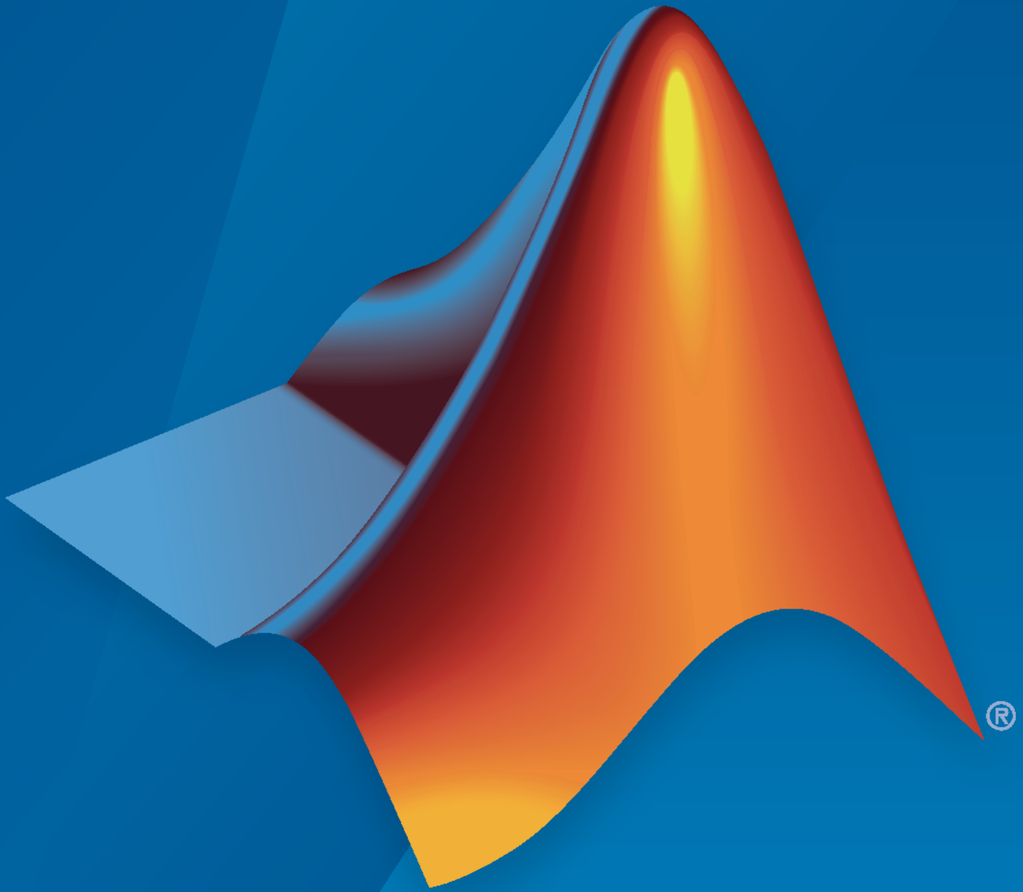
Polyspace® Bug Finder™ Server™

User's Guide



R2021**a**

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Polyspace® Bug Finder™ Server™ User's Guide

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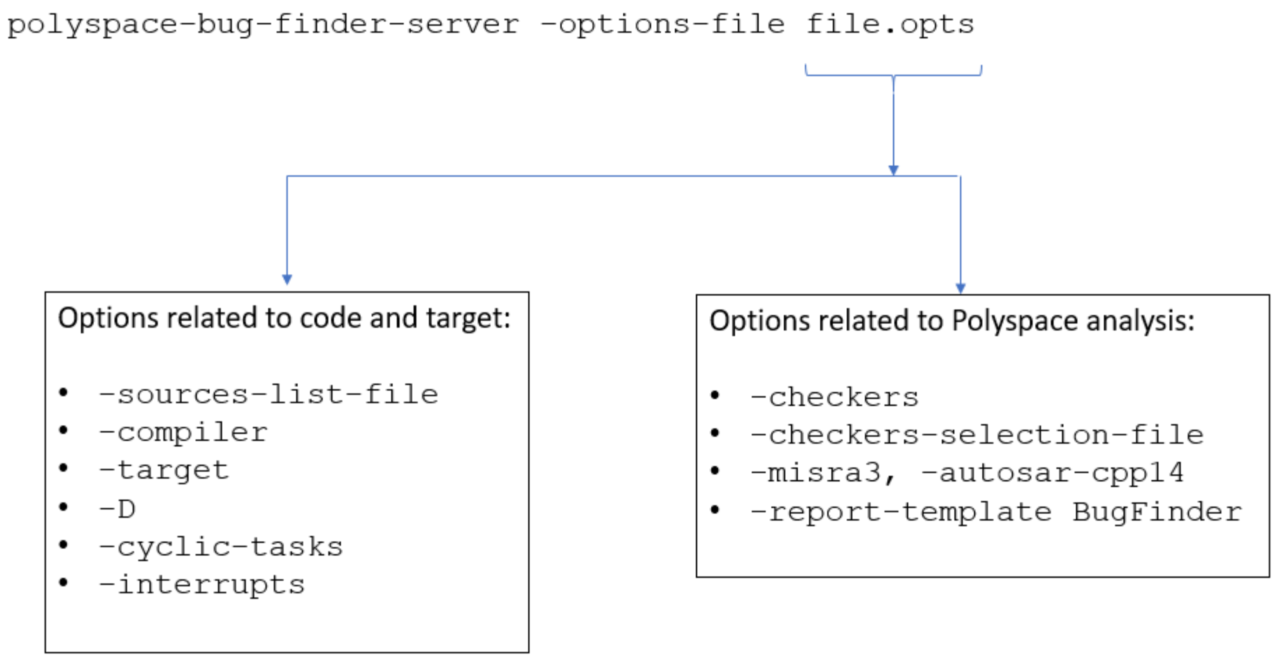
Polyspace Analysis on Server After Code Submission

Prepare Scripts for Polyspace Analysis

When you run Polyspace as part of your software development processes, your analysis scripts must be preconfigured for new code submissions. For instance, new source files must be automatically included in the Polyspace analysis. To keep the analysis configuration updated with new submissions, you can leverage existing artifacts such as your build command (makefiles) and create your analysis configuration on the fly when new submissions occur.

The analysis configuration consists of two parts:

- Options related to the source code and target, such as data type sizes, macro definitions, cyclic tasks and interrupts, and so on.
- Options related to the analysis, such as checkers, code verification assumptions, and so on.


polyspace-bug-finder-server -options-file file.opts
Options related to code and target:
-sources-list-file
-compiler
-target
-D
-cyclic-tasks
-interrupts
Options related to Polyspace analysis:
-checkers
-checkers-selection-file
-misra3, -autosar-cpp14
-report-template BugFinder

Options Related to Source Code and Target

The most common options related to the source code and target are:

- `-sources-list-file`: Specify a text file containing one source file per line.
- `-I`: Specify the folders containing included header files.
- `Compiler (-compiler)`: Specify the compiler used for building your source code.
- `Target processor type (-target)`: Specify sizes of data types and endianness by selecting a predefined target processor.

- `Preprocessor definitions (-D)`: Replace unrecognized code for the purposes of Polyspace analysis. You typically use this option if the analysis shows compilation errors from compiler-specific keywords and macros.
- `Constraint setup (-data-range-specifications)`: Define external constraints on global variables and function interfaces. The option is typically useful for a more precise Code Prover analysis.

For the full list of options, see:

- "Analysis Options in Polyspace Bug Finder Server"
- "Analysis Options in Polyspace Code Prover Server" (Polyspace Code Prover Server)

Extract Options from Build Command

In a continuous integration workflow, you typically do not specify the option arguments explicitly. Your build command contains the specifications for sources, compiler, macro definitions and so on. Run the `polyspace-configure` command to extract these specifications from your build command and create an options file. For instance, if you use `make` to build your source code, run the analysis as follows:

```
polyspace-configure -output-options-file polyspace_opts make
polyspace-bug-finder-server -options-file polyspace_opts
polyspace-code-prover-server -options-file polyspace_opts
```

The first command extracts source and target specifications by executing the instructions in the makefile and creates an analysis options file. The second and third commands runs a Bug Finder and Code Prover analysis with the options file. See "Create Polyspace Analysis Configuration from Build Command" on page 2-2.

Specify Options Explicitly in Options File

If you cannot extract the options from your build command, specify the options explicitly. You can create some of the option arguments on the fly from new submissions. For instance, the argument for the option `-sources-list-file` is a text file that lists the sources. You can update this text file based on any new source file added to the source code repository.

If you have to specify the target and compiler options explicitly, you might not get all the options right in the first run. To find the right combination of options:

1. Specify the options `Compiler (-compiler)` and `Target processor type (-target)` in your options file.
2. Compile the code with your compiler and fix all compilation errors. Then, run only the compilation part of the Polyspace analysis.

   - In Bug Finder, disable all checkers. Specify `-checkers none` in the options file. See `Find defects (-checkers)`.
   - In Code Prover, stop the analysis after compilation. Specify `-to compile` in the options file. See `Verification level (-to)`.

   If you run into compilation errors, you might have to work around the errors with Polyspace options. For instance, if you see a compilation error because the macro `_WIN32` is defined with a compiler option but Polyspace considers the macro as undefined by default, emulate your compiler option with the Polyspace option `-D _WIN32`. See “Target and Compiler”, “Macros” and “Environment Settings” for the target and compiler options.

Once you fix all compilation errors with Polyspace analysis options, your options file is prepared with the right set of Polyspace options for the analysis.

If you have an installation of the desktop products, Polyspace Bug Finder and/or Polyspace Code Prover™, you can perform the trial runs in the user interface of the desktop products. You can then generate an options file from the configuration defined in the user interface. The user interface provides various features such as:

- Compilation assistant that suggests workarounds for some compilation errors,
- Auto-generation of XML file for constraint specification,
- Context-sensitive help for options,

See “Configure Polyspace Analysis Options in User Interface and Generate Scripts” on page 1-14.

Options Related to Polyspace Analysis

Some options related to the Polyspace analysis are:

Bug Finder

- `Find defects (-checkers)`: Specify checkers to enable for the Bug Finder analysis.
- `Check MISRA C:2012 (-misra3)` and other options related to external standards: Specify an external standard and a predefined subset of that standard.
- `Set checkers by file (-checkers-selection-file)`: Specify a custom subset of rules from external standards.
- `Bug Finder and Code Prover report (-report-template)`: Specify that a PDF, Word or HTML report must be generated along with the analysis results and specify a template for the report.
- `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`: Offload the analysis to another server. See “Offload Polyspace Analysis from Continuous Integration Server to Another Server” on page 1-9.

Code Prover

- `Overflow mode for signed integer (-signed-integer-overflows)`: Specify the behavior following an overflow: stop analysis or continue with wrap-around.
- `Detect stack pointer dereference outside scope (-detect-pointer-escape)`: Specify if the analysis must find cases where a function returns a pointer to one of its local variables.
- `Detect uncalled functions (-uncalled-function-checks)`: Specify if the analysis must flag functions that are not called directly or indirectly from main or another entry point function.
- `Bug Finder and Code Prover report (-report-template)`: Specify that a PDF, Word or HTML report must be generated along with the analysis results and specify a template for the report.

- `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`: Offload the analysis to another server. See “Offload Polyspace Analysis from Continuous Integration Server to Another Server” (Polyspace Code Prover Server).

The checkers and other options related to the Polyspace analysis can be applicable to more than one project. To maintain uniform standards across projects, you can reuse this subset of analysis options. When running the analysis, specify two options files, one containing the options specific to the current project and the other containing the reusable options. You can extract the first options file from your build command but explicitly create the second options file.

For instance, in this example, the `polyspace-bug-finder-server` command uses two options files: `compile_opts` generated from a makefile and `runbf_opts` created manually. All reusable options can be specified in `runbf_opts`.

```
polyspace-configure -output-options-file compile_opts make
polyspace-bug-finder-server -options-file compile_opts -options-file runbf_opts
polyspace-code-prover-server -options-file compile_opts -options-file runcp_opts
```

If the same option appears in two options files, the last instance of the option is considered. In the preceding example, if an option occurs in both `compile_opts` and `runbf_opts`, the occurrence in `runbf_opts` is considered. If you want to override previous occurrences of an option, use an additional options file with your overrides. Append this options file to the end of the analysis command.

See Also

`polyspace-bug-finder-server` | `polyspace-configure`

More About

- “Run Polyspace Bug Finder on Server and Upload Results to Web Interface”
- “Create Polyspace Analysis Configuration from Build Command” on page 2-2
- “Configure Polyspace Analysis Options in User Interface and Generate Scripts” on page 1-14

Options Files for Polyspace Analysis

To adapt the Polyspace analysis configuration to your development environment and requirements, you have to modify the default configuration through command-line options such as `-compiler`. Options files are a convenient way to collect multiple options together and reuse them across projects.

What are Options Files

Options files are text files with one option per line. For instance, the content of an options file can look like this:

```
# Options for Polyspace analysis
# Options apply to all projects in Controller module
-compiler visual16.x
-D _WIN32
-code-behavior-specifications "Z:\utils\polyspace\forbiddenfunctions.xml"
```

The lines starting with # represent comments for better readability. These lines are ignored during analysis.

Specifying Options Files

Depending on the platform where you run analysis, you can specify an options file in one of the following ways.

Command Line

At the command line (and in scripts), specify an options file as argument to the option `-options-file`.

For instance, instead of the command:

```
polyspace-bug-finder -sources file.c -compiler visual16.x -D _WIN32
        -code-behavior-specifications "Z:\utils\polyspace\forbiddenfunctions.xml"
```

Save this content:

```
-compiler visual16.x
-D _WIN32
-code-behavior-specifications "Z:\utils\polyspace\forbiddenfunctions.xml"
```

In a file `options.txt` in the path `Z:\utils\polyspace\` and shorten the command to:

```
polyspace-bug-finder -sources file.c -options-file "Z:\utils\polyspace\options.txt"
```

You can use options files with these Polyspace commands:

- `polyspace-bug-finder`

- `polyspace-bug-finder-server`
- `polyspace-bug-finder-access`
- `polyspace-code-prover`
- `polyspace-code-prover-server`

IDEs

If you run Polyspace as You Code using IDE extensions, you typically specify three groups of options differently:

- *Build options*:

  You can extract build options from existing artifacts such as build commands and JSON compilation database, or collect all build options in an options file. You can specify this options file in the appropriate extension setting:

  - Visual Studio Code: **Analysis Options > Manual Setup > Build Setting : Polyspace Build Options File**
  - Visual Studio: **Get from Polyspace build options file** (in section **Build Configuration**)
  - Eclipse: **Get from Polyspace build options file** (in section **Build Configuration**)
- *Checkers*:

  You can specify checkers using a checkers selection wizard. For details, see “Setting Checkers in Polyspace as You Code” (Polyspace Bug Finder Access).
- *Other remaining options*:

  All remaining options can be collected in a second options file that goes into the appropriate extension setting:

  - Visual Studio Code: **Analysis Options > Manual Setup: Other Analysis Options**
  - Visual Studio: **Analysis configuration > Analysis options file**
  - Eclipse: **Analysis options file**

If you use options files both for build options and other options, the result is the same as specifying a single options file with the other options appended to the build options. See also “Specifying Multiple Options Files” on page 1-8.

For more information on IDE extensions, see:

- “Configure Polyspace as You Code Extension in Visual Studio” (Polyspace Bug Finder Access)
- “Configure Polyspace as You Code Extension in Visual Studio Code” (Polyspace Bug Finder Access)
- “Configure Polyspace as You Code Plugin in Eclipse” (Polyspace Bug Finder Access)

Polyspace User Interface

In the user interface of the Polyspace desktop products, you typically do not require an options file. Most options can be specified on the **Configuration** pane in the Polyspace user interface.

However, some options are available only at the command line and do not have a counterpart in the user interface. If you have to specify multiple command-line-only options, you can collect them in an options file, for instance `commandLineStyleOptions.txt`. On the **Configuration** pane, under the **Advanced Settings** node, you can enter the following in the **Other** field:

```
-options-file commandLineStyleOptions.txt
```

Specifying Multiple Options Files

You can specify multiple options files in an analysis. For instance, at the command line, you can enter:

```
polyspace-bug-finder -sources file.c -options-file opts1.txt -options-file opts2.txt
```

When you specify multiple options files in an analysis, all options from the options files are appended to the analysis command. For instance, the preceding command has the same effect as using a single options file that places the content of `opts1.txt` above `opts2.txt`.

If an option appears in multiple files with conflicting arguments, the argument in the last options file prevails. For instance, in the preceding command, if `opts1.txt` contains:

```
-checkers all
-misra3 all
```

And `opts2.txt` contains:

```
-misra3 single-unit-rules
```

The analysis uses only the argument `single-unit-rules` for the option `-misra3`.

You can use this stacking of options files to override options. For instance, suppose you use a read-only options file that applies to your entire team but want to override some of the options in the file. You can override the options by using a second options file that you create and specifying your options file *after* the team-wide options file.

You can also specify the option `-options-file` within an options file and aggregate several options files in this way.

See Also

`-options-file`

Related Examples

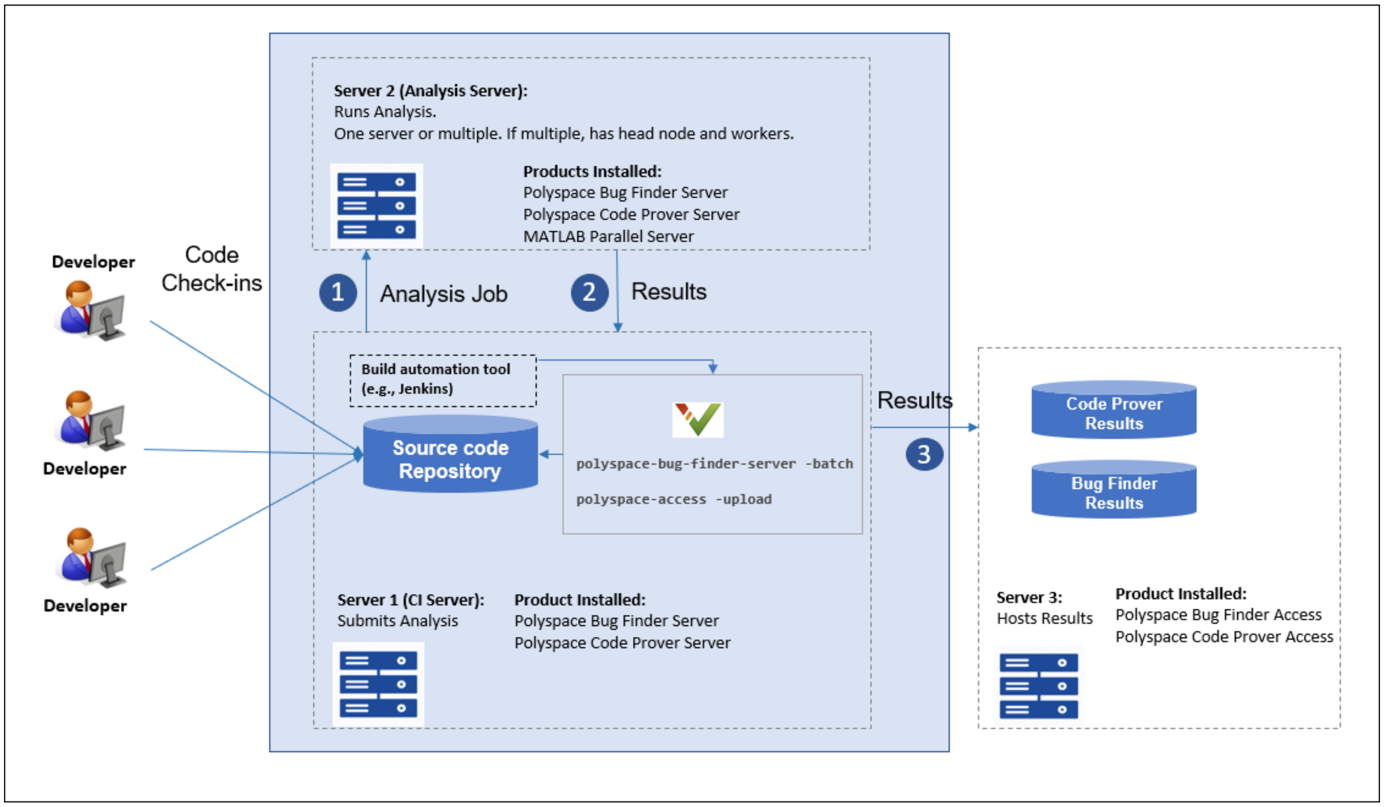
- "Run Polyspace Bug Finder on Server and Upload Results to Web Interface"
- "Prepare Scripts for Polyspace Analysis" on page 1-2
- "Analysis Options in Polyspace Bug Finder Server"

Offload Polyspace Analysis from Continuous Integration Server to Another Server

When running static code analysis with Polyspace as part of continuous integration, you might want the analysis to run on a server that is different from the server running your continuous integration (CI) scripts. For instance:

- You might want to perform the analysis on a server that has more processing power. You can offload the analysis from your CI server to the other server.
- You might want to submit analysis jobs from several CI servers to a dedicated analysis server, hold the jobs in queue, and execute them as Polyspace Server instances become available.

When you offload an analysis, the compilation phase of the analysis runs on the CI server. After compilation, the analysis job is submitted to the other server and continues on this server. On completion, the analysis results are downloaded back to the CI server. You can then upload the results to Polyspace Access for review, or report the results in some other format.

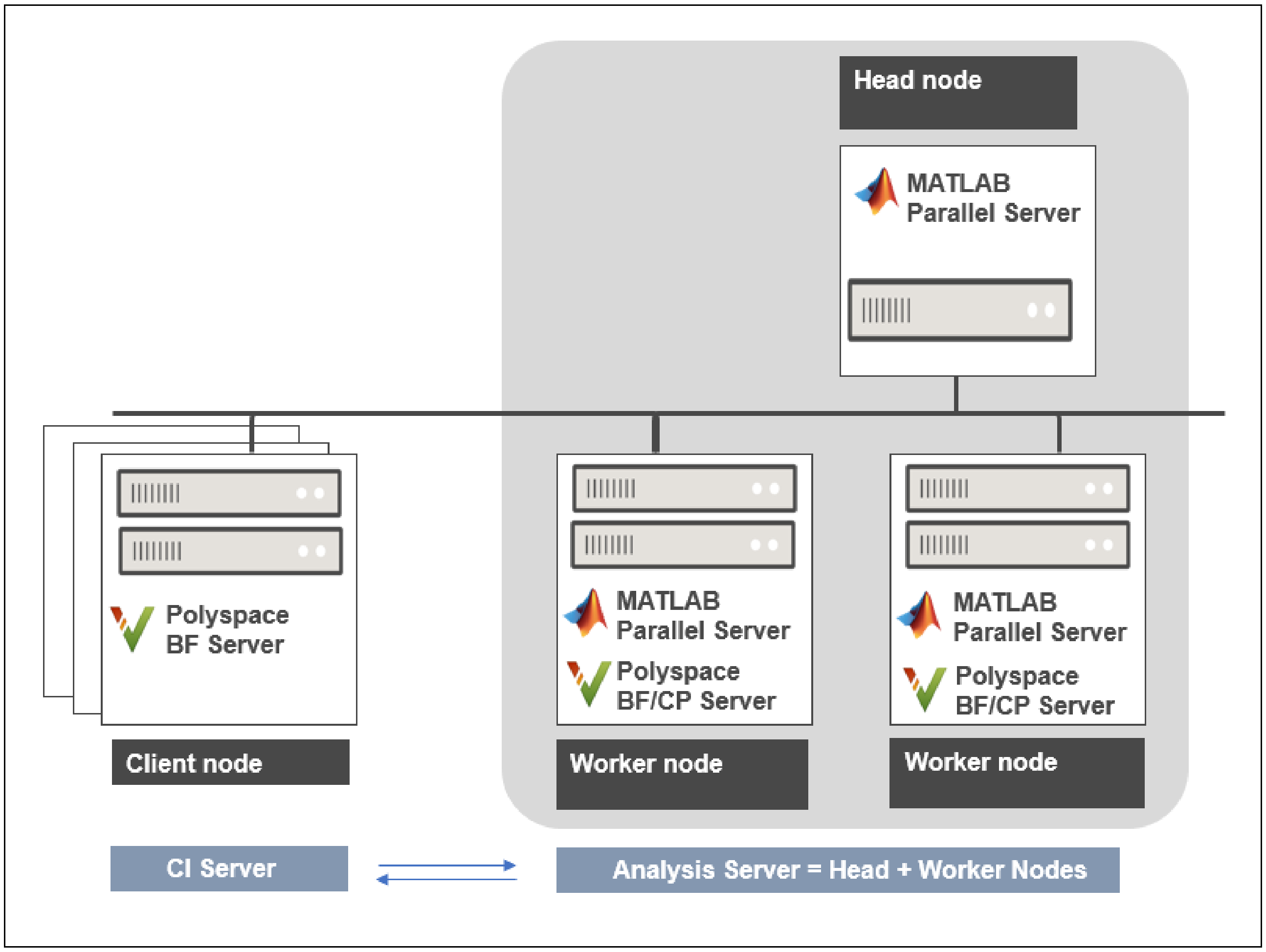

Server 2 (Analysis Server):
Runs Analysis.
One server or multiple. If multiple, has head node and workers.
Products Installed:
Polyspace Bug Finder Server
Polyspace Code Prover Server
MATLAB Parallel Server
Developer
Code Check-ins
1 Analysis Job
2 Results
Build automation tool (e.g., Jenkins)
Source code Repository
polyspace-bug-finder-server -batch
polyspace-access -upload
Results
3
Code Prover Results
Bug Finder Results
Developer
Developer
Server 1 (CI Server): Submits Analysis
Product Installed:
Polyspace Bug Finder Server
Polyspace Code Prover Server
Server 3: Hosts Results
Product Installed:
Polyspace Bug Finder Access
Polyspace Code Prover Access

Install Products

A typical distributed network for offloading an analysis consists of these parts:

- **Client node(s)**: Each CI server acts as a client node that submits Polyspace analysis jobs to a cluster.

  The cluster consists of a head node and one or more worker nodes. In this example, we use the same computer as the head node and one worker node.
- **Head node**: The head node distributes the submitted jobs to worker nodes.
- **Worker node(s)**: Each worker node executes one Polyspace analysis at a time.



Install these products:

- **Client nodes**: Polyspace Bug Finder Server or Polyspace Code Prover Server to submit jobs from the Continuous Integration server.
- **Head node**: MATLAB® Parallel Server™ to manage submissions from multiple clients. An analysis job is created for each submission and placed in a queue. As soon as a worker node is available, the next analysis job from the queue is run on the worker.
- **Worker node(s)**: MATLAB Parallel Server and Polyspace Bug Finder Server or Polyspace Code Prover Server on the worker nodes to run a Bug Finder or Code Prover analysis.

In the simplest configuration, where the same computer serves as the head node and one worker node, you install MATLAB Parallel Server and one or both Polyspace Bug Finder Server and Polyspace Code Prover Server on this computer. This example describes the simple configuration but you can generalize the steps to multiple workers on separate computers.

Configure and Start Job Scheduler Services on Head Node and Worker Node

Start a job scheduler service (the MATLAB Job Scheduler or `mjs` service) on the computer that acts as the head node and worker node. Before starting the service, you must perform an initial setup.

Specify Polyspace Installation Paths

MATLAB Parallel Server and Polyspace Server products are installed in two separate folders. The MATLAB Parallel Server installation routes the Polyspace analysis to the Polyspace Server products. To link the two installations, specify the path to the root folder of the Polyspace Server products in your MATLAB Parallel Server installation.

1. Navigate to *`matlabroot`*`\toolbox\parallel\bin\`. Here, *`matlabroot`* is the MATLAB Parallel Server installation folder, for instance, `C:\Program Files\MATLAB\R2021a`.
2. Uncomment and modify the following line in the file `mjs_polyspace.conf`. To edit and save the file, open your editor in administrator mode.

   ```
   POLYSPACE_SERVER_ROOT=polyspaceserverroot
   ```

   Here, *`polyspaceserverroot`* is the installation path of the server products, for instance:

   ```
   C:\Program Files\Polyspace Server\R2021a
   ```

The Polyspace Server product offloading the analysis must belong to the same release as the Polyspace Server product running the analysis. If you offload an analysis from an R2021a Polyspace Server product, the analysis must run using another R2021a Polyspace Server product.

Configure mjs Service Settings

Before starting MATLAB Parallel Server (the `mjs` service), you must perform a minimum configuration.

1. Navigate to *`matlabroot`*`\toolbox\parallel\bin`, where *`matlabroot`* is the MATLAB Parallel Server installation folder, for instance, `C:\Program Files\MATLAB\R2021a`.
2. Modify the file `mjs_def.bat` (Windows®) or `mjs_def.sh` (Linux®). To edit and save the file, open your editor in administrator mode.

   Read the instructions in the file and uncomment the lines as needed. At a minimum, uncomment these lines that specify:

   - Host name.

     Windows:

```
REM set HOSTNAME=%strHostname%.%strDomain%
```

Linux:

```
#HOSTNAME=`hostname -f`
```

Explicitly specify your computer host name.

- Security level.

  Windows:

  ```
  REM set SECURITY_LEVEL=
  ```

  Linux:

  ```
  #SECURITY_LEVEL=""
  ```

  Explicitly specify a security level to avoid future errors when starting the job scheduler.

  For security levels 2 and higher, you have to provide a password in a graphical window at the time of job submission.

Start mjs Service and One Worker

In a command-line terminal, `cd` to *`matlabroot`*`\toolbox\parallel\bin`, where *`matlabroot`* is the MATLAB Parallel Server installation folder, for instance, `C:\Program Files\MATLAB\R2021a`. Run these commands (directly at the command line or by using scripts):

```
mjs install
mjs start
startjobmanager -name JobScheduler -remotehost hostname -v
startworker -jobmanagerhost hostname -jobmanager JobScheduler
    -remotehost hostname -v
```

Here, *`hostname`* is the host name of your computer. This name is the host name that you specified in the file `mjs_def.bat` (Windows) or `mjs_def.sh` (Linux).

For more details and configuring services with multiple workers, see:

- “Install and Configure MATLAB Parallel Server for MATLAB Job Scheduler and Network License Manager” (MATLAB Parallel Server)
- `mjs`

Offload Analysis from Client Node

Once you have set up the computer that acts as the head node and worker node, you are ready to offload a Polyspace analysis from the client node (the CI server running scripts on Jenkins on another CI system).

To offload an analysis, enter:

```
polyspaceserverroot\polyspace\bin\polyspace-bug-finder-server
  -batch -scheduler hostname|MJSName@hostname [options] [-mjs-username name]
```

where:

- *polyspaceserverroot* is the installation folder of Polyspace Server products on the client node, for instance, `C:\Program Files\Polyspace Server\R2021a`.
- *hostname* is the host name of the computer that hosts the head node of the MATLAB Parallel Server cluster.

  MJSName is the name of the MATLAB Job Scheduler on the head node host.

  If you use the `startjobmanager` command to start the MATLAB Job Scheduler, *MJSName* is the argument of the option `-name`.
- *options* are the Polyspace analysis options. These options are the same as that of a local analysis. For instance, you can use these options:

  - `-sources-list-file`: Specify a text file that has one source file name per line.
  - `-options-file`: Specify a text file that has one option per line.
  - `-results-dir`: Specify a download folder for storing results after analysis.

  For the full list of options, see "Analysis Options in Polyspace Bug Finder Server".
- *name* is the user name required for job submissions using MATLAB Parallel Server. This credential is required only if you use a security level of 1 or higher for MATLAB Parallel Server submissions. See "Set MATLAB Job Scheduler Cluster Security" (MATLAB Parallel Server).

For security levels 2 and higher, you have to provide a password in a graphical window at the time of job submission. To avoid this prompt in the future, you can specify that the password be remembered on the computer.

The analysis executes locally on the CI server up to the end of the compilation phase. After compilation, the analysis job is submitted to the other server. On completion, the analysis results are downloaded back to the CI server. You can then upload the results to Polyspace Access for review, or report the results in some other format.

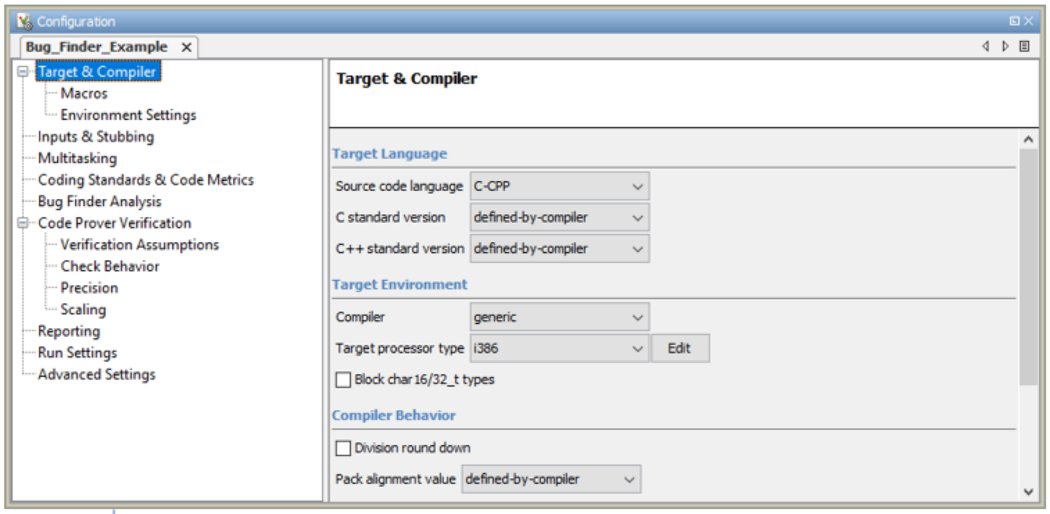
See Also
`polyspace-access`

More About
- "Run Polyspace Bug Finder on Server and Upload Results to Web Interface"

Configure Polyspace Analysis Options in User Interface and Generate Scripts

In this section...

If you have an installation of the desktop products, Polyspace Bug Finder and/or Polyspace Code Prover, you can configure your project in the user interface of the desktop products. You can then generate a script or an options file from the configuration defined in the user interface and use the script or options file for automated runs with the desktop or server products.



Target & Compiler

Target Language

Source code language: C-CPP
C standard version: defined-by-compiler
C++ standard version: defined-by-compiler

Target Environment

Compiler: generic
Target processor type: i386
☐ Block char16/32_t types

Compiler Behavior

☐ Division round down
Pack alignment value: defined-by-compiler

```
polyspace -generate-launching-script-for Bug_Finder_Example.psprj -bug-finder
polyspace -generate-launching-script-for Code_Prover_Example.psrpj
```

```
-target x86_64
-c-version c11
-compiler gnu4.6
-dos
-sources-list-file source_command.txt
...
```

Unless you create a Polyspace project from existing specifications such as a build command, when setting up the project, you might have to perform a few trial runs first. In these trial runs, if you run into compilation errors or unchecked code, you might have to modify your analysis configuration. It is easier performing this initial setup in the user interface of the desktop products. The user interface provides various features such as:

- Compilation assistant that suggests workarounds for some compilation errors,
- Auto-generation of XML file for constraint specification,
- Context-sensitive help for options.

Prerequisites

You must have at least one license of Polyspace Bug Finder and/or Polyspace Code Prover to open the Polyspace user interface and configure the options.

After generating the scripts, you can run the analysis using either the desktop products (Polyspace Bug Finder and Polyspace Code Prover) or the server products (Polyspace Bug Finder Server and/or Polyspace Code Prover Server).

Generate Scripts from Configuration

This example shows how to generate a script from a Bug Finder configuration. The same steps apply to a Code Prover configuration.

1. Add source files to a new project in the Polyspace user interface.

   Navigate to `*polyspaceroot*\polyspace\bin`, where *`polyspaceroot`* is the Polyspace installation folder, for instance, `C:\Program Files\Polyspace\R2021a`. Open the Polyspace user interface using the `polyspace` executable and create a new project.

   See “Add Source Files for Analysis in Polyspace User Interface” (Polyspace Bug Finder).
2. Specify the analysis options on the **Configuration** pane in the Polyspace project. To open this pane, in the project browser, click the configuration node in your Polyspace project.

   See “Specify Polyspace Analysis Options” (Polyspace Bug Finder).
3. Run the analysis. Based on compilation errors and analysis results, modify options as needed.

   See “Run Polyspace Analysis on Desktop” (Polyspace Bug Finder).
4. Once your analysis options are set, generate a script from the project (`.psprj` file).

   To generate a script from the demo project, `Bug_Finder_Example`:

   a. Load the project. Select **Help > Examples > Bug_Finder_Example.psprj**. A copy of this project is loaded in the `Examples` folder in your default workspace. To find the project location, place your cursor on the project name in the **Project Browser** pane.
   b. Navigate to the project location and enter:

      ```
      polyspace -generate-launching-script-for Bug_Finder_Example.psprj -bug-finder
      ```

      To generate Code Prover scripts, use the same command without the `-bug-finder` option.

      If a project has more than one module (with more than one configuration in each module), the options from the currently active configuration in the currently active module will be extracted in the script.

These files are generated for scripting the analysis:

- `source_command.txt`: Lists source files. This file can be provided as argument to the `-sources-list-file` option.
- `options_command.txt`: Lists analysis options. This file can be provided as argument to the `-options-file` option.
- `launchingCommand.bat` or `launchingCommand.sh`, depending on your operating system. The file uses the `polyspace-bug-finder` or `polyspace-code-prover` executable to run the analysis. The analysis runs on the source files listed in `source_command.txt` and uses the options listed in `options_command.txt`.

Run Analysis with Generated Scripts

After configuring your analysis and generating scripts, you can use the generated files to automate the subsequent analysis. You can automate the subsequent analysis using either the desktop or server products.

To automate a Bug Finder analysis with the desktop product, Polyspace Bug Finder:

1. Generate scripts as mentioned in the previous section.
2. Execute the script `launchingCommand.bat` or `launchingCommand.sh` at periodic intervals or based on predefined triggers.

To automate a Bug Finder analysis with the server product, Polyspace Bug Finder Server:

1. After specifying options in the user interface and before generating scripts, move the Polyspace project (`.psprj` file) to the server where the server product is running.
2. Generate scripts as mentioned in the previous section.

   The scripts refer to the server product executable instead of the desktop products.
3. Execute the script `launchingCommand.bat` or `launchingCommand.sh` at periodic intervals or based on predefined triggers.

Alternatively, you can modify the script generated for the desktop product so that the server product is executed. The script refers to the path to a desktop product executable, for instance:

```
"C:\Program Files\Polyspace\R2021a\polyspace\bin\polyspace-code-prover.exe"
```

Replace this with the path to a server product executable, for instance:

```
"C:\Program Files\Polyspace Server\R2021a\polyspace\bin\
    polyspace-code-prover-server.exe"
```

Sometimes, you might want to override some of the options in the options file. For instance, the option to specify a results folder is hardcoded in the script. You can remove this option or override it when launching the scripts:

```
launchingCommand -results-dir newResultsFolder
```

where *`newResultsFolder`* is the new results folder. This folder can even be dynamically generated for each run.

If you override multiple options in `options_command.txt`, you can save the overrides in a second options file. Modify the script `launchingCommand.bat` or `launchingCommand.sh` so that both options files are used. The script uses the option `-options-file` to use an options file, for instance:

```
-options-file options_command.txt
```

If you place your option overrides in a second options file `overrides.txt`, modify the script to append a second `-options-file` option:

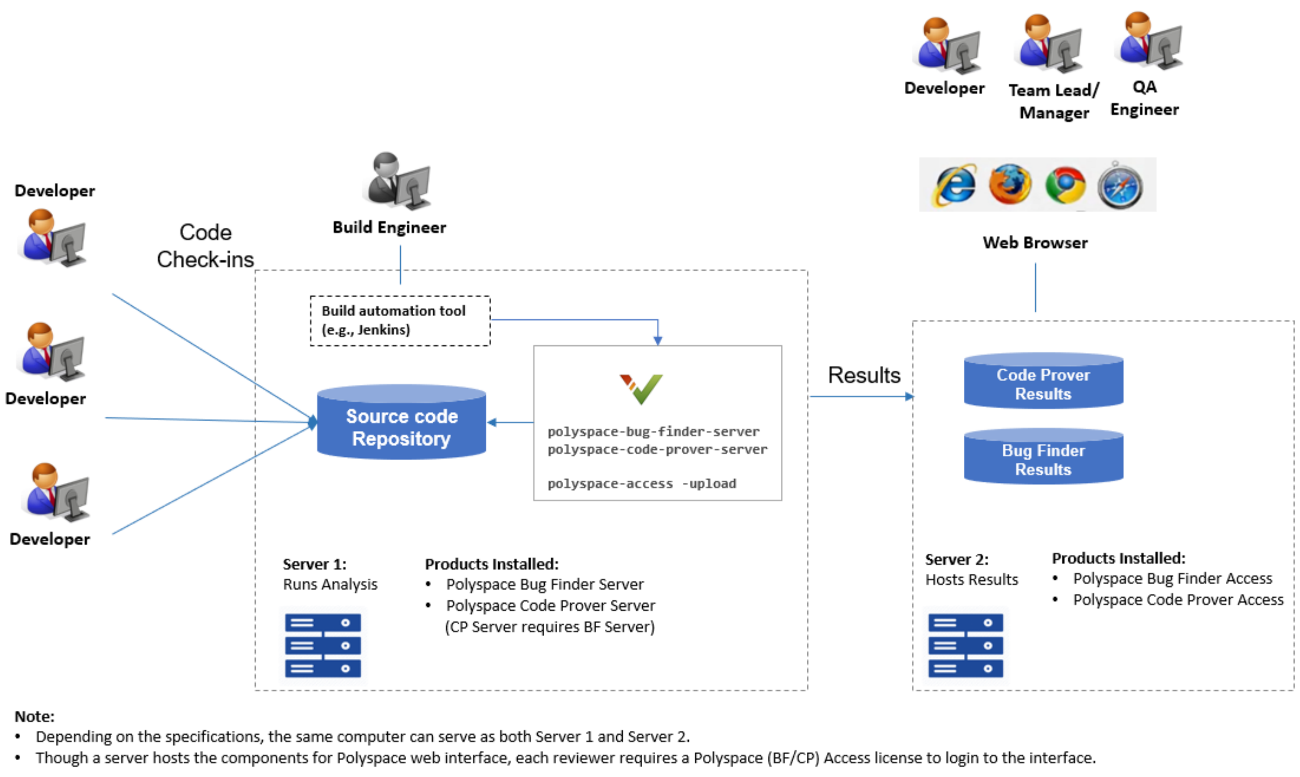
```
-options-file options_command.txt -options-file overrides.txt
```

See Also
`-generate-launching-script-for`

Related Examples
- “Run Polyspace Bug Finder on Server and Upload Results to Web Interface”
- “Prepare Scripts for Polyspace Analysis” on page 1-2

Sample Scripts for Polyspace Analysis with Jenkins

In a continuous integration process, developers submit code to a shared repository. An automated build system using a tool such as Jenkins builds and tests each submission at regular intervals or based on predefined triggers and integrates the code. You can run a Polyspace analysis as part of this process.


