrap or Wraparound)
- CWE-197: Numeric Truncation Error

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.

Correction — Check Before Division

```
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.

Correction — Change Denominator

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.

Correction — Check Divisor Before Operation

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];
}
```

Correction — Change Divisor

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

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60

Polyspace Results

Float division by zero

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-369: Divide By Zero

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 (C/C++)” on page 1-5.

Examples

Addition of Maximum Integer

```
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.

Correction — Different Storage Type

One possible correction is to change data types. Store the result of the operation in a larger data type. In this example, by returning a `long` instead of an `int`, the overflow error is fixed.

```
long plusplus(void) {

    long lvar = INT_MAX;
    lvar++;
    return lvar;
```

```
}
```

Check Information

Group: Numerical
Language: C | C++
Default: Off
Command-Line Syntax: `int_ovfl`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Unsigned integer overflow | Float overflow

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-190: Integer Overflow or Wraparound
- CWE-191: Integer Underflow (Wrap or Wraparound)

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.

Correction — Do Not Rely on Memory Organization

One possible correction is not perform direct computation on addresses to access separately declared variables.

Result Information

Category: Programming
Language: C/C++
Default: On
Command-Line Syntax: `invalid_memory_assumption`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–188: Reliance on Data/Memory Layout

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.

Correction: Remove Pointer Deallocation

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;
```

```
}
```

Correction — Introduce Pointer Allocation

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;
   }
```

Deleting an Array

```
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[]`. Do not use `delete` without the brackets when deleting arrays.

Correction — Match `delete` to Declaration

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;
```

```
}
```

Correction — Initialize Using Brackets

Another possible correction is to change the declaration of `p_scale`. Perhaps you meant to initialize `p_scale` as 5 itself instead of an array of size 5. For this correction, change the 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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Invalid free of pointer | Memory leak

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–404: Improper Resource Shutdown or Release

Introduced in R2013b

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.

Correction — Remove Pointer Deallocation

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 */
 }
```

Correction — Introduce Pointer Allocation

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

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60

Polyspace Results

Invalid deletion of pointer

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-404: Improper Resource Shutdown or Release
- CWE-590: Free of Memory not on the Heap
- CWE-762: Mismatched Memory Management Routines

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.

Correction — Change to Assignment Operator

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Invalid use of = operator

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-482: Comparing instead of Assigning

Introduced in R2013b

Invalid use of = operator

Assignment in control statement

Description

Invalid use of = operator occurs when an assignment is made inside a logical statement, such as `if` or `while`. Use the equals operator as an assignment operator, not to determine equality. A common correction for this defect is adding a second equal sign (==).

Examples

Assignment in an `if`-Statement

```
#include <stdio.h>

void equality_test(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 if-statement. Due to the single equal sign, the statement assigns the value `beta` to `alpha`, then determines the logical value of `alpha`.

Correction — Equality Operator in `if`-Statement

One possible correction is adding an additional equal sign. This correction changes the assignment operator to an equality operator. The if-statement evaluates the equality between `alpha` and `beta`.

```
#include <stdio.h>

void equality_test(int alpha, int beta)
{
```

```
    if(alpha == beta){
        printf("Equal\n");
    }
}
```

Correction — Assignment Inside an `if`-Statement

If an assignment must be made inside a control statement, one possible correction is clarifying the control statement. This correction assigns the value of `beta` to `alpha`, and determines if `alpha` is nonzero.

```
#include <stdio.h>

void equality_test(int alpha, int beta)
{
    if((alpha = beta) != 0){
        printf("Equal\n");
    }
}
```

Check Information

Group: Programming
Language: C | C++
Default: On for handwritten code, off for generated code
Command-Line Syntax: `bad_equal_use`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Invalid use of == operator

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-481: Assigning instead of Comparing

Introduced in R2013b

Invalid use of floating point operation

Imprecise comparison of floating point variables

Description

Invalid use of floating point operation 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.

There are two situations when Polyspace does not flag floating point comparison: when one of the operands is `0.0` because zero can be represented exactly, and when comparing a variable against itself such as `foo == foo` or `foo != foo`.

Examples

Two Equal Floats

```
float onePointOne(void) {
    float flt = 1.0;
    if (flt == 1.1)
        return flt;
    return 0;
}
```

In this function, the if-statement tests the equality of `flt` and the number 1.1. Even though the equality in this function is obvious (1.0 is not equal to 1.1), longer floating point values are not quite so simple. Do not use equality with floating points because it can produce unexpected behavior.

Correction — Change the Operator

One possible correction is to use a different operator that is not as strict. For example, an inequality like > or <.

```
float onePointOne(void) {
    float flt = 1.0;
```

```
    if (fabs(flt-1.1) < Epilson)
        return flt;
    return 0;
}
```

Correction — Change the Operands

Another possible correction is to change the operands to more precise data types. In this example, using integers instead of floats corrects the error.

```
int onePointOne(void) {
    int flt = 1;
    if (flt == 1)
        return flt;
    return 0;
}
```

Check Information

Group: Programming
Language: C | C++
Default: Off
Command-Line Syntax: `bad_float_op`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-873: CERT C++ Secure Coding Section 05 - Floating Point Arithmetic (FLP)

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.

Correction — Use Compatible Input Arguments

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.

```
void print_null(void) {
    char zero_val = '0';
    printf(zero_val);
}
```

Check Information

Group: Programming

Language: C | C++
Default: On
Command-Line Syntax: `other_std_lib`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE 227: Improper Fulfillment of API Contract

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

```
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.

Correction — Change Input Argument

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.

```
double arccosine(void) {

    double degree = 5.0;
    double radian = degree*180/(3.14159);
    return acos(radian);
}
```

Check Information

Group: Numerical
Language: C | C++
Default: On
Command-Line Syntax: `float_std_lib`
Impact: High

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60

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

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-227: Improper Fulfillment of API Contract ('API Abuse')
- CWE-369: Divide By Zero
- CWE-682: Incorrect Calculation

- CWE-873: CERT C++ Secure Coding Section 05 - Floating Point Arithmetic (FLP)

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`.

Correction — Change Input Argument

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-369: Divide By Zero

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.

Correction — Call Function with Valid Arguments

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Invalid use of standard library string routine

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-120: Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')
- CWE-227: Improper Fulfillment of API Contract ('API Abuse')

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`.

Correction — Use Valid Arguments

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Invalid use of standard library memory routine

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-120: Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')
- CWE-227: Improper Fulfillment of API Contract ('API Abuse')

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.

Correction — Call va_end After Using va_list Variable

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

Category: Programming
Language: C/C++
Default: On
Command-Line Syntax: `invalid_va_list_arg`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-628: Function Call with Incorrectly Specified Arguments

Introduced in R2015b

Large pass-by-value argument

Large argument passed between functions by value

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.

Examples

Passing a Large `struct` Between Functions

```
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.

Correction — Pass-By-Reference

One possible correction is to pass the argument by reference instead of by value. In this 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];
}
```

Check Information

Group: Good practice
Language: C | C++
Default: Off
Command-Line Syntax: `pass_by_value`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2013b

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.

Correction — Comma-Separated Initialization

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;
}
```

Correction — New Line for Each Initialization

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.

Correction — New Line for Each Loop Statement

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.

Correction — New Lines for Multi-Statement Conditionals

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 (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2013b

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.

Correction — Initialize All Members on All Execution Paths

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

Category: Object oriented
Language: C++
Default: Off
Command-Line Syntax: `non_init_member`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Copy constructor not called in initialization list

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-456: Missing Initialization of a Variable
- CWE-457: Use of Uninitialized Variable
- CWE-908: Use of Uninitialized Resource

Introduced in R2015b

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`.

Correction — Free Memory

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);
}
```

Correction — Return Pointer from Dynamic Allocation

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_arrs(void)
{
    int *p_scalar = new int(5);
    int *p_array = new int[5];
}
```

In this example, the function creates two variables, `p_scalar` and `p_array`, using the `new` keyword. However, the function ends without cleaning up the memory for these pointers. Because the function used `new` to create these variables, you must clean up their memory by calling `delete` at the end of the function.

Correction — Add Delete

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

See Also

“Find defects (C/C++)” on page 1-60

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE–401: Improper Release of Memory Before Removing Last Reference
- CWE–404: Improper Resource Shutdown or Release

Introduced in R2013b

Missing case for switch condition

Default case is missing and may be reached

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

When you design the `case` statements, incorporating anticipated `switch` variable values does not cover all cases. If the variable takes a value that is not covered by a `case` statement, your program can have unintended behavior. For example, if you use an enumerated type in the control expression, the possible values can still be outside the enumeration constants.

An attacker can deviate the normal execution flow. A switch-statement that makes a security decision is particularly vulnerable when all possible values are not explicitly handled.

Fix

One possible correction is to use a `default` statement as a catch-all for possible values that are not covered by a `case` statement.

Examples

Missing Default Condition

```
#include <stdio.h>

typedef enum E
```

```
{
    ADMIN=1,
    GUEST,
    UNKNOWN = 0
} LOGIN;


int identify_bad_user(LOGIN User)
{
    int r=0;

    switch(User)
    {
    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.

Correction — Add a Default Condition

One possible correction is to add a default condition for possible values that are not covered by a `case` statement.

```
#include <stdio.h>

typedef enum E
{
    ADMIN=1,
    GUEST,
    UNKNOWN = 0
} LOGIN;


int identify_bad_user(LOGIN User)
{
```

```
    int r=0;

    switch(User) /*@@Must-BF-MISSING_SWITCH_CASE@@*/
    {
    case ADMIN:
        r = 1;
        printf("Welcome,  Admin!\n");
        break;
    case GUEST:
        printf("Welcome, Guest!\n");
        r = 2;
        break;
    default:
        printf("Invalid login credentials!\n");
    }

    return r;
}
```

Result Information

Category: Security
Language: C/C++
Default: Off
Command-Line Syntax: `missing_switch_case`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-478: Missing Default Case in Switch Statement

Introduced in R2015b

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`.

Correction — Use `explicit` Keyword

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.

Correction — Use explicit Keyword

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

Category: Object oriented
Language: C++
Default: Off
Command-Line Syntax: `missing_explicit_keyword`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CERT C++ Coding Standard: OOP09-CPP — Ensure that single-argument constructors are marked "explicit"

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);

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	☑

<table>
<tr><th>Option</th><th colspan="2">Specification</th></tr>
<tr><td>Entry points</td><td colspan="2"><code>my_task</code></td></tr>
<tr><td rowspan="2">Critical section details</td><td>Starting procedure</td><td>Ending procedure</td></tr>
<tr><td><code>begin_critical_section</code></td><td><code>end_critical_section</code></td></tr>
</table>

`my_task` calls `end_critical_section` before calling `begin_critical_section`.

Correction — Provide Lock

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);

void my_task(void)
{
    begin_critical_section();
    global_var += 1;
    end_critical_section();
}
```

Lock in Condition

```
int global_var;
void reset() {
    global_var=0;
}

void begin_critical_section(void);
void end_critical_section(void);

void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      if(index%10==0) {
        begin_critical_section();
        global_var ++;
        reset();
```

```
        }
        end_critical_section();
        index++;
    }
}
```

In this example, to emulate multitasking behavior, you must specify the following options:

Option	Specification	
Configure multitasking manually	☑	
Entry points	`my_task`	
Critical section details	**Starting procedure**	**Ending procedure**
	`begin_critical_section`	`end_critical_section`

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: High

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60 | “Configure multitasking manually (C/C++)” on page 1-34 | “Entry points (C/C++)” on page 1-35 | “Critical section details (C/C++)” on page 1-37 | “Temporally exclusive tasks (C/C++)” on page 1-39

Polyspace Results

Data race including atomic operations | Data race | Deadlock | Double lock | Double unlock | Missing unlock

More About

- “Set Up Multitasking Analysis Manually”
- “Review Concurrency Defects”

External Websites

- CWE-832: Unlock of a Resource that is not Locked

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.

Correction — Increase Array Size

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";
}
```

Correction — Change Initialization Method

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 | C++
Default: On for handwritten code, off for generated code
Command-Line Syntax: `missing_null_char`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-170: Improper Null Termination

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);

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	☑

<table>
<tr><th>Option</th><th colspan="2">Value</th></tr>
<tr><td>Entry points</td><td colspan="2">my_task</td></tr>
<tr><td rowspan="2">Critical section details</td><td>Starting procedure</td><td>Ending procedure</td></tr>
<tr><td>begin_
critical_section</td><td>end_ critical_section</td></tr>
</table>

`my_task` enters a critical section through the call `begin_critical_section();`. `my_task` ends without calling `end_critical_section`.

Correction — Provide Unlock

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);

void my_task(void)
{
    begin_critical_section();
    global_var += 1;
    end_critical_section();
}
```

Unlock in Condition

```
int global_var;
void reset() {
    global_var=0;
}

void begin_critical_section(void);
void end_critical_section(void);

void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      begin_critical_section();
      global_var ++;
```

```
        if(index%10==0) {
          reset();
          end_critical_section();
        }
        index++;
      }
}
```

In this example, to emulate multitasking behavior, specify the following options.

Option	Specification	
Configure multitasking manually	☑	
Entry points	`my_task`	
Critical section details	**Starting procedure**	**Ending procedure**
	`begin_ critical_section`	`end_ critical_section`

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`.

Correction — Place Unlock Outside Condition

One possible correction is to call the unlock function `end_critical_section` outside the `if` condition.

```
int global_var;
void reset() {
```

```
    global_var=0;
}

void begin_critical_section(void);
void end_critical_section(void);

void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      begin_critical_section();
      global_var ++;
      if(index%10==0) {
        reset();
      }
      end_critical_section();
      index++;
    }
}
```

Correction — Place Unlock in Every Conditional Branch

Another possible correction is to call the unlock function `end_critical_section` in every branches of the `if` condition.

```
int global_var;
void reset() {
    global_var=0;
}

void begin_critical_section(void);
void end_critical_section(void);

void my_task(void) {
    int index=0;
    volatile int numCycles;

    while(numCycles) {
      begin_critical_section();
      global_var ++;
      if(index%10==0) {
        reset();
        end_critical_section();
      }
```

```
      else
        end_critical_section();
      index++;
    }
}
```

Check Information

Group: Concurrency
Language: C | C++
Default: On
Command-Line Syntax: `bad_lock`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60 | "Configure multitasking manually (C/C++)" on page 1-34 | "Entry points (C/C++)" on page 1-35 | "Critical section details (C/C++)" on page 1-37 | "Temporally exclusive tasks (C/C++)" on page 1-39

Polyspace Results

Data race including atomic operations | Data race | Deadlock | Double lock | Double unlock | Missing lock

More About

- "Set Up Multitasking Analysis Manually"
- "Review Concurrency Defects"

External Websites

- CWE-667: Improper Locking

Introduced in R2014b

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.

Correction — Place Return Statement on Every Execution Paths

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

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2013b

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**.

Correction — Make Both Inheritances Virtual

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

Category: Object oriented
Language: C++
Default: Off
Command-Line Syntax: `missing_virtual_inheritance`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2015b

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:

- You attempt to write to the memory location that a pointer points to.
- The pointer is returned from a nonreentrant standard function.

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.

Correction — Copy Return Value of getenv and Modify Copy

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

Category: Programming
Language: C/C++
Default: Off
Command-Line Syntax: `write_internal_buffer_returned_from_std_func`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–573: Improper Following of Specification by Caller
- CWE–628: Function Call with Incorrectly Specified Arguments

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.

Correction — Initialize Pointer on Every Execution Path

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Non-initialized variable

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-456: Missing Initialization of a Variable
- CWE-457: Use of Uninitialized Variable
- CWE-824: Access of Uninitialized Pointer
- CWE-908: Use of Uninitialized Resource

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.

Correction — Initialize During Declaration

One possible correction is to initialize `val` during declaration so that only its value is dependant on different 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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Non-initialized pointer

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-456: Missing Initialization of a Variable

- CWE-457: Use of Uninitialized Variable
- CWE-908: Use of Uninitialized Resource

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.

Correction — Assign Address to Null Pointer Before Dereference

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Arithmetic operation with NULL pointer | Non-initialized pointer

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-476: NULL Pointer Dereference

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()`.

Correction — Pass Object by Reference or Pointer

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

Category: Object oriented
Language: C++
Default: On
Command-Line Syntax: `object_slicing`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2015b

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

Category: Programming
Language: C/C++
Default: Off
Command-Line Syntax: `overlapping_assign`
Impact: Medium

See Also

Polyspace Analysis Options
"Find defects (C/C++)" on page 1-60

Polyspace Results
Copy of overlapping memory

More About

- "Navigate to Root Cause of Defect"

- "Review and Fix Results"

External Websites

- CWE-665: Improper Initialization

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.

Correction — Unhide Base Class Method

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

Category: Object oriented
Language: C++

Default: On
Command-Line Syntax: `partial_override`
Impact: Medium

See Also

“Find defects (C/C++)” on page 1-60

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

Introduced in R2015b

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.

Correction — Check Pointer Stays Within Bounds

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

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60

Polyspace Results

Array access out of bounds

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-119: Improper Restriction of Operations within the Bounds of a Memory Buffer

- CWE-188: Reliance on Data/Memory Layout
- CWE-466: Return of Pointer Value Outside of Expected Range
- CWE-823: Use of Out-of-range Pointer Offset

Introduced in R2013b

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 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

Category: Static memory
Language: C/C++
Default: On
Command-Line Syntax: `local_addr_escape`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–562: Return of Stack Variable Address

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`.

Correction — Store Value in Address Before Assignment to Pointer

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

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"

- "Review and Fix Results"

Introduced in R2013b

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.

Correction — Access Every Array Element

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 (C/C++)" on page 1-60

More About

- "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[1024]) {
    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.

Correction — Determine Array Size in Another Way

One possible correction is to use another means to determine the array size.

```
#define MAX_SIZE 1024

void func(int a[1024]) {
    int i;

    for (i = 0; i < MAX_SIZE; i++)    {
        a[i] = i + 1;
```

```
    }
}
```

Result Information

Category: Programming
Language: C | C++
Default: On
Command-Line Syntax: `sizeof_misuse`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–467: Use of sizeof() on a Pointer Type
- 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.

Correction — Parenthesis For Intended Order

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

Category: Programming
Language: C/C++
Default: On
Command-Line Syntax: `operator_precedence`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-783: Operator Precedence Logic Error

- Cert C Coding Standard: EXP00-C— Use parentheses for precedence of operation
- Cert C++ Coding Standard: EXP00-C— Use parentheses for precedence of operation
- Reference for operator precedence rules

Introduced in R2015b

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`.

Correction — Release FILE Pointer

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

Category: Resource management
Language: C | C++
Default: On
Command-Line Syntax: `resource_leak`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-772: Missing Release of Resource after Effective Lifetime

Introduced in R2015b

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`.

Correction: Return Member by Value

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

Category: Object oriented
Language: C++
Default: Off
Command-Line Syntax: `breaking_data_encapsulation`
Impact: Medium

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60

More About

- “Navigate to Root Cause of Defect”

- "Review and Fix Results"

External Websites

- CWE-767: Access to Critical Private Variable via Public Method
- CERT C++ Coding Standard: OOP08-CPP — Do not return references to private data

Introduced in R2015b

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.

Correction — Test for Self-Assignment

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

Category: Object oriented
Language: C++
Default: Off
Command-Line Syntax: `missing_self_assign_test`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2015b

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.

Correction — Add Qualifiers

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);
}
```

Correction — Remove Qualifiers

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 | C++
Default: Off
Command-Line Syntax: `qualifier_mismatch`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-704: Incorrect Type Conversion or Cast

Introduced in R2013b

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.

Correction — Change the Data Type

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Shift operation overflow

More About

- "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 (C/C++)" on page 1-5.

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.