Developer
Team Lead/ Manager
QA Engineer
Developer
Build Engineer
Code Check-ins
Web Browser
Build automation tool (e.g., Jenkins)
Developer
Source code Repository
polyspace-bug-finder-server
polyspace-code-prover-server
polyspace-access -upload
Results
Code Prover Results
Bug Finder Results
Developer
Server 1: Runs Analysis
Products Installed:
• Polyspace Bug Finder Server
• Polyspace Code Prover Server (CP Server requires BF Server)
Server 2: Hosts Results
Products Installed:
• Polyspace Bug Finder Access
• Polyspace Code Prover Access
Note:
• Depending on the specifications, the same computer can serve as both Server 1 and Server 2.
• Though a server hosts the components for Polyspace web interface, each reviewer requires a Polyspace (BF/CP) Access license to login to the interface.

This topic provides sample Shell scripts that run a Polyspace analysis using Polyspace Bug Finder Server and upload the results for review in the Polyspace Access web interface. The script also sends e-mail notifications to potential reviewers. Notified reviewers can login to the Polyspace Access web interface (if they have a Polyspace Bug Finder Access™ license) and review the results.

Extending Sample Scripts to Your Development Process

The scripts are written for a specific development toolchain but can be easily extended to the processes used in your project, team or organization. The scripts are also meant to be run in a Jenkins freestyle project. If you are using Jenkins Pipelines, see “Sample Jenkins Pipeline Scripts for Polyspace Analysis” on page 1-32.

In particular, the scripts:

- *Run on Linux only.*

The scripts use some Linux-specific commands such as `export`. However, these commands are not an integral part of the Polyspace workflow. If you write Windows scripts (`.bat` files), use the equivalent Windows commands instead.

- *Work only with Jenkins after you install the Polyspace plugin.*

  The scripts are designed for the Jenkins plugin in these two ways:

  - The scripts uses helper functions `$ps_helper` and `$ps_helper_access` for simpler scripting. The helper functions export Polyspace results for e-mail attachments and use command-line utilities to filter the results.

    These helper functions are available only with the Jenkins plugin. However, the underlying commands come with a Polyspace Bug Finder Server installation. On build automation tools other than Jenkins, you can create these helper functions using the `polyspace-report-generator` command or `polyspace-access` command (with the `-export` option). See “Send Email Notifications with Polyspace Bug Finder Server Results”.

    If you perform a distributed build in Jenkins, the plugin must be installed in the same folder in the same operating system on both the master node and the agent node executing the Polyspace analysis. Otherwise, you cannot use the helper functions.
  - The scripts create text files for e-mail attachments and mail subjects and bodies for personalized e-mails. If you install the Polyspace plugin in Jenkins, an extension of an e-mail plugin is available for use in your Jenkins projects. The e-mail plugin allows you to easily send the personalized e-mails with the previously created subjects, bodies and attachments. Without the Polyspace plugin, you have to find an alternative way to send the e-mails.
- *Run a Bug Finder analysis.*

  The scripts run Bug Finder on the demo example `Bug_Finder_Example`. If you install the product Polyspace Bug Finder Server, the folder containing the demo example is *`polyspaceserverroot`*`/polyspace/examples/cxx/Bug_Finder_Example`. Here, *`polyspaceserverroot`* is the installation folder for Polyspace Server products, for instance, `/usr/local/Polyspace Server/R2019a/`.

  You can easily adapt the script to run Code Prover. Replace `polyspace-bug-finder-server` with `polyspace-code-prover-server`. You can use the demo example `Code_Prover_Example` specifically meant for Code Prover.

Prerequisites

To run a Polyspace analysis on a server and review the results in the Polyspace Access web interface, you must perform a one-time setup.

- To run the analysis, you must install one instance of the Polyspace Server product.
- To upload results, you must set up the components required to host the web interface of Polyspace Access.
- To view the uploaded results, you (and each developer reviewing the results) must have one Polyspace license.

Similar requirements apply to a Polyspace Code Prover analysis on a server.

See “Install Polyspace Server and Access Products”.

To install the Polyspace plugin, in the Jenkins interface, select **Manage Jenkins** on the left. Select **Manage Plugin**. Search for the Polyspace plugin and then download and install the plugin.

Set Up Polyspace Plugin in Jenkins

The following steps outline how to set up a Polyspace analysis in Jenkins after installing the Polyspace plugin. Note that the steps refer to Jenkins version 2.150.1. The steps in your Jenkins version and your Polyspace plugin installation might be slightly different.

If you use a different build automation tool, you can perform similar setup steps.

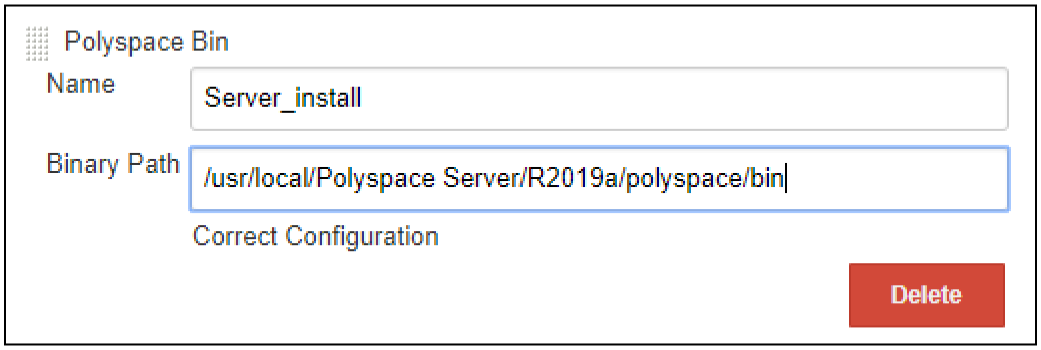
Specify Paths to Polyspace Commands and Server Details for Polyspace Access Web Interface

Specify the full paths of the folder containing the Polyspace commands and host name and port number of the server hosting the Polyspace Access web interface. After you specify the paths, in your scripts, you do not have to use the full paths to the commands or the server details for uploading results.

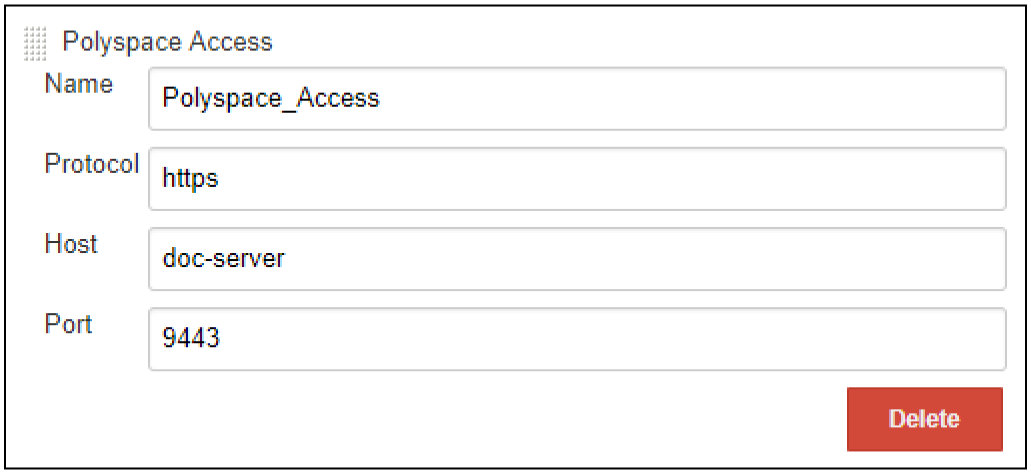
1 In the Jenkins interface, select **Manage Jenkins** on the left. Select **Configure System**.
2 In the **Polyspace** section, specify the following:

   - Paths to Polyspace commands.

     The path refers to *`polyspaceserverroot`*`/polyspace/bin`, where *`polyspaceserverroot`* is the installation folder for Polyspace Server products, for instance, `/usr/local/Polyspace Server/R2019a/`.


Polyspace Bin
Name: Server_install
Binary Path: /usr/local/Polyspace Server/R2019a/polyspace/bin
Correct Configuration

   - The host name, port number and protocol (`http` or `https`) used by the server hosting the Polyspace Access web interface.

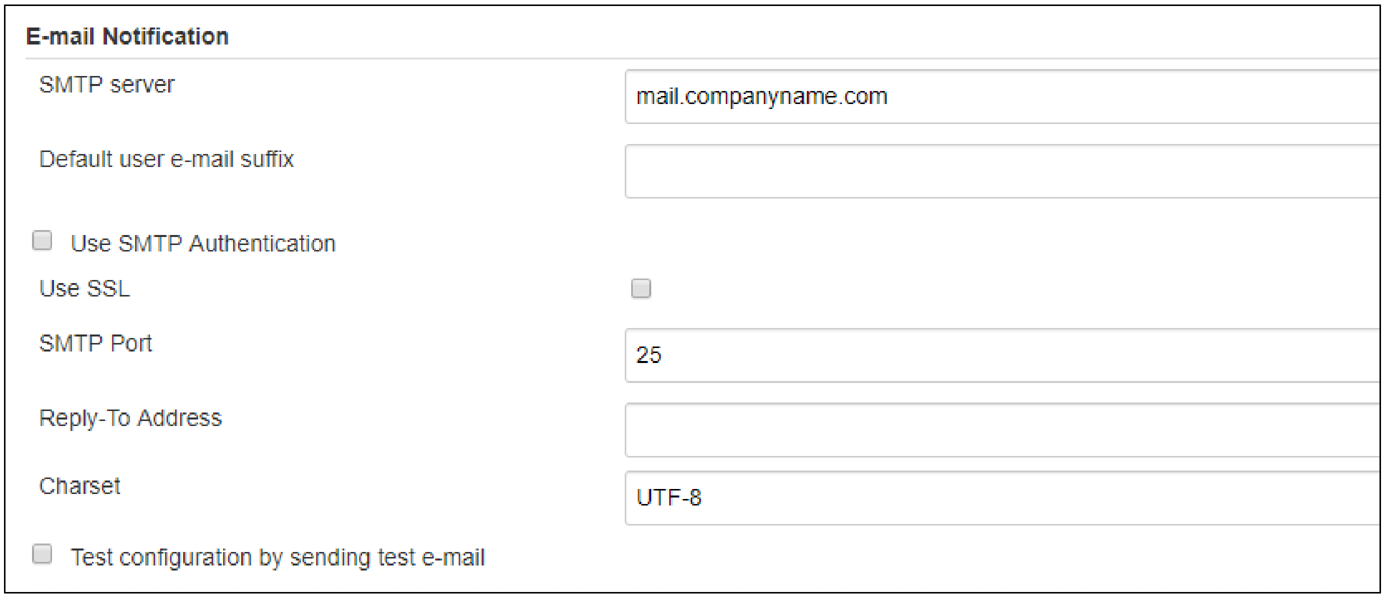


Polyspace Access

Name	Polyspace_Access
Protocol	https
Host	doc-server
Port	9443

The **Name** field allows you to define a convenient shorthand that you use later in Jenkins projects.

3 In the **E-mail Notification** section, specify your company's SMTP server (and other details needed for sending e-mails).



E-mail Notification

SMTP server	mail.companyname.com
Default user e-mail suffix	
☐ Use SMTP Authentication	
Use SSL	☐
SMTP Port	25
Reply-To Address	
Charset	UTF-8
☐ Test configuration by sending test e-mail	

Create Jenkins Project for Running Polyspace

When you create a Jenkins project (for instance, a Freestyle project), you can refer to the Polyspace paths by the global shorthands that you defined earlier.

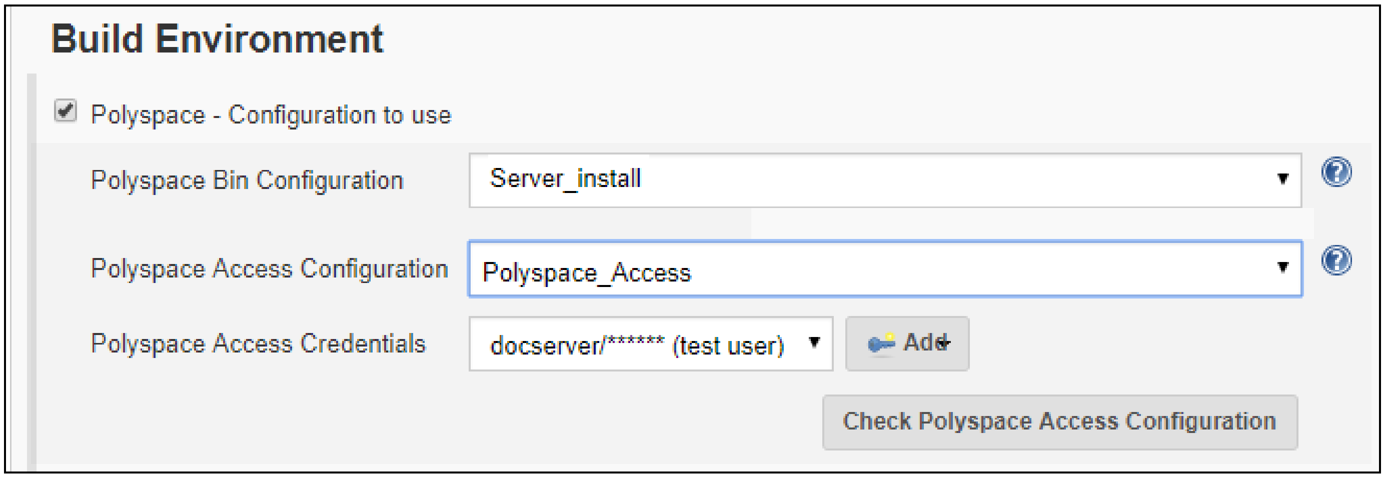
To create a Jenkins project for running Polyspace:

1 In the Jenkins interface, select **New Item** on the left. Select **Freestyle Project**.

2 In the **Build Environment** section of the project, enter the two shorthand names you defined earlier:

   - The name for the path to the folder containing the Polyspace commands
   - The name for the details of the server hosting the Polyspace Access web interface.

   Also, enter a login and password that can be used to upload to the Polyspace Access web interface. The login and password must be associated with a Polyspace Bug Finder Access license.


Build Environment

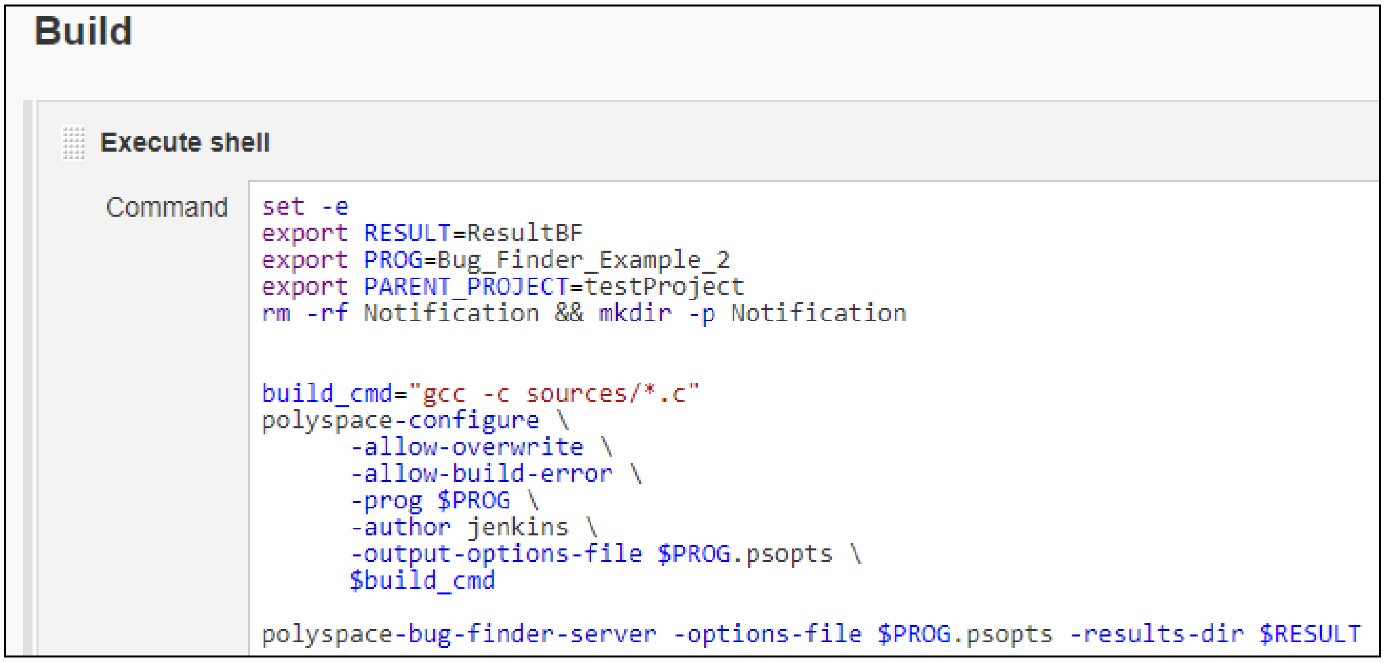
Polyspace - Configuration to use

Polyspace Bin Configuration: Server_install

Polyspace Access Configuration: Polyspace_Access

Polyspace Access Credentials: docserver/****** (test user)

3 In the **Build** section of the project, you can enter scripts that use the Polyspace commands and details of the server hosting the Polyspace Access web interface.



Build

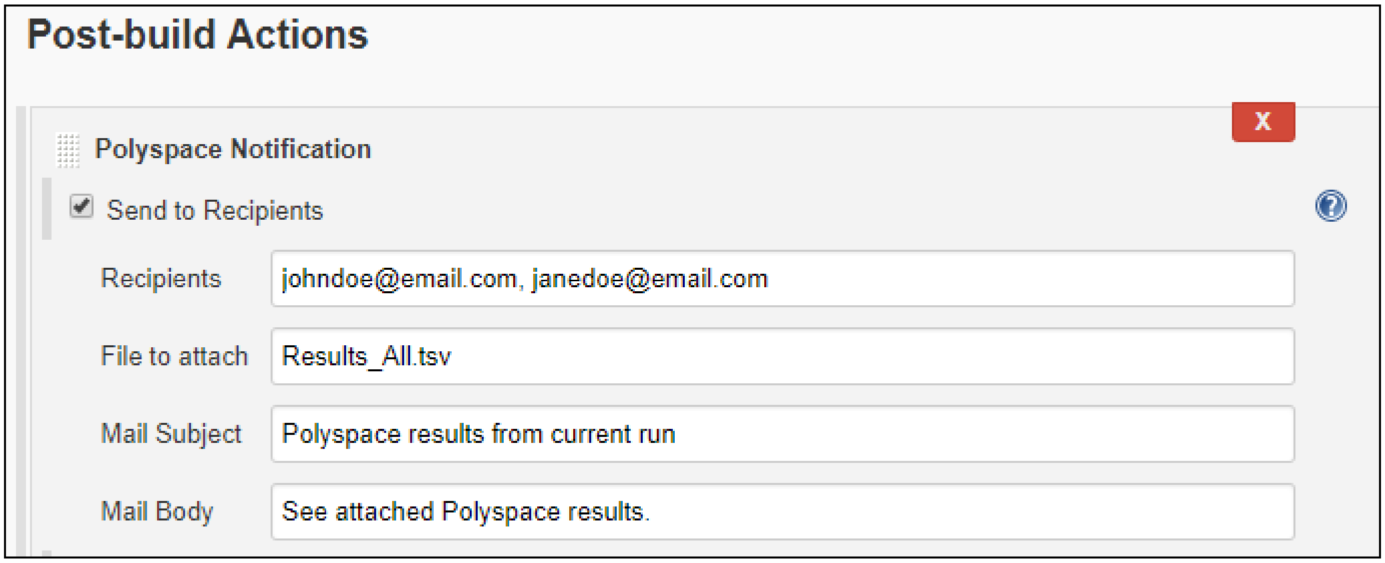
Execute shell

Command

```
set -e
export RESULT=ResultBF
export PROG=Bug_Finder_Example_2
export PARENT_PROJECT=testProject
rm -rf Notification && mkdir -p Notification


build_cmd="gcc -c sources/*.c"
polyspace-configure \
      -allow-overwrite \
      -allow-build-error \
      -prog $PROG \
      -author jenkins \
      -output-options-file $PROG.psopts \
      $build_cmd

polyspace-bug-finder-server -options-file $PROG.psopts -results-dir $RESULT
```

The scripts run a Polyspace analysis and upload results to the Polyspace Access web interface.

4 In the **Post-build Actions** section of the project, configure e-mail addresses and attachments to be sent after the analysis.



Post-build Actions

Polyspace Notification

✓ Send to Recipients

Recipients	johndoe@email.com, janedoe@email.com
File to attach	Results_All.tsv
Mail Subject	Polyspace results from current run
Mail Body	See attached Polyspace results.

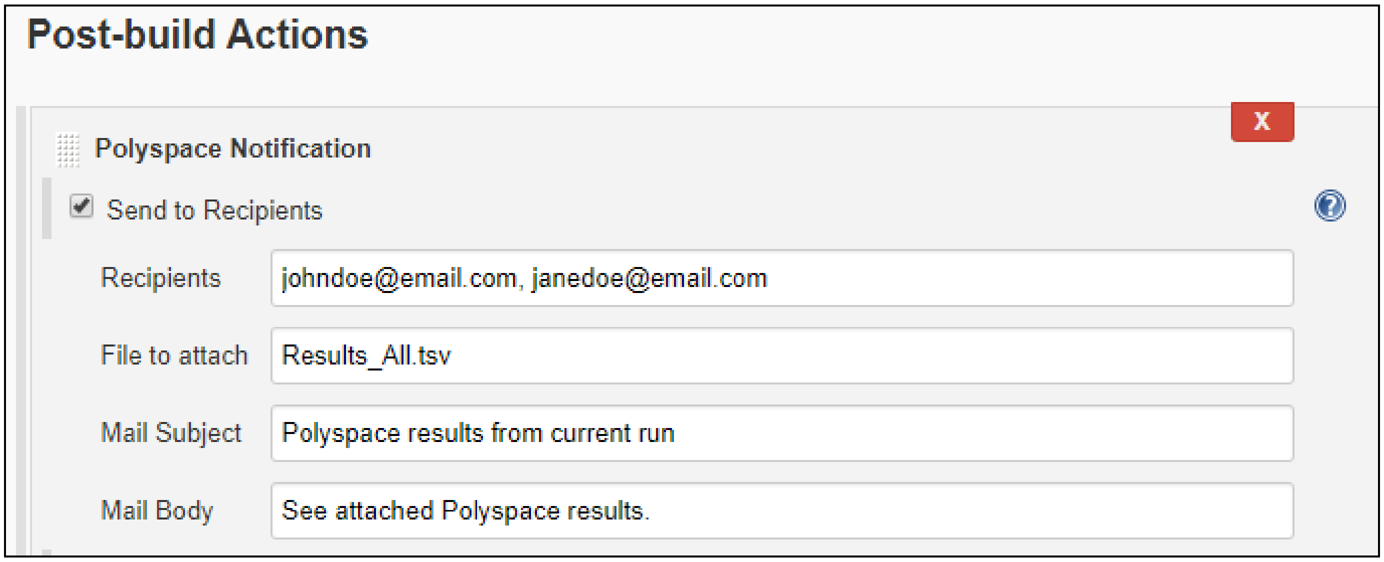
Script to Run Bug Finder, Upload Results and Send Common Notification

This script runs a Bug Finder analysis, uploads the results and exports defects with high impact for a common notification email to all recipients.

The script assumes that the current folder contains a folder `sources` with `.c` files. Otherwise modify the line `gcc -c sources/*.c` with the full path to the sources.

```
set -e
export RESULT=ResultBF
export PROG=Bug_Finder_Example
export PARENT_PROJECT=/public/BugFinderExample_PRS_01

# ================================================================
# Trace build command and create an options file

build_cmd="gcc -c sources/*.c"
polyspace-configure \
      -allow-overwrite \
      -allow-build-error \
      -prog $PROG \
      -author jenkins \
      -output-options-file $PROG.psopts \
      $build_cmd


# ================================================================
# Run Bug Finder on the options file

polyspace-bug-finder-server -options-file $PROG.psopts -results-dir $RESULT

# ================================================================
# Upload results to Polyspace Access web interface

$ps_helper_access -create-project $PARENT_PROJECT
$ps_helper_access \
      -upload $RESULT \
      -parent-project $PARENT_PROJECT \
      -project $PROG

# ================================================================
# Export results filtered for defects with "High" impact

$ps_helper_access \
      -export $PARENT_PROJECT/$PROG \
      -output Results_All.tsv \
      -defects High

# ================================================================
# Finalize Jenkins status

exit 0
```

After the script is run, you can create a post-build action to send an e-mail to all recipients with the exported file `Results_All.tsv`.



☑ Send to Recipients

Recipients	johndoe@email.com, janedoe@email.com
File to attach	Results_All.tsv
Mail Subject	Polyspace results from current run
Mail Body	See attached Polyspace results.

In this script, `$ps_helper_access` is a shorthand for the `polyspace-access` command with the options specifying host name, port, login and encrypted password included. The other `polyspace-access` options are explicitly written in the script.

Script to Run Bug Finder, Upload Results and Send Personalized Notification

This script runs the previous Bug Finder analysis and uploads the results. However, the script differs from the previous script in these ways:

- The script uses a `run_command` function that prints a message when running a command. The function helps determine from the console output which part of the script is running.
- When exporting the results, the script creates a separate results file for different owners.
  - A master file `Results_All.tsv` contains all results. This file is sent in e-mail attachment to a manager. The manager email is configured in the post-build step.

    If the file contains more than 10 defects, the build status is considered as a failure. The script sends a status `UNSTABLE` in the e-mail notification.
  - The results file `Results_Users_userA.tsv` exported for `userA` contains defects from the group Programming and with impact High.

    This result file is sent in e-mail attachment to `userA`.
  - The results file `Results_Users_userB.tsv` exported for `userB` contains defects from the function `bug_memstdlib()`.

This result file is sent in e-mail attachment to `userB`.

- A separate mail subject is created for the manager in the file `mailsubject_manager.txt` and for users `userA` and `userB` in the files `mailsubject_user_userA.txt` and `mailsubject_user_userB.txt` respectively.

  A mail body is created for the email to the manager in the file `mailbody_manager.txt`.

The script:

- Assumes that the current folder contains a folder `sources` with `.c` files.

  Otherwise, modify the line `gcc -c sources/*.c` with the full path to the sources.
- Assumes users named `userA` and `userB`. In particular, the email addresses `userA@companyname.com` and `userB@companyname.com` (determined from the user name and SMTP server configured earlier) must be real e-mail addresses.

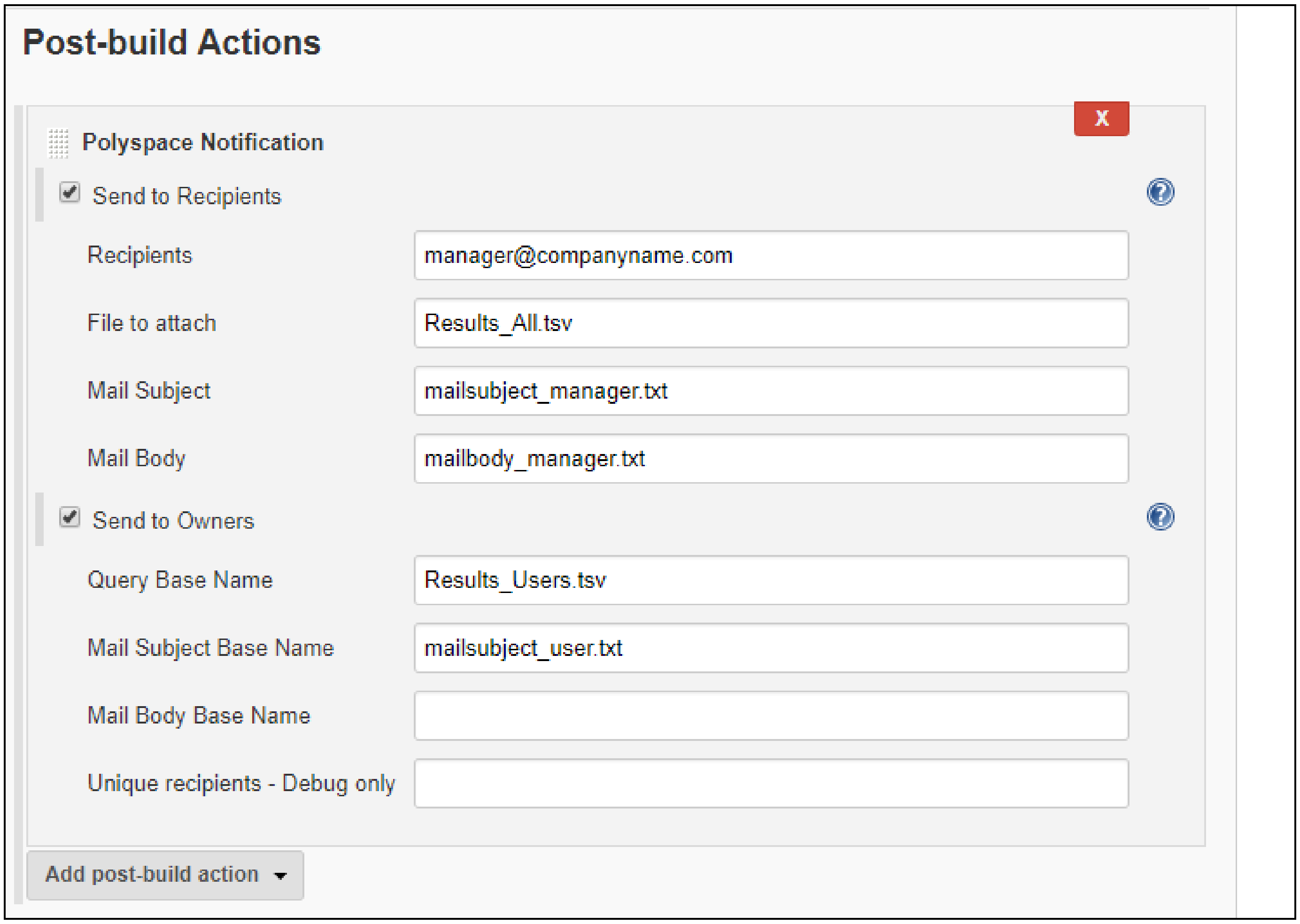
  Replace the names with real user names.

```
set -e
export RESULT=ResultBF
export PROG=Bug_Finder_Example
export REPORT=Results_List.tsv


# =================================================================
# Define function to print message while running command
run_command()
{
# $1 is a message
# $2 $3 ... is the command to dump and to run
message=$1
shift
cat >> mailbody_manager.txt << EOF
$(date): $message

EOF
"$@"
}

# =================================================================
# Initialize mail body
cat > mailbody_manager.txt << EOF
Dear Manager(s)

Here is the report of the Jenkins Job ${JOB_NAME} #${BUILD_NUMBER}
It contains all Red Defect found in Bug Finder Example project

EOF

# =================================================================
# Trace build command and create options file

build_cmd="gcc -c sources/*.c"
run_command "Tracing build command",               \
            polyspace-configure                   \
                -allow-overwrite                  \
                -allow-build-error                \
                -prog $PROG                       \
                -author jenkins                   \
                -output-options-file $PROG.psopts \
                    $build_cmd

# =================================================================
# Run Bug Finder on the options file

run_command "Running Bug finder" \
            polyspace-bug-finder-server -options-file $PROG.psopts\
            -results-dir $RESULT



# =================================================================
# Upload results to Polyspace Access web interface

run_command "Creating Project $PARENT_PROJECT" \
  $ps_helper_access -create-project $PARENT_PROJECT

run_command "Uploading on $PARENT_PROJECT/$PROG" \
  $ps_helper_access \
        -upload $RESULT \
        -parent-project $PARENT_PROJECT \
        -project $PROG \
        -output upload.output
PROJECT_RUNID=$($ps_helper prs_print_runid upload.output)
PROJECT_URL=$($ps_helper prs_print_projecturl upload.output $POLYSPACE_ACCESS_URL)

# ================================================================
# Export report

run_command "Exporting report from $PARENT_PROJECT/$PROG" \
  $ps_helper_access \
        -export $PROJECT_RUNID \
        -output $REPORT \
        -defects High


# ================================================================
# Filter Reports

run_command "Filtering reports for defects" \
            $ps_helper report_filter \
                $REPORT \
                Results_All.tsv \
                Family Defect \


# ================================================================
# Filter Reports for userA and userB

run_command "Filtering Reports for userA based on Group and Information" \
            $ps_helper report_filter \
                $REPORT \
                Results_Users.tsv \
                userA \
                Group Programming \
                Information "Impact: High"
run_command "Filtering Reports for userB based on Function" \
            $ps_helper report_filter \
                $REPORT \
                Results_Users.tsv \
                userB \
                Function "bug_memstdlib()"


# ================================================================
# Update Jenkins status
# Jenkins build status is unstable when there are more than 10 Defects

BUILD_STATUS=$($ps_helper report_status Results_All.tsv 10)

# ================================================================
# Update mail body and mail subject
```

```
NB_FINDINGS_ALL=$($ps_helper report_count_findings Results_All.tsv)
NB_FINDINGS_USERA=$($ps_helper report_count_findings Results_Users_userA.tsv)
NB_FINDINGS_USERB=$($ps_helper report_count_findings Results_Users_userB.tsv)
cat >> mailbody_manager.txt << EOF

Number of defects: $NB_FINDINGS_ALL
Number of findings owned by userA: $NB_FINDINGS_USERA
Number of findings owned by userB: $NB_FINDINGS_USERB

All results are uploaded in: $PROJECT_URL

Build Status: $BUILD_STATUS

EOF

cat >> mailsubject_manager.txt << EOF
Polyspace run completed with status $BUILD_STATUS and $NB_FINDINGS_ALL findings
EOF

for user in userA userB
do
echo "$user - $($ps_helper report_count_findings Results_Users_$user.tsv)) findings"\
      > mailsubject_user_$user.txt
done



# ================================================================
# Exit with correct build status

[ "$BUILD_STATUS" != "SUCCESS" ] && exit 129
exit 0
```

After the script is run, you can create a post-build action to send an e-mail to a manager with the exported file `Results_All.tsv`. Specify the e-mail address in the **Recipients** field, the email subject in the **Mail Subject** field and the email body in the **Mail Body** field.

In addition, a separate e-mail is sent to `userA` and `userB` with the files `Results_Users_userA.tsv` and `Results_Users_userB.tsv` in attachment (and the content of `mailsubject_user_userA.txt` and `mailsubject_user_userB.txt` as mail subjects). The e-mail addresses are `userA@companyname.com` and `userB@companyname.com` (determined from the user name and SMTP server configured earlier).



✓ Send to Recipients	
Recipients	manager@companyname.com
File to attach	Results_All.tsv
Mail Subject	mailsubject_manager.txt
Mail Body	mailbody_manager.txt
✓ Send to Owners	
Query Base Name	Results_Users.tsv
Mail Subject Base Name	mailsubject_user.txt
Mail Body Base Name	
Unique recipients - Debug only	

The script uses the helper function `$ps_helper` to filter the results based on group, impact and function. The helper function uses command-line utilities to filter the master file for results and perform actions such as create a separate results file for each owner. The function takes these actions as arguments:

- `report_filter`: Filters results from exported text file based on contents of the text file.

  For instance:

  ```
  $ps_helper report_filter \
                  Results_List.tsv \
                  Results_Users.tsv \
                  userA \
                  Group Programming \
                  Information "Impact: High"
  ```

  reads the file `Results_List.tsv` and writes to the file `Results_Users_userA.tsv`. The text file `Results_List.tsv` contains columns for `Group` and `Information`. Only those rows where the `Group` column contains `Programming` and the `Information` column contains `Impact: High` are written to the file `Results_Users_userA.tsv`.

- `report_status`: Returns `UNSTABLE` or `SUCCESS` based on the number of results in a file.

  For instance:

  ```
  BUILD_STATUS=$($ps_helper report_status Results_All.tsv 10))
  ```

  returns `UNSTABLE` if the file `Results_All.tsv` contains more than 10 results (10 rows).
- `report_count_findings`: Reports number of results in a file.

  For instance:

  ```
  NB_FINDINGS_ALL=$($ps_helper report_count_findings Results_All.tsv)
  ```

  returns the number of results (rows) in the file `Results_All.tsv`.
- `prs_print_projecturl`: Uses the host name and port number to create the URL of the Polyspace Access web interface.

  For instance:

  ```
  PROJECT_URL=$($ps_helper prs_print_projecturl Results_All.tsv $POLYSPACE_ACCESS_URL)
  ```

  reads the file `Results_All.tsv` (exported by the `polyspace-access` command) and extracts the URL of the Polyspace Access web interface in `$POLYSPACE_ACCESS_URL` and the URL of the current project in `$PROJECT_URL`.

See Also
`polyspace-access` | `polyspace-bug-finder-server` | `polyspace-code-prover-server` | `polyspace-configure` | `polyspace-report-generator`

More About
- “Run Polyspace Bug Finder on Server and Upload Results to Web Interface”
- “Send Email Notifications with Polyspace Bug Finder Server Results”
- “Sample Jenkins Pipeline Scripts for Polyspace Analysis” on page 1-32
- “Offload Polyspace Analysis from Continuous Integration Server to Another Server” on page 1-9

Sample Jenkins Pipeline Scripts for Polyspace Analysis

Jenkins Pipelines enable automating the workflow of a continuous delivery pipeline through scripts in Jenkins. You can write Pipeline scripts that build projects, run test suites and perform all necessary checks before your code is ready for shipping. You can check in these scripts as part of a version control system and subject them to the same review and versioning as the code itself.

You can run a Polyspace analysis in a Jenkins Pipeline script. If you are not using Freestyle Projects instead of Pipelines in Jenkins, use the Polyspace plugin for scripting conveniences. See "Sample Scripts for Polyspace Analysis with Jenkins" on page 1-18. If you are using Pipelines, modify the script provided to run a Polyspace analysis.

Prerequisites

To run a Polyspace analysis on a server and review the results in the Polyspace Access web interface, you must perform a one-time setup.

- To run the analysis, you must install one instance of the Polyspace Server product.
- To upload results, you must set up the components required to host the web interface of Polyspace Access.
- To view the uploaded results, you and each developer reviewing the results must have one Polyspace license.

See "Install Polyspace Server and Access Products".

Run Polyspace Analysis in Stages in a Pipeline Script

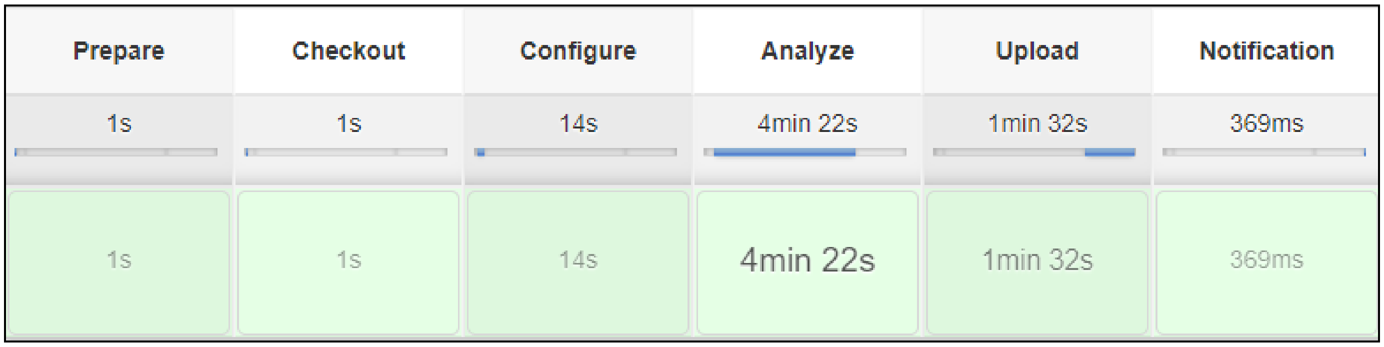
To create a Jenkins Pipeline script:

1. In the Jenkins interface, select **New Item** on the left. Select **Pipeline**.
2. In the **Pipeline** section of the project, select `Pipeline script` for **Definition**. Enter this script.

   The parts in bold indicate places where you have to modify the script for your source code and Polyspace installation.

   The script is not available in the PDF documentation. Search for `Polyspace Jenkins Pipelines` in the MathWorks® online documentation and copy the script from the online version of this page.

When you build this project, you can see the various stages of the analysis like this:



This script can be part of a larger script that you save in a Jenkinsfile and commit to your version control system. See Using a Jenkinsfile.