Correction — Different storage type

One possible correction is to store the shift operation result in a larger data type. In this example, by returning a `long` instead of an `int`, the overflow defect is fixed.

```
long left_shift(void) {

    int foo = 33;
    return 1 << foo;
}
```

Check Information

Group: Numerical

Language: C | C++
Default: Off
Command-Line Syntax: `shift_ovfl`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-190: Integer Overflow or Wraparound

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 (C/C++)” on page 1-5.

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.

Correction — Change conversion types

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Float conversion overflow | Unsigned integer conversion overflow | Integer conversion overflow

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-194: Unexpected Sign Extension
- CWE-195: Signed to Unsigned Conversion Error
- CWE-196: Unsigned to Signed Conversion Error

Introduced in R2013b

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. 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`. If the return value is -1, check the value of `errno` to see which error has occurred.
	The file descriptor argument represents	The behavior of the function is undefined.	Close the file descriptor only after you have completely

Function Type	Situation	Risk	Fix
	a closed file descriptor.		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 `""`. • `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, set your target operating system to Linux. For more information, see "Target operating system (C/C++)" on page 1-3.

Correction — Pass NULL-terminated String

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

Category: Programming

Language: C/C++
Default: On
Command-Line Syntax: `std_func_arg_mismatch`
Impact: Medium

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–628: Function Call with Incorrectly Specified Arguments
- CWE–685: Function Call With Incorrect Number of Arguments
- CWE–686: Function Call With Incorrect Argument Type
- CWE–687: Function Call With Incorrectly Specified Argument Value

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`.

Correction — Call Function at Least Once

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

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-561: Dead Code

Introduced in R2013b

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

Correction — Check for NULL Value

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

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-789: Uncontrolled Memory Allocation

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;
}
```

Correction — Remove Return

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;
}
```

Correction — Remove Unreachable Code

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.

Correction — Rewrite Loop Condition

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;
}
```

Correction — Add a Break Statement

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;
}
```

Correction — Remove Unreachable Code

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

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

`Code deactivated by constant false condition` | `Dead code` | `Useless if`

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE–561: Dead Code

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)`.

Correction — Avoid Function Pointer Cast

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
Default: On
Command-Line Syntax: `func_cast`
Impact: Medium

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60

Polyspace Results

Unreliable cast of pointer

More About

- “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*`.

Correction — Avoid Pointer Cast

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 | C++
Default: On
Command-Line Syntax: `ptr_cast`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Unreliable cast of function pointer

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-704: Incorrect Type Conversion or Cast
- CWE-843: Access of Resource Using Incompatible Type ('Type Confusion')

Introduced in R2013b

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 (C/C++)" on page 1-5.

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`.

Correction — Change Conversion Type

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

See Also

Polyspace Analysis Options

“Find defects (C/C++)” on page 1-60

Polyspace Results

Float conversion overflow | Integer conversion overflow | Sign change integer conversion overflow

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-190: Integer Overflow or Wraparound
- CWE-191: Integer Underflow (Wrap or Wraparound)
- CWE-197: Numeric Truncation Error

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 (C/C++)" on page 1-5.

Examples

Add One to Maximum Unsigned Integer

```
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`.

Correction — Different Storage Type

One possible correction is to store the operation result in a larger data type. In this example, by returning an `unsigned long` instead of an `unsigned int`, the overflow error is fixed.

```
unsigned long plusplus(void) {

    unsigned uvar = UINT_MAX;
```

```
    unsigned long ulvar = uvar++;
    return ulvar;
}
```

Check Information

Group: Numerical
Language: C | C++
Default: Off
Command-Line Syntax: `uint_ovfl`
Impact: Low

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Integer overflow | Float overflow

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-190: Integer Overflow or Wraparound
- CWE-191: Integer Underflow (Wrap or Wraparound)

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`.

Correction — Use Parameter

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;
}
```

Correction — Explicitly Indicate Unused Parameter

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

Category: Good practice
Language: C/C++
Default: Off
Command-Line Syntax: `unused_parameter`
Impact: Low

See Also

“Find defects (C/C++)” on page 1-60

More About

- “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, 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.

Correction — Change Condition

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, 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);
    }
}
```

Correction — Remove If

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, 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 (C/C++)" on page 1-60

Polyspace Results

`Code deactivated by constant false condition` | `Dead code` | `Unreachable code`

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2013b

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 calling_func(void) {
    unsigned int buf_size=0;
    func(buf_size);
}
```

```
void func (unsigned int size)
{
    char str[] = "Buffer to be filled.";
    memset (str,'-',size);
    puts (str);
}
```

In this example, the argument `size` of `memset` is zero.

Result Information

Category: Programming
Language: C/C++
Default: Off
Command-Line Syntax: `memset_invalid_size`
Impact: Medium

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

Call to memset with unintended value

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-665: Improper Initialization

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.

Correction — Use Array of Size `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

Category: Static memory

Language: C/C++
Default: Off
Command-Line Syntax: `path_buffer_overflow`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-785: Use of Path Manipulation Function without Maximum-sized Buffer

Introduced in R2015b

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.

Correction — Close Stream After All Operations

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

Category: Resource management
Language: C/C++
Default: On
Command-Line Syntax: `closed_resource_use`
Impact: High

See Also

Polyspace Analysis Options

"Find defects (C/C++)" on page 1-60

Polyspace Results

`MISRA C:2012 Rule 22.6`

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE 672: Operation on a Resource after Expiration or Release

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.

Correction — Free Pointer After Use

One possible correction is to free the pointer `pi` only after the last instance where it is accessed.

```
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

See Also

Polyspace Analysis Options
"Find defects (C/C++)" on page 1-60

Polyspace Results
Deallocation of previously deallocated pointer

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-416: Use After Free

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.

Correction — Use Alternative to `setjmp` and `longjmp`

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);
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

Category: Good practice
Language: C/C++
Default: Off
Command-Line Syntax: `setjmp_longjmp_use`
Impact: Low

See Also

“Find defects (C/C++)” on page 1-60

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE–691: Insufficient Control Flow Management
- CVE-2013-4788 - Eglibc PTR MANGLE vulnerability

- CERT C Coding Standard : MSC22-C — Use the setjmp(), longjmp() facility securely
- CERT C++ Coding Standard: ERR52-CPP — Do not use setjmp() or longjmp()
- Linux man page for setjmp

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];
        }
    }
    return r;
}

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`.

Correction — Make Array Size Positive

One possible correction is fix or remove calls that result in a nonpositive array size.

Result Information

Category: Programming
Language: C/C++
Default: On
Command-Line Syntax: `non_positive_vla_size`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-687: Function Call with Incorrectly Specified Argument Value

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`.

Correction — Change Variable Name

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

See Also

"Find defects (C/C++)" on page 1-60

More About

- "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: • `mkstemp` • `mkostemp` • `mkostemps` • `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: • `strcpy` • `strncpy` • `strcat` • `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.
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	Perform the write operation on a non-`const` object.

Situation	Risk	Fix
	modified. By writing to a `const`-qualified object, you break the agreement. The result of the operation is undefined.	

Examples

Writing to `const`-Qualified Object

```
#include <string.h>

const char* buffer = "abcdeXXXXXXX";

void func(char* string) {
    strcpy(strchr(buffer,'X'),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.

Correction — Copy `const`-Qualified Object to Non-`const` Object

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) {
    strcpy(strchr(buffer,'X'),string);
}
```

Result Information

Category: Programming

Language: C/C++
Default: On
Command-Line Syntax: `constant_object_write`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE 227: Improper Fulfillment of API Contract
- CWE 471: Modification of Assumed-Immutable Data
- CWE 686: Function Call with Incorrect Argument Type

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.

Correction — Open File as Writable

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

Category: Resource management
Language: C | C++
Default: On
Command-Line Syntax: read_only_resource_write
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

Introduced in R2015b

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.

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.

Correction — Use Value After Assignment

One possible correction is to use the variable `level` after the assignment.

```
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
Language: C | C++
Default: On for handwritten code, off for generated code
Command-Line Syntax: `useless_write`
Impact: Low

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-398: Indicator of Poor Code Quality

Introduced in R2013b

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

```
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.

Correction — Change the Size of the Pointer

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.

```
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.

Correction — Change the Size of the Pointer

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.

Correction — Change the Size of the Pointer

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

See Also

Polyspace Analysis Options
"Find defects (C/C++)" on page 1-60

Polyspace Results
Unreliable cast of pointer

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-704: Incorrect Type Conversion or Cast

Introduced in R2013b

Wrong type used in sizeof

`sizeof` argument does not match pointer type

Description

Wrong type used in sizeof occurs when the size specified for the block of memory does not match the pointer type being initialized.

Examples

Allocate a Char Array With `sizeof`

```
void test_case_1(void) {
    char* str;

    str = 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.

Correction — Match Pointer Type to `sizeof` Argument

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 = malloc(sizeof(char) * 5);
    free(str);

}
```

Check Information

Group: Programming
Language: C | C++
Default: On for handwritten code, off for generated code
Command-Line Syntax: `ptr_sizeof_mismatch`
Impact: High

See Also

"Find defects (C/C++)" on page 1-60

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-467: Use of sizeof() on a Pointer Type

Introduced in R2013b

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 <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.

Correction — Use Safe Socket

One possible correction is to write to the `connfd` function instead of the `listenfd` socket.

```
# include <stdio.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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-666: Operation on Resource in Wrong Phase of Lifetime

Introduced in R2015b

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 contrary to what you want. This error 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.

Correction — Negate Preferred Permissions

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

See Also

Vulnerable permission assignments

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-560: Use of umask() with chmod-style Argument
- umask — Linux Manual Page

Introduced in R2015b

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

```
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.

Correction — Call chdir("/")

Before opening files, call chdir("/").

```
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

See Also

Umask used with chmod-style arguments | Vulnerable path manipulation

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-243: Creation of chroot Jail Without Changing Working Directory

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

```
void bug_dangerouspermissions() {
    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`.

Correction — Modify User Permissions

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.

```
void corrected_dangerouspermissions() {
    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
Language: C | C++
Default: Off
Command-Line Syntax: `dangerous_permissions`
Impact: Medium

See Also

Umask used with chmod-style arguments

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-732: Incorrect Permission Assignment for Critical Resource

Introduced in R2015b

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.

Correction — Use `snprintf` with Buffer Size

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

See Also

Use of obsolete standard function | Unsafe standard function | Invalid use of standard library string routine

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-242: Use of Inherently Dangerous Function
- CWE-676: Use of Potentially Dangerous Function

Introduced in R2015b

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

```
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`.

Correction — Check Buffer Length

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.

```
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
Language: C | C++
Default: Off
Command-Line Syntax: `data_length_mismatch`
Impact: Medium

See Also

Copy of overlapping memory

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-130: Improper Handling of Length Parameter Inconsistency
- CWE-240: Improper Handling of Inconsistent Structural Elements

Introduced in R2015b

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.

Correction — Function Address

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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-587: Assignment of a Fixed Address to a Pointer

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.

Correction — Add O_EXCL Flag

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

See Also

Data race

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-377: Insecure Temporary File

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 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 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`, `gettimeofday`, `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

Obsolete Function	Standards	Risk	Replacement Function
utime	SVr4, POSIX.1-2001. POSIX.1-2008 marks as obsolete.		
valloc	Marked as obsolete in 4.3BSD. Marked as legacy in SUSv2. 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.

Correction — Different Time Function

One possible correction is to use `strftime` instead because this function uses a set buffer size.

```
# include <stdio.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

See Also

Use of dangerous standard function | Unsafe standard function | Invalid use of standard library string routine

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-477: Use of Obsolete Functions

Introduced in R2015b

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.

Correction — Use Fixed File Name

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

See Also

Use of path manipulation function without maximum sized buffer checking

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-22: Improper Limitation of a Pathname to a Restricted Directory
- CWE-23: Relative Path Traversal
- CWE-36: Absolute Path Traversal

Introduced in R2015b

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, 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.

Correction — Use Different Random Number Generator

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

See Also

Predictable random output from predictable seed | Unsafe standard encryption function | Vulnerable pseudo-random number generator

More About

- "Navigate to Root Cause of Defect"

- "Review and Fix Results"

External Websites

- CWE-336: Same Seed in PRNG
- CWE-330: Use of Insufficiently Random Values

Introduced in R2015b

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, and should not be used for security purposes.

Examples

Seed as an Argument

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

int generate_num(void)
```

```
{
    seed_rng(time(NULL) + 3);
   \*...
}

void seed_rng(int seed)
{
    srand(seed);
}
```

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`.

Correction — Use Different Random Number Generator

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>

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

See Also

Deterministic random output from constant seed | Unsafe standard encryption function | Vulnerable pseudo-random number generator

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-337: Predictable Seed in PRNG
- CWE-330: Use of Insufficiently Random Values

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.

Correction — Use Full Path

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

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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-114: Process Control
- CWE-427: Uncontrolled Search Path Element

Introduced in R2015b

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.

Correction — Use Full Path to Library

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

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

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-114: Process Control

- CWE-427: Uncontrolled Search Path Element

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.

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

```
extern void verify_null(const char* buf);
void bug_sensitivedataprint() {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[SIZE1024] = "";
    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`.

Correction — Obfuscate the Password

One possible correction is to obfuscate the password information so that the information is not visible.

```
extern void verify_null(const char* buf);

void sensitivedataprint() {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[SIZE1024] = "";
    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
Language: C | C++
Default: Off
Command-Line Syntax: `sensitive_data_print`
Impact: Medium

See Also

Sensitive heap memory not cleared before release | Uncleared sensitive data in stack

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-532: Information Exposure Through Log Files

- CWE-534: Information Exposure Through Debug Log Files
- CWE-535: Information Exposure Through Shell Error Message

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

```
void sensitiveheapnotcleared() {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char* buf = (char*) malloc(SIZE1024);
    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.

Correction — Nullify Data

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.

```
void sensitiveheapnotcleared() {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char* buf = (char*) malloc(SIZE1024);

    if (buf) {
        getpwnam_r(my_user, &pwd, buf, bufsize, &result);
        memset(buf, 0, (size_t)SIZE1024);
        verify_null(buf);
        free(buf);
    }
}
```

Result Information

Group: Security
Language: C | C++
Default: Off
Command-Line Syntax: `sensitive_heap_not_cleared`
Impact: Medium

See Also

Uncleared sensitive data in stack | Sensitive data printed out

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-244: Improper Clearing of Heap Memory Before Release

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

```
void bug_sensitivestacknotcleared() {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[SIZE1024] = "";
    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.

Correction — Clear 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.

```
void corrected_sensitivestacknotcleared() {
    struct passwd* result, pwd;
    long bufsize = sysconf(_SC_GETPW_R_SIZE_MAX);
    char buf[SIZE1024] = "";
    getpwnam_r(my_user, &pwd, buf, bufsize, &result);
    memset(buf, 0, (size_t)SIZE1024);
    verify_null(buf);
}
```

Result Information

Group: Security
Language: C | C++
Default: Off
Command-Line Syntax: `sensitive_stack_not_cleared`
Impact: Medium

See Also

Sensitive heap memory not cleared before release | Sensitive data printed out

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-226: Sensitive Information Uncleared Before Release

Introduced in R2015b

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`.

Correction — Check Range Before Use

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

See Also

Loop bounded with tainted value | Pointer dereference with tainted offset | Tainted size of variable length array

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-121: Stack-based Buffer Overflow

- CWE-124: Buffer Underwrite
- CWE-125: Out-of-bounds Read
- CWE-129: Improper Validation of Array Index

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.

Correction — Sanitize 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

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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-15: External Control of System or Configuration Setting

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.

Correction — Use a Predefined Command

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

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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-77: Improper Neutralization of Special Elements used in a Command
- CWE-78: Improper Neutralization of Special Elements used in an OS Command
- CWE-88: Argument Injection or Modification

Introduced in R2015b

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.

Correction — Predefined Host ID

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 */
    }
    if (hid > 0) {
        sethostid(hid);
    }
}
```

Result Information

Group: Tainted Data
Language: C | C++
Default: Off
Command-Line Syntax: `tainted_hostid`
Impact: Medium

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

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-15: External Control of System or Configuration Setting

Introduced in R2015b

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.

Correction — Check Values

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

See Also

Integer division by zero | Float division by zero | Tainted modulo operand

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-369: Divide By Zero

- CWE-190: Integer Overflow or Wraparound

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.

Correction — Check Operand Values

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

See Also

Integer division by zero | Tainted division operand

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-369: Divide By Zero
- CWE-682: Incorrect Calculation

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.

Correction — Check Loop Control

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

See Also

Array access with tainted index | Pointer dereference with tainted offset

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-606: Unchecked Input for Loop Condition

- CWE-400: Uncontrolled Resource Consumption
- CWE-835: Loop with Unreachable Exit Condition

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.

Correction — Check Size of Memory to be Allocated

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

See Also

Unprotected dynamic memory allocation

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-789: Uncontrolled Memory Allocation

Introduced in R2015b

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.

Correction — Use Trusted Path

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 */
        }
        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

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

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-114: Process Control
- CWE-426: Untrusted Search Path

Introduced in R2015b

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 hardcoded or fully qualified path names to load libraries. It is possible the hardcoded paths do not work on other systems. Use a centralized location for hardcoded 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.

Correction — Change and Check Path

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) {
    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;
}

void* taintedpathlib(char* userpath, size_t n) {
    void* libhandle = NULL;
    if (sanitize_str(userpath, n)) {
        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

See Also

Execution of externally controlled command | Use of externally controlled environment variable | Command executed from externally controlled path

More About

- "Navigate to Root Cause of Defect"

- "Review and Fix Results"

External Websites

- CWE-114: Process Control
- CWE-426: Untrusted Search Path

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.

Correction — Check Pointer

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.

```
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

See Also

Pointer dereference with tainted offset

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-822: Untrusted Pointer Dereference

Introduced in R2015b

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 = 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.

Correction — Check Index Before Dereference

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 = 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

See Also

Array access with tainted index | Use of tainted pointer

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-129: Improper Validation of Array Index
- CWE-823: Use of Out-of-range Pointer Offset
- CWE-122: Heap-based Buffer Overflow
- CWE-124: Buffer Underwrite

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.

Correction — Check Value of `size`

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

See Also

Sign change integer conversion overflow

More About

- “Navigate to Root Cause of Defect”
- “Review and Fix Results”

External Websites

- CWE-195: Signed to Unsigned Conversion Error
- CWE-194: Unexpected Sign Extension

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`.

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"

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};
extern void print_str(const char*);

void taintedstring(char* userstr)
{
    char str[SIZE128] = "Using ";
    strncat(str, userstr, SIZE100);
    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.

Correction — Validate the Data

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.

```
#include "stdio.h"
#include "string.h"
#include "stdlib.h"

enum {
    SIZE10  =  10,
    SIZE100 = 100,
    SIZE128 = 128
};
extern void print_str(const char*);
```

```
int sanitize_str(char* s, size_t n) {
    int res = 0;
    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;
}

void taintedstring(char* userstr, size_t n)
{
    char str[SIZE128] = "Using ";
   if (sanitize_str(userstr, n)) {
        strncat(str, userstr, SIZE100);
    }
    print_str(str);
}
```

Result Information

Group: Tainted Data
Language: C | C++
Default: Off
Command-Line Syntax: `tainted_string`
Impact: Low

See Also

Tainted string format

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-476: NULL Pointer Dereference
- CWE-170: Improper Null Termination

- CWE-822: Untrusted Pointer Dereference
- CWE-120: Buffer Copy without Checking Size of Input
- STR31-C. Guarantee that storage for strings has sufficient space for character data and the null terminator
- STR32-C. Do not pass a non-null-terminated character sequence to a library function that expects a string

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.

Correction — Print as String

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

See Also

Tainted NULL or non-null-terminated string

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-134: Uncontrolled Format String

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

```
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.