You can modify the script as needed:

- The script runs each step of the Polyspace analysis workflow in a separate `stage` section. You can combine several steps together in one `stage`.
- The script runs Linux Shell commands by using the `sh` directive. You can run Windows commands by using the `bat` directive instead.
- The script uses data from the Credentials plugin to extract user name and password. If you save credentials in some other form, you can replace the `withCredentials` command that binds user credentials to variables.
- The script builds source code using a makefile on a Git sandbox with this `make` command:

  ```
  make -C $git_sandbox
  ```

  If you use a different build command, you can replace this line with your build command.

For more information on the Pipeline-specific syntax in this script, see:

- Pipeline Syntax: Describes `node`, `stage`, `label`.
- Pipeline Steps Reference: Describes `sh`, `mail`.
- Credentials Binding Plugin: Describes `withCredentials`.

For more information on the Polyspace commands in this script, see:

- `polyspace-configure`
- `polyspace-bug-finder-server` (also `polyspace-code-prover-server`)
- `polyspace-access`

See Also

"Sample Scripts for Polyspace Analysis with Jenkins" on page 1-18

Run Polyspace Analysis on Generated Code by Using Packaged Options Files

When you start a Polyspace analysis directly from the Simulink toolstrip, the analysis takes the model-specific context, such a design ranges, into consideration. When running a Polyspace analysis without access to Simulink, you must specify the model-specific information by using options files. Instead of authoring these options files, use the options files generated and packaged by the function `polyspacePackNGo`.

Preserving the Simulink model context information when running a Polyspace analysis can be useful in various situations. For instance:

- Distributed workflow: A Simulink user generates code from a model and sends the code to another development environment. In this environment, a Polyspace user, who might not have Simulink, runs a separate analysis of the generated code. By using the packaged options files, the design ranges and other model-specific information is preserved in the Polyspace analysis.
- Analysis options not available in Simulink: Some Polyspace analysis options are available only when the Polyspace analysis is run separately from Simulink. Use packaged options files to run a separate Polyspace analysis while preserving the model-specific information. For instance, analyze concurrent threads in generated code by running a Polyspace analysis in the generated code by using the packaged options files.

You must have Simulink to run the function `polyspacePackNGo`. You do not need Polyspace to generate the options files from a Simulink model. The `polyspacePackNGo` function supports code generated by Embedded Coder® and TargetLink®. For a tutorial on using `polyspacePackNGo`, see "Analyze Code Generated as Standalone Code in a Distributed Workflow" (Simulink).

Generate and Package Polyspace Options Files

To generate and package Polyspace options file for analyzing code generated from a Simulink model, use `polyspacePackNGo`.

1. In the Simulink Editor, open the Configuration Parameters dialog box and configure the model for code generation.
2. To configure the model for compatibility with Polyspace, select `ert.tlc` as the **System target file**
3. To enable generating a code archive, select the option **Package code and artifacts**. Optionally, provide a name for the options package in the field **Zip file name**. If your code contains a custom code block, select **Use the same custom code settings as Simulation target** in the **Code Generation> Custom Code** pane.

   Alternatively, in the MATLAB Command Window, enter:

   ```
   % Configure the Simulink model mdlName for code generation
   configSet = getActiveConfigSet(mdlName);
   set_param(configSet, 'PackageGeneratedCodeAndArtifacts', true);
   set_param(configSet, 'PackageName', 'CodeArchive.zip');
   set_param(configSet, 'SystemTargetFile', 'ert.tlc');
   set_param(configSet,'RTWUseSimCustomCode','on');
   ```
4. Generate the code archive.

   - To generate an archive of standalone generated code from the top model, use the function `slbuild`.

- To generate code as a model reference, use the function `slbuild`. After generating code as model reference, create the code archive by using the function `packNGo`.
- Alternatively, you can use TargetLink to generate the code. Create the code archive by archiving the generated code into a zip file.

5. To generate and package the Polyspace option files, in the MATLAB Command Window ,use the `polyspacePackNGo` function :

   ```
   zipFile = polyspacePackNGo(mdlName);
   ```

   See “Generate and Package Polyspace Options Files”.

   If you use TargetLink to generate code, then use the TargetLink subsystem name as the input argument to `polyspacepacknGo`.
6. Optionally, you can use a `pslinkoptions` object as a second argument to modify the default model configuration for the Polyspace analysis. Create a `pslinkoptions` object, modify model configurations and specify the object when creating the archive:

   ```
   psOpt = pslinkoptions(mdlName);
   psOpt.InputRangeMode = 'FullRange';
   psOpt.ParamRangeMode = 'DesignMinMax';
   zipFile = polyspacePackNGo(mdlName,psOpt);
   ```

   See “Package Polyspace Options Files That Have Specific Polyspace Analysis Options”.
7. Use the optional third argument to specify whether to generate and package Polyspace options files for code generated as a model reference. Suppose you generated code as a model reference by using the `slbuild` function. To generate and package Polyspace options for the code, at the MATLAB Command Window, enter:

   ```
   zipFile = polyspacePackNGo(mdlName,[],true);
   ```

   See “Package Polyspace Options Files for Code Generated as a Model Reference”.

   The function `polyspacepackNGo` returns the full path to the archive containing the options files. The files are located in the `polyspace` folder within the archived folder hierarchy. The content of the `polyspace` folder depends on the inputs of `polyspacePackNGo` function.

   - If you do not specify the optional second and third arguments, then the folder `polyspace` contains these options files in a flat hierarchy:
     - `optionsFile.txt`: This file specifies the source files, the include files, data range specifications, and analysis options required for analyzing the generated code by using Polyspace. If your code contains custom C code, then this file specifies the relative paths of the custom source and header files.
     - *`modelname`*`_drs.xml`: This file specifies the design range specification of the model.
     - `linkdata.xml`: This file links the generated code to the components of the model.
   - If you specify `psOpts.ModelbyModelRef = true`, then corresponding options files are generated for all referenced models. These options files are stored in separate folders named `polyspace_<`*`referenced model name`*`>` within the code archive. The folder `polyspace` contains the options files for the top model.

Run Polyspace Analysis by Using the Packaged Options Files

Once the code archive and the Polyspace option files are generated, you can use the archive to run a Polyspace analysis on the generated code in a different development environment without Simulink.

1. Unzip the code archive and locate the `polyspace` folder.
2. On a Windows or Linux command line, run: `*productname* -options-file optionsFile.txt -results-dir *resultdir*`.

   - *`productname`* corresponds to one of: polyspace-bug-finder, polyspace-code-prover, polyspace-bug-finder-server, or polyspace-code-prover-server.
   - *`resultdir`* corresponds to the location of the Polyspace results. This argument is optional.

   To link the generated code with the Simulink model, the file `linkdata.xml` is required. In case the file `linkdata.xml` is not generated in the options file archive, use the option **Code Generator Support** in Polyspace desktop User Interface to specify which comments in the code act as links to the Simulink model. In the Polyspace desktop User Interface, select **Tools > Preferences** and locate the **Miscellaneous** tab. From the context menu **Code comments that act as code-to-model-link**, select the code generator that you used. If you select **User defined**, then specify the comments that act as a code-to-model link by specifying their prefix in the field **Comments beginning with**. For instance, if you specify the prefix as `//Link_to_model`, then Polyspace interprets comments starting with `//Link_to_model` as links to model.

   If you are using Polyspace Access to view the results, upload the file `linkdata.xml` in the same folder as your Polyspace results. You cannot link the code with Simulink model if you do not have the file `linkdata.xml` or if you upload it outside the Polyspace result folder.
3. To review the result, upload it to Polyspace Access and view the results in a web browser. Alternatively, view the result by using the user interface of the Polyspace desktop products.

See Also
`packNGo` | `polyspace.Project` | `slbuild`

More About
- "Analyze Code Generated as Standalone Code in a Distributed Workflow" (Simulink)
- "Integrate Polyspace Server Products with MATLAB" on page 4-2

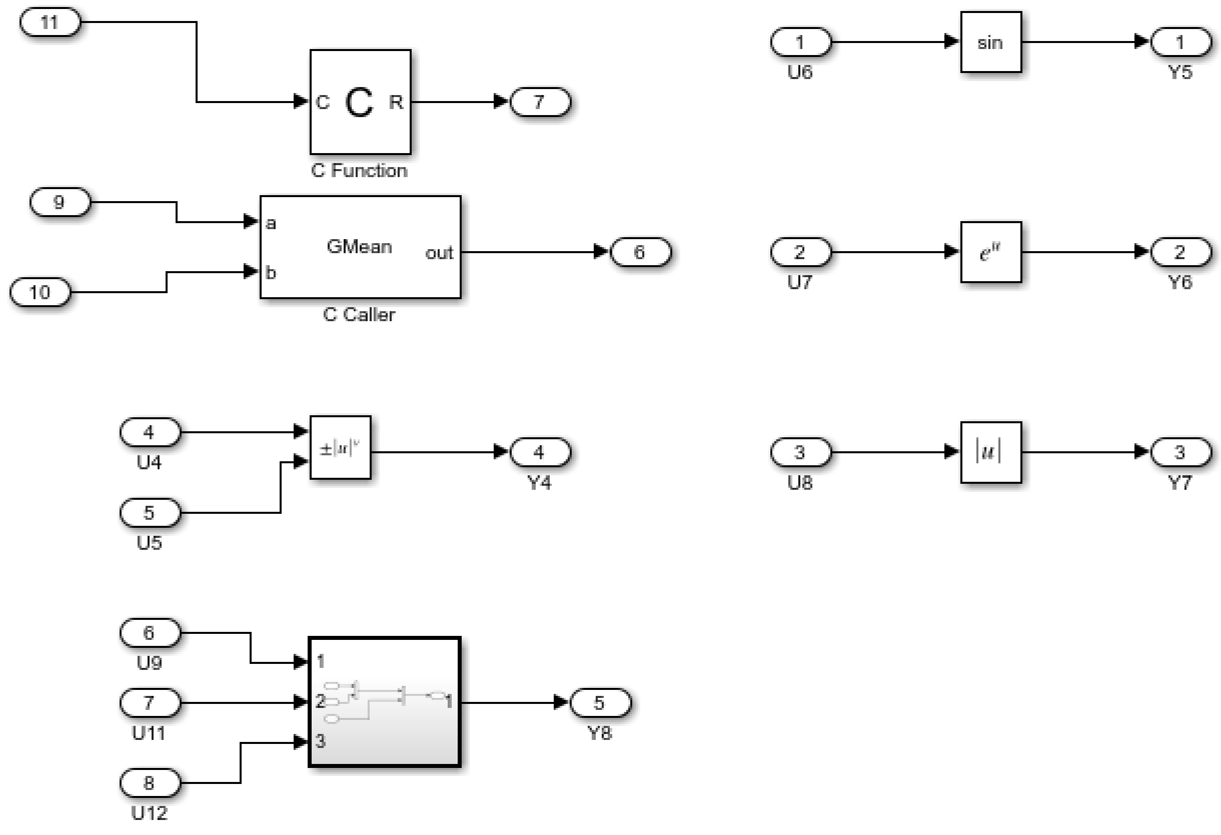
Analyze Code Generated as Standalone Code in a Distributed Workflow

Generate and package Polyspace options files from a Simulink model by using the function `polyspacepackNGo`. Use these options files to run a Polyspace analysis on the generated code that uses model-specific information, such as design range specifications, without requiring Simulink.

Open Model

The model `demo_math_operations` performs various mathematical operations on the model inputs. The model has a C Function block that executes a custom C code. The model also has a C Caller block that calls the C function `GMean`, which is implemented in the source file GMean.c. To open the model for code generation and packaging Polyspace options file, search for the current topic in the MATLAB help browser and click the **Open Model** button. Alternatively, in the MATLAB Command Window, paste and run the following code.

```
openExample('simulink_general/PPNGStandAloneExample');
open_system('demo_math_operations');
```



Configure Model

To configure the model for generating code and packaging Polyspace options files, specify these configuration parameters:

- To create an archive containing the generated code, set `'PackageGeneratedCodeAndArtifacts'` to `true`.
- Specify a name for the code archive. For instance, set the name to `genCodeArchive.zip`.
- To use the custom code setting specified in **Simulation Target** during code generation, set `'RTWUseSimCustomCode'` to `'on'`.
- To make the model and the generated code compatible with Polyspace, set `ert.tlc` as the system target file. See “Recommended Model Configuration Parameters for Polyspace Analysis” (Polyspace Bug Finder).

In Command Window or Editor, enter these parameter configurations:

```
configSet = getActiveConfigSet('demo_math_operations');
set_param(configSet, 'PackageGeneratedCodeAndArtifacts', true);
set_param(configSet, 'PackageName', 'genCodeArchive.zip');
set_param(configSet, 'SystemTargetFile', 'ert.tlc');
set_param(configSet,'RTWUseSimCustomCode','on')
```

Generate Code Archive

Specify a folder for storing the generated code. To start code generation, in the Command Window or in the Editor, enter:

```
codegenFolder = 'demo_math_operations_ert_rtw';
if exist(fullfile(pwd,codegenFolder), 'dir') == 0
    slbuild('demo_math_operations')
end
```

Because `PackageGeneratedCodeAndArtifacts` is set to `true`, the generated code is packed into the archive `genCodeArchive.zip`.

Generate and Package Polyspace Options File

To generate Polyspace options files for the generated code, in the Command Window or in the Editor, enter:

```
zipFile = polyspacePackNGo('demo_math_operations');
```

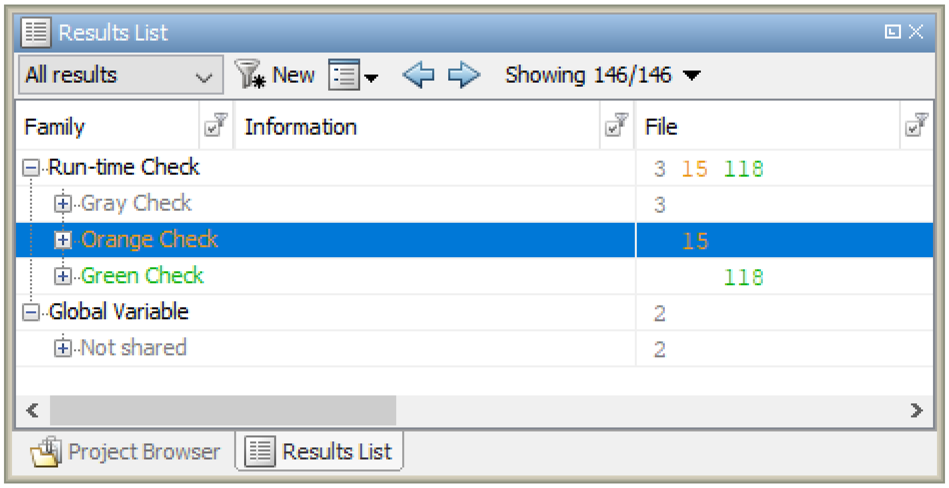
In the archive `genCodeArchive.zip`, find the options files in the folder `<`*`current folder`*`>/polyspace`.

Run Polyspace Analysis by Using the Packaged Options Files

1. Unzip the code archive `genCodeArchive.zip` and locate the `<`*`current folder`*`>/polyspace` folder.
2. Open a command-line terminal and change your working folder to the `polyspace` subfolder of the unzipped folder by using the `cd` command.
3. Start a Polyspace analysis.

    - To run a desktop Polyspace analysis, use either `polyspace-code-prover` or `polyspace-bug-finder`. To run the Polyspace analysis in a server, use either `polyspace-bug-finder-server` or `polyspace-code-prover-server`. Polyspace Bug Finder and Code Prover analyze the code differently. See “Choose Between Polyspace Bug Finder and Polyspace Code Prover”.
    - Specify the file `optionsFile.txt` as the argument to `-options-file`.

    To run a Code prover analysis, run this command: `polyspace-code-prover -options-file optionsFile.txt -results-dir Results`.
4. Follow the progress of the analysis in the log file that is generated in the `Results` folder.
5. To view the results in the desktop user interface, in the command-line interface, enter: `polyspace Results\ps_results.pscp`. The extension of the `ps_results` file changes depending on whether you run a Code Prover analysis or a Bug Finder analysis. The result contains several orange checks.



Family	Information	File
Run-time Check		3 15 118
Gray Check		3
Orange Check		15
Green Check		118
Global Variable		2
Not shared		2

Alternatively, upload the result to Polyspace Access. See “Upload Results to Polyspace Access” (Polyspace Bug Finder Access).

6 Address the results. For more information, see “Address Results in Polyspace Access Through Bug Fixes or Justifications” (Polyspace Bug Finder Access).

See Also

`packNGo` | `polyspace.Project` | `slbuild`

More About

- “Integrate Polyspace Server Products with MATLAB” on page 4-2

Use Existing Software Development Specifications for Polyspace Analysis

Create Polyspace Analysis Configuration from Build Command

To run Polyspace on a server during continuous integration, you must configure all analysis options beforehand so that the analysis completes without errors. These options must be updated as necessary to keep up with new code submissions. If you use existing artifacts such as a build command (makefile) to build new code submissions, you can reuse the build command to configure a Polyspace analysis and stay updated with new submissions. With the `polyspace-configure` command, you can monitor the execution of a build command and create an options file for analysis with Polyspace.

This topic shows a simple tutorial illustrating how to create an options file from a build command and use the file for the subsequent analysis. The topic uses a Linux makefile and the GCC compiler, but you can adapt the commands to other operating systems such as Windows and other compilers such as Microsoft® Visual Studio®.

1. Cope the demo source files from `*polyspaceserverroot*\polyspace\examples\cxx\Bug_Finder_Example\sources` to a folder with write permissions. Here, *`polyspaceserverroot`* is the root installation folder of the Polyspace server products, for instance, `C:\Program Files\Polyspace Server\R2019a`.
2. Create a simple makefile that compiles the demo source files. Save the makefile in the same folder as the source files.

   For instance, create a file named `makefile` and add this content:

   ```
   CC := gcc
   SOURCES := $(wildcard *.c)

   all: $(CC) -c $(SOURCES)
   ```

   Check that the makefile builds the source files successfully. Open a command terminal, navigate to the folder (using `cd`) and enter:

   ```
   make
   ```

   The `make` command should complete execution without errors.
3. Trace the build command with `polyspace-configure` and create an options file `compile_opts`.

   ```
   polyspace-configure -output-options-file compile_opts make
   ```
4. Create a second options file with additional options. For instance, create a file `run_opts` with this content:

   ```
   -checkers numerical
   -report-template BugFinder
   -output-format pdf
   ```

   The options run all numerical checkers in Bug Finder and creates a PDF report after analysis using the `BugFinder` template.
5. Run a Bug Finder analysis with the two options files: `compile_opts` created from your build command and `run_opts` created manually.

```
polyspace-bug-finder-server -options-file compile_opts -options-file run_opts
```

The analysis should complete without errors. You can open the results in the Polyspace user interface or upload the results to the Polyspace Access web interface (using the `polyspace-access` command).

To run Code Prover instead of Bug Finder, use the `polyspace-code-prover-server` command instead of the `polyspace-bug-finder-server` command.

You can run a similar analysis using MATLAB scripts. Replace `polyspace-bug-finder-server` with the function `polyspaceBugFinderServer` and `polyspace-configure` with the function `polyspaceConfigure`.

See Also

`polyspace-bug-finder-server` | `polyspace-configure`

See Also

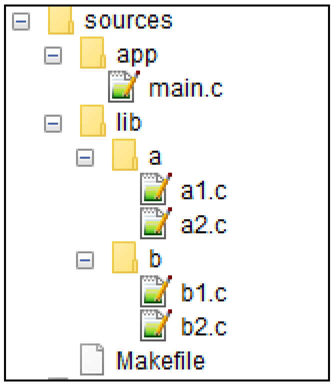
More About

- "Prepare Scripts for Polyspace Analysis" on page 1-2
- "Specify Target Environment and Compiler Behavior" on page 5-2
- "polyspace-configure Source Files Selection Syntax" on page 2-4
- "Modularize Polyspace Analysis by Using Build Command" on page 2-6

polyspace-configure Source Files Selection Syntax

When you create projects by using `polyspace-configure`, you can include or exclude source files whose paths match the pattern that you pass to the options `-include-sources` or `-exclude-sources`. You can specify these two options multiple times and combine them at the command line.

This folder structure applies to these examples.



To try these examples, use the demo files in `*polyspaceroot*\help\toolbox\polyspace_bug_finder_server\examples\sources-select`. `*polyspaceroot*` is the Polyspace installation folder.

Run this command:

```
polyspace-configure -allow-overwrite -include-sources "glob_pattern" \
-print-excluded-sources -print-included-sources make -B
```

`*glob_pattern*` is the glob pattern that you use to match the paths of the files you want to include or exclude from your project. To ensure the shell does not expand the glob patterns you pass to `polyspace-configure`, enclose them in double quotes.

In the table, the examples assume that `sources` is a top-level folder.

Glob Pattern Syntax	Example
No special characters, slashes ('/'), or backslashes ('\\'). Pattern matches corresponding files, but not folders.	`-include-sources "main.c"` matches: `/sources/app/main.c`

Pattern contains `'*'` or `'?'` special characters.
 	
`'*'` matches zero or more characters in file or folder name.
 	
`'?'` matches one character in file or folder name.
 	
The matches do not include path separators.
	`-include-sources "b?.c"` matches:
	
	`/sources/lib/b/b1.c`
	
	`/sources/lib/b/b2.c`
	
	`-include-sources "app/*.c"` matches:
	
	`/sources/app/main.c`

Glob Pattern Syntax	Example
Pattern starts with slash `'/'` (UNIX®) or drive letter (Windows). Pattern matches absolute path only.	`-include-sources "/a"` does not match anything. `-include-sources "/sources/app"` matches: `/sources/app/main.c`

Pattern ends with a slash (UNIX), backslash (Windows), or `'**'`.
 	
Pattern matches all files under specified folder.
 	
`'**'` is ignored if it is at the start of the pattern.
	`-include-sources "a/"` matches
	
	`/sources/lib/a/a1.c`
	
	`/sources/lib/a/a2.c`

Pattern contains `'/**/'` (UNIX) or `'\**\'` (Windows). Pattern matches zero or more folders in the specified path.	`-include-sources "lib/**/?1.c"` matches:
	
	`/sources/lib/a/a1.c`
	
	`/sources/lib/b/b1.c`

Pattern starts with `'.'` or `'..'`.
 	
Pattern matches paths relative to the path where you run the command.
	If you start `polyspace-configure` from `/sources/lib/a`,
	
	`-include-sources "../lib/**/b?.c"` matches:
	
	`/sources/lib/b/b1.c`
	
	`/sources/lib/b/b2.c`

Pattern is a UNC path on Windows .	If your files are on server `myServer`:
	
	`\\myServer\sources\lib\b\**` matches:
	
	`\\myServer\sources\lib\b\b1.c`
	
	`\\myServer\sources\lib\b\b2.c`

`polyspace-configure` does not support these glob patterns:

- Absolute paths relative to the current drive on Windows.

  For instance, `\foo\bar`.
- Relative paths to the current folder.

  For instance, `C:foo\bar`.
- Extended length paths in Windows.

  For instance, `\\?\foo`.
- Paths that contain '.' or '..' except at the start of the pattern.

  For instance, `/foo/bar/../a?.c`.
- The `'*'` character by itself.

Modularize Polyspace Analysis by Using Build Command

To configure the Polyspace analysis, you can reuse the compilation options in your build command such as `make`. First, you trace your build command with `polyspace-configure` (or `polyspaceConfigure` in MATLAB) and create a Polyspace options file. You later specify this options file for the subsequent Polyspace analysis.

If your build command creates several binaries, by default `polyspace-configure` groups the source files for all binaries into one Polyspace options file. If binaries that use the same source files or functions are compiled with different options, you lose this distinction in the subsequent Polyspace analysis. The presence of the same function multiple times can lead to link errors during the Polyspace analysis and sometimes to incorrect results.

This topic shows how to create a separate Polyspace options file for each binary created in your makefile. Suppose that a makefile creates four binaries: two executable (target `cmd1` and `cmd2`) and two shared libraries (target `liba` and `libb`). You can create a separate Polyspace options file for each of these binaries.

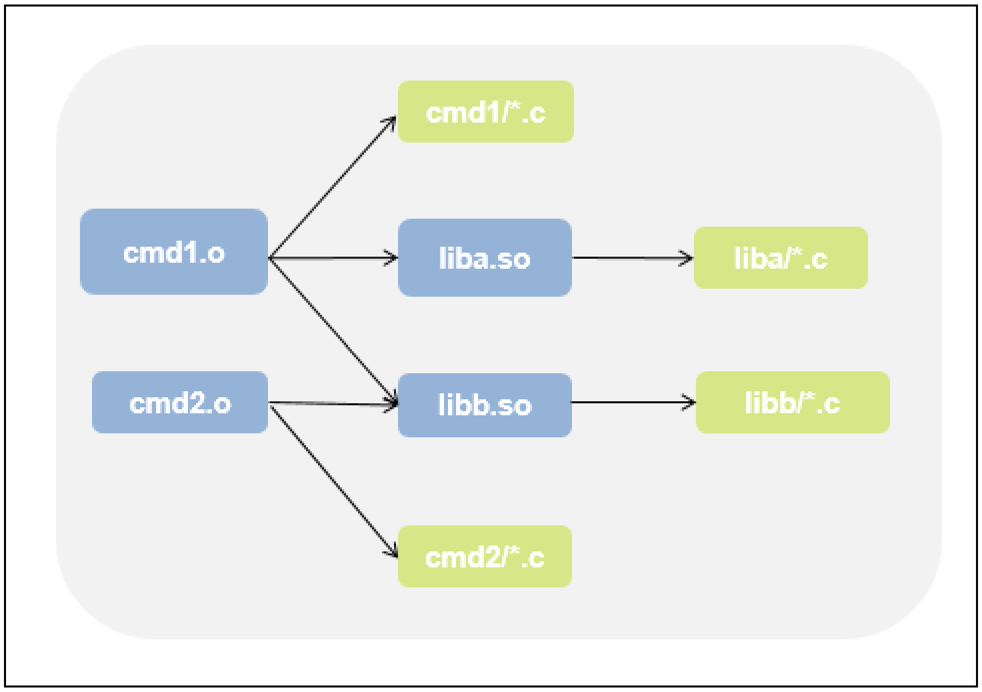
To try this example, use the files in *`polyspaceroot`*`\help\toolbox\polyspace_bug_finder_server\examples\multiple_modules`. Here, *`polyspaceroot`* is the Polyspace installation folder, for instance, `C:\Program Files\Polyspace\R2021a` or `C:\Program Files\Polyspace Server\R2021a`.

Build Source Code

Inspect the makefile. The makefile creates four binaries:

```
CC := gcc
LD := ld

LIBA_SOURCES := $(wildcard src/liba/*.c)
LIBB_SOURCES := $(wildcard src/libb/*.c)
CMD1_SOURCES := $(wildcard src/cmd1/*.c)
CMD2_SOURCES := $(wildcard src/cmd2/*.c)
LIBA_OBJ := $(notdir $(LIBA_SOURCES:.c=.o))
LIBB_OBJ := $(notdir $(LIBB_SOURCES:.c=.o))
CMD1_OBJ := $(notdir $(CMD1_SOURCES:.c=.o))
CMD2_OBJ := $(notdir $(CMD2_SOURCES:.c=.o))
LIBB_SOBJ := libb.so
LIBA_SOBJ := liba.so

all: cmd1 cmd2

cmd1: liba libb
    $(CC) -o  $@ $(CMD1_SOURCES) $(LIBA_SOBJ) $(LIBB_SOBJ)

cmd2: libb
    $(CC) -c $(CMD2_SOURCES)
    $(LD) -o $@ $(CMD2_OBJ) $(LIBB_SOBJ)

liba: libb
    $(CC) -fPIC -c $(LIBA_SOURCES)
    $(CC) -shared -o $(LIBA_SOBJ) $(LIBA_OBJ)

libb:
    $(CC) -fPIC -c $(LIBB_SOURCES)
    $(CC) -shared -o $(LIBB_SOBJ) $(LIBB_OBJ)

.PHONY: clean
clean:
    rm *.o
```

The binaries created have the dependencies shown in this figure. For instance, creation of the object `cmd1.o` depends on all `.c` files in the folder `cmd1` and the shared objects `liba.so` and `libb.so`.



Build your source code by using the makefile. Use the `-B` flag to ensure full build.

```
make -B
```

Make sure that the build runs to completion.

Create One Polyspace Options File for Full Build

Trace the build command by using `polyspace-configure`. Use the option `-output-options-file` to create a Polyspace options file `psoptions` from the build command.

```
polyspace-configure -output-options-file psoptions make -B
```

Run Bug Finder or Code Prover by using the previously created options file: Save the analysis results in a `results` subfolder.

```
polyspace-bug-finder-server -options-file psoptions -results-dir results
```

You see this link error (warning in Bug Finder):

```
Procedure 'main' multiply defined.
```

The error occurs because the files `cmd1/cmd1_main.c` and `cmd2/cmd2_main.c` both have a `main` function. When you run your build command, the two files are used in separate targets in the makefile. However, `polyspace-configure` by default creates one options file for the full build. The Polyspace options file contains both source files resulting in conflicting definitions of the `main` function.

To verify the cause of the error, open the Polyspace options file `psoptions`. You see these lines that include the files with conflicting definitions of the `main` function.

```
-sources src/cmd1/cmd1_main.c
-sources src/cmd2/cmd2_main.c
```

Create Options File for Specific Binary in Build Command

To avoid the link error, build the source code for a specific binary when tracing your build command by using `polyspace-configure`.

For instance, build your source code for the binary `cmd1.o`. Specify the makefile target `cmd1` for `make`, which creates this binary.

```
polyspace-configure -output-options-file psoptions make -B cmd1
```

Run Bug Finder or Code Prover by using the previously created options file.

```
polyspace-bug-finder-server -options-file psoptions -results-dir results
```

The link error does not occur and the analysis runs to completion. You can open the Polyspace options file `psoptions` and see that only the source files in the `cmd1` subfolder and the files involved in creating the shared objects are included with the `-sources` option. The source files in the `cmd2` subfolder, which are not involved in creating the binary `cmd1.o`, are not included in the Polyspace options file.

Special Considerations for Libraries (Code Prover only)

If you trace the creation of a shared object from libraries, the source files extracted do not contain a `main` function. In the subsequent Code Prover analysis, you can see an error because of the missing `main`.

Use the Polyspace option `Verify module or library (-main-generator)` to generate a `main` function. Specify the option in the options file that was created or directly at the command line. See “Verify C Application Without main Function” (Polyspace Code Prover Server).

In C++, use these additional options for classes:

- `Class (-class-analyzer)`
- `Functions to call within the specified classes (-class-analyzer-calls)`

Create One Options File Per Binary Created in Build Command

To create an options file for a specific binary created in the build command, you must know the details of your build command. If you are not familiar with the internal details of the build command, you can create a separate Polyspace options file for *every* binary created in the build command. The approach works for binaries that are executables, shared (dynamic) libraries and static libraries.

This approach works only if you use these compilers:

- GNU C or GNU C++
- Microsoft Visual C++

Trace the build command by using `polyspace-configure`.To create a separate options file for each binary, use the option `-module` with `polyspace-configure`.

```
polyspace-configure -module -output-options-path optionsFilesFolder make -B
```

The command creates options files in the folder `optionsFilesFolder`. In the preceding example, the command creates four options files for the four binaries:

- `cmd1.psopts`
- `cmd2.psopts`
- `liba_so.psopts`
- `libb_so.psopts`

You can run Polyspace on the code implementation of a specific binary by using the corresponding options file. For instance, you can run Code Prover on the code implementation of the binary created from the makefile target `cmd1` by using this command:

```
polyspace-bug-finder-server -options-file cmd1.psopts -results-dir results
```

For this approach, you do not need to know the details of your build command. However, when you create a separate options file for each binary in this way, each options file contains source files directly involved in the binary and not through shared objects. For instance, the options file `cmd1.psopts` in this example specifies only the source files in the `cmd1` subfolder and not the source files involved in creating the shared objects `liba.so` and `libb.so`. The subsequent analysis by using this options file cannot access functions from the shared objects and uses function stubs instead. In the Code Prover analysis, if you see too many orange checks due to the stubbing, use the approach stated in the section “Create Options File for Specific Binary in Build Command” on page 2-9.

Special Considerations for Libraries (Code Prover only)

If you trace the creation of a shared object from libraries, the source files extracted do not contain a `main` function. In the subsequent Code Prover analysis, you can see an error because of the missing `main`.

Use the Polyspace option `Verify module or library (-main-generator)` to generate a `main` function. Specify the option in the options file that was created or directly at the command line. See “Verify C Application Without main Function” (Polyspace Code Prover Server).

In C++, use these additional options for classes:

- `Class (-class-analyzer)`
- `Functions to call within the specified classes (-class-analyzer-calls)`

See Also
`polyspace-bug-finder-server` | `polyspace-configure`

More About
- "Create Polyspace Analysis Configuration from Build Command" on page 2-2

Offload Polyspace Analysis to Remote Servers from Desktop

Send Polyspace Analysis from Desktop to Remote Servers

In this section...

You can perform a Polyspace analysis locally on your desktop or offload the analysis to one or more dedicated servers. You offload a Polyspace analysis from a Polyspace desktop product such as Polyspace Bug Finder but the analysis runs on the server using a Polyspace server product such as Polyspace Bug Finder Server.

This topic shows how to send a Polyspace analysis from the user interface of the Polyspace desktop products.

- To offload an analysis with scripts, see "Send Polyspace Analysis from Desktop to Remote Servers Using Scripts" on page 3-6.
- For a simple tutorial that walks through all the steps for offloading a Polyspace analysis, see "Send Bug Finder Analysis from Desktop to Locally Hosted Server". In the tutorial, the same computer acts as the client and the server.

Client-Server Workflow for Running Analysis

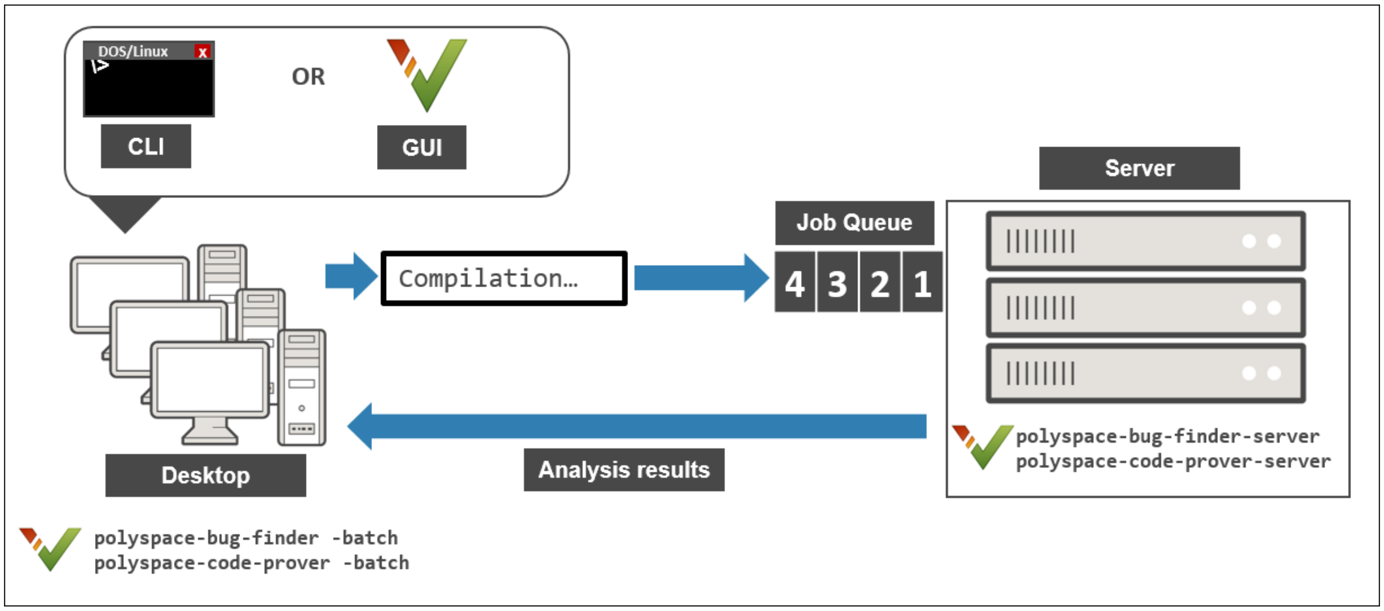
After the initial setup, you can submit a Polyspace analysis from a client desktop to a server. The client-server workflow happens in three steps. All three steps can be performed on the same computer or three different computers.

1. **Client node**: You specify Polyspace analysis options and start the analysis on the client desktop. The initial phase of analysis up to compilation runs on the desktop. After compilation, the analysis job is submitted to the server.

   You require the Polyspace desktop product, Polyspace Bug Finder on the computer that acts as the client node.
2. **Head node**: The server consists of a head node and several worker nodes. The head node uses a job scheduler to manage submissions from multiple client desktops. The jobs are then distributed to the worker nodes as they become available.

   You require the product MATLAB Parallel Server on the computer that acts as the head node.
3. **Worker nodes**: When a worker becomes available, the job scheduler assigns the analysis to the worker. The Polyspace analysis runs on the worker and the results are downloaded back to the client desktop for review.

   You require the product MATLAB Parallel Server on the computers that act as worker nodes. You also require the Polyspace server products, Polyspace Bug Finder Server and/or Polyspace Code Prover Server, to run the analysis.


DOS/Linux
CLI
OR
GUI
Desktop
Compilation…
Job Queue
4 3 2 1
Server
Analysis results
polyspace-bug-finder-server
polyspace-code-prover-server
polyspace-bug-finder -batch
polyspace-code-prover -batch

Prerequisites

Before offloading an analysis from the user interface of the Polyspace desktop products, you must set up your project’s source files, analysis options, and remote analysis settings. If you have not done so, for more information on:

- How to add source files, see “Add Source Files for Analysis in Polyspace User Interface” (Polyspace Bug Finder).
- How to set up communication between client and server, see “Install Products for Submitting Polyspace Analysis from Desktops to Remote Server”.

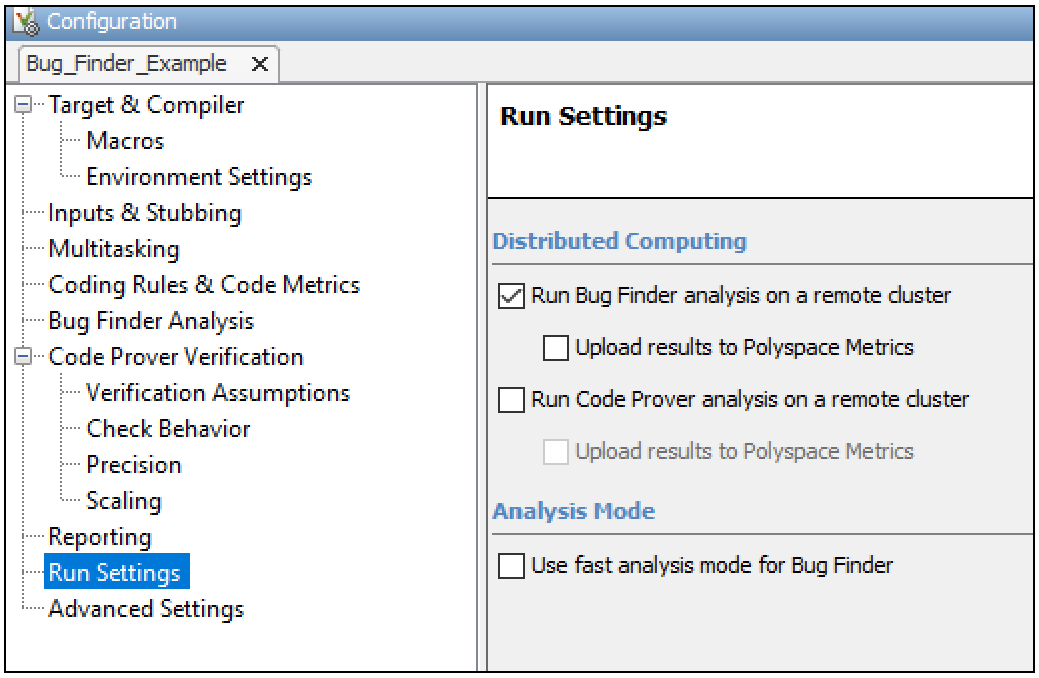
Once you have set up a Polyspace project and established communicated between a desktop and a remote server, you are ready to offload a Polyspace analysis.

Offload Analysis in Polyspace User Interface

To start a remote analysis:

1. Select a project to analyze.
2. On the **Configuration** pane, select **Run Settings**.

   Select **Run Bug Finder analysis on a remote cluster** and/or **Run Code Prover analysis on a remote cluster**.



Run Settings

Distributed Computing

[✓] Run Bug Finder analysis on a remote cluster

[ ] Upload results to Polyspace Metrics

[ ] Run Code Prover analysis on a remote cluster

[ ] Upload results to Polyspace Metrics

Analysis Mode

[ ] Use fast analysis mode for Bug Finder

3 If you want to store your results in the Polyspace Metrics repository, select **Upload results to Polyspace Metrics**.

   Otherwise, clear this check box. After analysis, the results are downloaded to the desktop for review.

4 Start the analysis. For instance, to start a Bug Finder analysis, click the **Run Bug Finder** button.

   The compilation part of the analysis takes place on the desktop product. After compilation, the analysis is offloaded to the server.

5 To monitor the analysis, select **Tools** > **Open Job Monitor**. In the Polyspace Job Monitor, follow your queued job to monitor progress.

   Once the analysis is complete, the results are downloaded back to the user interface of the Polyspace desktop products. You can open the results directly in the user interface. If you uploaded the results to Polyspace Metrics, you have to explicitly download them from the Polyspace Metrics interface.

   If the analysis stops after compilation and you have to restart the analysis, to avoid restarting from the compilation phase, use the option `-submit-job-from-previous-compilation-results`.