Correction — Check VLA Size

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 += tabval[i];
        }
    }
    return res;
}
```

Result Information

Group: Tainted Data
Language: C | C++
Default: Off
Command-Line Syntax: `tainted_vla_size`
Impact: Medium

See Also

Memory allocation with tainted size

More About

- “Navigate to Root Cause of Defect”

- “Review and Fix Results”

External Websites

- CWE-789: Uncontrolled Memory Allocation
- CWE-770: Allocation of Resources Without Limits or Throttling
- CERT Rule: ARR32-C. Ensure size arguments for variable length arrays are in a valid range

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

```
extern void print_tofile(FILE* f);

void toctou() {
    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.

Correction — Open Then Check

One possible correction is to open the file, and then check the existence and contents afterward.

```
extern void print_tofile(FILE* f);

void toctou() {
    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

See Also

Data race | Bad file access mode or status

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-367: Time-of-check Time-of-use (TOCTOU) Race Condition

Introduced in R2015b

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.

Correction — Use `crypt_r`

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

See Also

Deterministic random output from constant seed | Predictable random output from predictable seed | Vulnerable pseudo-random number generator

More About

- "Navigate to Root Cause of Defect"

- "Review and Fix Results"

External Websites

- CWE-327: Use of a Broken or Risky Cryptographic Algorithm
- CWE-663: Use of a Non-reentrant Function in a Concurrent Context

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.

Correction — Use `getlogin_r`

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

See Also

Use of obsolete standard function | Use of dangerous standard function | Invalid use of standard library string routine

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-558: Use of getlogin() in Multithreaded Application
- CWE-663: Use of a Non-reentrant Function in a Concurrent Context

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, such as `rand`, `rand48`.

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;
    unsigned char* buf;
    int i = 0;

    if (argc != 3)
    {
```

```
        fprintf(stderr, "Usage: %s <seed> <nloops>\n", argv[0]);
        exit(EXIT_FAILURE);
    }

    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.

Correction — Use Stronger PRNG

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, unsigned char* argv[])
{
    int j, r, nloops;
    unsigned char* buf;
    int i = 0;

    if (argc != 3)
    {
        fprintf(stderr, "Usage: %s <seed> <nloops>\n", argv[0]);
        exit(EXIT_FAILURE);
    }

    nloops = RAND_bytes();

    for (j = 0; j < nloops; j++) {
        if (RAND_bytes(&buf, &i) == 1)
            exit(1);
```

```
        printf("random_r: %ld\n", (long)i);
    }
    return 0;
}
```

Result Information

Group: Security
Language: C | C++
Default: Off
Command-Line Syntax: `vulnerable_prng`
Impact: Medium

See Also

Deterministic random output from constant seed | Predictable random output from predictable seed | Unsafe standard encryption function

More About

- "Navigate to Root Cause of Defect"
- "Review and Fix Results"

External Websites

- CWE-330: Use of Insufficiently Random Values
- CWE-338: Use of Cryptographically Weak Pseudo-Random Number Generator (PRNG)

Introduced in R2015b

5

Functions, Properties, 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.

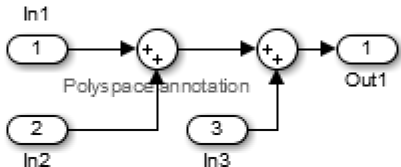
In the generated code associated with the annotated block, Polyspace adds code comments before and after the lines of code. Polyspace reads these comments and marks Polyspace results of the specified `kind` with the annotated information.

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:Fix>*/
  annotate_y.Out1=(annotate_u.In1+annotate_U.In2)+annotate_U.In3;
  /* polyspace:end<RTE:OVFL:Medium: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. If analysis results do not exist for `systemName`, Polyspace opens to the Project Browser pane.

`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_v2, add an annotation to the switch block for MISRA C rule 13.7 violations with a comment, a severity, and a status.

```
model = 'WhereAreTheErrors_v2';
open(model)
pslinkfun('annotations','type','Misra-C', 'kind', '13.7','block',...
 'WhereAreTheErrors_v2/Switch1','status','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_v2` and open the advanced options window.

```
model = 'WhereAreTheErrors_v2';
```

```
load_system(model)
pslinkfun('advancedoptions')
```

In the **Distributed Computing** pane, select the options **Batch** and **Add to results repository**.

Set the configuration template for new Polyspace analyses to have these options.

```
pslinkfun('settemplate',fullfile(cd,'pslink_config',...
    'WhereAreTheErrors_v2_config.psprj'))
```

View the current Polyspace template.

```
template = pslinkfun('gettemplate')
```

```
template =
C:\ModelLinkDemo\pslink_config\WhereAreTheErrors_v2_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_v2`, create a Polyspace options object, set the verification mode, and open the advanced options window.

```
model = 'WhereAreTheErrors_v2';
load_system(model)
slbuild(model)
opts = pslinkoptions(model);
opts.VerificationMode = 'BugFinder';
pslinkfun('advancedoptions')
```

In the **Distributed Computing** pane, select the **Batch** and **Add to results repository** options.

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. For the list of possible checks, see: "Polyspace Bug Finder Results".
'MISRA-C'	Use the rule number that you want to annotate. For example, '2.2'. 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'. For the list of supported MISRA C rules and their numbers, see "MISRA C:2004 and MISRA AC AGC Coding Rules".

type Value	kind Values
‘MISRA-CPP’	Use the rule number that you want to annotate. For example, '0-1-1'. 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'. 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_v2')`

`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’,’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'` | `'investigate'` | `'fix'` | `'improve'` | `'restart with different options'` | `'justify with annotation'` | `'no action planned'` | `'other'`

Action status of the check specified as `undecided`, `investigate`, `fix`, `improve`, `restart with different options`, `justify with annotation`, `no action planned`, or `other`.

Example: `'status','no action planned'`

`'comment'` — additional comments
string

Additional comments specified as a string. 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)
```

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.

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')
```

```
This model was saved in a previous release. The overflow diagnostic setting for Statefl

### Start Compiling Command_Strategy
    mex('-IB:\matlab\polyspace\toolbox\pslink\pslinkdemos\psdemo_model_link_sl', '-IC:\
Building with 'Microsoft Visual C++ 2012 (C)'.
MEX completed successfully.
    mex('Command_Strategy.c', '-IB:\matlab\polyspace\toolbox\pslink\pslinkdemos\psdemo_
Building with 'Microsoft Visual C++ 2012 (C)'.
MEX completed successfully.
### Finish Compiling Command_Strategy
### Exit
```

```
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
      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
      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
      CxxVerificationSettings: 'PrjConfig'
    CheckConfigBeforeAnalysis: 'OnWarn'
```

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'
          ModelRefVerifDepth: 'Current model only'
     ModelRefByModelRefVerif: 0
     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: 0
```

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: 0
```

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 Properties.

Example: `ec_opt = pslinkoptions('ec')`

Example: `tl_opt = pslinkoptions('tl')`

Data Types: `char`

model — Simulink model

model name

Simulink model, specified by the model name. Creates a Polyspace options object with the configuration options of that model. If you do not set any options, the object has the default configuration options. If a code generator has been set, the object has the default options for that code generator.

For a description of all configuration options and their values, see pslinkoptions Properties.

Example: `model_opt = pslinkoptions('my_model')`

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 Properties.

Example:
```
opts= pslinkoptions('ec')
opts.VerificationSettings = 'Misra'
```

More About

- pslinkoptions Properties

See Also

`pslinkfun` | `pslinkrun`

Introduced in R2012a

pslinkrun

Run Polyspace analysis on generated code from MATLAB command line

Syntax

```
resultsFolder = pslinkrun
resultsFolder = pslinkrun(system)
resultsFolder = pslinkrun(system,opts)
resultsFolder = pslinkrun(system,opts,asModelRef)
```

Description

`resultsFolder = pslinkrun` on generated code from the current system and returns the location of the results folder. It uses the analysis options associated with the current system. The current system, or model, is the system returned by the command `bdroot`.

`resultsFolder = pslinkrun(system)` runs Polyspace on the code generated from the model or subsystem specified by `system`. It uses the analysis options associated with `system`.

`resultsFolder = pslinkrun(system,opts)` analyzes `system` using the analysis options from the options object `opts`.

`resultsFolder = pslinkrun(system,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

Run Polyspace from the Command Line

Use a Simulink model to generate code, set configuration options, and then run an analysis from the command line.

Load and build the model `WhereAreTheErrors` to generate code.

```
model = 'WhereAreTheErrors';
load_system(model)
slbuild(model)
```

Create a Polyspace options object from the model and change the configuration to run a Bug Finder analysis.

```
opts = pslinkoptions(model);
opts.VerificationMode = 'BugFinder';
opts.VerificationSettings = 'PrjConfigAndMisra2012';
```

Run Polyspace using your options object:

```
results = pslinkrun(model,opts)
```

The results are saved to the `results_WhereAreTheErrors` folder, listed in the `results` variable.

Build and Analyze Referenced Model Code from the Command Line

Use a Simulink model to generate reference code, set configuration options, and then run an analysis from the command line.

Load and build the model `WhereAreTheErrors` to generate code as if it is referenced by another model:

```
model = 'WhereAreTheErrors';
load_system(model);
slbuild(model,'ModelReferenceRTWTargetOnly');
```

Create a Polyspace options object from the model and change the configuration to run a Bug Finder analysis.

```
opts = pslinkoptions(model);
opts.VerificationMode = 'BugFinder';
opts.VerificationSettings = 'PrjConfigAndMisra2012';
```

Run Polyspace using your options object:

```
results = pslinkrun(model,opts,true)
```

The results are saved to the `results_mr_WhereAreTheErrors` folder, listed in the `results` variable.

Input Arguments

`system` — Model or system

`bdroot` (default) | model or system name

Model or system that you want to analyze, specified as a string, with the model or system name in single quotes. The default value is the system returned by `bdroot`.

Example: `resultsFolder = pslinkrun('demo')` where `demo` is the name of a model.

Data Types: `char`

`opts` — Analysis options

options associated with `system` (default) | Polyspace options object

Analysis options for the analysis, specified as an options object or the options already associated with the model or system. The function `pslinkoptions` creates an options object. You can customize the options object by changing the

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 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 generated as model referenced code. This option is equivalent to choosing **Verify Code Generated For** > **Referenced Model** in the Simulink Polyspace options.

Data Types: `logical`

Output Arguments

`resultsFolder` — Variable for location of the results folder

string

Variable for location of the results folder, specified as a string. The default value of this variable is `results_$ModelName$`. You can change this value in the configuration options using `pslinkoptions`.

Data Types: `char`

See Also

`pslinkfun` | `pslinkoptions`

Introduced in R2012a

polyspaceBugFinder

Run Polyspace Bug Finder analysis from MATLAB

Syntax

```
polyspaceBugFinder
```

```
polyspaceBugFinder(projectFile)
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(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 *`Matlab_Install`*`\polyspace\examples\cxx\Bug_Finder_Example`.

Assign the full path to the project file to a MATLAB variable `prjFile`.

```
prjFile = fullfile(matlabroot, 'polyspace', 'examples', 'cxx', ...
         'Bug_Finder_Example', 'Bug_Finder_Example.psprj');
```

Use `prjFile` to open the project.

```
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 *`Matlab_Install`*`\polyspace\examples\cxx\Bug_Finder_Example\Results`.

Assign the full path to the folder to a MATLAB variable `resFolder`.

```
resFolder = fullfile(matlabroot, 'polyspace', 'examples',  ...
         'cxx', 'Bug_Finder_Example', 'Results');
```

Use `resFolder` to open the results.

```
polyspaceBugFinder('-results-dir',resFolder)
```

Run Polyspace Analysis from MATLAB

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`.

Run the following command on the MATLAB command line.

```
polyspaceBugFinder('-sources','C:\Polyspace_Sources\source.c', ...
```

```
    '-I','C:\Polyspace_Includes', ...
    '-results-dir','C:\Polyspace_Results')
```

Polyspace runs on the file `C:\Polyspace_Sources\source.c` and stores the result in `C:\Polyspace_Results`.

To view the results from the MATLAB command line, enter:

```
polyspaceBugFinder('-results-dir','C:\')
```

Run Polyspace Verification with Coding Rules Checking

This example shows how to run a Polyspace verification with additional options. You can specify as many additional options as you want as "Name-Value Pair Arguments" on page 5-22. Here you specify checking of MISRA C coding rules using the option `-misra2`. For more information on this option, see "Check MISRA C:2004" on page 1-41.

Assign the source file path to a MATLAB variable `sourceFileName`.

```
sourceFileName = fullfile(matlabroot, 'polyspace',...
'examples', 'cxx', 'Bug_Finder_Example','sources','dataflow.c')
```

Assign the results folder path to a MATLAB variable `resFolder`.

```
resFolder = fullfile('C:\','Polyspace_Results')
```

Run Polyspace Bug Finder analysis with additional option `-misra2`.

```
polyspaceBugFinder('-sources',sourceFileName,...
     '-results-dir',resFolder,'-misra2','required-rules')
```

Open the results file.

```
polyspaceBugFinder('-results-dir',resFolder)
```

- "Specify Options from MATLAB Command Line"

Input Arguments

`projectFile` — Name of `.psprj` file

string

Name of project file with extension `.psprj`, specified as a string.

If the file is not in the current folder, `projectFile` must include a full or relative path. Use `pwd` to identify the current folder and `cd` to change the current folder.

Example: `'C:\Polyspace_Projects\myProject.psprj'`

`resultsFile` — Name of `.psbf` file

string

Name of results file with extension `.psbf`, specified as a string.

If the file is not in the current folder, `resultsFile` must include a full or relative path. Use `pwd` to identify the current folder and `cd` to change the current folder.

Example: `'myResults.psbf'`

`resultsFolder` — Name of result folder

string

Name of result folder, specified as a string. 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. Use `pwd` to identify the current folder and `cd` to change the current folder.

Example: `'C:\Polyspace\Results\'`

`sourceFiles` — Comma-separated names of `.c` or `.cpp` files

string

Comma-separated source file names with extension `.c` or `.cpp`, specified as a single string.

If the files are not in the current folder, `sourceFiles` must include a full or relative path. Use `pwd` to identify the current folder and `cd` to change the current folder.

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: `'-OS-target','Linux','-dialect','gnu4.6'` specifies that the source code is intended for the Linux operating system and contains non-ANSI C syntax for the GCC 4.6 dialect.

- For options that can also be set from the user interface, see the **Command-Line Information** section in:
  - "Analysis Options for C"
  - "Analysis Options for C++"
- For options that cannot be set from the user interface, see the **Polyspace Analysis Options** section in "Command-Line Invocation".

Introduced in R2013b

polyspaceConfigure

Create Polyspace project from your build system at the MATLAB command line

Syntax

`polyspaceConfigure buildCommand`

`polyspaceConfigure buildCommand -option value`

Description

`polyspaceConfigure buildCommand` traces your build system and creates a Polyspace project with information gathered from your build system.

`polyspaceConfigure buildCommand -option value` traces your build system and uses the flag `-option value` to modify the default operation of `polyspaceConfigure`.

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
```

Trace Incremental Makefile Builds

This example shows how to trace incremental makefile builds to keep your Polyspace project updated. If you use this approach, polyspaceConfigure does not have to trace the entire makefile every time you make a change to it.

Create a Polyspace project from your makefile using polyspaceConfigure. For this first project creation:

- Use the -B or -W *makefileName* option with make so that all prerequisite targets in the makefile are remade.

  For the list of options allowed with the GNU make, see make options.
- Use the -incremental option so that the build trace information is saved.

```
polyspaceConfigure -prog myProject ...
        -incremental make -B targetName buildOptions
```

After you add, remove or change source files, to keep your Polyspace project updated, rerun polyspaceConfigure with the same options. Do not use the -B or -W *makefileName* option with make.

```
polyspaceConfigure -prog myProject ...
        -incremental make targetName buildOptions
```

The polyspaceConfigure function uses the previous build trace information to incrementally add or remove the updated files to your Polyspace project. It does not trace the entire makefile.

- “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 there is an error in the build process. If there is an error, the build trace log shows the following message: `polyspace-configure ERROR: build command command_name fail [status=status_value]` *`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.
`-author`	Author name	Name of project author. **Example:** `-author jsmith`
`-code-prover` (default) | `-bug-finder`	None	Option to create a Polyspace Bug Finder or Polyspace Code Prover project.
`-debug`	None	Option used by MathWorks technical support
`-help`	None	Option to display the full list of `polyspaceConfigure` commands
`-lang`	`auto`(default) |`c`|`cpp`	Option to specify source code language. By default,`polyspaceConfigure` detects the language. If it detects a mixture of languages

Option	Argument	Description
		in the compilation units, it assigns C++ as the project language. If it detects the use of C++11, it allows C++11 extensions.
`-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. **Example:** `-output-project ../myProjects/project1`
`-prog`	Project name	Project name that appears in the Polyspace user interface. The default is `polyspace`. **Example:** `-prog myProject`
`-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. 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”. **Example:** `-compiler-configuration myCompiler.xml`
`-incremental`	None	Option to save build trace information for reuse in incremental builds

Option	Argument	Description
`-no-build`	None	Option to create a Polyspace project using previously saved build trace information. To use this option, you must have the build trace information saved from an earlier run of `polyspaceConfigure` with the `-no-project` option. 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. Use this option to save your build trace information for a later run of `polyspaceConfigure` with the `-no-build` option.
`-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`. **Example:** `-build-trace ../build_info/trace.log`
`-no-cache` | `-cache-sources` (default) | `-cache-all-files`	None	Option to perform one of the following: • Not create a cache • Cache only source and header files. • Cache all files including binaries.
`-cache-path`	Path	Location of folder where cache information is stored.

Option	Argument	Description
		Example: `-cache-path ../cache`

More About

- "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,'-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,'-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')
```

```
ID AUTHOR APPLICATION LOCAL_RESULTS_DIR WORKER STATUS DATE LANG CLUSTER_MODE
...
19 user Polyspace C:\psdemo\res1  queued Wed Mar 16 16:48:38 EST 2014 C Batch
20 user Polyspace C:\psdemo\res2  queued Wed Mar 16 16:48:38 EST 2014 C Batch
```

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')
```

```
ID AUTHOR APPLICATION LOCAL_RESULTS_DIR WORKER STATUS DATE LANG CLUSTER_MODE
...
19 user Polyspace C:\psdemo\res1  cancelled Wed Mar 16 16:48:38 EST 2014 C Batch
20 user Polyspace C:\psdemo\res2  running Wed Mar 16 16:48:38 EST 2014 C Batch
```

Remove job 19.

```
polyspaceJobsManager('remove','-job','19','-scheduler',...
   'myMJS@myCompany.com')
polyspaceJobsManager('listjobs','-scheduler','myMJS@myCompany.com')
```