Note If you choose to upload results to Polyspace Metrics, your results are not downloaded automatically after verification. Use the Polyspace Metrics web dashboard to view the results and download them to your desktop. For more information, see “View Projects in Polyspace Metrics” (Polyspace Bug Finder).

See Also

`Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`

More About

- “Install Products for Submitting Polyspace Analysis from Desktops to Remote Server”
- “Send Polyspace Analysis from Desktop to Remote Servers Using Scripts” on page 3-6

Send Polyspace Analysis from Desktop to Remote Servers Using Scripts

Instead of running a Polyspace analysis on your local desktop, you can send the analysis to a remote cluster. You can use a dedicated cluster for running Polyspace to free up memory on your local desktop.

This topic shows how to use Windows or Linux scripts to send the analysis to a remote cluster and download the results to your desktop after analysis.

- To offload an analysis from the Polyspace user interface, see “Send Polyspace Analysis from Desktop to Remote Servers” on page 3-2.
- For a simple tutorial that walks through all the steps for offloading a Polyspace analysis, see “Send Bug Finder Analysis from Desktop to Locally Hosted Server”. In the tutorial, the same computer acts as the client and the server.

Client-Server Workflow for Running Analysis

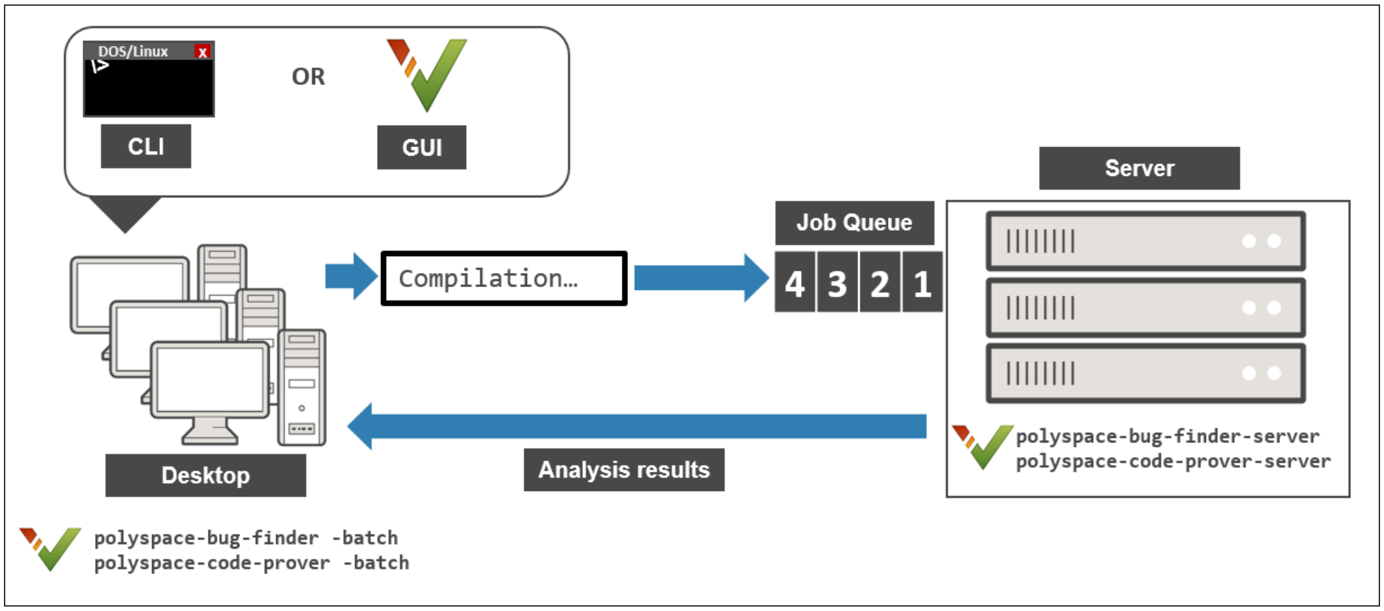
After the initial setup, you can submit a Polyspace analysis from a client desktop to a server. The client-server workflow happens in three steps. All three steps can be performed on the same computer or three different computers.

1. **Client node**: You specify Polyspace analysis options and start the analysis on the client desktop. The initial phase of analysis up to compilation runs on the desktop. After compilation, the analysis job is submitted to the server.

   You require the Polyspace desktop product, Polyspace Bug Finder on the computer that acts as the client node.
2. **Head node**: The server consists of a head node and several worker nodes. The head node uses a job scheduler to manage submissions from multiple client desktops. The jobs are then distributed to the worker nodes as they become available.

   You require the product MATLAB Parallel Server on the computer that acts as the head node.
3. **Worker nodes**: When a worker becomes available, the job scheduler assigns the analysis to the worker. The Polyspace analysis runs on the worker and the results are downloaded back to the client desktop for review.

   You require the product MATLAB Parallel Server on the computers that act as worker nodes. You also require the Polyspace server products, Polyspace Bug Finder Server and/or Polyspace Code Prover Server to run the analysis.


DOS/Linux
CLI
OR
GUI
Desktop
Compilation…
Job Queue
4 3 2 1
Server
Analysis results
polyspace-bug-finder-server
polyspace-code-prover-server
polyspace-bug-finder -batch
polyspace-code-prover -batch

Prerequisites

Before you run a remote analysis by using scripts, you must set up communication between a desktop and a remote server. See "Install Products for Submitting Polyspace Analysis from Desktops to Remote Server".

Run Remote Analysis

To run a remote analysis, use this command:

```
polyspaceroot\polyspace\bin\polyspace-bug-finder
  -batch -scheduler NodeHost|MJSName@NodeHost [options] [-mjs-username name]
```

where:

- *`polyspaceroot`* is the installation folder of Polyspace desktop products, for instance, `C:\Program Files\Polyspace\R2021a`.
- *`NodeHost`* is the name of the computer that hosts the head node of the MATLAB Parallel Server cluster.

  `MJSName` is the name of the MATLAB Job Scheduler on the head node host.

  If you set up communications with a cluster from the Polyspace user interface, you can determine *`NodeHost`* and *`MJSName`* from the user interface. Select **Metrics > Metrics and Remote Server Settings**. Open the MATLAB Parallel Server Admin Center. Under **MATLAB Job Scheduler**, see the **Name** and **Hostname** columns for *`MJSName`* and *`NodeHost`*.

If you use the `startjobmanager` command to start the MATLAB Job Scheduler, *`MJSName`* is the argument of the option `-name`. For details, see “Configure Advanced Options for MATLAB Job Scheduler Integration” (MATLAB Parallel Server).

- *`options`* are the analysis options. These options are the same as that of a local analysis. For instance, you can use these options:

  - `-sources-list-file`: Specify a text file with one source file name per line.
  - `-options-file`: Specify a text file with one option per line.
  - `-results-dir`: Specify a download folder for storing results after analysis.

  For the full list of options, see “Analysis Options in Polyspace Bug Finder Server”. Alternatively, you can:

  - Start an analysis in the user interface and stop after compilation. You can obtain the text files and scripts for running the analysis at the command line. See “Configure Polyspace Analysis Options in User Interface and Generate Scripts” on page 1-14.
  - Enter `polyspace-bug-finder -h`. The list of available options with a brief description are displayed.
  - Place your cursor over each option on the **Configuration** pane in the Polyspace user interface. Click the **More Help** button for information on the option syntax and when the option is required.
- *`name`* is the username required for job submissions using MATLAB Parallel Server. hese credentials are required only if you use a security level of 1 or higher for MATLAB Parallel Server submissions. See “Set MATLAB Job Scheduler Cluster Security” (MATLAB Parallel Server).

The analysis executes locally on your desktop up to the end of the compilation phase. After compilation, the software submits the analysis job to the cluster and provides a job ID. You can also read the ID from the file `ID.txt` in the results folder. To monitor your analysis, use the `polyspace-jobs-manager` command with the job ID.

If the analysis stops after compilation and you have to restart the analysis, to avoid rerunning the compilation phase, use the option `-submit-job-from-previous-compilation-results`.

Manage Remote Analysis

To manage multiple remote analyses, use the option `-batch`. For instance:

```
polyspaceroot\polyspace\bin\polyspace-jobs-manager action
          -scheduler schedulerName
```

See also `Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`. Here:

- *`polyspaceroot`* is your MATLAB installation folder.
- *`schedulerName`* is one of the following:

  - Name of the computer that hosts the head node of your MATLAB Parallel Server cluster (*`NodeHost`*).
  - Name of the MATLAB Job Scheduler on the head node host (*`MJSName`*@*`NodeHost`*).

    - Name of a MATLAB cluster profile (*`ClusterProfile`*).

      For more information about clusters, see “Discover Clusters and Use Cluster Profiles” (Parallel Computing Toolbox)

  If you do not specify a job scheduler, `polyspace-job-manager` uses the scheduler specified in the Polyspace preferences. To see the scheduler name, select **Tools** > **Preferences**. On the **Server Configuration** tab, see the **Job scheduler host name**.

- *`action`* refers to the possible action commands to manage jobs on the scheduler:

  - `listjobs`:

    Generate a list of Polyspace jobs on the scheduler. For each job, the software produces this information:

    - `ID` — Verification or analysis identifier.
    - `AUTHOR` — Name of user that submitted job.
    - `APPLICATION` — Name of Polyspace product, for example, Polyspace Code Prover or Polyspace Bug Finder.
    - `LOCAL_RESULTS_DIR` — Results folder on local computer, specified through the **Tools** > **Preferences** > **Server Configuration** tab.
    - `WORKER` — Local computer from which job was submitted.
    - `STATUS` — Status of job, for example, `running` and `completed`.
    - `DATE` — Date on which job was submitted.
    - `LANG` — Language of submitted source code.
  - `download -job` *`ID`* `-results-folder` *`FolderPath`*:

    Download results of analysis with specified ID to folder specified by *`FolderPath`*.

    When the analysis job is queued on the server, the command `polyspace-bug-finder` returns a job id. In addition, a file `ID.txt` in the results folder contains the job ID in this format:

    `job_id``;`*`server_name`*`:`*`project_name version_number`*

    For instance, `92;localhost:Demo 1.0`.

    If you do not use the `-results-folder` option, the software downloads the result to the folder that you specified when starting analysis, using the `-results-dir` option.

    After downloading results, use the Polyspace user interface to view the results.
  - `getlog -job` *`ID`*:

    Open log for job with specified ID.
  - `remove -job` *`ID`*:

    Remove job with specified ID.
  - `promote -job` *`ID`*:

    Promote job with specified ID in the queue.
  - `demote -job` *`ID`*

Demote job with specified ID in the queue.

Sample Scripts for Remote Analysis

In Windows, to avoid typing the commands each time, you can save the commands in a batch file. In Linux, you can relaunch the analysis by using a shell script. To create a batch file for running analysis:

1. Save your analysis options in a file `listofoptions.txt`. See `-options-file`.
2. Create a file `launcher.bat` in a text editor like Notepad.

   In the file, enter these commands:

   ```
   echo off
   set POLYSPACE_PATH=polyspaceroot\polyspace\bin
   set RESULTS_PATH=C:\Results
   set OPTIONS_FILE=C:\Options\listofoptions.txt
   "%POLYSPACE_PATH%\polyspace-bug-finder.exe" -batch -scheduler localhost
                         -results-dir "%RESULTS_PATH%" -options-file "%OPTIONS_FILE%"
   pause
   ```

   `polyspaceroot` is the Polyspace installation folder. *`localhost`* is the name of the computer that hosts the head node of your MATLAB Parallel Server cluster.
3. Replace the definitions of these variables in the file:
   - `POLYSPACE_PATH`: Enter the actual location of the `.exe` file.
   - `RESULTS_PATH`: Enter the path to a folder. The files generated during compilation are saved in the folder.
   - `OPTIONS_FILE`: Enter the path to the file `listofoptions.txt`.
4. Double-click `launcher.bat` to run the analysis.

Tip If you run a Polyspace analysis, a Windows `.bat` or Linux `.sh` file is generated. The file is in the `.settings` subfolder in your results folder. Instead of writing a script from scratch, you can relaunch the analysis using this file.

See Also

`Run Bug Finder or Code Prover analysis on a remote cluster (-batch)`

More About

- "Install Products for Submitting Polyspace Analysis from Desktops to Remote Server"
- "Send Polyspace Analysis from Desktop to Remote Servers" on page 3-2

Run Polyspace Analysis on Server with MATLAB Scripts

Integrate Polyspace Server Products with MATLAB

You can install Polyspace Bug Finder Server and Polyspace Code Prover Server as standalone products and analyze C/C++ code.

When installing Polyspace server products and MATLAB, you cannot install MATLAB and Polyspace server products together in a single run of the installer. First install MATLAB by running the MATLAB installer. Then install the Polyspace server product in a different root folder by running the installer separately. For instance, in Windows:

- Your default MATLAB root folder is `C:\Program Files\MATLAB\R2021a`.
- Your default Polyspace root folder is `C:\Program Files\Polyspace Server\R2021a` for the Polyspace server products.

To automate the Polyspace analysis by using MATLAB scripts, integrate the Polyspace server products and MATLAB by running a post-installation step.

Integrate Polyspace Server Products with MATLAB

You can integrate your Polyspace server product with MATLAB only if both installations are from the same release. After the integration, you can use all MATLAB functions and classes available for running Polyspace.

To link your MATLAB and Polyspace installations:

1. Open MATLAB with administrator privileges.
2. At the MATLAB command prompt, enter:

   ```
   polyspacesetup('install');
   ```

   By default, Polyspace is installed in the folder `C:\Program Files\Polyspace\R2021a`. If you install Polyspace in the default folder, the command integrates Polyspace with MATLAB. If a Polyspace installation is not detected at the default location, provide the path to the Polyspace installation folder when prompted. The process might take a few minutes to complete.

   To avoid the prompt during installation, enter:

   ```
   polyspacesetup('install', 'polyspaceFolder', FOLDER, 'silent', true);
   ```
3. Restart MATLAB. You can now use all functions and classes available for running Polyspace server products.

A MATLAB installation can be integrated with only one Polyspace installation. To integrate to a new Polyspace installation, any previous integration must be removed. To remove the integration between a Polyspace and MATLAB installation, open MATLAB with administrator privilege and at the MATLAB command prompt, enter:

```
polyspacesetup('uninstall')
```

Check Integration Between MATLAB and Polyspace

To check if a MATLAB installation is already integrated with a Polyspace installation, open MATLAB and at the command prompt, enter:

```
ver
```

You see the list of products installed. If Polyspace is integrated with MATLAB, you can see the Polyspace products in the list.

The MATLAB-Polyspace integration adds some Polyspace installation subfolders to the MATLAB search path. To see which paths were added, enter:

```
polyspacesetup('showpolyspacefolders')
```

Run Polyspace Server Products with MATLAB Scripts

In a continuous integration process, you can execute MATLAB scripts that run a Polyspace analysis on new code submissions and compares the results against predefined criteria. Use these functions/classes:

- Create a `polyspace.Project` object to configure Polyspace analysis options, run an analysis and read results to MATLAB tables. You can use other MATLAB functions for comparing results against predefined criteria.

  To only read existing results without running an analysis, use the `polyspace.BugFinderResults` class with the path to a results folder.
- If you want a more granular selection of checkers for:

  - Coding rules, create a `polyspace.CodingRulesOptions` object.
  - Bug Finder defects, create a `polyspace.DefectsOptions` object.

  To create a custom target for the analysis and explicitly specify sizes of data types, create a `polyspace.GenericTargetOptions` object.

You can also use the `polyspaceBugFinderServer` function to run the analysis and then read results with the `polyspace.BugFinderResults` class. If you use build commands to build your source code, you can create a Polyspace configuration from the build command using the `polyspaceConfigure` function.

See Also

Configure Target and Compiler Options

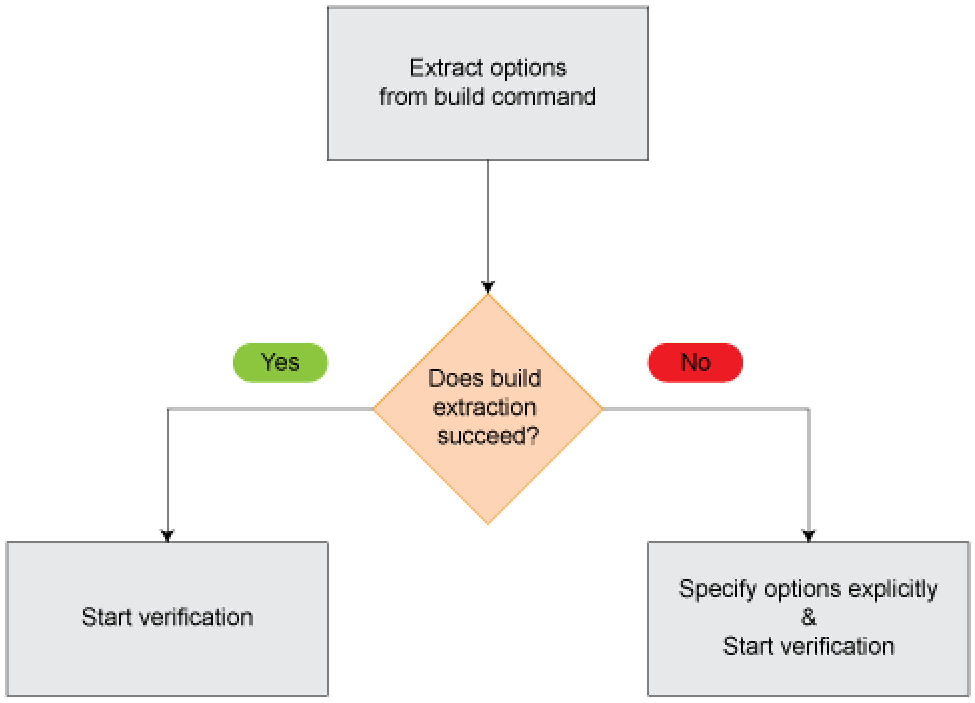
Specify Target Environment and Compiler Behavior

Before verification, specify your source code language (C or C++), target processor, and the compiler that you use for building your code. In certain cases, to emulate your compiler behavior, you might have to specify additional options.

Using your specification, the verification determines the sizes of fundamental types, considers certain macros as defined, and interprets compiler-specific extensions of the Standard. If the options do not correspond to your run-time environment, you can encounter:

- Compilation errors
- Verification results that might not apply to your target

If you use a build command such as `gmake` to build your code and the build command meets certain restrictions, you can extract the options from the build command. Otherwise, specify the options explicitly.


Extract options from build command
Yes
Does build extraction succeed?
No
Start verification
Specify options explicitly & Start verification

Extract Options from Build Command

If you use build automation scripts to build your source code, you can set up a Polyspace project from your scripts. The options associated with your compiler are specified in that project.

In the Polyspace desktop products, for information on how to trace your build command from the:

- Polyspace user interface, see "Add Source Files for Analysis in Polyspace User Interface" (Polyspace Bug Finder).
- DOS or UNIX command line, see `polyspace-configure`.

- MATLAB command line, see `polyspaceConfigure`.

In the Polyspace server products, for information on how to trace your build command, see "Create Polyspace Analysis Configuration from Build Command" on page 2-2.

For Polyspace project creation, your build automation script (makefile) must meet certain requirements. See "Requirements for Project Creation from Build Systems" on page 5-20.

Specify Options Explicitly

If you cannot trace your build command and therefore manually create a project, you have to specify the options explicitly.

- In the user interface of the Polyspace desktop products, select a project configuration. On the **Configuration** pane, select **Target & Compiler**. Specify the options.
- At the DOS or UNIX command line, specify flags with the `polyspace-bug-finder`, `polyspace-code-prover`, `polyspace-bug-finder-server` or `polyspace-code-prover-server` command.
- At the MATLAB command line, specify arguments with the `polyspaceBugFinder`, `polyspaceCodeProver`, `polyspaceBugFinderServer` or `polyspaceCodeProverServer` function.

Specify the options in this order.

- Required options:
  - `Source code language (-lang)`: If all files have the same extension `.c` or `.cpp`, the verification uses the extension to determine the source code language. Otherwise, explicitly specify the option.
  - `Compiler (-compiler)`: Select the compiler that you use for building your source code. If you cannot find your compiler, use an option that closely matches your compiler.
  - `Target processor type (-target)`: Specify the target processor on which you intend to execute your code. For some processors, you can change the default specifications. For instance, for the processor `hc08`, you can change the size of types `double` and `long double` from 32 to 64 bits.

    If you cannot find your target processor, you can create your own target and specify the sizes of fundamental types, default signedness of `char`, and endianness of the target machine. See `Generic target options`.
- Language-specific options:
  - `C standard version (-c-version)`: The default C language standard depends on your compiler specification. If you do not specify a compiler explicitly, the default analysis uses the C99 standard. Specify an earlier standard such as C90 or a later standard such as C11.
  - `C++ standard version (-cpp-version)`: The default C++ language standard depends on your compiler specification. If you do not specify a compiler explicitly, the default analysis uses the C++03 standard. Specify later standards such as C++11 or C++14.
- Compiler-specific options:

  Whether these options are available or not depends on your specification for `Compiler (-compiler)`. For instance, if you select a `visual` compiler, the option `Pack alignment value`

`(-pack-alignment-value)` is available. Using the option, you emulate the compiler option `/Zp` that you use in Visual Studio.

For all compiler-specific options, see “Target and Compiler”.

- Advanced options:

  Using these options, you can modify the verification results. For instance, if you use the option `Division round down (-div-round-down)`, the verification considers that quotients from division or modulus of negative numbers are rounded down. Use these options only if you use similar options when compiling your code.

  For all advanced options, see “Target and Compiler”.
- Compiler header files:

  If you specify the `diab`, `tasking` or `greenhills` compiler, you must specify the path to your compiler header files. See “Provide Standard Library Headers for Polyspace Analysis” on page 5-19.

If you still see compilation errors after running analysis, you might have to specify other options:

- *Define macros*: Sometimes, a compilation error occurs because the analysis considers a macro as undefined. Explicitly define these macros. See `Preprocessor definitions (-D)`.
- *Specify include files*: Sometimes, a compilation error occurs because your compiler defines standard library functions differently from Polyspace and you do not provide your compiler include files. Explicitly specify the path to your compiler include files. See “Provide Standard Library Headers for Polyspace Analysis” on page 5-19.

See Also

`C standard version (-c-version)` | `C++ standard version (-cpp-version)` | `Compiler (-compiler)` | `Preprocessor definitions (-D)` | `Source code language (-lang)` | `Target processor type (-target)`

More About

- “C/C++ Language Standard Used in Polyspace Analysis” on page 5-5
- “Provide Standard Library Headers for Polyspace Analysis” on page 5-19

C/C++ Language Standard Used in Polyspace Analysis

The Polyspace analysis adheres to a specific language standard for code compilation. The language standard, along with your compiler specification, defines the language elements that you can use in your code. For instance, if the Polyspace analysis uses the C99 standard, C11 features such as use of the thread support library from `threads.h` causes compilation errors.

Supported Language Standards

The Polyspace analysis supports these standards:

- **C**: C90, C99, C11

  The default standard depends on your compiler specification. If you do not specify a compiler explicitly, the default analysis uses the C99 standard. To change the language standard, use the option `C standard version (-c-version)`.
- **C++**: C++03, C++11, C++14

  The default standard depends on your compiler specification. If you do not specify a compiler explicitly, the default analysis uses the C++03 standard. To change the language standard, use the option `C++ standard version (-cpp-version)`.

Default Language Standard

The default language standard depends on your specification for the option `Compiler (-compiler)`.

Compiler	C Standard	C++ Standard
`generic`	C99	C++03
`gnu3.4`, `gnu4.6`, `gnu4.7`, `gnu4.8`, `gnu4.9`	C99	C++03
`gnu5.x`	C11	C++03
`gnu6.x`	C11	C++14
`gnu7.x`	C11	C++14
`gnu8.x`	C11	C++14
`clang3.x`	C99	C++03 The analysis accepts some C++11 extensions.
`clang4.x`	C99	C++03 The analysis accepts C++14 extensions.
`clang5.x`	C99	C++03 The analysis accepts C++14 extensions.

Compiler	C Standard	C++ Standard
visual9.0, visual10.0, visual11.0, visual12.0	C99	C++03
visual14.0	C99	C++14
visual15.x	C99	C++14
visual16.x	C99	C++14
keil	C99	C++03
iar	C99	C++03
armcc	C99	C++03
armclang	C11	C++03
codewarrior	C99	C++03
cosmic	C99	Not supported
diab	C99	C++03
greenhills	C99	C++03
iar-ew	C99	C++03
microchip	C99	Not supported
renesas	C99	C++03
tasking	C99	C++03
ti	C99	C++03

See Also

`C standard version (-c-version)` | `C++ standard version (-cpp-version)` | `Compiler (-compiler)`

More About

- “C11 Language Elements Supported in Polyspace” on page 5-7
- “C++11 Language Elements Supported in Polyspace” on page 5-9
- “C++14 Language Elements Supported in Polyspace” on page 5-12
- “C++17 Language Elements Supported in Polyspace” on page 5-15

C11 Language Elements Supported in Polyspace

This table provides a partial list of C language elements that have been introduced since C11 and the corresponding Polyspace support. If your code contains non-supported constructions, Polyspace reports a compilation error.

C11 Language Element	Supported
`alignas` and `alignof` convenience macros	Yes
`aligned_alloc` function	Yes
`noreturn` convenience macros	Yes
Generic selection	Yes
Thread support library (`threads.h`)	Yes
Atomic operations library (`stdatomic.h`)	Yes
Atomic types with `_Atomic`	Yes. If you use the Clang compiler, see limitations book for limitations on atomic data types. See “Limitations of Polyspace Verification” (Polyspace Code Prover).
UTF-16 and UTF-32 character utilities	Yes
Bound-checking interfaces or alternative versions of standard library functions that check for buffer overflows (Annex K of C11) For instance, `strcpy_s` is an alternative to `strcpy` that checks for certain errors in the string copy.	No. Polyspace checks for certain run-time errors in use of standard library functions. The checking does not extend to these alternatives.
Anonymous structures and unions	Yes
Static assert declaration	Yes
Features related to error handling such as `errno_t` and `rsize_t` `typedef`-s	No. If you see compilation errors from use of these `typedef`-s, explicitly specify the path to your compiler headers. See “Provide Standard Library Headers for Polyspace Analysis” on page 5-19.
`quick_exit` and `at_quick_exit`	Yes. In Bug Finder, functions registered with `at_quick_exit` appear as uncalled.
`CMPLX`, `CMPLXF` and `CMPLXL` macros	Yes

See Also

`C standard version (-c-version)`

More About

- “C/C++ Language Standard Used in Polyspace Analysis” on page 5-5

C++11 Language Elements Supported in Polyspace

This table provides a partial list of C++ language elements that have been introduced since C++11 and its corresponding Polyspace support. If your code contains nonsupported constructions, Polyspace reports a compilation error.

C++11 Std Ref	Description	Supported
C++2011-DR226	Default template arguments for function templates	Yes
C++2011-DR339	Solving the SFINAE problem for expressions	Yes
C++2011-N1610	Initialization of class objects by rvalues	Yes
C++2011-N1653	C99 preprocessor	Yes
C++2011-N1720	Static assertions	Yes
C++2011-N1737	Multi-declarator auto	Yes
C++2011-N1757	Right angle brackets	Yes
C++2011-N1791	Extended friend declarations	No
C++2011-N1811	long long	Yes
C++2011-N1984	auto-typed variables	Yes
C++2011-N1986	Delegating constructors	Yes
C++2011-N1987	Extern templates	Yes
C++2011-N1988	Extended integral types	Yes
C++2011-N2118	Rvalue references	Yes
C++2011-N2170	Universal character name literals	Yes
C++2011-N2179	Concurrency: Propagating exceptions	No
C++2011-N2235	Generalized constant expressions	Yes
C++2011-N2239	Concurrency: Sequence points	No new syntax/ keyword is introduced and therefore does not affect Polyspace support for C++11.
C++2011-N2242	Variadic templates	Yes
C++2011-N2249	New character types	Yes
C++2011-N2253	Extending sizeof	Yes
C++2011-N2258	Template aliases	Yes
C++2011-N2340	__func__ predefined identifier	Yes
C++2011-N2341	Alignment support	Yes
C++2011-N2342	Standard Layout Types	Yes
C++2011-N2343	Declared type of an expression	Yes
C++2011-N2346	Defaulted and deleted functions	Yes
C++2011-N2347	Strongly typed enums	Yes

C++11 Std Ref	Description	Supported
C++2011-N2427	Concurrency: Atomic operations	No
C++2011-N2429	Concurrency: Memory model	No new syntax/ keyword is introduced and therefore does not affect Polyspace support for C++11.
C++2011-N2431	Null pointer constant	Yes
C++2011-N2437	Explicit conversion operators	Yes
C++2011-N2439	Rvalue references for *this	Yes
C++2011-N2440	Concurrency: Abandoning a process and at_quick_exit	Yes
C++2011-N2442	Unicode string literals	Yes
C++2011-N2442	Raw string literals	Yes
C++2011-N2535	Inline namespaces	Yes
C++2011-N2540	Inheriting constructors	Yes
C++2011-N2541	New function declarator syntax	Yes
C++2011-N2544	Unrestricted unions	Yes
C++2011-N2546	Removal of auto as a storage-class specifier	Yes
C++2011-N2547	Concurrency: Allow atomics use in signal handlers	No
C++2011-N2555	Extending variadic template template parameters	Yes
C++2011-N2657	Local and unnamed types as template arguments	Yes
C++2011-N2659	Concurrency: Thread-local storage	No
C++2011-N2660	Concurrency: Dynamic initialization and destruction with concurrency	Yes
C++2011-N2664	Concurrency: Data-dependency ordering: atomics and memory model	No
C++2011-N2672	Initializer lists	Yes
C++2011-N2748	Concurrency: Strong Compare and Exchange	No
C++2011-N2752	Concurrency: Bidirectional Fences	No
C++2011-N2756	Nonstatic data member initializers	Yes
C++2011-N2761	Generalized attributes	Yes
C++2011-N2764	Forward declarations for enums	Yes
C++2011-N2765	User-defined literals	Yes
C++2011-N2927	New wording for C++0x lambdas	Yes
C++2011-N2928	Explicit virtual overrides	Yes
C++2011-N2930	Range-based for	Yes
C++2011-N3050	Allowing move constructors to throw [noexcept]	Yes
C++2011-N3053	Defining move special member functions	Yes

C++11 Std Ref	Description	Supported
C++2011-N3276	decltype and call expressions	Yes

See Also

`C++ standard version (-cpp-version)`

More About

- “C/C++ Language Standard Used in Polyspace Analysis” on page 5-5
- “C++14 Language Elements Supported in Polyspace” on page 5-12
- “C++17 Language Elements Supported in Polyspace” on page 5-15

C++14 Language Elements Supported in Polyspace

This table provides a partial list of C++ language elements that have been introduced since C++14 and its corresponding Polyspace support. If your code contains nonsupported constructions, Polyspace reports a compilation error.

C++14 Std Ref	Description	Supported
C++2014-N3323	Implicit conversion from class type in certain contexts such as `delete` or `switch` statement.	This C++14 feature allows implicit conversion from class type in certain contexts. No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.
C++2014-N3462	More SFINAE-friendly `std::result_of`	Yes
C++2014-N3472	Binary literals, for instance, `0b100`.	Yes
C++2014-N3545	`operator()` in `integral_constant` template of `constexpr` type	Yes
C++2014-N3637	Relation between `std::async` and destructor of `std::future`	No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.
C++2014-N3638	Automatic deduction of return type for functions where an explicit return type is not specified	Yes. In some cases, Code Prover can show compilation errors.
C++2014-N3642	Suffixes for user-defined literals indicating time (`h`, `min`, `s`, `ms`, `us`, `ns`) and strings (`s`)	Yes
C++2014-N3648	Initialization of captured members in lambda functions	Yes. In some cases, during initialization, Code Prover can call the corresponding constructors more number of times than necessary.
C++2014-N3649	Generic (polymorphic) lambda expressions: • Using `auto` type-specifier for parameter and return type • Conversion of generic capture-less lambda expressions to pointer-to-function.	Yes

C++14 Std Ref	Description	Supported
C++2014-N3651	Variable templates	Yes
C++2014-N3652	Declarations, conditions and loops in `constexpr` functions.	Yes

C++2014-N3653	Initialization of aggregate classes with fewer initializers than members
	
	For instance, this initialization has fewer initializers than members. The member `c` is initialized with the value 0 and `d` is initialized with the value `s`.
	
	`struct S {`
	`   int a;`
	`   const char* b;`
	`   int c;`
	`   int d = b[a];};`
	`S ss = { 1, "asdf" };`
		Yes

C++2014-N3654	`std::quoted`	Yes
C++2014-N3656	`std::make_unique`	Yes
C++2014-N3658	`std::integer_sequence`	Yes
C++2014-N3658	`std::shared_lock`	No. The use of `std::shared_lock` does not cause compilation errors but the construct is not semantically supported.
C++2014-N3664	Calling `new` and `delete` operators in batches.	This C++14 feature clarifies how successive calls to the `new` operator are implemented. No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.
C++2014-N3668	`std::exchange`	Partially supported.
C++2014-N3670	Using `std::get` with a data type to get one element in an `std::tuple` (provided there is only one element of the type in the tuple)	Yes
C++2014-N3671	Overloads for `std::equal`, `std::mismatch` and `std::is_permutation` function templates that accept two separate ranges	Yes
C++2014-N3733	Removal of `std::gets` from `<cstdio>`	Yes

C++14 Std Ref	**Description**	**Supported**
C++2014-N3776	Wording change for destructor of `std::future`	No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.
C++2014-N3779	`std::complex` literals representing pure imaginary numbers with suffix `i`, `if` or `il`	Yes
C++2014-N3781	Use of single quotation mark as digit separator, for instance, `1'000`.	Yes
C++2014-N3786	Prohibiting "out of thin air' results in C++14	No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.
C++2014-N3910	Synchronizing behavior of signal handlers	No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.
C++2014-N3924	Discouraging use of `rand()`	No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.
C++2014-N3927	Lock-free executions	No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++14.

See Also
`C++ standard version (-cpp-version)`

More About
- “C/C++ Language Standard Used in Polyspace Analysis” on page 5-5
- “C++11 Language Elements Supported in Polyspace” on page 5-9
- “C++17 Language Elements Supported in Polyspace” on page 5-15

C++17 Language Elements Supported in Polyspace

This table provides a partial list of C++ language elements that have been introduced since C++17 and its corresponding Polyspace support. If your code contains nonsupported constructions, Polyspace reports a compilation error.

C++17 Std Ref	Description	Supported
C++2017-N3921	`std::string-view`: Observe the content of an `std::string` object without owning the resource	Yes
C++2017-N3922	• When used in copy-list-initialization, `auto` deduces the type to be an `std::initializer_list` if the elements of the initializer list have an identical type. Otherwise, the `auto` deduction is ill-formed. • When using direct list-initialization with a braced initializer list containing a single element, `auto` deduces the type from that element. • When using direct list-initialization with a braced initializer list containing more than a single element, `auto` deduction of type is ill-formed.	Yes
C++2017-N3928	The `static_assert` declaration no longer requires a second argument. Invoking `static_assert` with no message is now allowed: `static_assert(N > 0);`	Yes
C++2017-N4051	C++ has templates that are not `class` templates, such as a template that takes templates as an argument. Previously, declaring such template-template parameters required the use of the `class` keyword. In C++17, you can use `typename` when declaring template-template parameters , such as: `template <template <typename> typename Tmpl> struct X;`	Yes
C++2017-N4086	Starting in C++17, trigraphs are no longer supported.	No

C++2017-N4230	Starting in C++17, use a qualified name in a namespace definition to define several nested namespaces at once. For instance, these code snippets are equivalent:
	• `namespace base::derived{`
	`//..`
	`}`
	• `namespace {`
	    `namespace derived{`
	        `//...`
	    `}`
	`}`
		Yes

C++17 Std Ref	Description	Supported
C++2017-N4259	The function `std::uncaught_exceptions` is introduced in C++17, which returns the number of exceptions in your code that are not handled. The function `std:uncaught_exception`, which returns a Boolean value, is deprecated.	Yes
C++2017-N4266	Starting in C++17, namespaces and enumerators can be annotated with attributes to allows clearer communication of developer intention.	Yes
C++2017-N4267	Starting in C++17, the prefix `u8` is supported. This prefix creates a UTF-8 character literal. The value of the UTF-8 character literal is equal to its ISO 10646 code point value if the code point value is in the C0 Controls and Basic Latin Unicode block.	Yes
C++2017-N4268	Allow constant evaluation of nontype template arguments.	Yes
C++2017-N4295	Allow fold expressions	Yes
C++2017-N4508	Allow untimed `std::shared_mutex`	The use of `std::shared_mutex` does not cause a compilation error. Polyspace does not support sharing mutex objects by using `std::shared_mutex`.
C++2017-P0001R1	Remove the use of the `register` keyword	Yes
C++2017-P0002R1	Remove `operator++(bool)`	Yes
C++2017-P0003R5	Remove deprecated exception specifications by using `throw(<>)`	Bug Finder removes the exception specification specified by using `throw()` statements. Code Prover raises a compilation error when `throw()` statements are present in C++17 code.
C++2017-P0012R1	Make exception specifications part of the type system	Yes
C++2017-P0017R1	Aggregate initialization of classes with base classes	Yes
C++2017-P0018R3	Allow capturing the pointer `*this` in Lambda expressions	Yes
C++2017-P0024R2	Standardization of the C++ technical specification for Extension for Parallelism	Polyspace supports this feature when you use the Visual 15.x and Intel C++ 18.0 compilers.

C++17 Std Ref	Description	Supported
C++2017-P002842	Using attribute namespaces without repetition	Yes
C++2017-P0035R4	Dynamic memory allocation for over-aligned data	Yes
C++2017-P0036R0	Unary fold expressions and empty parameter packs	Yes
C++2017-P0061R1	Use of `__has_include` in preprocessor conditionals	Yes
C++2017-P0067R5	Elementary string conversions	No
C++2017-P0083R3	Splicing maps and sets	Polyspace supports this feature when the compiler you use also supports this feature. For instance, Polyspace supports this feature when you use g++ as compiler.
C++2017-P0088R3	`std::variant`	Partially supported.
C++2017-P0091R3	Template argument deduction for class templates	Partially supported.
C++2017-P0127R2	Non-type template parameters that have auto type	Yes
C++2017-P0135R1	Guaranteed copy elision	Partially supported.
C++2017-P0136R1	New specification for inheriting constructors	No
C++2017-P0137R1	Replacement of class objects containing reference members	Yes
C++2017-P0138R2	Direct-list-initialization of enumerations	Yes
C++2017-P0145R3	Stricter expression evaluation order	No new syntax/keyword is introduced and therefore does not affect Polyspace support for C++17.
C++2017-P0154R1	Hardware interference size	Supported with Visual Studio Compiler
C++2017-P0170R1	`constexpr` Lambda expressions	Partially supported
C++2017-P018R0	Differing begin and end types in range-based `for` loops	Yes
C++2017-P0188R1	`[[fallthrough]]` attribute	Yes

C++17 Std Ref	Description	Supported
C++2017-P0189R1	`[[nodiscard]]` attribute	Yes
C++2017-P0195R2	Pack expansions in using-declarations	Yes
C++2017-P0212R1	`[[maybe_unused]]` attribute	Yes
C++2017-P0217R3	Structured Bindings	Polyspace does not support binding by using an rvalue.
C++2017-P0218R1	`std::filesystem`	No
C++2017-P0220R1	`std::any`	Yes
C++2017-P0220R1	`std::optional`	Bug Finder supports the syntax. The semantics are partially supported. Code Prover does not support this feature.
C++2017-P0226R1	Mathematical special functions	No
C++2017-P0245R1	Hexadecimal floating-point literals	Yes
C++2017-P0283R2	Ignore unknown attributes	Yes
C++2017-P0292R2	`constexpr` if statements	Yes
C++2017-P0298R3	`std::byte`	Yes
C++2017-P0305R1	init-statements for if and switch	Yes
C++2017-P0386R2	Inline variables	No
C++2017-P0522R0	Invoke partial ordering to determine when a template *template-argument* is a valid match for a *template-parameter*	Partially supported

See Also

`C++ standard version (-cpp-version)`

More About

- "C/C++ Language Standard Used in Polyspace Analysis" on page 5-5
- "C++11 Language Elements Supported in Polyspace" on page 5-9
- "C++14 Language Elements Supported in Polyspace" on page 5-12

Provide Standard Library Headers for Polyspace Analysis

Before Polyspace analyzes the code for bugs and run-time errors, it compiles your code. Even if the code compiles with your compiler, you can see compilation errors with Polyspace. If the error comes from a standard library function, it usually indicates that Polyspace is not using your compiler headers. To work around the errors, provide the path to your compiler headers.

This topic shows how to locate the standard library headers from your compiler. The code examples cause a compilation error that shows the location of the headers.

- To locate the folder containing your C compiler system headers, compile this C code by using your compilation toolchain:

  ```
  float fopen(float f);
  #include <stdio.h>
  ```

  The code does not compile because the `fopen` declaration conflicts with the declaration inside `stdio.h`. The compilation error shows the location of your compiler implementation of `stdio.h`. Your C standard library headers are all likely to be in that folder.
- To locate the folder containing your C++ compiler system headers, compile this C++ code by using your compilation toolchain:

  ```
  namespace std {
      float cin;
  }
  #include <iostream>
  ```

  The code does not compile because the `cin` declaration conflicts with the declaration inside `iostream.h`. The compilation error shows the location of your compiler implementation of `iostream.h`. Your C++ standard library headers are all likely to be in that folder.

After you locate the path to your compiler's header files, specify the path for the Polyspace analysis. For C++ code, specify the paths to both your C and C++ headers.

- In the user interface (Polyspace desktop products), add the folder to your project.

  For more information, see “Add Source Files for Analysis in Polyspace User Interface” (Polyspace Bug Finder).
- At the command line, use the flag `-I` with the `polyspace-bug-finder`, `polyspace-code-prover`, `polyspace-bug-finder-server` or `polyspace-code-prover-server` command..