```
ID AUTHOR APPLICATION LOCAL_RESULTS_DIR WORKER STATUS DATE LANG CLUSTER_MODE
...
20 user Polyspace C:\psdemo\res2  completed Wed Mar 16 16:48:38 EST 2014 C Batch
```

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

string

Number of the queued job that you want to manage, specified as a string in single quotes.

Example: `'-job','10'`

`resultsFolder` — Path to results folder

string

Path to results folder specified as a string 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'`

More About

- “Clusters and Cluster Profiles”
- “Run Remote Analysis at Command Line”

See Also

`polyspaceBugFinder`

Introduced in R2013b

pslinkoptions Properties

Properties for the `pslinkoptions` object

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, any additional files to include, and data range modes.

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 verification 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`, to use Lookup Table code during the analysis, or `false`, to not.

Only for TargetLink

Example: `opts.AutoStubLUT = true;`

See Also

`pslinkoptions` | `pslinkrun`

Polyspace Bug Finder

Identify software defects via static analysis

Description

Polyspace Bug Finder 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

- Open from the Apps tab of the MATLAB toolstrip, in the Code Verification group
- Alternatively, start it from the MATLAB command prompt using `polyspaceBugFinder`

Examples

- "Find Defects from the Polyspace Environment"
- "Run Local Analysis from Command Line"

Programmatic Use

`polyspaceBugFinder`

See Also

Apps
Polyspace Code Prover

Functions
`polyspaceBugFinder` | `polyspaceConfigure`

Introduced in R2013b

6

MISRA C 2012

MISRA C:2012 Directive 2.1
MISRA C:2012 Directive 4.1
MISRA C:2012 Directive 4.3
MISRA C:2012 Directive 4.5
MISRA C:2012 Directive 4.6
MISRA C:2012 Directive 4.9
MISRA C:2012 Directive 4.10
MISRA C:2012 Directive 4.11
MISRA C:2012 Directive 4.13
MISRA C:2012 Rule 1.1
MISRA C:2012 Rule 1.2
MISRA C:2012 Rule 1.3
MISRA C:2012 Rule 2.1
MISRA C:2012 Rule 2.2
MISRA C:2012 Rule 2.3
MISRA C:2012 Rule 2.4
MISRA C:2012 Rule 2.5
MISRA C:2012 Rule 2.6
MISRA C:2012 Rule 2.7
MISRA C:2012 Rule 3.1
MISRA C:2012 Rule 3.2
MISRA C:2012 Rule 4.1
MISRA C:2012 Rule 4.2
MISRA C:2012 Rule 5.1
MISRA C:2012 Rule 5.2
MISRA C:2012 Rule 5.3
MISRA C:2012 Rule 5.4
MISRA C:2012 Rule 5.5
MISRA C:2012 Rule 5.6
MISRA C:2012 Rule 5.7
MISRA C:2012 Rule 5.8
MISRA C:2012 Rule 5.9

MISRA C:2012 Rule 6.1
MISRA C:2012 Rule 6.2
MISRA C:2012 Rule 7.1
MISRA C:2012 Rule 7.2
MISRA C:2012 Rule 7.3
MISRA C:2012 Rule 7.4
MISRA C:2012 Rule 8.1
MISRA C:2012 Rule 8.2
MISRA C:2012 Rule 8.3
MISRA C:2012 Rule 8.4
MISRA C:2012 Rule 8.5
MISRA C:2012 Rule 8.6
MISRA C:2012 Rule 8.7
MISRA C:2012 Rule 8.8
MISRA C:2012 Rule 8.9
MISRA C:2012 Rule 8.10
MISRA C:2012 Rule 8.11
MISRA C:2012 Rule 8.12
MISRA C:2012 Rule 8.13
MISRA C:2012 Rule 8.14
MISRA C:2012 Rule 9.1
MISRA C:2012 Rule 9.2
MISRA C:2012 Rule 9.3
MISRA C:2012 Rule 9.4
MISRA C:2012 Rule 9.5
MISRA C:2012 Rule 10.1
MISRA C:2012 Rule 10.2
MISRA C:2012 Rule 10.3
MISRA C:2012 Rule 10.4
MISRA C:2012 Rule 10.5
MISRA C:2012 Rule 10.6
MISRA C:2012 Rule 10.7
MISRA C:2012 Rule 10.8
MISRA C:2012 Rule 11.1
MISRA C:2012 Rule 11.2
MISRA C:2012 Rule 11.3
MISRA C:2012 Rule 11.4
MISRA C:2012 Rule 11.5
MISRA C:2012 Rule 11.6
MISRA C:2012 Rule 11.7

MISRA C:2012 Rule 11.8
MISRA C:2012 Rule 11.9
MISRA C:2012 Rule 12.1
MISRA C:2012 Rule 12.2
MISRA C:2012 Rule 12.3
MISRA C:2012 Rule 12.4
MISRA C:2012 Rule 13.1
MISRA C:2012 Rule 13.2
MISRA C:2012 Rule 13.3
MISRA C:2012 Rule 13.4
MISRA C:2012 Rule 13.5
MISRA C:2012 Rule 13.6
MISRA C:2012 Rule 14.1
MISRA C:2012 Rule 14.2
MISRA C:2012 Rule 14.3
MISRA C:2012 Rule 14.4
MISRA C:2012 Rule 15.1
MISRA C:2012 Rule 15.2
MISRA C:2012 Rule 15.3
MISRA C:2012 Rule 15.4
MISRA C:2012 Rule 15.5
MISRA C:2012 Rule 15.6
MISRA C:2012 Rule 15.7
MISRA C:2012 Rule 16.1
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
MISRA C:2012 Rule 16.7
MISRA C:2012 Rule 17.1
MISRA C:2012 Rule 17.2
MISRA C:2012 Rule 17.3
MISRA C:2012 Rule 17.4
MISRA C:2012 Rule 17.5
MISRA C:2012 Rule 17.6
MISRA C:2012 Rule 17.7
MISRA C:2012 Rule 17.8
MISRA C:2012 Rule 18.1
MISRA C:2012 Rule 18.2

MISRA C:2012 Rule 18.3
MISRA C:2012 Rule 18.4
MISRA C:2012 Rule 18.5
MISRA C:2012 Rule 18.6
MISRA C:2012 Rule 18.7
MISRA C:2012 Rule 18.8
MISRA C:2012 Rule 19.1
MISRA C:2012 Rule 19.2
MISRA C:2012 Rule 20.1
MISRA C:2012 Rule 20.2
MISRA C:2012 Rule 20.3
MISRA C:2012 Rule 20.4
MISRA C:2012 Rule 20.5
MISRA C:2012 Rule 20.6
MISRA C:2012 Rule 20.7
MISRA C:2012 Rule 20.8
MISRA C:2012 Rule 20.9
MISRA C:2012 Rule 20.10
MISRA C:2012 Rule 20.11
MISRA C:2012 Rule 20.12
MISRA C:2012 Rule 20.13
MISRA C:2012 Rule 20.14
MISRA C:2012 Rule 21.1
MISRA C:2012 Rule 21.2
MISRA C:2012 Rule 21.3
MISRA C:2012 Rule 21.4
MISRA C:2012 Rule 21.5
MISRA C:2012 Rule 21.6
MISRA C:2012 Rule 21.7
MISRA C:2012 Rule 21.8
MISRA C:2012 Rule 21.9
MISRA C:2012 Rule 21.10
MISRA C:2012 Rule 21.11
MISRA C:2012 Rule 21.12
MISRA C:2012 Rule 22.1
MISRA C:2012 Rule 22.2
MISRA C:2012 Rule 22.3
MISRA C:2012 Rule 22.4
MISRA C:2012 Rule 22.5
MISRA C:2012 Rule 22.6

MISRA C:2012 Directive 2.1

All source files shall compile without any compilation errors

Description

Rule 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`

More About

- "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 Directive 4.1

Run-time failures shall be minimized

Description

Rule 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.

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 Directive 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

More About

- “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 Directive 4.3

Assembly language shall be encapsulated and isolated

Description

Rule 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 `asm` functions or in `asm` pragmas.

Message in Report

Assembly language shall be encapsulated and isolated

Check Information

Group: Code Design
Category: Required

AGC Category: Required
Language: C90, C99

See Also

MISRA C:2012 Rule 1.2

More About

- “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 Directive 4.5

Identifiers in the same name space with overlapping visibility should be typographically unambiguous

Description

Rule 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_zer0;
    int id5_zerO;     /* 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

More About

- "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 Directive 4.6

`typedefs` that indicate size and signedness should be used in place of the basic numerical types

Description

Rule 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 not issue a warning for the `typedef` definition.

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

More About

- "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 Directive 4.9

A function should be used in preference to a function-like macro where they are interchangeable

Description

Rule 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 raises a warning on 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

More About

- "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 Directive 4.10

Precautions shall be taken in order to prevent the contents of a header file being included more than once

Description

Rule 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. This situation can be a source of confusion. If this multiple inclusion leads to multiple or conflicting definitions, then your program can have undefined or erroneous behavior.

Polyspace Specification

Try to prevent multiple inclusions when a header file is formatted as:

```
#ifndef <control macro>
#define <control macro>
    contents
#endif
```

or

```
#ifdef <control macro>
#error ...
#else
#define <control macro>
    contents
#endif
```

Otherwise, Polyspace flags the inclusion as non-compliant.

Message in Report

Precautions shall be taken in order to prevent the contents of a header file being included more than once.

Check Information

Group: Code Design
Category: Required
AGC Category: Required
Language: C90, C99

More About

- "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 Directive 4.11

The validity of values passed to library functions shall be checked

Description

Rule 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`

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 Directive 4.1

More About

- "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 Directive 4.13

Functions which are designed to provide operations on a resource should be called in an appropriate sequence

Description

Rule 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`
	
	`task2`	

Critical section details	**Starting procedure**	**Ending procedure**
	`mutex_lock`	`mutex_unlock`

For more information on the options, see:

- "Entry points (C/C++)" on page 1-35
- "Critical section details (C/C++)" on page 1-37

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`

More About

- "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 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

Standard compilation error messages do not lead to a violation of this MISRA rule.

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

More About

- "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

More About

- “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 Directive 4.1

More About

- "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.

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

More About

- “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

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 checks for useless writes during the Polyspace Bug Finder 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  */

    *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

More About

- "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

More About

- "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

More About

- "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

More About

- "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

More About

- "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`

More About

- "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 Code for Rule Violations”.

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

More About

- "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

More About

- “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

More About

- "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.

Message in Report

Trigraphs should not be used.

Check Information

Group: Character Sets and Lexical Conventions
Category: Advisory
AGC Category: Advisory
Language: C90, C99

More About

- "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 command-line option `-no-language-extensions`.

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

More About

- “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 command-line option `-no-language-extensions`.

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

More About

- “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 command-line option `-no-language-extensions`.

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

More About

- "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 command-line option `-no-language-extensions`.

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

More About

- "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 command-line option `-no-language-extensions`.

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

More About

- "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

More About

- "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

More About

- "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

More About

- "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

More About

- “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

More About

- "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
Category: Required
AGC Category: Required
Language: C90, C99

More About

- “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

More About

- "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

More About

- "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

More About

- “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

More About

- "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

More About

- “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

More About

- “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

More About

- "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

More About

- “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).

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

More About

- “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

Polyspace considers tentative definitions as definitions, but does not raise warnings on predefined symbols.

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 of definition for object *object_name*.
- Global variable *variable_name* multiply defined.
- Function *function_name* multiply defined.
- Global variable has multiple tentative of definitions.
- Undefined global variable *variable_name*.

Check Information

Group: Declarations and Definitions
Category: Required
AGC Category: Required
Language: C90, C99

More About

- "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

More About

- "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`.

Correction — Consistent `static` and `extern` Use

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

More About

- "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

More About

- "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

More About

- "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

More About

- "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
Category: Required
AGC Category: Required
Language: C90, C99

More About

- "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 8.13

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.

Correction — Use `const` Keywords

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

More About

- “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

More About

- "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

More About

- “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

More About

- "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

More About

- "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 an 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

More About

- “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

More About

- "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

What Are Essential Types?

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) 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

Amplification and Rationale

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

More About

- "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

More About

- "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

More About

- "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.

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

More About

- "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

More About

- "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

More About

- "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

More About

- “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

More About

- "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

More About

- "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

More About

- “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

More About

- "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 “Files and folders to ignore (C)” on page 1-55 or “Files and folders to ignore (C++)” on page 2-24.
- 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

More About

- "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

More About

- “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

More About

- "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
Category: Required
AGC Category: Required
Language: C90, C99

See Also

MISRA C:2012 Rule 11.4

More About

- "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.

Check Information

Group: Pointer Type Conversions

Category: Required
AGC Category: Required
Language: C90, C99

See Also

MISRA C:2012 Rule 11.3

More About

- “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

More About

- “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
Bitwise XOR	`^`	6
Bitwise OR	`|`	5

<table>
<tr><th>Description</th><th>Operator and Operand</th><th>Precedence</th></tr>
<tr><td>Logical AND</td><td>&&</td><td>4</td></tr>
<tr><td>Logical OR</td><td>||</td><td>3</td></tr>
<tr><td>Conditional</td><td>?:</td><td>2</td></tr>
<tr><td>Assignment</td><td>= *= /= += -= <<= >>= &= ^= |=</td><td>1</td></tr>
<tr><td>Comma</td><td>,</td><td>0</td></tr>
</table>

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.

Correction — Clarify With Parentheses

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.

Correction — Clarify with Parentheses

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

More About

- “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

More About

- "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

Use of the comma operator is generally detrimental to the readability of code. The same code can usually be written 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 */

int foo(void)
{
    volatile int rd = 1;                   /* Compliant */
    int var=0, foo=0, k=0, n=2, p, t[10];  /* Compliant */

    int abc = 0, xyz = abc + 1;            /* Compliant */
    int jkl = ( abc + xyz, abc + xyz );    /* Not compliant */

    var = 1, foo += var, kkk = 3;          /* Not compliant */
```

```
    var = (kkk = 1, foo = 2);              /* Not compliant */

    for ( var = 0, ptr = &t[ 0 ]; var < num; ++var, ++ptr){}
                                           /* Not compliant */

    if ((abc,xyz)<0) { return 1; }         /* Not compliant */
}
```

In this example, the code shows various uses of commas in C code. Using commas to call functions with variables is allowed (line 3). When using the comma for initialization, the variables and values must be clear (line 8 and 10). Line 11 is not compliant because it is unclear what `jkl` is initialized to. (For example, `abc+xyz`, `(abc+xyz)*(abc+xyz)`, `f((abc+xyz),(abc+xyz))`, etc.)

Line 13 and 14 are both assignment statements, but it is unclear which variables are getting assigned which values.

Line 16 violates multiple MISRA coding rules because the complex `for` statement makes it unclear which values control the loop.

Line 18 violates rule 12.3 because it is unclear if the `if` statement depends on `abc`, `xyz`, or both.

Check Information

Group: Expressions
Category: Advisory
AGC Category: Advisory
Language: C90, C99

See Also

MISRA C:2012 Rule 12.1

More About

- "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

More About

- "Activate Coding Rules Checker"
- "Review Coding Rule Violations"
- "Polyspace MISRA C:2012 Checker"

- “Software Quality Objective Subsets (C:2012)”

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

More About

- "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.

Polyspace Specification

Rule 13.2 assumes that the comma operator is not used (rule 12.3).

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 Directive 4.9 | MISRA C:2012 Rule 13.1 | MISRA C:2012 Rule 13.3 | MISRA C:2012 Rule 13.4

More About

- "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

More About

- "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

More About

- "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

More About

- "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

More About

- “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

More About

- “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.

Correction — Use Another Variable to Terminate Early

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

More About

- "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

Category: Required
AGC Category: Required
Language: C90, C99

See Also

MISRA C:2012 Rule 2.1 | MISRA C:2012 Rule 14.2

More About

- "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

More About

- "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

More About

- “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

More About

- “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

More About

- "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

More About

- “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.

Correction — Use Variable to Store Return Value

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

More About

- "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`.

Correction — Place Selection Statement Block in Braces

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

More About

- "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.

Correction — Add `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

More About

- “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.

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

More About

- "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

More About

- “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

More About

- "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.

Correction — Add `default` With Error Flag

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.

Correction — Add `default`

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

More About

- "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

More About

- “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
Category: Required
AGC Category: Advisory
Language: C90, C99

See Also

MISRA C:2012 Rule 16.1

More About

- “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

More About

- “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

More About

- "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

More About

- "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 examples, 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

More About

- "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

More About

- “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`

More About

- "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
Category: Mandatory
AGC Category: Mandatory
Language: C99

More About

- "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

More About

- "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

More About

- "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 Directive 4.1 | MISRA C:2012 Rule 18.4

More About

- "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.

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 Directive 4.1 | MISRA C:2012 Rule 18.4

More About

- "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 Directive 4.1

More About

- “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

More About

- "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

More About

- “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

More About

- "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.

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

More About

- “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

More About

- "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

More About

- "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

More About

- "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

More About

- “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

More About

- "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
Category: Required
AGC Category: Required
Language: C90, C99

More About

- "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.

Correction — Rename keyword

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`

More About

- "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

More About

- "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

More About

- “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
Category: Required
AGC Category: Required
Language: C90, C99

See Also

MISRA C:2012 Directive 4.9

More About

- "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

More About

- "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 Directive 4.9

More About

- "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

More About

- “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

More About

- “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

More About

- “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 can use a preprocessing directive to conditionally exclude source code until it encounters a corresponding `#else`, `#elif`, `#endif` directive. If your compiler does not detect a malformed or invalid preprocessing directive inside excluded source code, more code than you intended to excluded.

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

More About

- "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

More About

- "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
- Macro names described in the C Standard Library as being defined in a standard header.

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_squrt      /* 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

More About

- “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.

Polyspace Specification

Message in Report

Identifier 'XX' shall not be reused.

Check Information

Group: Standard Libraries
Category: Required
AGC Category: Required
Language: C90, C99

More About

- "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

More About

- “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

More About

- "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

More About

- “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

More About

- "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

More About

- "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

More About

- "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

More About

- "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

More About

- "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.

Correction — Use Appropriate Function in math.h

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

More About

- “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

More About

- "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 22.1

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`

More About

- "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`

More About

- "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
Category: Required
AGC Category: Required
Language: C

See Also

`MISRA C:2012 Rule 21.6` | `Resource leak`

More About

- "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`

More About

- "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`

More About

- “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`

More About

- "Activate Coding Rules Checker"
- "Review Coding Rule Violations"
- "Polyspace MISRA C:2012 Checker"
- "Software Quality Objective Subsets (C:2012)"

Introduced in R2015b

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.	

8

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 {`
`    char name[40];`
`    long double salary;`
`    int isEmployed;`
`};`
	0	1

`struct record dataBase[100];`
`struct record fetch(void);`
`void remove(int);`
	0	4

`void maintenanceRoutines() {`	0	4
`// This function implements` `// regular maintenance on an internal database`	1	4
`int i;` `struct record tempRecord;`	1	6
`for(i=0; i <100; i++) {`	1	6

` tempRecord = fetch(); // This`
`      function fetches a record`
`        // from the database`
	2	7

`if(tempRecord.isEmployed == 0)`
`            remove(i);`
`        // Remove employee record`
`        //from the database`
`  }`
`}`
	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

Cyclomatic Complexity

Number of linearly independent paths through source code

Description

This metric specifies the number of linearly independent paths through the source code.

To calculate this metric, add 1 to the number of decision points in your code. A decision point is a statement that causes your program to branch into two paths. For example, at an `if` statement, your program can either enter the `if` branch or not.

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”.

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
Acronym: `VG`
HIS Metric: Yes

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 10. 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

Estimated Function Coupling

Measure of complexity between levels of call tree

Description

This metric is defined as (number of call occurrences – number of function definitions + 1). The metric provides an approximate measure of complexity between different levels of the call tree.

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.

Metric Information

Group: File
Acronym: `FCO`
HIS Metric: No

See Also

Number of Call Occurrences

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 with no 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

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.

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

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.

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

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.

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

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 no indirect recursions 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.

Note: This metric is available only in the Polyspace Metrics web interface.

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

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.

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

Number of Files

Number of source files

Description

This metric calculates the number of source files in your project.

Note: This metric is available only in the Polyspace Metrics web interface.

Metric Information

Group: Project
Acronym: `FILES`
HIS Metric: No

See Also

Number of Header Files

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

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
Acronym: `GOTO`
HIS Metric: Yes

Number of Header Files

Number of header files

Description

This metric measures the number of header files in the project. Both directly and indirectly included header files are counted. Polyspace internal header files and header files included by those files are also counted.

Note: This metric is available only in the Polyspace Metrics interface.

Metric Information

Group: Project
Acronym: `INCLUDES`
HIS Metric: No

See Also

Number of Files

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”.

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
Acronym: `STMT`
HIS Metric: Yes

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.

Metric Information

Group: File
Acronym: `TOTAL_LINES`
HIS Metric: No

See Also

Number of Lines Without Comment

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.

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

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.

Metric Information

Group: File
Acronym: `LINES_WITHOUT_CMT`
HIS Metric: No

See Also

Number of Lines

Number of Paths

Estimated static path count

Description

This metric measures the number of paths through your source code.

If there are `goto` statements 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 there is more than one control flow statement 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 there are many control flow statements 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 8-38.

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 all the `case`s 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

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 there is one return statement, 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

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