  For more information, see `-I`.

See Also

More About

- “Errors from Conflicts with Polyspace Header Files” on page 11-35

Requirements for Project Creation from Build Systems

For automatic project creation from build systems, your build commands or makefiles must meet certain requirements.

Compiler Requirements

- Your compiler must be called locally.

  If you use a compiler cache such as `ccache` or a distributed build system such as `distmake`, the software cannot trace your build. You must deactivate them.
- Your compiler must perform a clean build.

  If your compiler performs only an incremental build, use appropriate options to build all your source files. For example, if you use `gmake`, append the `-B` or `-W` *`makefileName`* option to force a clean build. For the list of options allowed with the GNU® `make`, see make options.
- Your compiler configuration must be available to Polyspace. The compilers currently supported include the following:

  - arm Keil
  - Clang
  - Wind River® Diab
  - GNU C/C++
  - IAR Embedded Workbench
  - Green Hills®
  - NXP CodeWarrior®
  - Renesas®
  - Altium® Tasking
  - Texas Instruments™
  - tcc - Tiny C Compiler
  - Microsoft Visual C++®

  If your compiler configuration is not available to Polyspace:

  - Write a compiler configuration file for your compiler in a specific format. For more information, see “Compiler Not Supported for Project Creation from Build Systems” on page 11-7.
  - Contact MathWorks Technical Support. For more information, see “Contact Technical Support About Issues with Running Polyspace” on page 11-4.
- If you build your code in Cygwin™, you must be using version 2.x or 3.x of Cygwin for Polyspace project creation from your build system (for instance, Cygwin version 2.10 or 3.0).
- With the TASKING compiler, if you use an alternative sfr file with extension `.asfr`, Polyspace might not be able to locate your file. If you encounter an error, explicitly `#include` your `.asfr` file in the preprocessed code using the option `Include (-include)`.

  Typically, you use the statement `#include __SFRFILE__(__CPU__)` along with the compiler option `--alternative-sfr-file` to specify an alternative sfr file. The path to the file is typically *`Tasking_C166_INSTALL_DIR`*`\include\sfr\reg`*`CPUNAME`*`.asfr`. For instance, if your

TASKING compiler is installed in `C:\Program Files\Tasking\C166-VX_v4.0r1\` and you use the CPU-related flag `-Cxc2287m_104f` or `--cpu=xc2287m_104f`, the path is `C:\Program Files\Tasking\C166-VX_v4.0r1\include\sfr\regxc2287m.asfr`.

Build Command Requirements

- Your build command must run to completion without any user interaction.
- In Linux, only UNIX shell (sh) commands must be used. If your build uses advanced commands such as commands supported only by bash, tcsh or zsh, Polyspace cannot trace your build.

  In Windows, only DOS commands must be used. If your build uses advanced commands such as commands supported only by PowerShell or Cygwin, Polyspace cannot trace your build. To see if Polyspace supports your build command, run the command from `cmd.exe` in Windows. For more information, see “Check if Polyspace Supports Build Scripts” on page 11-14.
- If you use statically linked libraries, Polyspace cannot trace your build. In Linux, you can install the full Linux Standard Base (LSB) package to allow dynamic linking. For example, on Debian® systems, install LSB with the command `apt-get install lsb`.
- Your build command must not use aliases.

  The `alias` command is used in Linux to create an alternate name for commands. If your build command uses those alternate names, Polyspace cannot recognize them.
- Your build process must not use the `LD_PRELOAD` mechanism.
- Your build command must be executable completely on the current machine and must not require privileges of another user.

  If your build uses `sudo` to change user privileges or `ssh` to remotely log in to another machine, Polyspace cannot trace your build.
- If your build command uses redirection with the `>` or `|` character, the redirection occurs after Polyspace traces the command. Therefore, Polyspace does not handle the redirection.

  For example, if your command occurs as

  ```
  command1 | command2
  ```

  And you enter

  ```
  polyspace-configure command1 | command2
  ```

  When tracing the build, Polyspace traces the first command only.
- If the System Integrity Protection (SIP) feature is active on the operating system macOS El Capitan (10.11) or a later macOS version, Polyspace cannot trace your build command. Before tracing your build command, disable the SIP feature. You can reenable this feature after tracing the build command.

  Similar considerations apply to other security applications such as security-related products from CylanceProtect, Avecto and Tanium.
- If your computer hibernates during the build process, Polyspace might not be able to trace your build.
- When creating projects from build commands in the Polyspace User Interface, you might encounter errors such as `libcurl.so.4: version 'CURL_OPENSSL_3' not found`. In such

cases, create the Polyspace project by using the command `polyspace-configure` in the system command line interface, using the build command as the argument. See `polyspace-configure`.

Note Your environment variables are preserved when Polyspace traces your build command.

See Also

`polyspace-configure`

Related Examples

- "Create Polyspace Analysis Configuration from Build Command" on page 2-2

Supported Keil or IAR Language Extensions

Polyspace analysis can interpret a subset of common C/C++ language constructs and extended keywords by default. For compiler-specific keywords, you must specify your choice of compiler. If you specify `keil` or `iar` for `Compiler (-compiler)`, the Polyspace verification allows language extensions specific to the Keil or IAR compilers.

Special Function Register Data Type

Embedded control applications frequently read and write port data, set timer registers, and read input captures. To deal with these requirements without using assembly language, some microprocessor compilers define special data types such as `sfr` and `sbit`. Typical declarations are:

```
sfr A0 = 0x80;
sfr A1 = 0x81;
sfr ADCUP = 0xDE;
sbit EI = 0x80;
```

The declarations reside in header files such as `regxx.h` for the basic `80Cxxx` micro processor. The declarations customize the compiler to the target processor.

You access a register or a port by using the `sfr` and `sbit` data as follows. However, these data types are not part of the C99 Standard.

```
int status,P0;

void main (void) {
  ADCUP = 0x08; /* Write data to register */
  A1 = 0xFF; /* Write data to Port */
  status = P0; /* Read data from Port */
  EI = 1; /* Set a bit (enable all interrupts) */
}
```

To analyze this type of code, use these options:

- `Compiler (-compiler)`: Specify `keil` or `iar`.
- `Sfr type support (-sfr-types)`: Specify the data type and size in bits.

For example, depending on how you define the `sbit` data type, you use these options:

- `sbit ADST = ADCUP^7;`

  Use options: `-compiler keil -sfr-type sfr=8`
- `sbit ADST = ADCUP.7;`

  Use options: `-compiler iar -sfr-type sfr=8`

The analysis then supports the Keil or IAR language extensions even if some structures, keywords, and syntax are not part of the C99 standard.

Keywords Removed During Preprocessing

Once you specify the Keil or IAR compiler, the analysis recognizes compiler-specific keywords in your code. If a keyword is not relevant for the analysis, it is removed from the source code during preprocessing.

If you disable the keyword and use it as an identifier instead, you can encounter a compilation error when you compile your code with Polyspace. See “Errors Related to Keil or IAR Compiler” on page 11-28.

These keywords are removed during preprocessing:

- Keil: `bdata`, `far`, `idata`, `huge`, `sdata`
- IAR: `saddr`, `reentrant`, `reentrant_idata`, `non_banked`, `plm`, `bdata`, `idata`, `pdata`, `code`, `xdata`, `xhuge`, `interrupt`, `__interrupt`, `__intrinsic`

  The `data` keyword is not removed.

Remove or Replace Keywords Before Compilation

The Polyspace compiler strictly follows the ANSI® C99 Standard (ISO/IEC 9899:1999). If your compiler allows deviation from the Standard, the Polyspace compilation using default options cannot emulate your compiler. For instance, your compiler can allow certain non-ANSI keyword, which Polyspace does not recognize by default.

To emulate your compiler closely, you specify the "Target and Compiler" options. If you still get compilation errors from unrecognized keywords, you can remove or replace them only for the purposes of verification. The option `Preprocessor definitions (-D)` allows you to make simple substitutions. For complex substitutions, for instance to remove a group of space-separated keywords such as a function attribute, use the option `Command/script to apply to preprocessed files (-post-preprocessing-command)`.

Remove Unrecognized Keywords

You can remove unsupported keywords from your code for the purposes of analysis. For instance, follow these steps to remove the `far` and `0x` keyword from your code (`0x` precedes an absolute address).

1 Save the following template as `C:\Polyspace\myTpl.pl`.

Content of myTpl.pl

```
#!/usr/bin/perl

##############################################################
# Post Processing template script
#
##############################################################
# Usage from GUI:
#
# 1) Linux: /usr/bin/perl PostProcessingTemplate.pl
# 2) Windows: polyspaceroot\sys\perl\win32\bin\perl.exe <pathtoscript>\
# PostProcessingTemplate.pl
#
##############################################################

$version = 0.1;

$INFILE = STDIN;
$OUTFILE = STDOUT;

while (<$INFILE>)
{

    # Remove far keyword
    s/far//;

    # Remove "@ 0xFE1" address constructs
    s/\@\s0x[A-F0-9]*//g;

    # Remove "@0xFE1" address constructs
    s/\@0x[A-F0-9]*//g;

    # Remove "@ ((unsigned)&LATD*8)+2" type constructs
    s/\@\s\(\(unsigned\)\&[A-Z0-9]+\*8\)\+\d//g;

    # DON'T DELETE LINE BELOW: Print the current processed line
    print $OUTFILE $_;
}
```

For reference, see a summary of Perl regular expressions.

Perl Regular Expressions

```
#########################################################
# Metacharacter What it matches
```

```
#########################################################
# Single Characters
# . Any character except newline
# [a-z0-9] Any single character in the set
# [^a-z0-9] Any character not in set
# \d A digit same as
# \D A non digit same as [^0-9]
# \w An Alphanumeric (word) character
# \W Non Alphanumeric (non-word) character
#
# Whitespace Characters
# \s Whitespace character
# \S Non-whitespace character
# \n newline
# \r return
# \t tab
# \f formfeed
# \b backspace
#
# Anchored Characters
# \B word boundary when no inside []
# \B non-word boundary
# ^ Matches to beginning of line
# $ Matches to end of line
#
# Repeated Characters
# x? 0 or 1 occurrence of x
# x* 0 or more x's
# x+ 1 or more x's
# x{m,n} Matches at least m x's and no more than n x's
# abc All of abc respectively
# to|be|great One of "to", "be" or "great"
#
# Remembered Characters
# (string) Used for back referencing see below
# \1 or $1 First set of parentheses
# \2 or $2 First second of parentheses
# \3 or $3 First third of parentheses
##########################################################
# Back referencing
#
# e.g. swap first two words around on a line
# red cat -> cat red
# s/(\w+) (\w+)/$2 $1/;
#
##########################################################
```

2. On the **Configuration** pane, select **Environment Settings**.
3. To the right of **Command/script to apply to preprocessed files**, click 📁.
4. Use the Open File dialog box to navigate to `C:\Polyspace`.
5. In the **File name** field, enter `myTpl.pl`.
6. Click **Open**. You see `C:\Polyspace\myTpl.pl` in the **Command/script to apply to preprocessed files** field.

Remove Unrecognized Function Attributes

You can remove unsupported function attributes from your code for the purposes of analysis.

If you run verification on this code specifying a generic compiler, you can see compilation errors from the `noreturn` attribute. The code compiles using a GNU compiler.

```
void fatal () __attribute__ ((noreturn));

void fatal (/* ... */)
{
    /* ... */ /* Print error message. */ /* ... */
    exit (1);
}
```

If the software does not recognize an attribute and the attribute does not affect the code analysis, you can remove it from your code for the purposes of verification. For instance, you can use this Perl script to remove the `noreturn` attribute.

```
while ($line = <STDIN>)
{

# __attribute__ ((noreturn))

  # Remove far keyword
  $line =~ s/__attribute__\ \(\(noreturn\)\)//g;

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

Specify the script using the option `Command/script to apply to preprocessed files (-post-preprocessing-command)`.

See Also

Polyspace Analysis Options
`Command/script to apply to preprocessed files (-post-preprocessing-command)` | `Preprocessor definitions (-D)`

Related Examples

- "Troubleshoot Compilation Errors"

Gather Compilation Options Efficiently

Polyspace verification can sometimes stop in the compilation or linking phase due to the following reasons:

- The Polyspace compiler strictly follows a C or C++ Standard (depending on your choice of compiler). See “C/C++ Language Standard Used in Polyspace Analysis” on page 5-5. If your compiler allows deviation from the Standard, the Polyspace compilation using default options cannot emulate your compiler.
- Your compiler declares standard library functions with argument or return types different from the standard types. Unless you also provide the function definition, for efficient verification, Polyspace uses its own definitions of standard library functions, which have the usual prototype. The mismatch in types causes a linking error.

You can easily work around the compilation and standard library function errors. To work around the errors, you typically specify certain analysis options. In some cases, you might have to add a few lines to your code. For instance:

- To emulate your compiler behavior more closely, you specify the “Target and Compiler” options. If you still face compilation errors, you might have to remove or replace certain unrecognized keywords using the option `Preprocessor definitions (-D)`. However, the option allows only simple substitution of a string with another string. For more complex replacements, you might have to add `#define` statements to your code.
- To avoid errors from stubbing standard library functions, you might have to `#define` certain Polyspace-specific macros so that Polyspace does not use its own definition of standard library functions.

Instead of adding these modifications to your original code, create a single `polyspace.h` file that contains all modifications. Use the option `Include (-include)` to force inclusion of the `polyspace.h` file in all source files under verification.

Benefits of this approach include:

- The error detection is much faster since it will be detected during compilation rather than in the link or subsequent phases.
- There will be no need to modify original source files.
- The file is automatically included as the very first file in the original `.c` files.
- The file is reusable for other projects developed under the same environment.

Example 5.1. Example

This is an example of a file that can be used with the option `Include (-include)`.

```
// The file may include (say) a standard include file implicitly
// included by the cross compiler

#include <stdlib.h>
#include "another_file.h"

// Workarounds for compilation errors
#define far
#define at(x)
```

```
// Workarounds for errors due to redefining standard library functions

#define POLYSPACE_NO_STANDARD_STUBS    // use this flag to prevent the
           //automatic stubbing of std functions
#define __polyspace_no_sscanf
#define __polyspace_no_fgetc
void sscanf(int, char, char, char, char, char);
void fgetc(void);
```

See Also

More About

- "Troubleshoot Compilation Errors"

Configure Inputs and Stubbing Options

Specify External Constraints

This example shows how to specify constraints (also known as data range specifications or DRS) on variables in your code. Polyspace uses the code that you provide to make assumptions about items such as variable ranges and allowed buffer size for pointers. Sometimes the assumptions are broader than what you expect because:

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

Because of these broad assumptions:

- Code Prover can consider more execution paths than those paths that occur at run time. If an operation fails along one of the execution paths, Polyspace places an orange check on the operation. If that execution path comes from an assumption that is too broad, the orange check might indicate a false positive.
- Bug Finder can sometimes produce false positives.

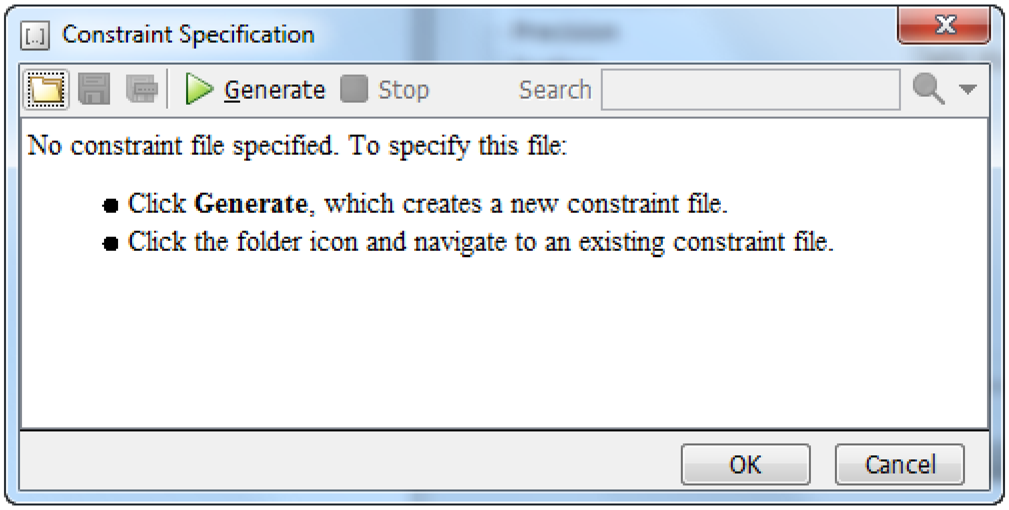
To reduce the number of such false positives, you can specify additional constraints on global variables, function inputs, and return values and modifiable arguments of stubbed functions. You save the constraints as an XML file to use them for subsequent analyses. If your source code changes, you can update the previous constraints. You do not have to create a new constraint template.

Note In Bug Finder, you can only constrain global variables. You cannot constrain function inputs or return values of stubbed functions.

Create Constraint Template

User Interface (Desktop Products Only)

1. Open the project configuration. On the **Configuration** pane, select **Inputs & Stubbing**.
2. To the right of **Constraint setup**, click the **Edit** button to open the **Constraint Specification** window.



No constraint file specified. To specify this file:

- Click **Generate**, which creates a new constraint file.
- Click the folder icon and navigate to an existing constraint file.

3 In the Constraint Specification dialog box, create a blank constraint template. The template contains a list of all variables on which you can provide constraints. To create a new template, click Generate. The software compiles your project and creates a template. The new template is stored in a file `*Module_number_Project_name*_drs_template.xml` in your project folder.

4 Specify your constraints and save the template as an XML file. For more information, see "External Constraints for Polyspace Analysis" on page 6-7.

5 Click **OK**.

You see the full path to the template XML file in the **Constraint setup** field. If you run an analysis, Polyspace uses this template for extracting variable constraints.

Command Line

Use the option `Constraint setup (-data-range-specifications)` to specify the constraints XML file.

To specify constraints in the XML file:

1 First, create a blank XML template. The template lists all global variables, function inputs and modifiable arguments and return values of stubbed functions without specifying any constraints on them.

To create a blank template, run an analysis only up to the compilation phase. In Bug Finder, disable checking of defects. Use the option `Find defects (-checkers)`. In Code Prover, check for source compliance only. Use the argument `compile` for the option `Verification level (-to)`. After the analysis, a blank template XML `drs-template.xml` is created in the results folder.

For C++ projects, to create a blank constraints template, you have to use the argument `cpp-normalize` for the option `Verification level (-to)`.

2 Edit the XML file to specify your constraints.

For examples, see:

- “Constrain Global Variable Range” (Polyspace Code Prover Server)
- “Constrain Function Inputs” (Polyspace Code Prover Server)

Create Constraint Template from Code Prover Analysis Results

You can constrain variable ranges based on their expected range in real-world applications. For instance, if a variable represents vehicle speed, you can set a maximum possible value. You can also constrain variable ranges only if they cause too many orange checks from overapproximation.

A Code Prover analysis shows all global variables, function inputs and stubbed functions that lead to orange checks from possible overapproximation. You can constrain only these variables for a more precise analysis.

1. Open Code Prover results in the Polyspace user interface or Polyspace Access web interface.
2. Open the **Orange Sources** pane. Do one of the following:

   - Select an orange check. If the software can trace an orange check to a root cause, a ? icon appears on the **Result Details** pane. Click this icon to open the **Orange Sources** pane.
   - In the Polyspace user interface, select **Window** > **Show/Hide View** > **Orange Sources**. In the Polyspace Access web interface, select **Layout** > **Show/Hide View** > **Orange Sources**.

   You see the full list of variables (function inputs or return values of stubbed functions) that can cause orange checks. Constrain the ranges of these variables.

In the details for individual orange checks, you often see a message similar to this:

```
If appropriate, applying DRS to stubbed function random_float in example.c
line 44 may remove this orange.
```

The message is an indication that the stubbed function is a possible source of the orange check. You can apply external constraints on the function to enforce more precise assumptions and possibly remove the orange check (in case it came from the broader assumptions).

Update Existing Template

With new code submissions, you might have to specify additional constraints. You can update an existing template to add global variables, function inputs and stubbed functions that come from the new code submissions.

Additionally, if you remove some variables or functions from your code, constraints on them are not applicable any more. Instead of regenerating a constraint template and respecifying the constraints, you can update an existing template and remove the variables that are not present in your code.

User Interface (Desktop Products Only)

1. On the **Configuration** pane, select **Inputs & Stubbing**.

2 Open the existing template in one of the following ways:

   - In the **Constraint setup** field, enter the path to the template XML file. Click **Edit**.
   - Click **Edit**. In the Constraint Specification dialog box, click the icon to navigate to your template file.

3 Click **Update**.

   a Variables that are no longer present in your source code appear under the **Non Applicable** node. To remove an entry under the **Non Applicable** node or the node itself, right-click and select **Remove This Node**.

   b Specify your new constraints for any of the other variables.

Command Line

In a continuous integration workflow, you can use the constraints XML file from the previous run. If new code submissions require additional constraints:

1 Specify constraints on variables from new code submissions in a constraints XML file. See Create Constraint Template: Command Line on page 6-3.

2 Merge the constraints XML file with the new constraints and the constraints XML file from the previous run.

Specify Constraints in Code

Specifying constraints outside your code allows for more precise analysis. However, you must use the code within the specified constraints because the constraints are *outside* your code. Otherwise, the results might not apply. For example, if you use function inputs outside your specified range, a run-time error can occur on an operation even though checks on the operation are green.

To specify constraints *inside* your code, you can use:

- Appropriate error handling tests in your code.

  Polyspace checks to determine if the errors can actually occur. If they do not occur, the test blocks appear as **Unreachable code**.
- The `assert` macro. For example, to constrain a variable `var` in the range [0,10], you can use `assert(var >= 0 && var <=10);`.

  Polyspace checks your `assert` statements to see if the condition can be false. Following the `assert` statement, Polyspace considers that the `assert` condition is true. Using `assert` statements, you can constrain your variables for the remaining code in the same scope. For examples, see `Assertion` (Polyspace Bug Finder).

See Also

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

Related Examples

- “External Constraints for Polyspace Analysis” on page 6-7
- “Constrain Global Variable Range” (Polyspace Code Prover Server)
- “Constrain Function Inputs” (Polyspace Code Prover Server)
- “XML File Format for Constraints” on page 6-19

External Constraints for Polyspace Analysis

For a more precise analysis with Polyspace, you can specify external constraints on:

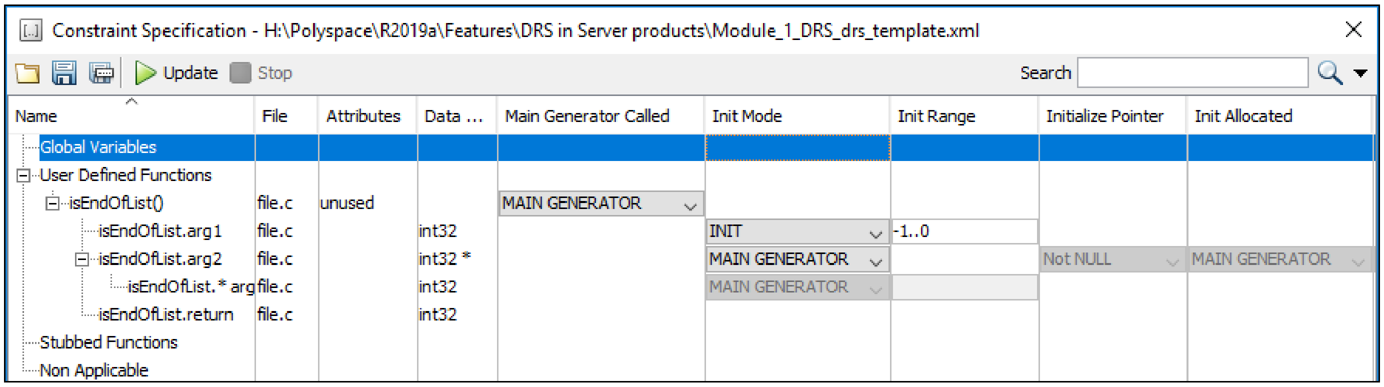
- Global Variables.
- User-defined Functions.

  Constraints on user-defined functions do not apply to a Bug Finder analysis.
- Stubbed Functions.

  Constraints on stubbed functions do not apply to a Bug Finder analysis.

For more information, see "Specify External Constraints" on page 6-2. For a partial list of limitations, see "Constraint Specification Limitations" on page 6-11.

In the user interface of the Polyspace desktop products, you can specify the constraints through a **Constraint Specification** window. The constraints are saved in an XML file that you can reuse for other projects.



Constraint Specification - H:\Polyspace\R2019a\Features\DRS in Server products\Module_1_DRS_drs_template.xml

Name	File	Attributes	Data ...	Main Generator Called	Init Mode	Init Range	Initialize Pointer	Init Allocated
Global Variables								
User Defined Functions								
isEndOfList()	file.c	unused		MAIN GENERATOR				
isEndOfList.arg1	file.c		int32		INIT	-1..0		
isEndOfList.arg2	file.c		int32 *		MAIN GENERATOR		Not NULL	MAIN GENERATOR
isEndOfList.* arg	file.c		int32		MAIN GENERATOR			
isEndOfList.return	file.c		int32					
Stubbed Functions								
Non Applicable								

This table explains the various columns in the **Constraint Specification** window. If you directly edit the constraint XML file to specify a constraint (for instance, in the Polyspace Server products), this table also shows the correspondence between columns in the user interface and entries in the XML file. The XML entry highlighted in bold appears in the corresponding column of the **Constraint Specification** window.

Column	Settings
Name	Displays the list of variables and functions in your Project for which you can specify data ranges. This Column displays three expandable menu items: • **Globals** – Displays global variables in the project. • **User defined functions** – Displays user-defined functions in the project. Expand a function name to see its inputs. • **Stubbed functions** – Displays a list of stub functions in the project. Expand a function name to see the inputs and return values.

	XML File Entry:
	
	`<function name = "`**`funcName`**`" ...>`
	
	`<scalar name = "`**`arg1`**`" ...>`
	
	`<pointer name = "`**`arg2`**`" ...>`

File	Displays the name of the source file containing the variable or function.
	XML File Entry: `<file name = "`**`C:\Project1\Sources\file.c`**`" ...>`
Attributes	Displays information about the variable or function. For example, static variables display `static`. Uncalled functions display `unused`.
	XML File Entry: `<function name="funcName" attributes="`**`unused`**`" ...>`
Data Type	Displays the variable type.
	XML File Entry: `<scalar name="arg1" complete_type="`**`int32`**`" ...>`
Main Generator Called	Applicable only for user-defined functions. Specifies whether the main generator calls the function: • **`MAIN GENERATOR`** – Main generator may call this function, depending on the value of the `-functions-called-in-loop` (C) or `-main-generator-calls` (C++) parameter. • **`NO`** – Main generator will not call this function. • **`YES`** – Main generator will call this function.
	XML File Entry: `<function name="funcName" main_generator_called="`**`MAIN_GENERATOR`**`" ...>`

Column	Settings
Init Mode	Specifies how the software assigns a range to the variable: • **`MAIN GENERATOR`** – Variable range is assigned depending on the settings of the main generator options `-main-generator-writes-variables` and `-no-def-init-glob`. • **`IGNORE`** – Variable is not assigned to any range, even if a range is specified. • **`INIT`** – Variable is assigned to the specified range only at initialization, and keeps the range until first write. • **`PERMANENT`** – Variable is permanently assigned to the specified range. If the variable is assigned outside this range during the program, no warning is provided. Use the `globalassert` mode if you need a warning. User-defined functions support only `INIT` mode. Stub functions support only `PERMANENT` mode. For C verifications, global pointers support `MAIN GENERATOR`, `IGNORE`, or `INIT` mode. • **`MAIN GENERATOR`** – Pointer follows the options of the main generator. • **`IGNORE`** – Pointer is not initialized • **`INIT`** – Specify if the pointer is NULL, and how the pointed object is allocated (**Initialize Pointer** and **Init Allocated** options).
	XML File Entry: `<scalar name="arg1" init_mode="`**`INIT`**`" ...>`

Init Range	Specifies the minimum and maximum values for the variable.
	
	You can use the keywords `min` and `max` to denote the minimum and maximum values of the variable type. For example, for the type long, `min` and `max` correspond to -2^31 and 2^31-1 respectively.
	
	You can also use hexadecimal values. For example: `0x12..0x100`
	
	For `enum` variables, you cannot specify ranges directly using the enumerator constants. Instead use the values represented by the constants.
	
	For `enum` variables, you can also use the keywords `enum_min` and `enum_max` to denote the minimum and maximum values that the variable can take. For example, for an `enum` variable of the type defined below, `enum_min` is 0 and `enum_max` is 5:
	
	`enum week{ sunday, monday=0, tuesday,`
	`     wednesday, thursday, friday, saturday};`

	XML File Entry: `<scalar name="arg1" init_range="`**`-1..0`**`"...>`

Column	Settings
Initialize Pointer	Applicable only to pointers. Enabled only when you specify **Init Mode**:`INIT`. Specifies whether the pointer should be NULL: • **`May-be NULL`** – The pointer could potentially be a NULL pointer (or not). • **`Not Null`** – The pointer is never initialized as a null pointer. • **`Null`** – The pointer is initialized as NULL. **Note** Not applicable for C++ projects. See “Constraint Specification Limitations” on page 6-11. **XML File Entry**: `<pointer name="arg1" initialize_pointer="`**`Not NULL`**`"...>`
Init Allocated	Applicable only to pointers. Enabled only when you specify **Init Mode**:`INIT`. Specifies how the pointed object is allocated: • **`MAIN GENERATOR`** – The pointed object is allocated by the main generator. • **`None`** – Pointed object is not written. • **`SINGLE`** – Write the pointed object or the first element of an array. (This setting is useful for stubbed function parameters.) • **`MULTI`** – All objects (or array elements) are initialized. **Note** Not applicable for C++ projects. See “Constraint Specification Limitations” on page 6-11. **XML File Entry**: `<pointer name="arg1" init_pointed="`**`MAIN_GENERATOR`**`"...>`

Column	Settings

# Allocated Objects	Applicable only to pointers. 	
	
	Specifies how many objects are pointed to by the pointer (the pointed object is considered as an array).
	
	The **Init Allocated** parameter specifies how many allocated objects are actually initialized. For instance, consider this code:
	
	`void func(int *ptr) {`
	`    assert(ptr[0]==1);`
	`    assert(ptr[1]==1);`
	`}`
	
	If you specify these constraints:
	• `ptr` has **Init Allocated** set to `MULTI` and **# Allocated Objects** set to 2,
	• `*ptr` has **Init Range** set to `1..1`,
	
	both assertions are green. However, if you specify these constraints:
	• `ptr` has **Init Allocated** set to `SINGLE`
	• `*ptr` has **Init Range** set to `1..1`,
	
	the second assertion is orange. Only the first object that `ptr` points to initialized to 1. Objects beyond the first can be potentially full range.
	
	Note Not applicable for C++ projects. See “Constraint Specification Limitations” on page 6-11.

	XML File Entry: `<pointer name="arg1" number_allocated="10"...>`
Global Assert	Specifies whether to perform an assert check on the variable at global initialization, and after each assignment.
	XML File Entry: `<scalar name="glob" global_assert="YES"...>`
Global Assert Range	Specifies the minimum and maximum values for the range you want to check.
	XML File Entry: `<scalar name="glob" assert_range="0..200"...>`
Comment	Remarks that you enter, for example, justification for your DRS values.
	XML File Entry: `<scalar name="glob" comment="Speed Range"...>`

Constraint Specification Limitations

You cannot specify these constraints:

- *C++ Pointers cannot be constrained*:

  In C++, you cannot constrain pointer arguments of functions. Functions that have pointer arguments only do not appear in the constraint specification interface.

  Because of polymorphism, a C++ pointer can point to objects of multiple classes in a class hierarchy and can require invoking different constructors. The pre-analysis for constraint specification cannot determine which object type to constrain or which constructor to call.
- *Constraints cannot be relations*:

  You cannot specify a constraint that relates the return value of a function to its inputs. You can only specify a constant range for the constraints.
- *Multiple ranges not possible*:

  You cannot specify multiple ranges for a constraint. For instance, you cannot specify that a function argument has either the value -1 or a value in the range [1,100]. Instead, specify the range [-1,100] or perform two separate analyses, once with the value -1 and once with the range [1,100].

See Also

More About

- "Specify External Constraints" on page 6-2

Constrain Global Variable Range

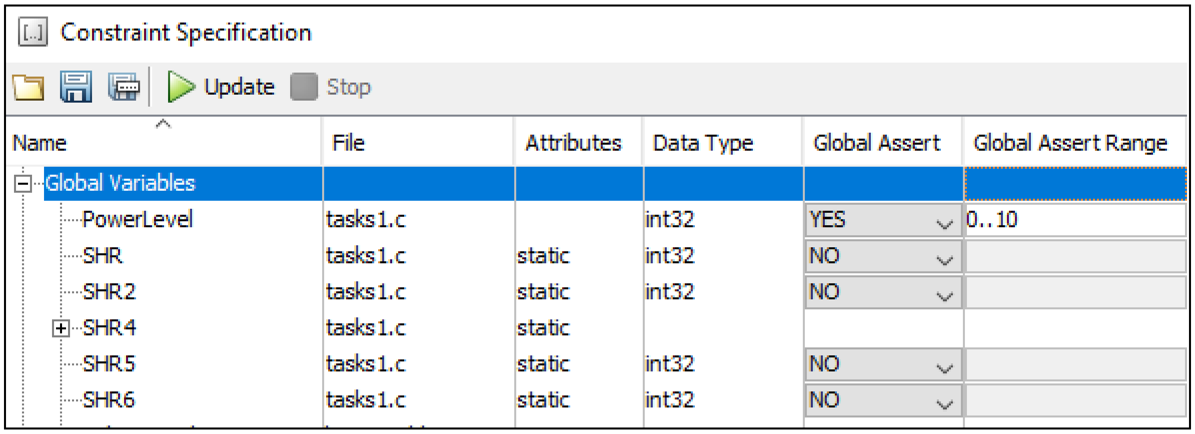
You can impose constraints (also known as data range specifications or DRS) on the range of a global variable and check with Code Prover whether write operations on the variable violate the constraint. For the general workflow, see “Specify External Constraints” on page 6-2.

User Interface (Desktop Products Only)

To constrain a global variable range and also check for violation of the constraint:

1. In your project configuration, select **Inputs & Stubbing**. Click the Edit button next to the **Constraint setup** field.
2. In the Constraint Specification window, click Generate.

   Under the **Global Variables** node, you see a list of global variables.



Name	File	Attributes	Data Type	Global Assert	Global Assert Range
Global Variables					
PowerLevel	tasks1.c		int32	YES	0..10
SHR	tasks1.c	static	int32	NO	
SHR2	tasks1.c	static	int32	NO	
SHR4	tasks1.c	static			
SHR5	tasks1.c	static	int32	NO	
SHR6	tasks1.c	static	int32	NO	

3. For the global variable that you want to constrain:

   - From the drop-down list in the **Global Assert** column, select `YES`.
   - In the **Global Assert Range** column, enter the range in the format `*min*..*max*`. `*min*` is the minimum value and `*max*` the maximum value for the global variable.
4. To save your specifications, click the button.

   In **Save a Constraint File** window, save your entries as an `xml` file.
5. Run a verification and open the results.

   For every write operation on the global variable, you see a green, orange, or red **Correctness condition** check. If the check is:

- Green, the variable is within the range that you specified.
- Orange, the variable can be outside the range that you specified.
- Red, the variable is outside the range that you specified.

When two or more tasks write to the same global variable, the **Correctness condition** check can appear orange on all write operations to the variable even when only one write operation takes the variable outside the **Global Assert** range.

Command Line

Use the option `Constraint setup (-data-range-specifications)` with an XML file specifying your constraint.

For instance, for an analysis with Polyspace Code Prover Server, specify the option as follows:

```
polyspace-code-prover-server -sources filename
         -data-range-specifications "C:\Polyspace\drs_project1.xml"
```

Create a blank constraint XML template as described in “Specify External Constraints” on page 6-2. In the XML file, locate and constrain the global variables. XML tags for global variables appear directly within the `file` tag without an enclosing `function` tag. For instance, in this constraint XML, `PowerLevel` and `SHR` are global variables:

```
<file name="\\\\home\\Polyspace_Workspace\\Examples\\Code_Prover_Example
                                                     \\sources\\tasks1.c">
   <scalar name="PowerLevel" line="26" .. global_assert="YES" assert_range="0..10"/>
   <scalar name="SHR" line="30" ... global_assert="NO" assert_range="" />
   <function name="Tserver" line="73" .../>
   <function name="initregulate" line="47" .../>
   <function name="orderregulate" line="35" ...>
     <scalar name="return" ... global_assert="unsupported" assert_range="unsupported" />
   </function>
   <function name="proc1" line="101" .../>
</file>
```

To specify a constraint on a global variable and check during a Code Prover analysis if the constraint is violated:

1. Set the `global_assert` attribute of the variable's `scalar` tag to `YES`.
2. Set the `assert_range` attribute to a range in the form *`min..max`*, for instance, `0..10`.

In the preceding example, the variable `PowerLevel` is constrained this way.

See Also

Polyspace Analysis Options
`Constraint setup (-data-range-specifications)`

Polyspace Results
`Correctness condition`

More About

- “Specify External Constraints” on page 6-2
- “External Constraints for Polyspace Analysis” on page 6-7
- “Constrain Function Inputs” (Polyspace Code Prover Server)

Constrain Function Inputs

For a more precise Code Prover analysis, you can specify constraints (also known as data range specifications or DRS) on function inputs. Code Prover checks your function definition for run-time errors with respect to the constrained inputs. For the general workflow, see “Specify External Constraints” on page 6-2.

For instance, for a function defined as follows, you can specify that the argument `val` has values in the range `[1..10]`. You can also specify that the argument `ptr` points to a 3-element array where each element is initialized:

```
int func(int val, int* ptr) {
      .
      .
}
```

User Interface (Desktop Products Only)

To specify constraints on function inputs:

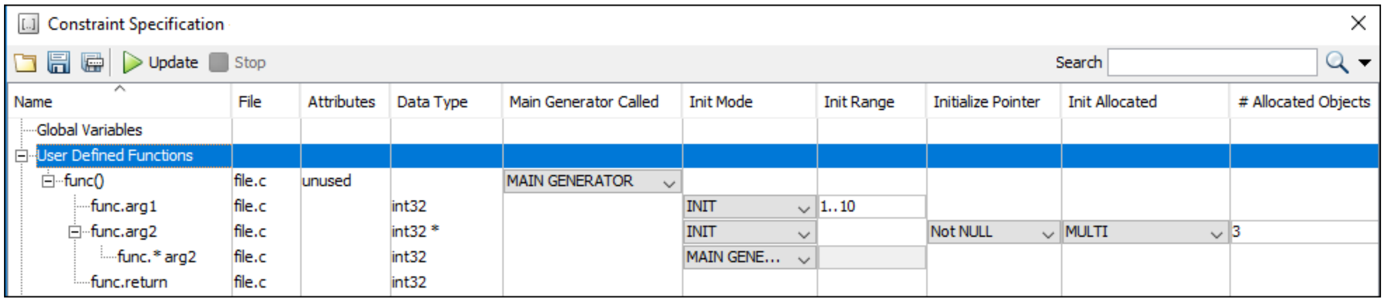
1. In your project configuration, select **Inputs & Stubbing**. Click the Edit button for **Constraint setup**.
2. In the Constraint Specification window, click Generate.

   Under the **User Defined Functions** node, you see a list of functions whose inputs can be constrained.
3. Expand the node for each function.

   You see each function input on a separate row. The inputs have the syntax *`function_name`*`.arg1`, *`function_name`*`.arg2`, etc.
4. Specify your constraints on one or more of the function inputs. For more information, see “External Constraints for Polyspace Analysis” on page 6-7.

   For example, in the preceding code:

   - To constrain `val` to the range `[1..10]`, select `INIT` for **Init Mode** and enter `1..10` for **Init Range**.
   - To specify that `ptr` points to a 3-element array where each element is initialized, select `MULTI` for **Init Allocated** and enter `3` for **# Allocated Objects**.



Name	File	Attributes	Data Type	Main Generator Called	Init Mode	Init Range	Initialize Pointer	Init Allocated	# Allocated Objects
Global Variables									
User Defined Functions									
func()	file.c	unused		MAIN GENERATOR					
func.arg1	file.c		int32		INIT	1..10			
func.arg2	file.c		int32 *		INIT		Not NULL	MULTI	3
func.*arg2	file.c		int32		MAIN GENE...				
func.return	file.c		int32						

5 Run verification and open the results. On the **Source** pane, place your cursor on the function inputs.

The tooltips display the constraints. For example, in the preceding code, the tooltip displays that `val` has values in `1..10`.

Command Line

Use the option `Constraint setup (-data-range-specifications)` with an XML file specifying your constraint.

For instance, for an analysis with Polyspace Code Prover Server, specify the option as follows:

```
polyspace-code-prover-server -sources filename
          -data-range-specifications "C:\Polyspace\drs_project1.xml"
```

Create a blank constraint XML template as described in “Specify External Constraints” on page 6-2. In the XML file, locate and constrain the function inputs. The function inputs appear as a `scalar` or `pointer` tag in a `function` tag. The inputs are named as `arg1`, `arg2` and so on. For instance, for the preceding code, the XML structure for the inputs of `func` appear as follows:

```
<function name="func" line="1" attributes="unused"
    main_generator_called="MAIN_GENERATOR" comment="">
     <scalar name="arg1" line="1" base_type="int32"
            complete_type="int32" init_mode="INIT" init_range="1..10" />
     <pointer name="arg2" line="1" complete_type="int32 *"
            init_mode="INIT" initialize_pointer="Not NULL" number_allocated="3"
            init_pointed="MULTI">
         <scalar line="1" base_type="int32" complete_type="int32"
               init_mode="MAIN_GENERATOR" init_range=""/>
    </pointer>
     <scalar name="return" line="1" base_type="int32" complete_type="int32"
               init_mode="disabled" init_range="disabled"/>
</function>
```

To specify a constraint on a function input, set the attributes `init_mode` and `init_range` for scalar variables, and `init_pointed` and `number_allocated` for pointer variables.

- To constrain `val` to the range `[1..10]`, set the `init_mode` attribute of the tag with name `arg1` to `INIT` and `init_range` to `1..10`.

- To specify that `ptr` points to a 3-element array where each element is initialized, set the `init_mode` attribute of the tag with name `arg2` to `INIT`, `init_pointed` to `MULTI` and `number_allocated` to `3`.

See Also

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

More About

- “Specify External Constraints” on page 6-2
- “External Constraints for Polyspace Analysis” on page 6-7
- “Constrain Global Variable Range” (Polyspace Code Prover Server)

XML File Format for Constraints

For a more precise Polyspace analysis, you can specify constraints on global variables, function inputs and stubbed functions. You can specify the constraints in the user interface of the Polyspace desktop products or at the command line as an XML file. For the general workflow, see “Specify External Constraints” on page 6-2.

This topic describes details of the constraint XML file schema. You typically require this information only if you create a constraint XML from scratch. If you run a verification once, the software automatically generates a template constraint file `drs-template.xml` in your results folder. Instead of creating a constraint XML file from scratch, it is easier to edit this template XML file to specify your constraints. For some examples, see:

- “Constrain Global Variable Range” (Polyspace Code Prover Server)
- “Constrain Function Inputs” (Polyspace Code Prover Server)

For another explanation of what the XML tags mean, see “External Constraints for Polyspace Analysis” on page 6-7.

You can also see the information in this topic and the underlying XML schema in *`polyspaceroot`* `\polyspace\drs`. Here, *`polyspaceroot`* is the Polyspace installation folder, for instance, `C:\Program Files\Polyspace\R2019a`.

Syntax Description — XML Elements

The constraints file contains the following XML elements:

- `<global>` element — Declares the global scope, and is the root element of the XML file.
- `<file>` element — Declares a file scope. Must be enclosed in the `<global>` element. May enclose any variable or function declaration. Static variables must be enclosed in a file element to avoid conflicts.
- `<scalar>` element— Declares an integer or a floating point variable. May be enclosed in any recognized element, but cannot enclose any element. Sets init/permanent/global asserts on variables.
- `<pointer>` element — Declares a pointer variable. May enclose any other variable declarations (including itself), to define the pointed objects. Specifies what value is written into pointer (NULL or not), how many objects are allocated and how the pointed objects are initialized.
- `<array>` element — Declares an array variable. May enclose any other variable definition (including itself), to define the members of the array.
- `<struct>` element — Declares a structure variable or object (instance of class). May enclose any other variable definition (including itself), to define the fields of the structure.
- `<function>` element — Declares a function or class method scope. May enclose any variable definition, to define the arguments and the return value of the function. Arguments should be named *`arg1, arg2, …argn`* and the return value should be called *`return`*.

The following notes apply to specific fields in each XML element:

- **(*)** — Fields used only by the GUI. These fields are not mandatory for verification to accept the ranges. The field line contains the line number where the variable is declared in the source code, `complete_type` contains a string with the complete variable type, and `base_type` is used by the

GUI to compute the min and max values. The field comment is used to add information about any node.

- **(**)** — The field name is mandatory for scope elements `<file>` and `<function>` (except for function pointers). For other elements, the name must be specified when declaring a root symbol or a `struct` field.
- **(***)** — If more than one attribute applies to the variable, the attributes must be separated by a space. Only the static attribute is mandatory, to avoid conflicts between static variables having the same name. An attribute can be defined multiple times without impact.
- **(****)** — This element is used only by the GUI, to determine which `init` modes are allowed for the current element (according to its type). The value works as a mask, where the following values are added to specify which modes are allowed:

  - **1**: The mode "`NO`" is allowed.
  - **2** : The mode "`INIT`" is allowed.
  - **4**: The mode "`PERMANENT`" is allowed.
  - **8**: The mode "`MAIN_GENERATOR`" is allowed.

  For example, the value "**10**" means that modes "`INIT`" and "`MAIN_GENERATOR`" are allowed. To see how this value is computed, refer to "Valid Modes and Default Values" on page 6-23.
- **(*****)** — A sub-element of a pointer (i.e. a pointed object) will be taken into account only if `init_pointed` is equal to SINGLE, MULTI, SINGLE_CERTAIN_WRITE or MULTI_CERTAIN_WRITE.
- **(******)** — SINGLE_CERTAIN_WRITE or MULTI_CERTAIN_WRITE are available for parameters and return values of stubbed functions only if they are pointers. If the parameter or return value is a structure and the structure has a pointer field, they are also available for the pointer field.

<file> Element

Field	Syntax
`name`	*`filepath_or_filename`*
`comment`	*`string`*

<scalar> Element

Field	Syntax
`name` (**)	*`name`*
`line` (*)	*`line`*

`base_type` (*)	`intx`
	`uintx`
	`floatx`

`Attributes` (***)	`volatile`
	`extern`
	`static`
	`const`

`complete_type` (*)	*`type`*

Field	**Syntax**

`init_mode`	`MAIN_GENERATOR`
	`IGNORE`
	`INIT`
	`PERMANENT`
	`disabled`
	`unsupported`

`init_modes_allowed` (*)	*`single value`* (****)

`init_range`	*`range`*
	`disabled`
	`unsupported`

`global_ assert`	`YES`
	`NO`
	`disabled`
	`unsupported`

`assert_range`	*`range`*
	`disabled`
	`unsupported`

`comment`(*)	*`string`*

<pointer> Element

Field	**Syntax**
Name (**)	*`name`*
`line` (*)	*`line`*

`Attributes` (***)	`volatile`
	`extern`
	`static`
	`const`

`complete_type` (*)	*`type`*

`init_mode`	`MAIN_GENERATOR`
	`IGNORE`
	`INIT`
	`PERMANENT`
	`disabled`
	`unsupported`

`init_modes_allowed` (*)	*`single value`* (****)

`initialize_ pointer`	May be:
	`NULL`
	`Not NULL`
	`NULL`

`number_ allocated`	*`single value`*
	`disabled`
	`unsupported`

Field	Syntax
init_pointed (******)	MAIN_GENERATOR NONE SINGLE MULTI SINGLE_CERTAIN_WRITE MULTI_CERTAIN_WRITE disabled
comment	*string*

<array> and <struct> Elements

Field	Syntax
Name (**)	*name*
line (*)	*line*
complete_type (*)	*type*
attributes (***)	volatile extern static const
comment	*string*

<function> Element

Field	Syntax
Name (**)	*name*
line (*)	*line*
main_generator_called	MAIN_GENERATOR YES NO disabled
attributes (***)	static extern unused
comment	*string*

Valid Modes and Default Values

Scope	Type		Init modes	Gassert mode	Initialize pointer	Init allocated	Default
Global variables	Base type	Unqualified/ static/ const scalar	MAIN_ GENERATOR IGNORE INIT PERMANENT	YES NO			Main generator dependent
		Volatile scalar	PERMANENT	disabled			PERMANENT min..max
		Extern scalar	INIT PERMANENT	YES NO			INIT min..max
	Struct	Struct field	Refer to field type				
	Array	Array element	Refer to element type				
Global variables	Pointer	Unqualified/ static/ const scalar	MAIN_ GENERATOR IGNORE INIT		May be NULL Not NULL NULL	NONE SINGLE MULTI	Main generator dependent
		Volatile pointer	un- supported		un- supported	un- supported	
		Extern pointer	IGNORE INIT		May be NULL Not NULL NULL	NONE SINGLE MULTI	INIT May be NULL max MULTI
		Pointed volatile scalar	un- supported	un- supported			
		Pointed extern scalar	INIT	un- supported			INIT min..max
		Pointed other scalars	MAIN_ GENERATOR INIT	un- supported			MAIN_ GENERATOR dependent
		Pointed pointer	MAIN_ GENERATOR INIT/	un- supported	May be NULL Not NULL NULL	NONE SINGLE MULTI	MAIN_ GENERATOR dependent
		Pointed function	un- supported	un- supported			
Function parameters	Userdef function	Scalar parameters	MAIN_ GENERATOR INIT	un- supported			INIT min..max

Scope	Type		Init modes	Gassert mode	Initialize pointer	Init allocated	Default
		Pointer parameters	MAIN_ GENERATOR INIT	un-supported	May be NULL Not NULL NULL	NONE SINGLE MULTI	INIT May be NULL max MULTI
		Other parameters	Refer to parameter type				
	Stubbed function	Scalar parameter	disabled	un-supported			
		Pointer parameters	disabled		disabled	NONE SINGLE MULTI SINGLE_ CERTAIN_ WRITE MULTI_ CERTAIN_ WRITE	MULTI
		Pointed parameters	PERMANENT	un-supported			PERMANENT min..max
		Pointed const parameters	disabled	un-supported			
Function return	Userdef function	Return	disabled	un-supported	disabled	disabled	
	Stubbed function	Scalar return	PERMANENT	un-supported			PERMANENT min..max
		Pointer return	PERMANENT	un-supported	May be NULL Not NULL NULL	NONE SINGLE MULTI SINGLE_ CERTAIN_ WRITE MULTI_ CERTAIN_ WRITE	PERMANENT May be NULL max MULTI

See Also

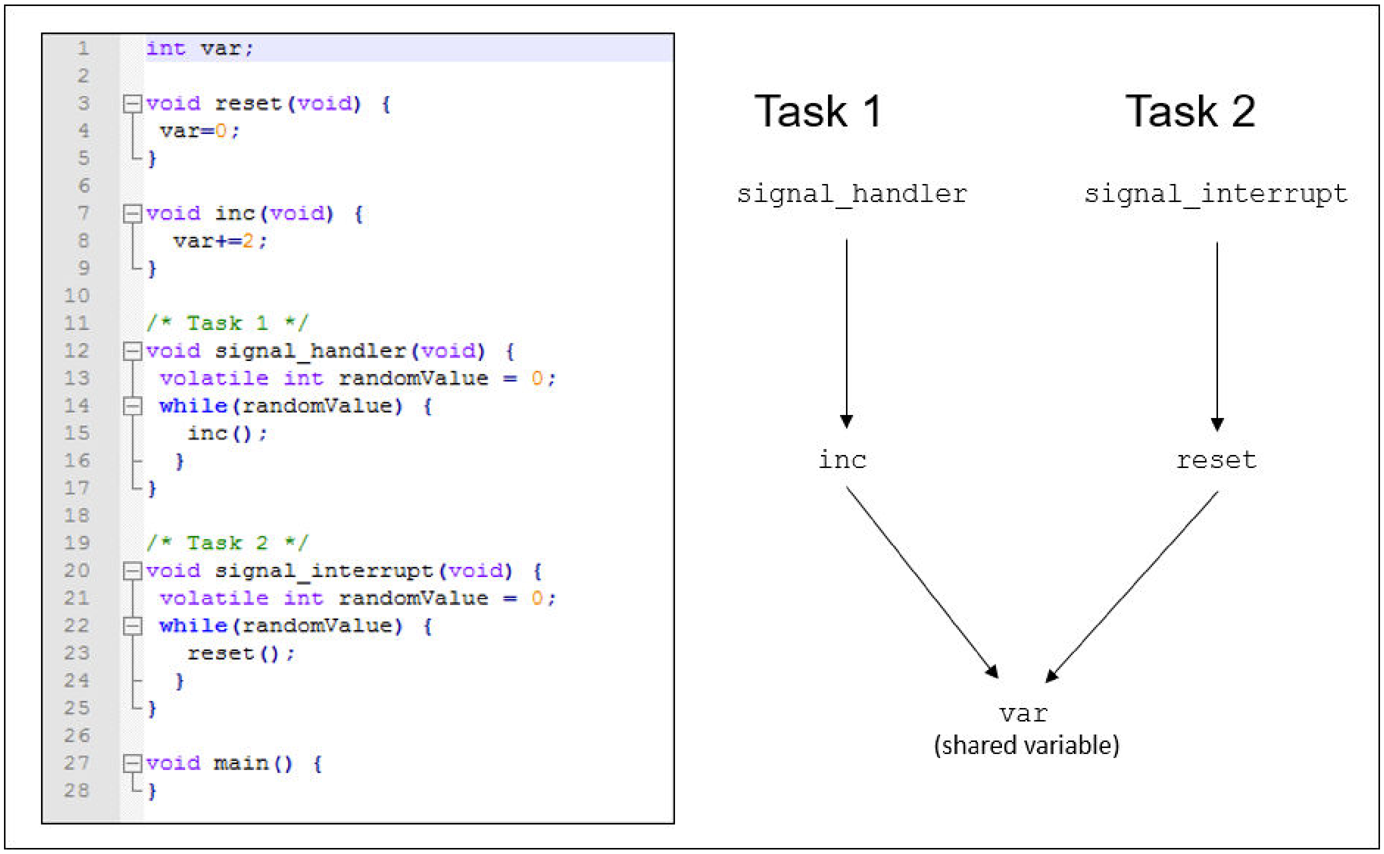
More About

- “Specify External Constraints” on page 6-2
- “Constrain Global Variable Range” (Polyspace Code Prover Server)
- “Constrain Function Inputs” (Polyspace Code Prover Server)

Configure Multitasking Analysis

Analyze Multitasking Programs in Polyspace

With Polyspace, you can analyze programs where multiple threads (tasks) run concurrently.

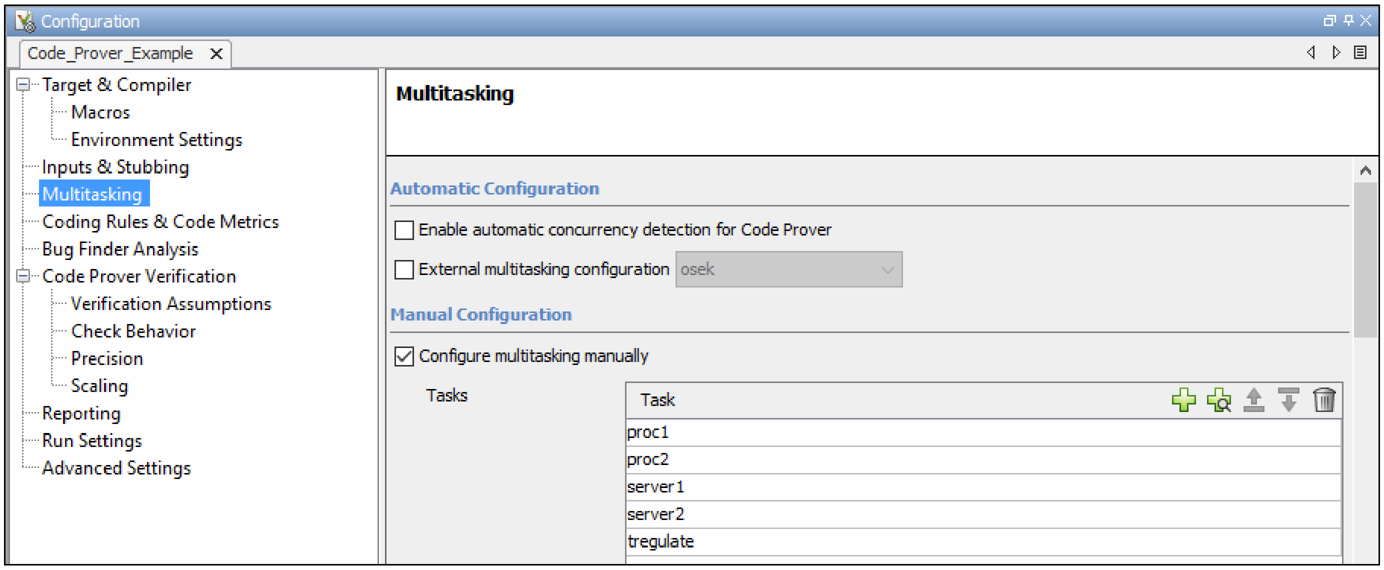


```c
int var;

void reset(void) {
 var=0;
}

void inc(void) {
  var+=2;
}

/* Task 1 */
void signal_handler(void) {
 volatile int randomValue = 0;
 while(randomValue) {
    inc();
  }
}

/* Task 2 */
void signal_interrupt(void) {
 volatile int randomValue = 0;
 while(randomValue) {
    reset();
  }
}

void main() {
}
```

In addition to regular run-time checks, the analysis looks for issues specific to concurrent execution:

- Data races, deadlocks, consecutive or missing locks and unlocks (Bug Finder)
- Unprotected shared variables (Code Prover)

Configure Analysis



Configuration

Code_Prover_Example

- Target & Compiler
  - Macros
  - Environment Settings
- Inputs & Stubbing
- Multitasking
- Coding Rules & Code Metrics
- Bug Finder Analysis
- Code Prover Verification
  - Verification Assumptions
  - Check Behavior
  - Precision
  - Scaling
- Reporting
- Run Settings
- Advanced Settings

Multitasking

Automatic Configuration

☐ Enable automatic concurrency detection for Code Prover

☐ External multitasking configuration: osek

Manual Configuration

☑ Configure multitasking manually

Tasks

Task
proc1
proc2
server1
server2
tregulate

If your code uses multitasking primitives from certain families, for instance, `pthread_create` for thread creation:

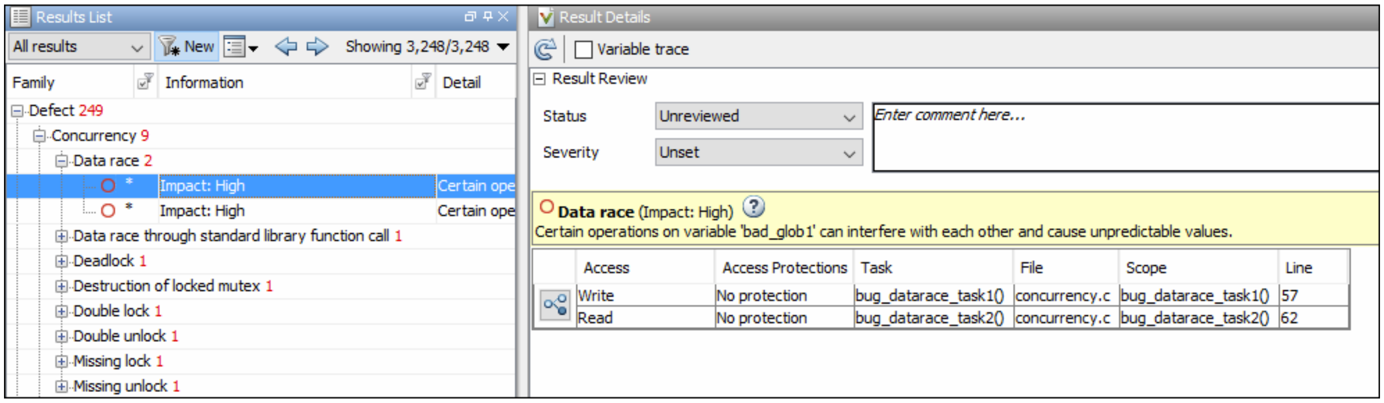
- In Bug Finder, the analysis detects them and extracts your multitasking model from the code.
- In Code Prover, you must enable this automatic detection explicitly.

See “Auto-Detection of Thread Creation and Critical Section in Polyspace” on page 7-5.

Alternatively, define your multitasking model through the analysis options. In the user interface, the options are on the **Multitasking** node in the **Configuration** pane. For more information, see “Configuring Polyspace Multitasking Analysis Manually” on page 7-16.

Review Analysis Results

Bug Finder



Results List

All results | New | Showing 3,248/3,248

Family	Information	Detail
Defect 249		
Concurrency 9		
Data race 2		
○ *	Impact: High	Certain ope
○ *	Impact: High	Certain ope
Data race through standard library function call 1		
Deadlock 1		
Destruction of locked mutex 1		
Double lock 1		
Double unlock 1		
Missing lock 1		
Missing unlock 1		

Result Details

☐ Variable trace

Result Review

Status: Unreviewed

Severity: Unset

Enter comment here...

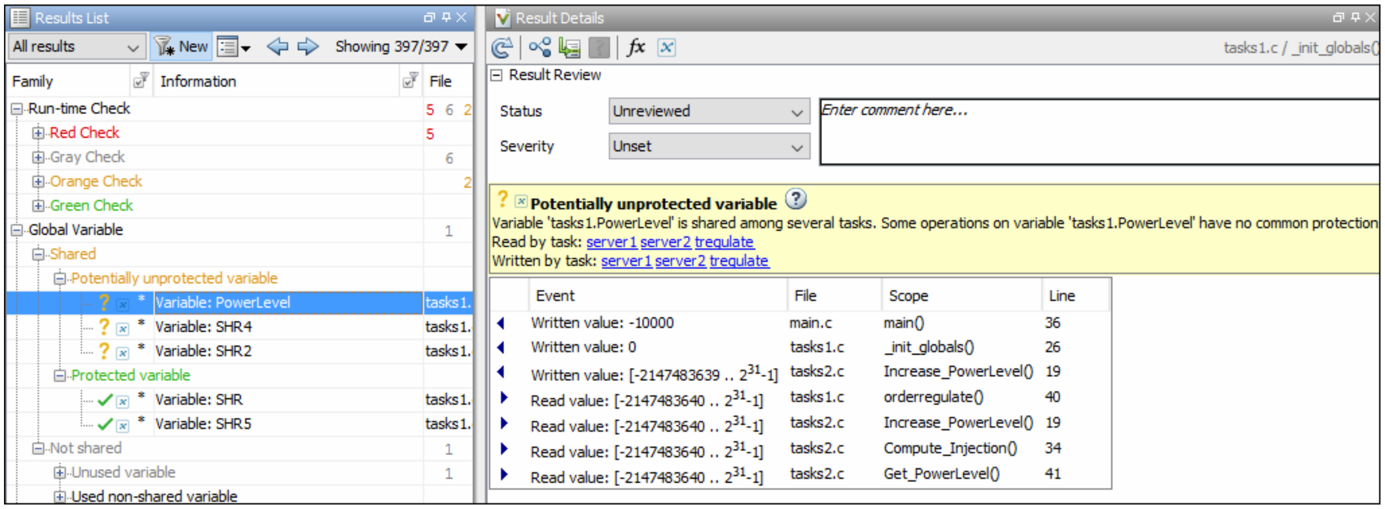
Data race (Impact: High)

Certain operations on variable 'bad_glob1' can interfere with each other and cause unpredictable values.

Access	Access Protections	Task	File	Scope	Line
Write	No protection	bug_datarace_task1()	concurrency.c	bug_datarace_task1()	57
Read	No protection	bug_datarace_task2()	concurrency.c	bug_datarace_task2()	62

The Bug Finder analysis shows concurrency defects such as data races and deadlocks. See “Concurrency Defects” (Polyspace Bug Finder Access).

Code Prover



Family	Information	File
Run-time Check		5 6 2
Red Check		5
Gray Check		6
Orange Check		2
Green Check		
Global Variable		1
Shared		
Potentially unprotected variable		
? *	Variable: PowerLevel	tasks1.
? *	Variable: SHR4	tasks1.
? *	Variable: SHR2	tasks1.
Protected variable		
✓ *	Variable: SHR	tasks1.
✓ *	Variable: SHR5	tasks1.
Not shared		1
Unused variable		1
Used non-shared variable		

Result Review

Status: Unreviewed

Severity: Unset

Enter comment here...

Potentially unprotected variable

Variable 'tasks1.PowerLevel' is shared among several tasks. Some operations on variable 'tasks1.PowerLevel' have no common protection

Read by task: server1 server2 tregulate

Written by task: server1 server2 tregulate

Event	File	Scope	Line
Written value: -10000	main.c	main()	36
Written value: 0	tasks1.c	_init_globals()	26
Written value: [-2147483639 .. 2^{31}-1]	tasks2.c	Increase_PowerLevel()	19
Read value: [-2147483640 .. 2^{31}-1]	tasks1.c	orderregulate()	40
Read value: [-2147483640 .. 2^{31}-1]	tasks2.c	Increase_PowerLevel()	19
Read value: [-2147483640 .. 2^{31}-1]	tasks2.c	Compute_Injection()	34
Read value: [-2147483640 .. 2^{31}-1]	tasks2.c	Get_PowerLevel()	41

The Code Prover analysis exhaustively checks if shared global variables are protected from concurrent access. See “Global Variables” (Polyspace Code Prover Access).

Review the results using the message on the **Result Details** pane. See a visual representation of conflicting operations using the (graph) icon.

See Also

More About

- “Auto-Detection of Thread Creation and Critical Section in Polyspace” on page 7-5
- “Configuring Polyspace Multitasking Analysis Manually” on page 7-16
- “Protections for Shared Variables in Multitasking Code” on page 7-20

Auto-Detection of Thread Creation and Critical Section in Polyspace

With Polyspace, you can analyze programs where multiple threads run concurrently. Polyspace can analyze your multitasking code for data races, deadlocks and other concurrency defects, if the analysis is aware of the concurrency model in your code. In some situations, Polyspace can detect thread creation and critical sections in your code automatically. Bug Finder detects them by default. In Code Prover, you enable automatic detection using the option `Enable automatic concurrency detection for Code Prover (-enable-concurrency-detection)`.

For the multitasking code analysis workflow, see “Analyze Multitasking Programs in Polyspace” on page 7-2.

If your thread creation function is not detected automatically:

- You can also map the function to a thread-creation function that Polyspace can detect automatically. Use the option `-code-behavior-specifications`.
- Otherwise, you must manually model your multitasking threads by using configuration options. See “Configuring Polyspace Multitasking Analysis Manually” on page 7-16.

Multitasking Routines that Polyspace Can Detect

Polyspace can detect thread creation and critical sections if you use primitives from these groups. Polyspace recognizes calls to these routines as the creation of a new thread or as the beginning or end of a critical section.

POSIX

Thread creation: `pthread_create`

Critical section begins: `pthread_mutex_lock`

Critical section ends: `pthread_mutex_unlock`

VxWorks

Thread creation: `taskSpawn`

Critical section begins: `semTake`

Critical section ends: `semGive`

To activate automatic detection of concurrency primitives for VxWorks®, in the user interface of the Polyspace desktop products, use the `VxWorks` template. For more information on templates, see “Create Project Using Configuration Template” (Polyspace Bug Finder). At the command-line, use these options:

```
-D1=CPU=I80386
-D2=__GNUC__=2
-D3=__OS_VXWORKS
```

Concurrency detection is possible only if the multitasking functions are created from an entry point named `main`. If the entry point has a different name, such as `vxworks_entry_point`, do one of the following:

- Provide a `main` function.
- `Preprocessor definitions (-D)`: In preprocessor definitions, set `vxworks_entry_point=main`.

Windows

Thread creation: `CreateThread`

Critical section begins: `EnterCriticalSection`

Critical section ends: `LeaveCriticalSection`

µC/OS II

Thread creation: `OSTaskCreate`

Critical section begins: `OSMutexPend`

Critical section ends: `OSMutexPost`

C++11

Thread creation: `std::thread::thread`

Critical section begins: `std::mutex::lock`

Critical section ends: `std::mutex::unlock`

For autodetection of C++11 threads, explicitly specify paths to your compiler header files or use `polyspace-configure`.

For instance, if you use `std::thread` for thread creation, explicitly specify the path to the folder containing `thread.h`.

See also “Limitations of Automatic Thread Detection” on page 7-11.

C11

Thread creation: `thrd_create`

Critical section begins: `mtx_lock`

Critical section ends: `mtx_unlock`

Example of Automatic Thread Detection

The following multitasking code models five philosophers sharing five forks. The example uses POSIX® thread creation routines and illustrates a classic example of a deadlock. Run Bug Finder on this code to see the deadlock.

```
#include "pthread.h"
#include <stdio.h>
#include <unistd.h>

pthread_mutex_t forks[5];

void* philo1(void* args)
{
    while (1) {
        printf("Philosopher 1 is thinking\n");
        sleep(1);
        pthread_mutex_lock(&forks[0]);
        printf("Philosopher 1 takes left fork\n");
        pthread_mutex_lock(&forks[1]);
        printf("Philosopher 1 takes right fork\n");
        printf("Philosopher 1 is eating\n");
        sleep(1);
        pthread_mutex_unlock(&forks[1]);
        printf("Philosopher 1 puts down right fork\n");
        pthread_mutex_unlock(&forks[0]);
        printf("Philosopher 1 puts down left fork\n");
    }
    return NULL;
}

void* philo2(void* args)
{
    while (1) {
        printf("Philosopher 2 is thinking\n");
        sleep(1);
        pthread_mutex_lock(&forks[1]);
        printf("Philosopher 2 takes left fork\n");
        pthread_mutex_lock(&forks[2]);
        printf("Philosopher 2 takes right fork\n");
        printf("Philosopher 2 is eating\n");
        sleep(1);
        pthread_mutex_unlock(&forks[2]);
        printf("Philosopher 2 puts down right fork\n");
        pthread_mutex_unlock(&forks[1]);
        printf("Philosopher 2 puts down left fork\n");
    }
    return NULL;
}

void* philo3(void* args)
{
    while (1) {
        printf("Philosopher 3 is thinking\n");
        sleep(1);
        pthread_mutex_lock(&forks[2]);
        printf("Philosopher 3 takes left fork\n");
        pthread_mutex_lock(&forks[3]);
        printf("Philosopher 3 takes right fork\n");
        printf("Philosopher 3 is eating\n");
        sleep(1);
        pthread_mutex_unlock(&forks[3]);
        printf("Philosopher 3 puts down right fork\n");
        pthread_mutex_unlock(&forks[2]);
        printf("Philosopher 3 puts down left fork\n");
    }
    return NULL;
}

void* philo4(void* args)
{
    while (1) {
        printf("Philosopher 4 is thinking\n");
        sleep(1);
        pthread_mutex_lock(&forks[3]);
        printf("Philosopher 4 takes left fork\n");
        pthread_mutex_lock(&forks[4]);
        printf("Philosopher 4 takes right fork\n");
        printf("Philosopher 4 is eating\n");
        sleep(1);
        pthread_mutex_unlock(&forks[4]);
        printf("Philosopher 4 puts down right fork\n");
        pthread_mutex_unlock(&forks[3]);
        printf("Philosopher 4 puts down left fork\n");
    }
    return NULL;
}

void* philo5(void* args)
{
    while (1) {
        printf("Philosopher 5 is thinking\n");
        sleep(1);
        pthread_mutex_lock(&forks[4]);
        printf("Philosopher 5 takes left fork\n");
        pthread_mutex_lock(&forks[0]);
        printf("Philosopher 5 takes right fork\n");
        printf("Philosopher 5 is eating\n");
        sleep(1);
        pthread_mutex_unlock(&forks[0]);
        printf("Philosopher 5 puts down right fork\n");
        pthread_mutex_unlock(&forks[4]);
        printf("Philosopher 5 puts down left fork\n");
    }
    return NULL;
}

int main(void)
{
    pthread_t ph[5];
    pthread_create(&ph[0], NULL, philo1, NULL);
    pthread_create(&ph[1], NULL, philo2, NULL);
    pthread_create(&ph[2], NULL, philo3, NULL);
    pthread_create(&ph[3], NULL, philo4, NULL);
    pthread_create(&ph[4], NULL, philo5, NULL);

    pthread_join(ph[0], NULL);
    pthread_join(ph[1], NULL);
    pthread_join(ph[2], NULL);
    pthread_join(ph[3], NULL);
    pthread_join(ph[4], NULL);
    return 1;
}
```

Each philosopher needs two forks to eat, a right and a left fork. The functions `philo1`, `philo2`, `philo3`, `philo4`, and `philo5` represent the philosophers. Each function requires two `pthread_mutex_t` resources, representing the two forks required to eat. All five functions run at the same time in five concurrent threads.

However, a deadlock occurs in this example. When each philosopher picks up their first fork (each thread locks one `pthread_mutex_t` resource), all the forks are being used. So, the philosophers (threads) wait for their second fork (second `pthread_mutex_t` resource) to become available. However, all the forks (resources) are being held by the waiting philosophers (threads), causing a deadlock.

Naming Convention for Automatically Detected Threads

If you use a function such as `pthread_create()` to create new threads (tasks), each thread is associated with an unique identifier. For instance, in this example, two threads are created with identifiers `id1` and `id2`.

```
pthread_t* id1, id2;

void main()
{
    pthread_create(id1, NULL, start_routine, NULL);
    pthread_create(id2, NULL, start_routine, NULL);
}
```

If a data race occurs between the threads, the analysis can detect it. When displaying the results, the threads are indicated as `task_`*`id`*, where `id` is the identifier associated with the thread. In the preceding example, the threads are identified as `task_id1` and `task_id2`.

If a thread identifier is:

- Local to a function, the thread name shows the function.

  For instance, the thread created below appears as `task_f:id`

  ```
  void f(void)
  {
      pthread_t* id;
      pthread_create(id, NULL, start_routine, NULL);
  }
  ```
- A field of a structure, the thread name shows the structure.

  For instance, the thread created below appears as `task_a#id`

  ```
  struct {pthread_t* id; int x;} a;
  pthread_create(a.id,NULL,start_routine,NULL);
  ```
- An array member, the thread name shows the array.

  For instance, the thread created below appears as `task_tab[1]`.

```
pthread_t* tab[10];
pthread_create(tab[1],NULL,start_routine,NULL);
```

If you create two threads with distinct thread identifiers, but you use the same local variable name for the thread identifiers, the name of the second thread is modified to distinguish it from the first thread. For instance, the threads below appear as `task_func:id` and `task_func:id:1`.

```
void func()
{
    {
        pthread_t id;
        pthread_create(&id, NULL, &task, NULL);

    }
    {
        pthread_t id;
        pthread_create(&id, NULL, &task, NULL);

    }
}
```

Limitations of Automatic Thread Detection

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

- Thread priorities and attributes — Ignored by Polyspace.
- Recursive semaphores.
- Unbounded thread identifiers, such as `extern pthread_t ids[]` — Warning.
- Calls to concurrency primitive through high-order calls — Warning.
- Aliases on thread identifiers — Polyspace over-approximates when the alias is used.
- Termination of threads — Polyspace ignores `pthread_join` and `thrd_join`. Polyspace replaces `pthread_exit` and `thrd_exit` by a standard exit.
- (Polyspace Bug Finder only) Creation of multiple threads through multiple calls to the same function with different pointer arguments.

  Example

  In this example, Polyspace considers that only one thread is created.

  ```
  pthread_t id1, id2;
  void start(pthread_t* id)
  {
      pthread_create(id, NULL, start_routine, NULL);
  }
  void main()
  {
      start(&id1);
      start(&id2);
  }
  ```

- (Polyspace Code Prover only) Shared local variables — Only global variables are considered shared. If a local variable is accessed by multiple threads, the analysis does not take into account the shared nature of the variable.

  Example

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

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


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

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

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

  int main(void)
  {
      task1();
      return 0;
  }
  ```
- (Polyspace Code Prover only) Shared dynamic memory — Only global variables are considered shared. If a dynamically allocated memory region is accessed by multiple threads, the analysis does not take into account its shared nature.

  Example

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

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

static int* lx;

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

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

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

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

    *lx = 3 ;

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

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

- Number of tasks created with `CreateThread` when `threadId` is set to `NULL`— When you create multiple threads that execute the same function, if the last argument of `CreateThread` is `NULL`, Polyspace only detects one instance of this function, or task.

  Example

  In this example, Polyspace detects only one instance of `thread_function1()`, but 10 instances of `thread_function2()`.

```
#include <windows.h>

#define MAX_LOOP_THREADS 10

DWORD WINAPI thread_function1(LPVOID data) {}
DWORD WINAPI thread_function2(LPVOID data) {}

HANDLE hds1[MAX_LOOP_THREADS];
HANDLE hds2[MAX_LOOP_THREADS];
DWORD threadId[MAX_LOOP_THREADS];

int main(void)
{
    for (int i = 0; i < MAX_LOOP_THREADS; i++) {

      hds1[i] = CreateThread(NULL, 0, thread_function1, NULL, 0, NULL);
      hds2[i] = CreateThread(NULL, 0, thread_function2, NULL, 0, &threadId[i]);
    }

    return 0;
}
```

- (C++11 only) If you use lambda expressions as start functions during thread creation, Polyspace does not detect shared variables in the lambda expressions.

  Example

  In this example, Polyspace does not detect that the variable `y` used in the lambda expressions is shared between two threads. As a result, Bug Finder, for instance, does not show a **Data race** defect.

  ```
  #include <thread>
  int y;
  int main() {
     std::thread t1([] {y++;});
     std::thread t2([] {y++;});
     t1.join();
     t2.join();
     return 0;
  }
  ```

- (C++11 threads with Polyspace Code Prover only) String literals as thread function argument — Code Prover shows a red **Illegally dereferenced pointer** error if the thread function has an `std::string&` parameter and you pass a string literal argument.

  Example

  In this example, the thread function `foo` has an `std::string&` parameter. When starting a thread, a string literal is passed as argument to this function, which undergoes an implicit conversion to `std::string` type. Code Prover loses track of the original string literal in this conversion. Therefore, a dashed red underline appears on `operator<<` in the body of `foo` and a red **Illegally dereferenced pointer** check in the body of `operator<<`.

```
#include <iostream>
#include <thread>

using namespace std;

void foo(const std::string& f) {
    std::cout << f;
}

void main() {
  std::thread t1(foo,"foo_arg");
}
```

To work around this issue, assign the string literal to a temporary variable and pass the variable as argument to the thread function.

```
#include <iostream>
#include <thread>

using namespace std;

void foo(const std::string& f) {
    std::cout << f;
}

void main() {
  std::string str = "foo_arg";
  std::thread t1(foo, str);
}
```

See Also

`-code-behavior-specifications` | `Enable automatic concurrency detection for Code Prover (-enable-concurrency-detection)`

More About

- “Analyze Multitasking Programs in Polyspace” on page 7-2
- “Configuring Polyspace Multitasking Analysis Manually” on page 7-16

Configuring Polyspace Multitasking Analysis Manually

With Polyspace, you can analyze programs where multiple threads run concurrently. In some situations, Polyspace can detect thread creation and critical sections in your code automatically. See "Auto-Detection of Thread Creation and Critical Section in Polyspace" on page 7-5.

If your code has functions that are intended for concurrent execution, but that cannot be detected automatically, you must specify them before analysis. If these functions operate on a common variable, you must also specify protection mechanisms for those operations.

For the multitasking code analysis workflow, see "Analyze Multitasking Programs in Polyspace" on page 7-2.

Specify Options for Multitasking Analysis

Use these options to specify cyclic tasks, interrupts and protections for shared variables. In the Polyspace user interface, the options are on the **Multitasking** node in the **Configuration** pane.

- `Entry points (-entry-points)`: Specify noncyclic entry point functions.

  Do not specify `main`. Polyspace implicitly considers `main` as an entry point function.
- `Cyclic tasks (-cyclic-tasks)`: Specify functions that are scheduled at periodic intervals.
- `Interrupts (-interrupts)`: Specify functions that can run asynchronously.
- `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`: Specify functions that disable and reenable interrupts (Bug Finder only).
- `Critical section details (-critical-section-begin -critical-section-end)`: Specify functions that begin and end critical sections.
- `Temporally exclusive tasks (-temporal-exclusions-file)`: Specify groups of functions that are temporally exclusive.
- `-preemptable-interrupts`: Specify functions that have lower priority than interrupts, but higher priority than tasks (preemptable or non-preemptable).

  Only the Bug Finder analysis considers priorities.
- `-non-preemptable-tasks`: Specify functions that have higher priority than tasks, but lower priority than interrupts (preemptable or non-preemptable).

  Only the Bug Finder analysis considers priorities.

Adapt Code for Code Prover Multitasking Analysis

The multitasking analysis in Code Prover is more exhaustive about finding potentially unprotected shared variables and therefore follows a strict model.

Tasks and interrupts must be void-void functions.

Functions that you specify as tasks and interrupts must have the prototype:

```
void func(void);
```

Suppose you want to specify a function `func` that takes `int` arguments and has return type `int`:

```
int func(int);
```

Define a wrapper void-void function that calls `func` with a volatile value. Specify this wrapper function as a task or interrupt.

```
void func_wrapper() {
  volatile int arg;
  (void)func(arg);
}
```

You can save the wrapper function definition along with a declaration of the original function in a separate file and add this file to the analysis.

The `main` function must end.

Code Prover assumes that the `main` function ends before all tasks and interrupts begin. If the `main` function contains an infinite loop or run-time error, the tasks and interrupts are not analyzed. If you see that there are no checks in your tasks and interrupts, look for a token underlined in dashed red to identify the issue in the `main` function. See “Reasons for Unchecked Code” (Polyspace Code Prover).

Suppose you want to specify the `main` function as a cyclic task.

```
void performTask1Cycle(void);
void performTask2Cycle(void);

void main() {
 while(1) {
    performTask1Cycle();
  }
}

void task2() {
 while(1) {
    performTask2Cycle();
  }
}
```

Replace the definition of `main` with:

```
#ifdef POLYSPACE
void main() {
}
void task1() {
 while(1) {
    performTask1Cycle();
  }
}

#else
void main() {
 while(1) {
    performTask1Cycle();
  }
}
#endif
```

The replacement defines an empty `main` and places the content of `main` into another function `task1` if a macro `POLYSPACE` is defined. Define the macro `POLYSPACE` using the option `Preprocessor definitions (-D)` and specify `task1` for the option `Tasks (-entry-points)`.

This assumption does not apply to automatically detected threads. For instance, a `main` function can create threads using `pthread_create`.

All tasks and interrupts can interrupt each other.

The Bug Finder analysis considers priorities of tasks. A function that you specify as a task cannot interrupt a function that you specify as an interrupt because an interrupt has higher priority.

The Code Prover analysis considers that all tasks and interrupts can interrupt each other.

The Polyspace multitasking analysis assumes that a task or interrupt cannot interrupt itself.

All tasks and interrupts can run any number of times in any sequence.

The Code Prover analysis considers that all tasks and interrupts can run any number of times in any sequence.

Suppose in this example, you specify `reset` and `inc` as cyclic tasks. The analysis shows an overflow on the operation `var+=2`.

```
void reset(void) {
 var=0;
}

void inc(void) {
  var+=2;
}
```

Suppose you want to model a scheduling of tasks such that `reset` executes after `inc` has executed five times. Write a wrapper function that implements this sequence. Specify this new function as a cyclic task instead of `reset` and `inc`.

```
void task() {
 volatile int randomValue = 0;
 while(randomValue) {
   inc();
   inc();
   inc();
   inc();
   inc();
   reset();
   }
 }
```

Suppose you want to model a scheduling of tasks such that `reset` executes after `inc` has executed zero to five times. Write a wrapper function that implements this sequence. Specify this new function as a cyclic task instead of `reset` and `inc`.

```
void task() {
 volatile int randomValue = 0;
while(randomValue) {
  if(randomValue)
    inc();
  if(randomValue)
    inc();
  if(randomValue)
    inc();
  if(randomValue)
    inc();
  if(randomValue)
    inc();
  reset();
  }
}
```

See Also

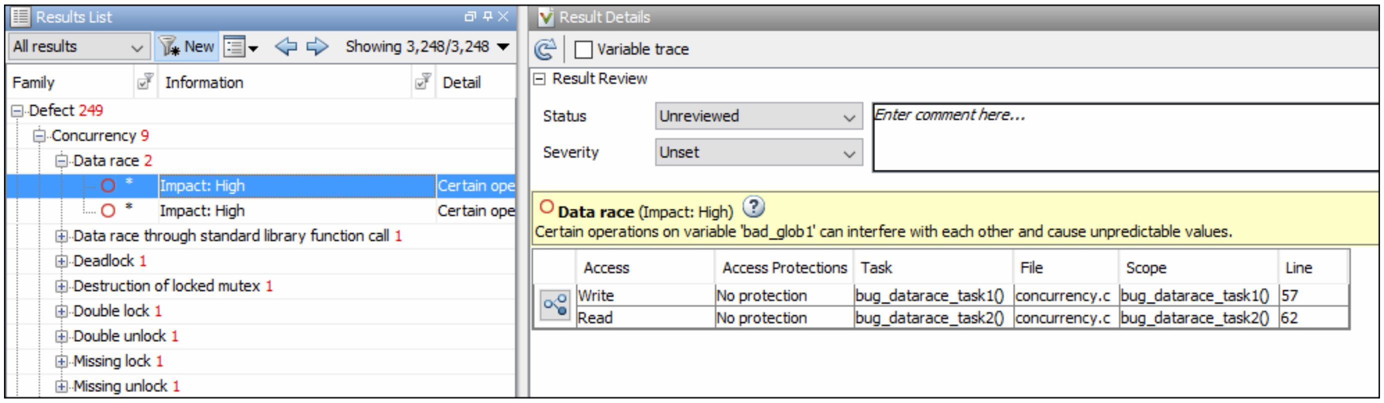
More About

- “Analyze Multitasking Programs in Polyspace” on page 7-2
- “Auto-Detection of Thread Creation and Critical Section in Polyspace” on page 7-5

Protections for Shared Variables in Multitasking Code

If your code is intended for multitasking, tasks in your code can access a common shared variable. To prevent data races, you can protect read and write operations on the variable. This topic shows the various protection mechanisms that Polyspace can recognize.

Detect Unprotected Access



Results List

All results | New | Showing 3,248/3,248

Family	Information	Detail
Defect 249		
Concurrency 9		
Data race 2		
○ *	Impact: High	Certain ope
○ *	Impact: High	Certain ope
Data race through standard library function call 1		
Deadlock 1		
Destruction of locked mutex 1		
Double lock 1		
Double unlock 1		
Missing lock 1		
Missing unlock 1		

Result Details

Variable trace

Result Review

Status: Unreviewed

Severity: Unset

Enter comment here...

Data race (Impact: High)
Certain operations on variable 'bad_glob1' can interfere with each other and cause unpredictable values.

Access	Access Protections	Task	File	Scope	Line
Write	No protection	bug_datarace_task1()	concurrency.c	bug_datarace_task1()	57
Read	No protection	bug_datarace_task2()	concurrency.c	bug_datarace_task2()	62

You can detect an unprotected access using either Bug Finder or Code Prover. Code Prover is more exhaustive and proves if a shared variable is protected from concurrent access.

- Bug Finder detects an unprotected access using the result **Data race**. See `Data race`.
- Code Prover detects an unprotected access using the result **Shared unprotected global variable**. See `Potentially unprotected variable`.

Suppose you analyze this code, specifying `signal_handler_1` and `signal_handler_2` as cyclic tasks. Use the analysis option `Cyclic tasks (-cyclic-tasks)`.

```
#include <limits.h>
int shared_var;

void inc() {
 shared_var+=2;
}

void reset() {
 shared_var = 0;
}

void signal_handler_1(void) {
    reset();
    inc();
    inc();
}

void signal_handler_2(void) {
 shared_var = INT_MAX;
}

 void main() {
}
```

Bug Finder shows a data race on `shared_var`. Code Prover shows that `shared_var` is a potentially unprotected shared variable. Code Prover also shows that the operation `shared_var += 2` can overflow. The overflow occurs if the call to `inc` in `signal_handler_1` immediately follows the operation `shared_var = INT_MAX` in `signal_handler_2`.

Protect Using Critical Sections

One possible solution is to protect operations on shared variables using critical sections.

In the preceding example, modify your code so that operations on `shared_var` are in the same critical section. Use the functions `take_semaphore` and `give_semaphore` to begin and end the critical sections. To specify these functions that begin and end critical sections, use the analysis options `Critical section details (-critical-section-begin -critical-section-end)`.

```
#include <limits.h>
int shared_var;

void inc() {
 shared_var+=2;
}

void reset() {
 shared_var = 0;
}

/* Declare lock and unlock functions */
void take_semaphore(void);
void give_semaphore(void);

void signal_handler_1() {
    /* Begin critical section */
    take_semaphore();
    reset();
    inc();
    inc();
    /* End critical section */
    give_semaphore();

}

void signal_handler_2() {
   /* Begin critical section */
   take_semaphore();
   shared_var = INT_MAX;
   /* End critical section */
   give_semaphore();

}
```

```
void main() {
}
```

You do not see the data race in Bug Finder. Code Prover proves that the shared variable is protected. You also do not see the overflow because the call to `reset()` in `signal_handler_1` always precedes calls to `inc()`.

You can also use primitives such as the POSIX functions `pthread_mutex_lock` and `pthread_mutex_unlock` to begin and end critical sections. For a list of primitives that Polyspace can detect automatically, see "Auto-Detection of Thread Creation and Critical Section in Polyspace" on page 7-5.

Protect Using Temporally Exclusive Tasks

Another possible solution is to specify a group of tasks as temporally exclusive. Temporally exclusive tasks cannot interrupt each other.

In the preceding example, specify that `signal_handler_1` and `signal_handler_2` are temporally exclusive. Use the option `Temporally exclusive tasks (-temporal-exclusions-file)`.

You do not see the data race in Bug Finder. Code Prover proves that the shared variable is protected. You also do not see the overflow because the call to `reset()` in `signal_handler_1` always precedes calls to `inc()`.

Protect Using Priorities

Another possible solution is to specify that one task has higher priority over another.

In the preceding example, specify that `signal_handler_1` is an interrupt. Retain `signal_handler_2` as a cyclic task. Use the options `Cyclic tasks (-cyclic-tasks)` and `Interrupts (-interrupts)`.

Bug Finder does not show the data race defect anymore. The reason is this:

- The operation `shared_var = INT_MAX` in `signal_handler_2` is atomic. Therefore, the operations in `signal_handler_1` cannot interrupt it.
- The operations in `signal_handler_1` cannot be interrupted by the operation in `signal_handler_2` because `signal_handler_1` has higher priority.

You can specify up to four different priorities with these options (with highest priority listed first):

- `Interrupts (-interrupts)`
- `-preemptable-interrupts`
- `-non-preemptable-tasks`
- `Cyclic tasks (-cyclic-tasks)`

A task with higher priority is atomic with respect to a task with lower priority. Note that the checker `Data race including atomic operations` ignores the difference in priorities and continues to show the data race. See also “Define Preemptable Interrupts and Nonpreemptable Tasks” on page 7-27.

Code Prover does not consider priorities of tasks. Therefore, Code Prover still shows `shared_var` as a potentially unprotected global variable.

Protect By Disabling Interrupts

In a Bug Finder analysis, you can protect a group of operations by disabling all interrupts. Use the option `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`.

After you call a routine to disable interrupts, all subsequent operations are atomic until you call another routine to reenable interrupts. The operations are atomic with respect to operations in all other tasks.

See Also

More About

- “Analyze Multitasking Programs in Polyspace” on page 7-2
- “Define Atomic Operations in Multitasking Code” on page 7-24

Define Atomic Operations in Multitasking Code

In code with multiple threads, you can use Polyspace Bug Finder to detect data races or Polyspace Code Prover to list potentially unprotected shared variables.

To determine if a variable shared between multiple threads is protected against concurrent access, Polyspace checks if the operations on the variable are atomic.

Nonatomic Operations

If an operation is nonatomic, Polyspace considers that the operation involves multiple steps. These steps do not need to occur together and can be interrupted by operations in other threads.

For instance, consider these two operations in two different threads:

- Thread 1: `var++;`

  This operation is nonatomic because it takes place in three steps: reading `var`, incrementing `var`, and writing back `var`.
- Thread 2: `var = 0;`

  This operation is atomic if the size of `var` is less than the word size on the target. See details below for how Polyspace determines the word size.

If the two operations are not protected (by using, for instance, critical sections), the operation in the second thread can interrupt the operation in the first thread. If the interruption happens after `var` is incremented in the first thread but before the incremented value is written back, you can see unexpected results.

What Polyspace Considers as Nonatomic

Code Prover considers all operations as nonatomic unless you protect them, for instance, by using critical sections. See “Define Specific Operations as Atomic” on page 7-25.

Bug Finder considers an operation as nonatomic if it 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 nonatomic.

See also `Target processor type (-target)`.

- 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 detect data races where at least one of the two interrupting operations is nonatomic, enable the Bug Finder checker `Data race`. To remove this constraint on the checker, enable `Data race including atomic operations`.

Define Specific Operations as Atomic

You might want to define a group of operations as atomic. This group of operations cannot be interrupted by operations in another thread or task.

Use one of these techniques:

- **Critical sections**

  Protect a group of operations with critical sections.

  A critical section begins and ends with calls to specific functions. You can use a predefined set of primitives to begin or end critical sections, or use your own functions.

  A group of operations in a critical section are atomic with respect to another group of operations that are in the same critical section (that is, having the same beginning and ending function).

  Specify critical sections using the option `Critical section details (-critical-section-begin -critical-section-end)`.
- **Temporally exclusive tasks**

  Protect a group of operations by specifying certain tasks as temporally exclusive.

  If a group of tasks are temporally exclusive, all operations in one task are atomic with respect to operations in the other tasks.

  Specify temporal exclusion using the option `Temporally exclusive tasks (-temporal-exclusions-file)`.
- **Task priorities** (Bug Finder only)

  Protect a group of operations by specifying that certain tasks have higher priorities. For instance, interrupts have higher priorities over cyclic tasks.

  You can specify up to four different priorities with these options (with highest priority listed first):

  - `Interrupts (-interrupts)`
  - `-preemptable-interrupts`
  - `-non-preemptable-tasks`
  - `Cyclic tasks (-cyclic-tasks)`

  All operations in a task with higher priority are atomic with respect to operations in tasks with lower priorities. See also “Define Preemptable Interrupts and Nonpreemptable Tasks” on page 7-27.

- **Routine disabling interrupts** (Bug Finder only)

  Protect a group of operations by disabling all interrupts. Use the option `Disabling all interrupts (-routine-disable-interrupts -routine-enable-interrupts)`.

  After you call a routine to disable interrupts, all subsequent operations are atomic until you call another routine to reenable interrupts. The operations are atomic with respect to operations in all other tasks.

For a tutorial, see “Protections for Shared Variables in Multitasking Code” on page 7-20.

See Also

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

More About

- “Analyze Multitasking Programs in Polyspace” on page 7-2
- “Protections for Shared Variables in Multitasking Code” on page 7-20

Define Preemptable Interrupts and Nonpreemptable Tasks

Bug Finder detects data races between concurrent tasks. Using Bug Finder analysis options, you can fix data race detection by specifying that certain tasks have higher priorities over others. A task with higher priority is atomic with respect to tasks with lower priority and cannot be interrupted by those tasks.

Emulating Task Priorities

You can specify up to four different priorities with these options (with highest priority listed first):

- Interrupts (nonpreemptable): Use option `Interrupts (-interrupts)`.
- Interrupts (preemptable): Use options `Interrupts (-interrupts)` and `-preemptable-interrupts`.
- Cyclic tasks (nonpreemptable): Use options `Cyclic tasks (-cyclic-tasks)` and `-non-preemptable-tasks`.

  You can also define preemptable noncyclic tasks with the option `Entry points (-entry-points)` and `-non-preemptable-tasks`.
- Cyclic tasks (preemptable): Use option `Cyclic tasks (-cyclic-tasks)`.

  You can also define noncyclic tasks with the option `Entry points (-entry-points)`.

For instance, interrupts have the highest priority and cannot be preempted by other tasks. To define a class of interrupts that can be preempted, lower their priority by making them preemptable.

Examples of Task Priorities

Consider this example with three tasks. A variable `var` is shared between the two tasks `task1` and `task2` without any protection such as a critical section. Depending on the priorities of `task1` and `task2`, Bug Finder shows a data race. The third task is not relevant for the example (and is added only to include a critical section, otherwise data race detection is disabled).

```
int var;

void begin_critical_section(void);
void end_critical_section(void);

void task1(void)  {
    var++;
}

void task2(void)  {
    var=0;
}

void task3(void){
    begin_critical_section();
    /* Some atomic operation */
    end_critical_section();
}
```

Adjust the priorities of `task1` and `task2` and see whether a data race is detected. For instance:

1. Configure these multitasking options:
   - `Interrupts (-interrupts)`: Specify `task1` and `task2` as interrupts.
   - `Cyclic tasks (-cyclic-tasks)`: Specify `task3` as a cyclic task.
   - `Critical section details (-critical-section-begin -critical-section-end)`: Specify `begin_critical_section` as a function beginning a critical section and `end_critical_section` as a function ending a critical section.
2. Run Bug Finder.

   You do not see a data race. Since `task1` and `task2` are nonpreemptable interrupts, the shared variable cannot be accessed concurrently.
3. Change `task1` to a preemptable interrupt by using the option `-preemptable-interrupts`.
4. Run Bug Finder again. You now see a data race on the shared variable `var`.

Further Explorations

Modify this example in the following ways and see the effect of the modification:

- Change the priorities of `task1` and `task2`.

  For instance, you can leave `task1` as a nonpreemptable interrupt but change `task2` to a preemptable interrupt by using the option `-preemptable-interrupts`.

  The data race disappears. The reason is:

  - `task1` has higher priority and cannot be interrupted by `task2`.
  - The operation in `task2` is atomic and cannot be interrupted by `task1`.
- Enable the checker `Data race including atomic operations` (not enabled by default). Use the option `Find defects (-checkers)`.

  You see the data race again. The checker considers all operations as potentially nonatomic and the operation in `task2` can now be interrupted by the higher priority operation in `task1`.

Try other modifications to the analysis options and see the result of the checkers.

See Also

Polyspace Analysis Options
`-non-preemptable-tasks` | `-preemptable-interrupts` | `Cyclic tasks (-cyclic-tasks)` | `Interrupts (-interrupts)`

Polyspace Results
`Data race` | `Data race including atomic operations`

More About

- “Analyze Multitasking Programs in Polyspace” on page 7-2
- “Protections for Shared Variables in Multitasking Code” on page 7-20
- “Define Atomic Operations in Multitasking Code” on page 7-24

Define Critical Sections with Functions That Take Arguments

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

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

A group of operations in a critical section are atomic with respect to another group of operations that are in the same critical section (that is, having the same lock and unlock function). See also “Define Atomic Operations in Multitasking Code” on page 7-24.

Polyspace Assumption on Functions Defining Critical Sections

Polyspace ignores arguments to functions that begin and end critical sections.

For instance, Polyspace treats the two code sections below as the same critical section if you specify `my_task_1` and `my_task_2` as entry points, `my_lock` as the lock function and `my_unlock` as the unlock function.

```
int shared_var;

void my_lock(int);
void my_unlock(int);

void my_task_1() {
   my_lock(1);
   /* Critical section code */
   shared_var=0;
   my_unlock(1);
}

void my_task_2() {
   my_lock(2);
   /* Critical section code */
   shared_var++;
   my_unlock(2);
}
```

As a result, the analysis considers that these two sections are protected from interrupting each other even though they might not be protected. For instance, Bug Finder does not detect the data race on `shared_var`.

Often, the function arguments can be determined only at run time. Since Polyspace models the critical sections prior to the static analysis and run-time error checking phase, the analysis cannot determine if the function arguments are different and ignores the arguments.

Adapt Polyspace Analysis to Lock and Unlock Functions with Arguments

When the arguments to the functions defining critical sections are compile-time constants, you can adapt the analysis to work around the Polyspace assumption.

For instance, you can use Polyspace analysis options so that the code in the preceding example appears to Polyspace as shown here.

```
int shared_var;

void my_lock_1(void);
void my_lock_2(void);
void my_unlock_1(void);
void my_unlock_2(void);

void my_task_1() {
   my_lock_1();
   /* Critical section code */
   shared_var=0;
   my_unlock_1();
}

void my_task_2() {
   my_lock_2();
   /* Critical section code */
   shared_var++;
   my_unlock_2();
}
```

If you then specify `my_lock_1` and `my_lock_2` as the lock functions and `my_unlock_1` and `my_unlock_2` as the unlock functions, the analysis recognizes the two sections of code as part of different critical sections. For instance, Bug Finder detects a data race on `shared_var`.

To adapt the analysis for lock and unlock functions that take compile-time constants as arguments:

1. In a header file `common_polyspace_include.h`, convert the function arguments into extensions of the function name with `#define`-s. In addition, provide a declaration for the new functions.

   For instance, for the preceding example, use these `#define`-s and declarations:

   ```
   #define my_lock(X) my_lock_##X()
   #define my_unlock(X) my_unlock_##X()

   void my_lock_1(void);
   void my_lock_2(void);
   void my_unlock_1(void);
   void my_unlock_2(void);
   ```
2. Specify the file name `common_polyspace_include.h` as argument for the option `Include (-include)`.

   The analysis considers this header file as `#include`-d in all source files that are analyzed.
3. Specify the new function names as functions beginning and ending critical sections. Use the options `Critical section details (-critical-section-begin -critical-section-end)`.

See Also

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

More About

- “Protections for Shared Variables in Multitasking Code” on page 7-20

Configure Coding Rules Checking and Code Metrics Computation

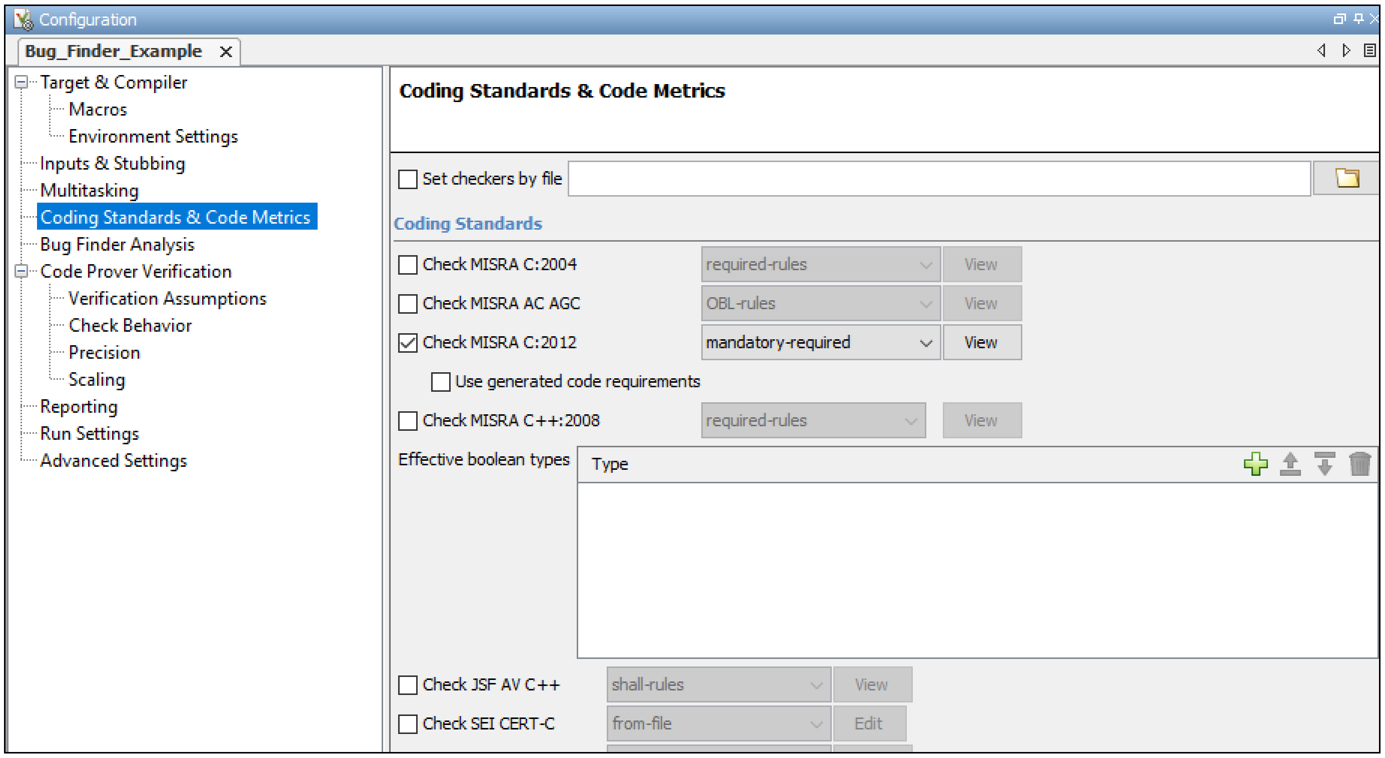
Check for Coding Standard Violations

With Polyspace, you can check your C/C++ code for violations of coding rules such as MISRA C:2012 rules. Adhering to coding rules can reduce the number of defects and improve the quality of your code.

Polyspace can detect the violations of these rules:

- MISRA C:2004
- MISRA C:2012
- MISRA C++
- JSF AV C++
- AUTOSAR C++14 *(Bug Finder only)*
- CERT C *(Bug Finder only)*
- CERT C++ *(Bug Finder only)*
- ISO®/IEC TS 17961 *(Bug Finder only)*
- Guidelines

Configure Coding Rules Checking



Coding Standards & Code Metrics

☐ Set checkers by file

Coding Standards

☐ Check MISRA C:2004 — required-rules

☐ Check MISRA AC AGC — OBL-rules

☑ Check MISRA C:2012 — mandatory-required

☐ Use generated code requirements

☐ Check MISRA C++:2008 — required-rules

Effective boolean types

☐ Check JSF AV C++ — shall-rules

☐ Check SEI CERT-C — from-file

Specify Standard and Predefined Checker Subsets

Specify the coding rules through Polyspace analysis options. When you run Bug Finder or Code Prover, the analysis looks for coding rule violations in addition to other checks. You can disable the other checks and look for coding rule violations only.

In the Polyspace user interface (desktop products), the options are on the **Configuration** pane under the **Coding Standards & Code Metrics** node.

For C code, use one of these options:

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

  For generated code, enable the option specific to generated code.
- `Check MISRA C:2012 (-misra3)`

  For generated code, enable the option specific to generated code.
- `Check SEI CERT-C (-cert-c)`
- `Check ISO/IEC TS 17961 (-iso-17961)`
- `Check Guidelines (-guidelines)`

For C++ code, use one of these options:

- `Check MISRA C++ rules (-misra-cpp)`
- `Check JSF C++ rules (-jsf-coding-rules)`
- `Check AUTOSAR C++ 14 (-autosar-cpp14)`
- `Check SEI CERT-C++ (-cert-cpp)`
- `Check Guidelines (-guidelines)`

You can specify a predefined subset of rules, for instance, `mandatory` for MISRA C:2012. These subsets are typically defined by the standard.

You can also define naming conventions for identifiers using regular expressions. See “Create Custom Coding Rules” on page 8-47.

Customize Checker Subsets

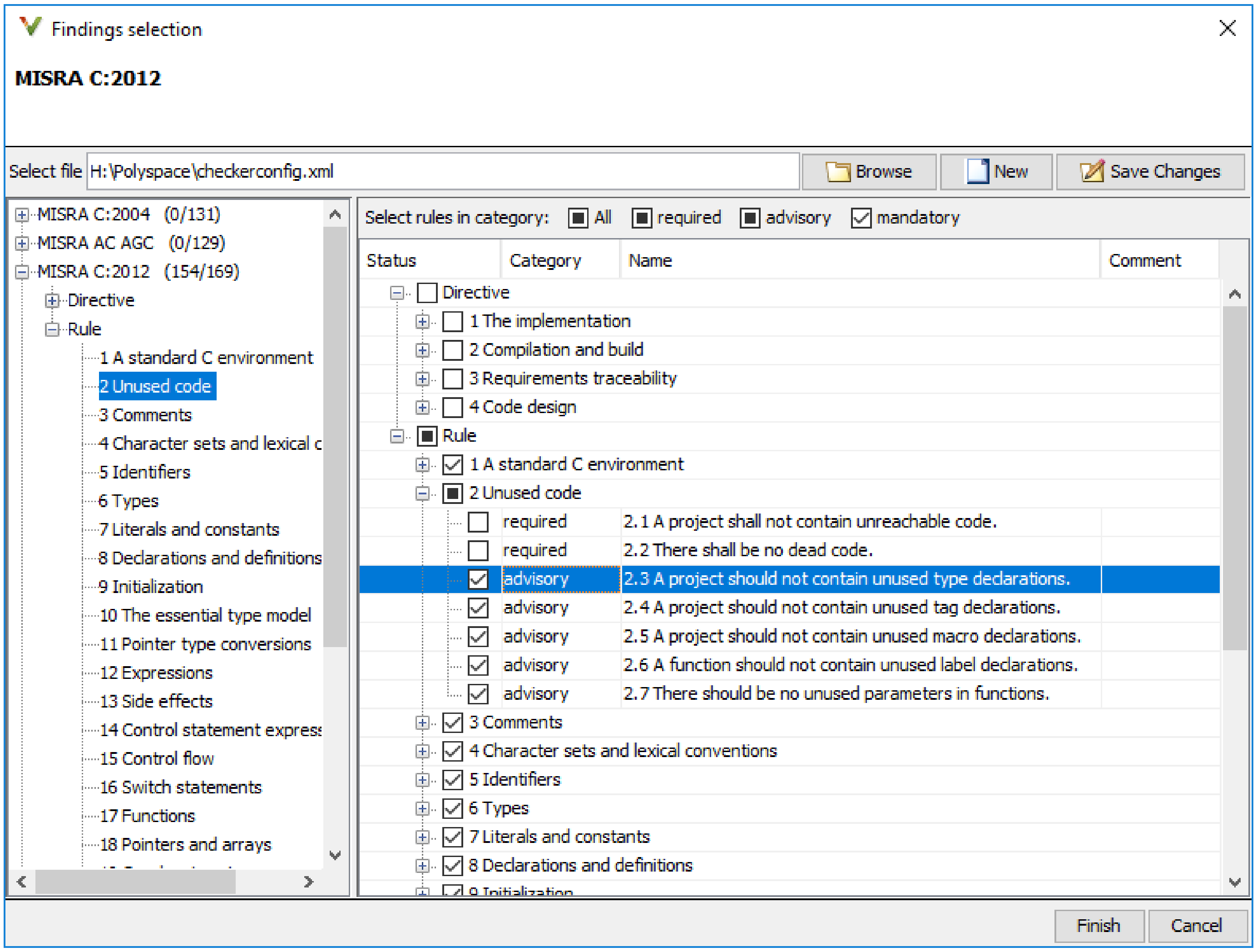
Instead of the predefined subsets, you can specify your own subset of rules from a coding standard.

User Interface (Desktop Products Only)

1. Select the coding standard. From the drop-down list for the subset of rules, select `from-file`. Click **Edit**.
2. In the **Findings selection** window, the coding standard is highlighted on the left pane. On the right pane, select the rules that you want to include in your analysis.

   - When selecting **Guidelines > Software Complexity** checkers, review their thresholds. If the default thresholds are not acceptable, specify a suitable threshold in the **Threshold** column. See .

- When selecting **Custom** rules, review the **Pattern** and **Convention** for the rules. See `Check custom rules (-custom-rules)`.



Findings selection

MISRA C:2012

Select file H:\Polyspace\checkerconfig.xml Browse New Save Changes

- MISRA C:2004 (0/131)
- MISRA AC AGC (0/129)
- MISRA C:2012 (154/169)
  - Directive
  - Rule
    - 1 A standard C environment
    - 2 Unused code
    - 3 Comments
    - 4 Character sets and lexical c
    - 5 Identifiers
    - 6 Types
    - 7 Literals and constants
    - 8 Declarations and definitions
    - 9 Initialization
    - 10 The essential type model
    - 11 Pointer type conversions
    - 12 Expressions
    - 13 Side effects
    - 14 Control statement express
    - 15 Control flow
    - 16 Switch statements
    - 17 Functions
    - 18 Pointers and arrays

Select rules in category: ■ All ■ required ■ advisory ☑ mandatory

Status	Category	Name	Comment
☐ Directive			
☐ 1 The implementation			
☐ 2 Compilation and build			
☐ 3 Requirements traceability			
☐ 4 Code design			
■ Rule			
☑ 1 A standard C environment			
■ 2 Unused code			
☐	required	2.1 A project shall not contain unreachable code.	
☐	required	2.2 There shall be no dead code.	
☑	advisory	2.3 A project should not contain unused type declarations.	
☑	advisory	2.4 A project should not contain unused tag declarations.	
☑	advisory	2.5 A project should not contain unused macro declarations.	
☑	advisory	2.6 A function should not contain unused label declarations.	
☑	advisory	2.7 There should be no unused parameters in functions.	
☑ 3 Comments			
☑ 4 Character sets and lexical conventions			
☑ 5 Identifiers			
☑ 6 Types			
☑ 7 Literals and constants			
☑ 8 Declarations and definitions			
☑ 9 Initialization			

Finish Cancel

When you save the rule selections, the configuration is saved in an XML file that you can reuse for multiple analyses. The same file contains rules selected for all coding standards. You can reuse this file across multiple projects to enforce common coding standards in a team or organization. To reuse this file in another project in the Polyspace user interface:

- Choose a coding standard in the project configuration. From the drop-down list for the subset of rules, select `from-file`.
- Click **Edit** and browse to the file location. Alternatively, enter the file name as argument for the option `Set checkers by file (-checkers-selection-file)`.

Command Line

With the Polyspace desktop products, you can create a coding standard XML file in the user interface and then use this file for command-line analysis. Provide this XML file with the option `Set checkers by file (-checkers-selection-file)`.

With the Polyspace Server products, you have to create a coding standard XML from scratch. Depending on the standard that you want to enable, make a writeable copy of one of the files in *`polyspaceserverroot`*`\help\toolbox\polyspace_bug_finder_server\examples\coding_standards_XML` and turn off rules using entries in the XML file (all rules from a standard are enabled in the template). Here, *`polyspaceserverroot`* is the root installation folder for the Polyspace Server products, for instance, `C:\Program Files\Polyspace Server\R2019a`.

For instance, to turn off MISRA C:2012 rule 8.1, use this entry in a copy of the file `misra_c_2012_rules.xml`:

```
<standard name="MISRA C:2012">
  ...
  <section name="8 Declarations and definitions">
      ...
      <check id="8.1" state="off">
      </check>
      ...
  </section>
  ...
</standard>
```

When using the Guideline checkers, specify their threshold between the `threshold` tags. For instance, to activates the checker `Cyclomatic Complexity Exceeds Threshold` and set the threshold for the checker to five, use this entry in a copy of the `guidelines.xml`:

```
<check id="SC18" state="on">
        <threshold>5</threshold>
</check>
```

To use the XML file for a MISRA C:2012 analysis in Bug Finder, enter:

```
polyspace-bug-finder -sources filename -misra3 from-file
                     -checkers-selection-file misra_c_2012_rules.xml
```

For full list of rule id-s and section names, see:

- "AUTOSAR C++14 Rules" (Polyspace Bug Finder Access)
- "CERT C Rules and Recommendations" (Polyspace Bug Finder Access)
- "CERT C++ Rules" (Polyspace Bug Finder Access)
- "ISO/IEC TS 17961 Rules" (Polyspace Bug Finder Access)
- "Custom Coding Rules" (Polyspace Bug Finder Access)
- "JSF C++ Rules" (Polyspace Bug Finder Access)
- "MISRA C:2004 and MISRA AC AGC Rules" (Polyspace Bug Finder Access)
- "MISRA C:2012 Directives and Rules" (Polyspace Bug Finder Access)
- "MISRA C++:2008 Rules" (Polyspace Bug Finder Access)
- "Guidelines" (Polyspace Bug Finder Access)

Note The XML format of the checker configuration file can change in future releases.

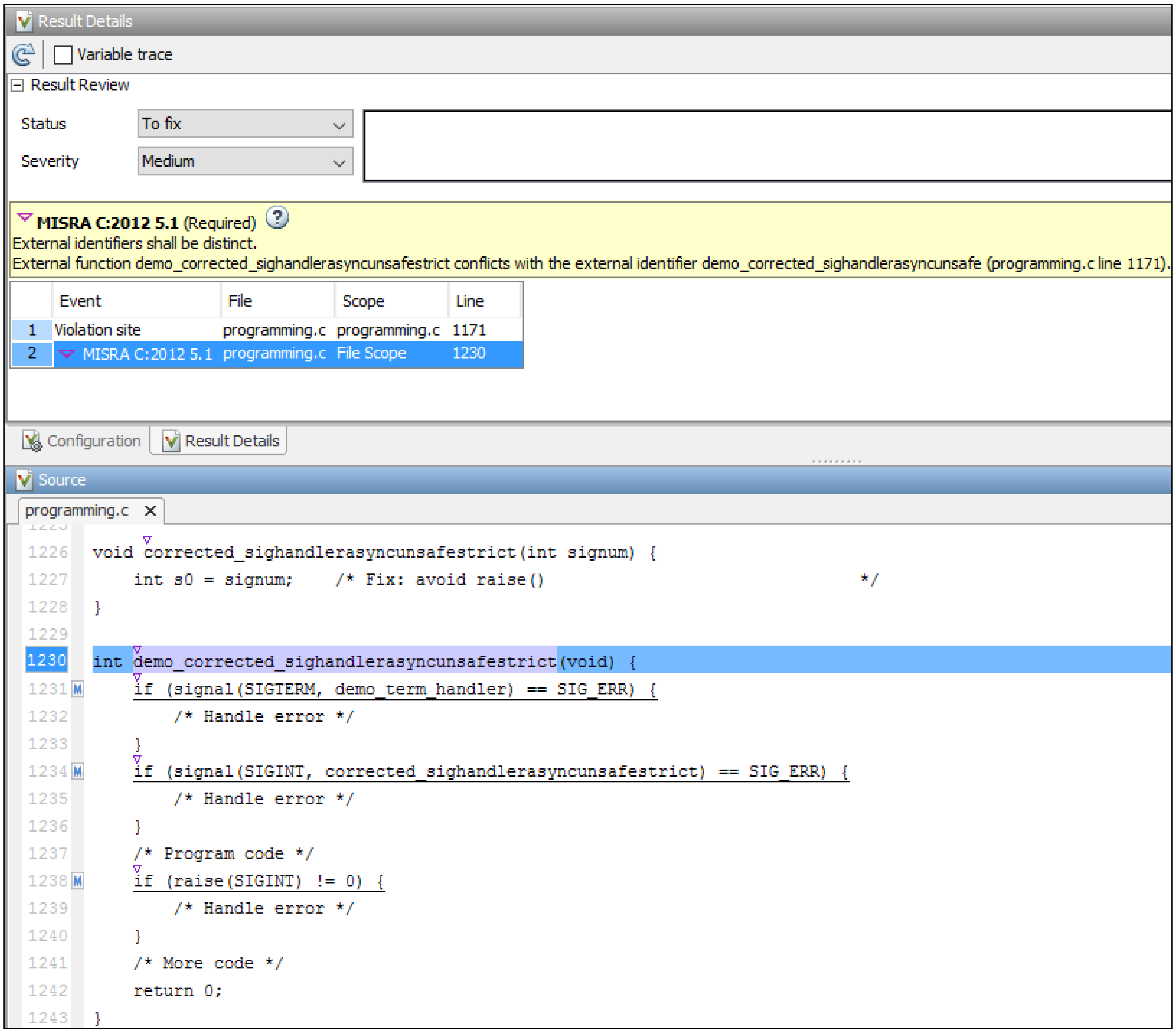
Check for Coding Standards Only

To check for coding standards only:

- In Bug Finder, disable checking of defects. Use the option `Find defects (-checkers)`.
- In Code Prover, check for source compliance only. Use the option `Verification level (-to)`.

  These rules are checked in the later stages of a Code Prover analysis: MISRA C:2004 rules 9.1, 13.7, and 21.1, and MISRA C:2012 rules 2.2, 9.1, 14.3, and 18.1. If you stop Code Prover at source compliance checking, the analysis might not find all violations of these rules. You can also see a difference in results based on your choice for the option `Verification level (-to)`. For example, it is possible that Code Prover suspects in the first pass that a variable may be uninitialized but proves in the second pass that the variable is initialized. In that case, you see a violation of MISRA C:2012 Rule 9.1 in the first pass but not in the second pass.

Review Coding Rule Violations



Status: To fix

Severity: Medium

MISRA C:2012 5.1 (Required)
External identifiers shall be distinct.
External function demo_corrected_sighandlerasyncunsafestrict conflicts with the external identifier demo_corrected_sighandlerasyncunsafe (programming.c line 1171).

	Event	File	Scope	Line
1	Violation site	programming.c	programming.c	1171
2	MISRA C:2012 5.1	programming.c	File Scope	1230

```
void corrected_sighandlerasyncunsafestrict(int signum) {
    int s0 = signum;    /* Fix: avoid raise()                      */
}

int demo_corrected_sighandlerasyncunsafestrict(void) {
    if (signal(SIGTERM, demo_term_handler) == SIG_ERR) {
        /* Handle error */
    }
    if (signal(SIGINT, corrected_sighandlerasyncunsafestrict) == SIG_ERR) {
        /* Handle error */
    }
    /* Program code */
    if (raise(SIGINT) != 0) {
        /* Handle error */
    }
    /* More code */
    return 0;
}
```

After analysis, you see the coding standard violations on the **Results List** pane. Select a violation to see further details on the **Result Details** pane and the source code on the **Source** pane.

Violations of coding standards are indicated in the source code with the ▽ icon.

For further steps, see “Review Polyspace Bug Finder Results in Web Browser” (Polyspace Bug Finder Access).

Generate Reports

You can generate reports using templates that are explicitly defined for coding standards. Use the `CodingStandards` template. This template:

- Reports only coding standard violations in your analysis results, and omits other types of results such as defects, run-time errors or code metrics.
- Creates a separate chapter in the report for each coding standard. the chapter provides an overview of all violations of the standard and then lists each violation.

To specify a report template, use the option `Bug Finder and Code Prover report (-report-template)`.

See Also

More About

- “Interpret Bug Finder Results in Polyspace Access Web Interface” (Polyspace Bug Finder Access)

Avoid Violations of MISRA C:2012 Rules 8.x

MISRA C:2012 rules 8.1-8.14 enforce good coding practices surrounding declarations and definitions. If you follow these practices, you are less likely to have conflicting declarations or to unintentionally modify variables.

If you do not follow these practices *during coding*, your code might require major changes later to be MISRA C-compliant. You might have too many MISRA C violations. Sometimes, in fixing a violation, you might violate another rule. Instead, keep these rules in mind when coding. Use the MISRA C:2012 checker to spot any issues that you might have missed.

- **Explicitly specify all data types in declarations.**

  Avoid implicit data types like this declaration of `k`:

  ```
  extern void foo (char c, const k);
  ```

  Instead use:

  ```
  extern void foo (char c, const int k);
  ```

  That way, you do not violate `MISRA C:2012 Rule 8.1` (Polyspace Bug Finder Access).
- **When declaring functions, provide names and data types for all parameters.**

  Avoid declarations without parameter names like these declarations:

  ```
  extern int func(int);
  extern int func2();
  ```

  Instead use:

  ```
  extern int func(int arg);
  extern int func2(void);
  ```

  That way, you do not violate `MISRA C:2012 Rule 8.2` (Polyspace Bug Finder Access).
- **If you want to use an object or function in multiple files, declare the object or function once in only one header file.**

  To use an object in multiple source files, declare it as `extern` in a header file. Include the header file in all the source files where you need the object. In one of those source files, define the object. For instance:

  ```
  /* header.h */
  extern int var;

  /* file1.c */
  #include "header.h"
  /* Some usage of var */

  /* file2.c */
  #include "header.h"
  int var=1;
  ```

  To use a function in multiple source files, declare it in a header file. Include the header file in all the source files where you need the function. In one of those source files, define the function.

That way, you do not violate `MISRA C:2012 Rule 8.3` (Polyspace Bug Finder Access), `MISRA C:2012 Rule 8.4` (Polyspace Bug Finder Access), `MISRA C:2012 Rule 8.5` (Polyspace Bug Finder Access), or `MISRA C:2012 Rule 8.6` (Polyspace Bug Finder Access).

- **If you want to use an object or function in one file only, declare and define the object or function with the `static` specifier.**

  Make sure that you use the `static` specifier in all declarations and the definition. For instance, this function `func` is meant to be used only in the current file:

  ```
  static int func(void);
  static int func(void){
  }
  ```

  That way, you do not violate `MISRA C:2012 Rule 8.7` (Polyspace Bug Finder Access) and `MISRA C:2012 Rule 8.8` (Polyspace Bug Finder Access).

- **If you want to use an object in one function only, declare the object in the function body.**

  Avoid declaring the object outside the function.

  For instance, if you use `var` in `func` only, do declare it outside the body of `func`:

  ```
  int var;
  void func(void) {
     var=1;
  }
  ```

  Instead use:

  ```
  void func(void) {
     int var;
     var=1;
  }
  ```

  That way, you do not violate `MISRA C:2012 Rule 8.7` (Polyspace Bug Finder Access) and `MISRA C:2012 Rule 8.9` (Polyspace Bug Finder Access).

- **If you want to inline a function, declare and define the function with the `static` specifier.**

  Every time you add `inline` to a function definition, add `static` too:

  ```
  static inline double func(int val);
  static inline double func(int val) {
  }
  ```

  That way, you do not violate `MISRA C:2012 Rule 8.10` (Polyspace Bug Finder Access).

- **When declaring arrays, explicitly specify their size.**

  Avoid implicit size specifications like this:

  ```
  extern int32_t array[];
  ```

  Instead use:

  ```
  #define MAXSIZE 10
  extern int32_t array[MAXSIZE];
  ```

That way, you do not violate `MISRA C:2012 Rule 8.11` (Polyspace Bug Finder Access).

- **When declaring enumerations, try to avoid mixing implicit and explicit specifications.**

  Avoid mixing implicit and explicit specifications. You can specify the first enumeration constant explicitly, but after that, use either implicit or explicit specifications. For instance, avoid this type of mix:

  ```
  enum color {red = 2, blue, green = 3, yellow};
  ```

  Instead use:

  ```
  enum color {red = 2, blue, green, yellow};
  ```

  That way, you do not violate `MISRA C:2012 Rule 8.12` (Polyspace Bug Finder Access).

- **When declaring pointers, point to a `const`-qualified type unless you want to use the pointer to modify an object.**

  Point to a `const`-qualified type by default unless you intend to use the pointer for modifying the pointed object. For instance, in this example, `ptr` is not used to modify the pointed object:

  ```
  char last_char(const char * const ptr){
  }
  ```

  That way, you do not violate `MISRA C:2012 Rule 8.13` (Polyspace Bug Finder Access).

Reduce Software Complexity by Using Polyspace Checkers

Software complexity refers to various quantifiable metrics of a software module or source files, such as number of lines, number of paths, number of functions, or the complexity of the function call tree. The Polyspace software complexity checkers are raised when these metrics exceeds a threshold. High software complexity might indicate that your code is difficult to read, understand, and debug. It is more efficient to maintain the acceptable level of software complexity during development instead of refactoring complex projects later on. Use the software complexity checkers to detect complex modules early in the development cycle to reduce later refactoring efforts.

You can also calculate the absolute values of code complexity metrics for all files and functions. See “Compute Code Complexity Metrics” on page 8-49.

Configure Thresholds for Software Complexity Checkers

Each software complexity checker corresponds to a complexity metric. Polyspace raises a software complexity checker when the corresponding code complexity metric exceeds a threshold.

The default thresholds of these checkers follow the Hersteller Initiative Software (HIS) Code Complexity standard. See “HIS Code Complexity Metrics” on page 8-52. For checkers that are not present in the HIS standard, the default thresholds are high enough that the code complexity metrics of your code might always be below the threshold. To use these checkers effectively, specify an appropriate threshold for them.

Determine an appropriate set of thresholds for these checkers depending on the best practice for your use case. For instance, when analyzing new projects or newly developed code, you might want to reduce the use of `GOTO` statements by setting the threshold of `Number of goto statements exceeds threshold` to zero. When analyzing modules containing legacy libraries, you might want to set the threshold to a higher number.

Depending on your Polyspace product, use the user interface or the command-line interface to specify the threshold. For instance:

- In Polyspace desktop or Server products, in the Checkers selection window, navigate to **Guidelines** > **Software Complexity** and specify the threshold. In the command line, use the analysis option `Check Guidelines (-guidelines)`. See “Check for Coding Standard Violations” on page 8-2.
- In Polyspace as You Code extension, start the Checkers selection window and specify the thresholds in the **Guidelines** > **Software Complexity** node.
  - In Eclipse™, open the Checkers selection window from the Configure Project window. See “Configure Checkers for Polyspace as You Code in Eclipse” (Polyspace Bug Finder Access).
  - In Visual Studio, open the Checkers selection window from the **Polyspace** > **Project** node of the Options window. See “Configure Checkers for Polyspace as You Code in Visual Studio” (Polyspace Bug Finder Access).
  - In Visual Studio Code, open the Checkers selection window from the command palette. See “Configure Checkers for Polyspace as You Code in Visual Studio Code” (Polyspace Bug Finder Access).
  - At the command line, open the Checkers selection window by running the command `polyspace-checkers-selection`. See “Configure Checkers for Polyspace as You Code at the Command Line” (Polyspace Bug Finder Access).

Identify and Reduce Software Complexity

Identify Software Complexity by Running Bug Finder Analysis

To identify software complexity, configure the thresholds of the checkers. For instance, set the thresholds of the checkers listed in this table.

Checker	Threshold
`Comment density below threshold`	20
`Call tree complexity exceeds threshold`	10
`Number of call occurrences exceeds threshold`	10
`Language scope exceeds threshold`	400

The thresholds indicate the acceptable level of software complexity. To identify issues in your code that might lead to a higher level of complexity, after configuring the software complexity checkers, run a Polyspace Bug Finder analysis. Consider this code:

```
long long power(double x, int n){
    long long BN = 1;
    for(int i = 0; i<n;++i){
        BN*=x;
    }
    return BN;
}

double AppxIndex(double m, double f){//Noncompliant
    double U = (power(m,2) - 1)/(power(m,2)+2);
    double V = (power(m,4) + 27*power(m,2)+38)/(2*power(m,2)+3);
    return (1+2*f*power(U,2)*(1+power(m,2)*U*V+ power(m,3)
            /power(m,3)*(U-V)))/( (1-2*f*power(U,2)*(1+power(m,2)*U*V
           + power(m,3)/power(m,3)*(U-V))));
}
```

The function `AppxIndex` appears complex. It is not obvious how you might reduce the complexity. The software complexity checkers help you identify the sources of complexity.

After the Bug Finder analysis, the configured checkers are raised:

- `Comment density below threshold`: The functions in the code contain no explanatory comments.
- `Call tree complexity exceeds threshold` and `Number of call occurrences exceeds threshold`: There are too many function calls compared to the number of function definitions. These checks indicate that you can package some of the expressions into separate functions.
- `Language scope exceeds threshold`: The same operand is repeated several times. You can reduce some of the repetition. For instance, the function `power` is called with the same arguments several times.

These checks indicate that the function `AppxIndex` might make the code difficult to read, understand, and debug. To reduce the complexity of the code, address the raised checks.

Reduce Software Complexity

Reduce the complexity of your code by addressing the identified issues. In this case, the root cause of the raised checks is that the function `AppxIndex` performs several tasks instead of performing one single task. For instance, the function first calculates `U`, then it calculates `V`, and finally it evaluates a lengthy expression containing both `U` and `V`. To address these issues, refactor the function `AppxIndex` so that each task is delegated to a separate function. You might break down the lengthy expression into smaller parts. For instance:

```
// This code calculates effective index of materials  as described in
// the formula in 10.1364...
// power(x,n) returns the nth power of x (x^n)
// n is an integer
// x is a double
// return type is long long

long long power(double x, int n){//Compliant
    long long BN = 1;
    for(int i = 0; i<n;++i){
        BN*=x;
    }
    return BN;
}
// CalculateU(m) calculates the first intermediate variable
// required to calculate  polarization
// m is the relative refractive index
// return type is double;

double CalculateU(double m){//Compliant
    return (power(m,2) - 1)/(power(m,2)+2);
}
// CalculateV(m) calculates the second intermediate variable
// required to calculate  polarization
// m is the relative refractive index
// return type is double;

double CalculateV(double m){//Compliant
    return (power(m,4) + 27*power(m,2)+38)/(2*power(m,2)+3);
}
// CalculateMid(m,f) calculates the large term present
// in both numerator and denominator
// of the effective index calculation
// m is the relative refractive index
// f is the fillfactor
// return type is double;

double CalculateMid(double m, double f){//Compliant
    double U = CalculateU(m);
    double V = CalculateU(m);
    return 2*f*power(U,2)*(1+power(m,2)*U*V + power(m,3)/power(m,3)*(U-V));
}
//AppxIndex(m,f) calculates the approximate effective index
// m is the relative refractive index
// f is the fillfactor
//return type is double
double AppxIndex(double m, double f){//Compliant
```

```
    return (1+CalculateMid(m,f))/( (1-CalculateMid(m,f)));
}
```

In this code, none of the software complexity checkers is raised, which indicates that you reduced the complexity of this code to an acceptable level. To reduce the software complexity:

1. Document the code with sufficient comments.
2. Break down the The large complex task performed by `AppxIndex` into smaller and simpler tasks, which are then delegated to individual functions such as `CalculateU`, `CalculateV` and `CalculateMid`. The function `power` is now called less frequently. If you later implement a different function to calculate a power and want to use the new function instead of the current one, you have to make fewer replacements.
3. Write the new functions to perform one specific task with as little overlap of their functionalities as possible. As a result, these functions contain less repetition of the same operands.

For details about addressing a software complexity check, see the documentation of the checker.

In cases when you are unable to refactor the code, address the checks through code annotations. For instance, if you are using a complex library, you might choose to annotate the checks that are raised on the library. See “Hide Known or Acceptable Polyspace Results” (Polyspace Bug Finder Access). When you annotate a file or function code metric, the corresponding software complexity checker is also annotated by the same comment.

See Also

Software Quality Objective Subsets (C:2004)

In this section...
“Rules in SQO-Subset1” on page 8-16
“Rules in SQO-Subset2” on page 8-17

Rules in SQO-Subset1

In Polyspace Code Prover, the following set of coding rules will typically reduce the number of unproven results.

Rule number	Description
5.2	Identifiers in an inner scope shall not use the same name as an identifier in an outer scope, and therefore hide that identifier.
8.11	The *static* storage class specifier shall be used in definitions and declarations of objects and functions that have internal linkage.
8.12	When an array is declared with external linkage, its size shall be stated explicitly or defined implicitly by initialization.
11.2	Conversion shall not be performed between a pointer to an object and any type other than an integral type, another pointer to a object type or a pointer to void.
11.3	A cast should not be performed between a pointer type and an integral type.
12.12	The underlying bit representations of floating-point values shall not be used.
13.3	Floating-point expressions shall not be tested for equality or inequality.
13.4	The controlling expression of a *for* statement shall not contain any objects of floating type.
13.5	The three expressions of a *for* statement shall be concerned only with loop control.
14.4	The *goto* statement shall not be used.
14.7	A function shall have a single point of exit at the end of the function.
16.1	Functions shall not be defined with variable numbers of arguments.
16.2	Functions shall not call themselves, either directly or indirectly.
16.7	A pointer parameter in a function prototype should be declared as pointer to const if the pointer is not used to modify the addressed object.
17.3	>, >=, <, <= shall not be applied to pointer types except where they point to the same array.
17.4	Array indexing shall be the only allowed form of pointer arithmetic.
17.5	The declaration of objects should contain no more than 2 levels of pointer indirection.
17.6	The address of an object with automatic storage shall not be assigned to an object that may persist after the object has ceased to exist.
18.3	An area of memory shall not be reused for unrelated purposes.
18.4	Unions shall not be used.

Rule number	Description
20.4	Dynamic heap memory allocation shall not be used.

Note Polyspace software does not check MISRA rule **18.3**.

Rules in SQO-Subset2

Good design practices generally lead to less code complexity, which can reduce the number of unproven results in Polyspace Code Prover. The following set of coding rules enforce good design practices. The `SQO-subset2` option checks the rules in `SQO-subset1` and some additional rules.

Rule number	Description
5.2	Identifiers in an inner scope shall not use the same name as an identifier in an outer scope, and therefore hide that identifier.
6.3	*typedefs* that indicate size and signedness should be used in place of the basic types
8.7	Objects shall be defined at block scope if they are only accessed from within a single function
8.11	The *static* storage class specifier shall be used in definitions and declarations of objects and functions that have internal linkage.
8.12	When an array is declared with external linkage, its size shall be stated explicitly or defined implicitly by initialization.
9.2	Braces shall be used to indicate and match the structure in the nonzero initialization of arrays and structures
9.3	In an enumerator list, the = construct shall not be used to explicitly initialize members other than the first, unless all items are explicitly initialized
10.3	The value of a complex expression of integer type may only be cast to a type that is narrower and of the same signedness as the underlying type of the expression
10.5	Bitwise operations shall not be performed on signed integer types
11.1	Conversion shall not be performed between a pointer to a function and any type other than an integral type
11.2	Conversion shall not be performed between a pointer to an object and any type other than an integral type, another pointer to a object type or a pointer to void.
11.3	A cast should not be performed between a pointer type and an integral type.
11.5	Type casting from any type to or from pointers shall not be used
12.1	Limited dependence should be placed on C's operator precedence rules in expressions
12.2	The value of an expression shall be the same under any order of evaluation that the standard permits
12.5	The operands of a logical && or || shall be primary-expressions

Rule number	Description
12.6	Operands of logical operators (&&, || and !) should be effectively Boolean. Expression that are effectively Boolean should not be used as operands to operators other than (&&, || or !)
12.9	The unary minus operator shall not be applied to an expression whose underlying type is unsigned
12.10	The comma operator shall not be used
12.12	The underlying bit representations of floating-point values shall not be used.
13.1	Assignment operators shall not be used in expressions that yield Boolean values
13.2	Tests of a value against zero should be made explicit, unless the operand is effectively Boolean
13.3	Floating-point expressions shall not be tested for equality or inequality.
13.4	The controlling expression of a *for* statement shall not contain any objects of floating type.
13.5	The three expressions of a *for* statement shall be concerned only with loop control.
13.6	Numeric variables being used within a “*for*” loop for iteration counting should not be modified in the body of the loop
14.4	The *goto* statement shall not be used.
14.7	A function shall have a single point of exit at the end of the function.
14.8	The statement forming the body of a *switch, while, do while* or *for* statement shall be a compound statement
14.10	All *if else if* constructs should contain a final *else* clause
15.3	The final clause of a *switch* statement shall be the *default* clause
16.1	Functions shall not be defined with variable numbers of arguments.
16.2	Functions shall not call themselves, either directly or indirectly.
16.3	Identifiers shall be given for all of the parameters in a function prototype declaration
16.7	A pointer parameter in a function prototype should be declared as pointer to const if the pointer is not used to modify the addressed object.
16.8	All exit paths from a function with non-void return type shall have an explicit return statement with an expression
16.9	A function identifier shall only be used with either a preceding &, or with a parenthesized parameter list, which may be empty
17.3	>, >=, <, <= shall not be applied to pointer types except where they point to the same array.
17.4	Array indexing shall be the only allowed form of pointer arithmetic.
17.5	The declaration of objects should contain no more than 2 levels of pointer indirection.
17.6	The address of an object with automatic storage shall not be assigned to an object that may persist after the object has ceased to exist.

Rule number	Description
18.3	An area of memory shall not be reused for unrelated purposes.
18.4	Unions shall not be used.
19.4	C macros shall only expand to a braced initializer, a constant, a parenthesized expression, a type qualifier, a storage class specifier, or a do-while-zero construct
19.9	Arguments to a function-like macro shall not contain tokens that look like preprocessing directives
19.10	In the definition of a function-like macro each instance of a parameter shall be enclosed in parentheses unless it is used as the operand of # or ##
19.11	All macro identifiers in preprocessor directives shall be defined before use, except in #ifdef and #ifndef preprocessor directives and the defined() operator
19.12	There shall be at most one occurrence of the # or ## preprocessor operators in a single macro definition.
20.3	The validity of values passed to library functions shall be checked.
20.4	Dynamic heap memory allocation shall not be used.

Note Polyspace software does not check MISRA rule **20.3** directly.

However, you can check this rule by writing manual stubs that check the validity of values. For example, the following code checks the validity of an input being greater than 1:

```
int my_system_library_call(int in) {assert (in>1); if random \
return -1 else return 0; }
```

See Also
`Check MISRA C:2004 (-misra2)`

More About
- “Check for Coding Standard Violations” on page 8-2

Software Quality Objective Subsets (AC AGC)

In this section...
"Rules in SQO-Subset1" on page 8-20
"Rules in SQO-Subset2" on page 8-20

Rules in SQO-Subset1

In Polyspace Code Prover, the following set of coding rules will typically reduce the number of unproven results.

Rule number	Description
5.2	Identifiers in an inner scope shall not use the same name as an identifier in an outer scope, and therefore hide that identifier.
8.11	The *static* storage class specifier shall be used in definitions and declarations of objects and functions that have internal linkage.
8.12	When an array is declared with external linkage, its size shall be stated explicitly or defined implicitly by initialization.
11.2	Conversion shall not be performed between a pointer to an object and any type other than an integral type, another pointer to a object type or a pointer to void.
11.3	A cast should not be performed between a pointer type and an integral type.
12.12	The underlying bit representations of floating-point values shall not be used.
14.7	A function shall have a single point of exit at the end of the function.
16.1	Functions shall not be defined with variable numbers of arguments.
16.2	Functions shall not call themselves, either directly or indirectly.
17.3	>, >=, <, <= shall not be applied to pointer types except where they point to the same array.
17.6	The address of an object with automatic storage shall not be assigned to an object that may persist after the object has ceased to exist.
18.4	Unions shall not be used.

For more information about these rules, see *MISRA AC AGC Guidelines for the Application of MISRA-C:2004 in the Context of Automatic Code Generation*.

Rules in SQO-Subset2

Good design practices generally lead to less code complexity, which can reduce the number of unproven results in Polyspace Code Prover. The following set of coding rules enforce good design practices. The `SQO-subset2` option checks the rules in `SQO-subset1` and some additional rules.

Rule number	Description
5.2	Identifiers in an inner scope shall not use the same name as an identifier in an outer scope, and therefore hide that identifier.

Rule number	Description
6.3	*typedefs* that indicate size and signedness should be used in place of the basic types
8.7	Objects shall be defined at block scope if they are only accessed from within a single function
8.11	The *static* storage class specifier shall be used in definitions and declarations of objects and functions that have internal linkage.
8.12	When an array is declared with external linkage, its size shall be stated explicitly or defined implicitly by initialization.
9.3	In an enumerator list, the = construct shall not be used to explicitly initialize members other than the first, unless all items are explicitly initialized
11.1	Conversion shall not be performed between a pointer to a function and any type other than an integral type
11.2	Conversion shall not be performed between a pointer to an object and any type other than an integral type, another pointer to a object type or a pointer to void.
11.3	A cast should not be performed between a pointer type and an integral type.
11.5	Type casting from any type to or from pointers shall not be used
12.2	The value of an expression shall be the same under any order of evaluation that the standard permits
12.9	The unary minus operator shall not be applied to an expression whose underlying type is unsigned
12.10	The comma operator shall not be used
12.12	The underlying bit representations of floating-point values shall not be used.
14.7	A function shall have a single point of exit at the end of the function.
16.1	Functions shall not be defined with variable numbers of arguments.
16.2	Functions shall not call themselves, either directly or indirectly.
16.3	Identifiers shall be given for all of the parameters in a function prototype declaration
16.8	All exit paths from a function with non-void return type shall have an explicit return statement with an expression
16.9	A function identifier shall only be used with either a preceding &, or with a parenthesized parameter list, which may be empty
17.3	>, >=, <, <= shall not be applied to pointer types except where they point to the same array.
17.6	The address of an object with automatic storage shall not be assigned to an object that may persist after the object has ceased to exist.
18.4	Unions shall not be used.
19.9	Arguments to a function-like macro shall not contain tokens that look like preprocessing directives
19.10	In the definition of a function-like macro each instance of a parameter shall be enclosed in parentheses unless it is used as the operand of # or ##

Rule number	Description
19.11	All macro identifiers in preprocessor directives shall be defined before use, except in #ifdef and #ifndef preprocessor directives and the defined() operator
19.12	There shall be at most one occurrence of the # or ## preprocessor operators in a single macro definition.
20.3	The validity of values passed to library functions shall be checked.

Note Polyspace software does not check MISRA rule **20.3** directly.

However, you can check this rule by writing manual stubs that check the validity of values. For example, the following code checks the validity of an input being greater than 1:

```
int my_system_library_call(int in) {assert (in>1); if random \
return -1 else return 0; }
```

For more information about these rules, see *MISRA AC AGC Guidelines for the Application of MISRA-C:2004 in the Context of Automatic Code Generation*.

See Also

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

More About

- "Check for Coding Standard Violations" on page 8-2

Software Quality Objective Subsets (C:2012)

In this section...

These subsets of MISRA C:2012 guidelines can have a direct or indirect impact on the precision of your Polyspace results. When you set up coding rules checking, you can select these subsets.

Guidelines in SQO-Subset1

The following set of MISRA C:2012 coding guidelines typically reduces the number of unproven results in Polyspace Code Prover.

Rule	Description
8.8	The static storage class specifier shall be used in all declarations of objects and functions that have internal linkage
8.11	When an array with external linkage is declared, its size should be explicitly specified
8.13	A pointer should point to a const-qualified type whenever possible
11.1	Conversions shall not be performed between a pointer to a function and any other type
11.2	Conversions shall not be performed between a pointer to an incomplete type and any other type
11.4	A conversion should not be performed between a pointer to object and an integer type
11.5	A conversion should not be performed from pointer to void into pointer to object
11.6	A cast shall not be performed between pointer to void and an arithmetic type
11.7	A cast shall not be performed between pointer to object and a non-integer arithmetic type
14.1	A loop counter shall not have essentially floating type
14.2	A for loop shall be well-formed
15.1	The goto statement should not be used
15.2	The goto statement shall jump to a label declared later in the same function
15.3	Any label referenced by a goto statement shall be declared in the same block, or in any block enclosing the goto statement
15.5	A function should have a single point of exit at the end
17.1	The features of <starg.h> shall not be used
17.2	Functions shall not call themselves, either directly or indirectly
18.3	The relational operators >, >=, < and <= shall not be applied to objects of pointer type except where they point into the same object
18.4	The +, -, += and -= operators should not be applied to an expression of pointer type

Rule	Description
18.5	Declarations should contain no more than two levels of pointer nesting
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
19.2	The union keyword should not be used
21.3	The memory allocation and deallocation functions of <stdlib.h> shall not be used

Guidelines in SQO-Subset2

Good design practices generally lead to less code complexity, which can reduce the number of unproven results in Polyspace Code Prover. The following set of coding rules enforce good design practices. The `SQO-subset2` option checks the rules in `SQO-subset1` and some additional rules.

Rule	Description
8.8	The static storage class specifier shall be used in all declarations of objects and functions that have internal linkage
8.11	When an array with external linkage is declared, its size should be explicitly specified
8.13	A pointer should point to a const-qualified type whenever possible
11.1	Conversions shall not be performed between a pointer to a function and any other type
11.2	Conversions shall not be performed between a pointer to an incomplete type and any other type
11.4	A conversion should not be performed between a pointer to object and an integer type
11.5	A conversion should not be performed from pointer to void into pointer to object
11.6	A cast shall not be performed between pointer to void and an arithmetic type
11.7	A cast shall not be performed between pointer to object and a non-integer arithmetic type
11.8	A cast shall not remove any const or volatile qualification from the type pointed to by a pointer
12.1	The precedence of operators within expressions should be made explicit
12.3	The comma operator should not be used
13.2	The value of an expression and its persistent side effects shall be the same under all permitted evaluation orders
13.4	The result of an assignment operator should not be used
14.1	A loop counter shall not have essentially floating type
14.2	A for loop shall be well-formed
14.4	The controlling expression of an if statement and the controlling expression of an iteration-statement shall have essentially Boolean type
15.1	The goto statement should not be used
15.2	The goto statement shall jump to a label declared later in the same function

Rule	Description
15.3	Any label referenced by a goto statement shall be declared in the same block, or in any block enclosing the goto statement
15.5	A function should have a single point of exit at the end
15.6	The body of an iteration- statement or a selection- statement shall be a compound-statement
15.7	All if … else if constructs shall be terminated with an else statement
16.4	Every switch statement shall have a default label
16.5	A default label shall appear as either the first or the last switch label of a switch statement
17.1	The features of <starg.h> shall not be used
17.2	Functions shall not call themselves, either directly or indirectly
17.4	All exit paths from a function with non-void return type shall have an explicit return statement with an expression
18.3	The relational operators >, >=, < and <= shall not be applied to objects of pointer type except where they point into the same object
18.4	The +, -, += and -= operators should not be applied to an expression of pointer type
18.5	Declarations should contain no more than two levels of pointer nesting
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
19.2	The union keyword should not be used
20.4	A macro shall not be defined with the same name as a keyword
20.6	Tokens that look like a preprocessing directive shall not occur within a macro argument
20.7	Expressions resulting from the expansion of macro parameters shall be enclosed in parentheses
20.9	All identifiers used in the controlling expression of #if or #elif preprocessing directives shall be #define'd before evaluation
20.11	A macro parameter immediately following a # operator shall not immediately be followed by a ## operator
21.3	The memory allocation and deallocation functions of <stdlib.h> shall not be used

See Also

`Check MISRA C:2012 (-misra3)`

More About

- "Check for Coding Standard Violations" on page 8-2

Software Quality Objective Subsets (C++)

In this section...

SQO Subset 1 – Direct Impact on Selectivity

The following set of MISRA C++ coding rules will typically improve the number of unproven results in Polyspace Code Prover.

MISRA C++ Rule	Description
2-10-2	Identifiers declared in an inner scope shall not hide an identifier declared in an outer scope.
3-1-3	When an array is declared, its size shall either be stated explicitly or defined implicitly by initialization.
3-3-2	The One Definition Rule shall not be violated.
3-9-3	The underlying bit representations of floating-point values shall not be used.
5-0-15	Array indexing shall be the only form of pointer arithmetic.
5-0-18	>, >=, <, <= shall not be applied to objects of pointer type, except where they point to the same array.
5-0-19	The declaration of objects shall contain no more than two levels of pointer indirection.
5-2-8	An object with integer type or pointer to void type shall not be converted to an object with pointer type.
5-2-9	A cast should not convert a pointer type to an integral type.
6-2-2	Floating-point expressions shall not be directly or indirectly tested for equality or inequality.
6-5-1	A for loop shall contain a single loop-counter which shall not have floating type.
6-5-2	If loop-counter is not modified by -- or ++, then, within condition, the loop-counter shall only be used as an operand to <=, <, > or >=.
6-5-3	The loop-counter shall not be modified within condition or statement.
6-5-4	The loop-counter shall be modified by one of: --, ++, -=n, or +=n ; where n remains constant for the duration of the loop.
6-6-1	Any label referenced by a goto statement shall be declared in the same block, or in a block enclosing the goto statement.
6-6-2	The goto statement shall jump to a label declared later in the same function body.
6-6-4	For any iteration statement there shall be no more than one break or goto statement used for loop termination.
6-6-5	A function shall have a single point of exit at the end of the function.
7-5-1	A function shall not return a reference or a pointer to an automatic variable (including parameters), defined within the function.

MISRA C++ Rule	Description
7-5-2	The address of an object with automatic storage shall not be assigned to another object that may persist after the first object has ceased to exist.
7-5-4	Functions should not call themselves, either directly or indirectly.
8-4-1	Functions shall not be defined using the ellipsis notation.
9-5-1	Unions shall not be used.
10-1-2	A base class shall only be declared virtual if it is used in a diamond hierarchy.
10-1-3	An accessible base class shall not be both virtual and nonvirtual in the same hierarchy.
10-3-1	There shall be no more than one definition of each virtual function on each path through the inheritance hierarchy.
10-3-2	Each overriding virtual function shall be declared with the virtual keyword.
10-3-3	A virtual function shall only be overridden by a pure virtual function if it is itself declared as pure virtual.
15-0-3	Control shall not be transferred into a try or catch block using a goto or a switch statement.
15-1-3	An empty throw (throw;) shall only be used in the compound- statement of a catch handler.
15-3-3	Handlers of a function-try-block implementation of a class constructor or destructor shall not reference non-static members from this class or its bases.
15-3-5	A class type exception shall always be caught by reference.
15-3-6	Where multiple handlers are provided in a single try-catch statement or function-try-block for a derived class and some or all of its bases, the handlers shall be ordered most-derived to base class.
15-3-7	Where multiple handlers are provided in a single try-catch statement or function-try-block, any ellipsis (catch-all) handler shall occur last.
15-4-1	If a function is declared with an exception-specification, then all declarations of the same function (in other translation units) shall be declared with the same set of type-ids.
15-5-1	A class destructor shall not exit with an exception.
15-5-2	Where a function's declaration includes an exception-specification, the function shall only be capable of throwing exceptions of the indicated type(s).
18-4-1	Dynamic heap memory allocation shall not be used.

SQO Subset 2 – Indirect Impact on Selectivity

Good design practices generally lead to less code complexity, which can improve the number of unproven results in Polyspace Code Prover. The following set of coding rules may help to address design issues in your code. The `SQO-subset2` option checks the rules in `SQO-subset1` and `SQO-subset2`.

MISRA C++ Rule	Description
2-10-2	Identifiers declared in an inner scope shall not hide an identifier declared in an outer scope.

MISRA C++ Rule	Description
3-1-3	When an array is declared, its size shall either be stated explicitly or defined implicitly by initialization.
3-3-2	If a function has internal linkage then all re-declarations shall include the static storage class specifier.
3-4-1	An identifier declared to be an object or type shall be defined in a block that minimizes its visibility.
3-9-2	typedefs that indicate size and signedness should be used in place of the basic numerical types.
3-9-3	The underlying bit representations of floating-point values shall not be used.
4-5-1	Expressions with type bool shall not be used as operands to built-in operators other than the assignment operator =, the logical operators &&, ||, !, the equality operators == and !=, the unary & operator, and the conditional operator.
5-0-1	The value of an expression shall be the same under any order of evaluation that the standard permits.
5-0-2	Limited dependence should be placed on C++ operator precedence rules in expressions.
5-0-7	There shall be no explicit floating-integral conversions of a cvalue expression.
5-0-8	An explicit integral or floating-point conversion shall not increase the size of the underlying type of a cvalue expression.
5-0-9	An explicit integral conversion shall not change the signedness of the underlying type of a cvalue expression.
5-0-10	If the bitwise operators ~ and << are applied to an operand with an underlying type of unsigned char or unsigned short, the result shall be immediately cast to the underlying type of the operand.
5-0-13	The condition of an if-statement and the condition of an iteration- statement shall have type bool
5-0-15	Array indexing shall be the only form of pointer arithmetic.
5-0-18	>, >=, <, <= shall not be applied to objects of pointer type, except where they point to the same array.
5-0-19	The declaration of objects shall contain no more than two levels of pointer indirection.
5-2-1	Each operand of a logical && or || shall be a postfix - expression.
5-2-2	A pointer to a virtual base class shall only be cast to a pointer to a derived class by means of dynamic_cast.
5-2-5	A cast shall not remove any const or volatile qualification from the type of a pointer or reference.
5-2-6	A cast shall not convert a pointer to a function to any other pointer type, including a pointer to function type.
5-2-7	An object with pointer type shall not be converted to an unrelated pointer type, either directly or indirectly.
5-2-8	An object with integer type or pointer to void type shall not be converted to an object with pointer type.
5-2-9	A cast should not convert a pointer type to an integral type.

MISRA C++ Rule	Description
5-2-11	The comma operator, && operator and the || operator shall not be overloaded.
5-3-2	The unary minus operator shall not be applied to an expression whose underlying type is unsigned.
5-3-3	The unary & operator shall not be overloaded.
5-18-1	The comma operator shall not be used.
6-2-1	Assignment operators shall not be used in sub-expressions.
6-2-2	Floating-point expressions shall not be directly or indirectly tested for equality or inequality.
6-3-1	The statement forming the body of a switch, while, do ... while or for statement shall be a compound statement.
6-4-2	All if ... else if constructs shall be terminated with an else clause.
6-4-6	The final clause of a switch statement shall be the default-clause.
6-5-1	A for loop shall contain a single loop-counter which shall not have floating type.
6-5-2	If loop-counter is not modified by -- or ++, then, within condition, the loop-counter shall only be used as an operand to <=, <, > or >=.
6-5-3	The loop-counter shall not be modified within condition or statement.
6-5-4	The loop-counter shall be modified by one of: --, ++, -=n, or +=n ; where n remains constant for the duration of the loop.
6-6-1	Any label referenced by a goto statement shall be declared in the same block, or in a block enclosing the goto statement.
6-6-2	The goto statement shall jump to a label declared later in the same function body.
6-6-4	For any iteration statement there shall be no more than one break or goto statement used for loop termination.
6-6-5	A function shall have a single point of exit at the end of the function.
7-5-1	A function shall not return a reference or a pointer to an automatic variable (including parameters), defined within the function.
7-5-2	The address of an object with automatic storage shall not be assigned to another object that may persist after the first object has ceased to exist.
7-5-4	Functions should not call themselves, either directly or indirectly.
8-4-1	Functions shall not be defined using the ellipsis notation.
8-4-3	All exit paths from a function with non- void return type shall have an explicit return statement with an expression.
8-4-4	A function identifier shall either be used to call the function or it shall be preceded by &.
8-5-2	Braces shall be used to indicate and match the structure in the non- zero initialization of arrays and structures.
8-5-3	In an enumerator list, the = construct shall not be used to explicitly initialize members other than the first, unless all items are explicitly initialized.
9-5-1	Unions shall not be used.
10-1-2	A base class shall only be declared virtual if it is used in a diamond hierarchy.

MISRA C++ Rule	Description
10-1-3	An accessible base class shall not be both virtual and nonvirtual in the same hierarchy.
10-3-1	There shall be no more than one definition of each virtual function on each path through the inheritance hierarchy.
10-3-2	Each overriding virtual function shall be declared with the virtual keyword.
10-3-3	A virtual function shall only be overridden by a pure virtual function if it is itself declared as pure virtual.
11-0-1	Member data in non- POD class types shall be private.
12-1-1	An object's dynamic type shall not be used from the body of its constructor or destructor.
12-8-2	The copy assignment operator shall be declared protected or private in an abstract class.
15-0-3	Control shall not be transferred into a try or catch block using a goto or a switch statement.
15-1-3	An empty throw (throw;) shall only be used in the compound- statement of a catch handler.
15-3-3	Handlers of a function-try-block implementation of a class constructor or destructor shall not reference non-static members from this class or its bases.
15-3-5	A class type exception shall always be caught by reference.
15-3-6	Where multiple handlers are provided in a single try-catch statement or function-try-block for a derived class and some or all of its bases, the handlers shall be ordered most-derived to base class.
15-3-7	Where multiple handlers are provided in a single try-catch statement or function-try-block, any ellipsis (catch-all) handler shall occur last.
15-4-1	If a function is declared with an exception-specification, then all declarations of the same function (in other translation units) shall be declared with the same set of type-ids.
15-5-1	A class destructor shall not exit with an exception.
15-5-2	Where a function's declaration includes an exception-specification, the function shall only be capable of throwing exceptions of the indicated type(s).
16-0-5	Arguments to a function-like macro shall not contain tokens that look like preprocessing directives.
16-0-6	In the definition of a function-like macro, each instance of a parameter shall be enclosed in parentheses, unless it is used as the operand of # or ##.
16-0-7	Undefined macro identifiers shall not be used in #if or #elif preprocessor directives, except as operands to the defined operator.
16-2-2	C++ macros shall only be used for: include guards, type qualifiers, or storage class specifiers.
16-3-1	There shall be at most one occurrence of the # or ## operators in a single macro definition.
18-4-1	Dynamic heap memory allocation shall not be used.

See Also

`Check MISRA C++:2008 (-misra-cpp)`

More About

- "Check for Coding Standard Violations" on page 8-2

Coding Rule Subsets Checked Early in Analysis

In the initial compilation phase of the analysis, Polyspace checks those coding rules that do not require the run-time error detection part of the analysis. If you want only those rules checked, you can perform a much quicker analysis.

The software provides two predefined subsets of rules that it checks earlier in the analysis. The subsets are available with the options `Check MISRA C:2004 (-misra2)`, `Check MISRA AC AGC (-misra-ac-agc)`, and `Check MISRA C:2012 (-misra3)`.

Argument	Purpose
`single-unit-rules`	Check rules that apply only to single translation units. If you detect only coding rule violations and select this subset, a Bug Finder analysis stops after the compilation phase.
`system-decidable-rules`	Check rules in the `single-unit-rules` subset and some rules that apply to the collective set of program files. The additional rules are the less complex rules that apply at the integration level. These rules can be checked only at the integration level because the rules involve more than one translation unit. If you detect only coding rule violations and select this subset, a Bug Finder analysis stops after the linking phase.

See also “Check for Coding Standard Violations” on page 8-2.

MISRA C:2004 and MISRA AC AGC Rules

The software checks the following rules early in the analysis. The rules that are checked at a system level and appear only in the `system-decidable-rules` subset are indicated by an asterisk.

Environment

Rule	Description
1.1*	All code shall conform to ISO 9899:1990 "Programming languages - C", amended and corrected by ISO/IEC 9899/COR1:1995, ISO/IEC 9899/AMD1:1995, and ISO/IEC 9899/COR2:1996.

Language Extensions

Rule	Description
2.1	Assembly language shall be encapsulated and isolated.
2.2	Source code shall only use `/* */` style comments.
2.3	The character sequence `/*` shall not be used within a comment.

Documentation

Rule	Description
3.4	All uses of the `#pragma` directive shall be documented and explained.

Character Sets

Rule	Description
4.1	Only those escape sequences which are defined in the ISO C standard shall be used.
4.2	Trigraphs shall not be used.

Identifiers

Rule	Description
5.1*	Identifiers (internal and external) shall not rely on the significance of more than 31 characters.
5.2	Identifiers in an inner scope shall not use the same name as an identifier in an outer scope, and therefore hide that identifier.
5.3*	A typedef name shall be a unique identifier.
5.4*	A tag name shall be a unique identifier.
5.5*	No object or function identifier with a static storage duration should be reused.
5.6*	No identifier in one name space should have the same spelling as an identifier in another name space, with the exception of structure and union member names.
5.7*	No identifier name should be reused.

Types

Rule	Description
6.1	The plain char type shall be used only for the storage and use of character values.
6.2	Signed and unsigned char type shall be used only for the storage and use of numeric values.
6.3	`typedefs` that indicate size and signedness should be used in place of the basic types.
6.4	Bit fields shall only be defined to be of type `unsigned int` or `signed int`.
6.5	Bit fields of type `signed int` shall be at least 2 bits long.

Constants

Rule	Description
7.1	Octal constants (other than zero) and octal escape sequences shall not be used.

Declarations and Definitions

Rule	Description
8.1	Functions shall have prototype declarations and the prototype shall be visible at both the function definition and call.
8.2	Whenever an object or function is declared or defined, its type shall be explicitly stated.
8.3	For each function parameter the type given in the declaration and definition shall be identical, and the return types shall also be identical.
8.4*	If objects or functions are declared more than once their types shall be compatible.
8.5	There shall be no definitions of objects or functions in a header file.
8.6	Functions shall always be declared at file scope.
8.7	Objects shall be defined at block scope if they are only accessed from within a single function.
8.8*	An external object or function shall be declared in one file and only one file.
8.9*	An identifier with external linkage shall have exactly one external definition.
8.10*	All declarations and definitions of objects or functions at file scope shall have internal linkage unless external linkage is required.
8.11	The `static` storage class specifier shall be used in definitions and declarations of objects and functions that have internal linkage
8.12	When an array is declared with external linkage, its size shall be stated explicitly or defined implicitly by initialization.

Initialization

Rule	Description
9.2	Braces shall be used to indicate and match the structure in the nonzero initialization of arrays and structures.
9.3	In an enumerator list, the = construct shall not be used to explicitly initialize members other than the first, unless all items are explicitly initialized.

Arithmetic Type Conversion

Rule	Description
10.1	The value of an expression of integer type shall not be implicitly converted to a different underlying type if: • It is not a conversion to a wider integer type of the same signedness, or • The expression is complex, or • The expression is not constant and is a function argument, or • The expression is not constant and is a return expression
10.2	The value of an expression of floating type shall not be implicitly converted to a different type if • It is not a conversion to a wider floating type, or • The expression is complex, or • The expression is a function argument, or • The expression is a return expression
10.3	The value of a complex expression of integer type may only be cast to a type that is narrower and of the same signedness as the underlying type of the expression.
10.4	The value of a complex expression of float type may only be cast to narrower floating type.
10.5	If the bitwise operator ~ and << are applied to an operand of underlying type `unsigned char` or `unsigned short`, the result shall be immediately cast to the underlying type of the operand
10.6	The "U" suffix shall be applied to all constants of `unsigned` types.

Pointer Type Conversion

Rule	Description
11.1	Conversion shall not be performed between a pointer to a function and any type other than an integral type.
11.2	Conversion shall not be performed between a pointer to an object and any type other than an integral type, another pointer to a object type or a pointer to `void`.
11.3	A cast should not be performed between a pointer type and an integral type.
11.4	A cast should not be performed between a pointer to object type and a different pointer to object type.
11.5	A cast shall not be performed that removes any `const` or `volatile` qualification from the type addressed by a pointer

Expressions

Rule	Description
12.1	Limited dependence should be placed on C's operator precedence rules in expressions.
12.3	The `sizeof` operator should not be used on expressions that contain side effects.
12.5	The operands of a logical && or `||` shall be primary-expressions.
12.6	Operands of logical operators (&&, `||` and `!`) should be effectively Boolean. Expression that are effectively Boolean should not be used as operands to operators other than (&&, `||` or `!`).
12.7	Bitwise operators shall not be applied to operands whose underlying type is signed.
12.9	The unary minus operator shall not be applied to an expression whose underlying type is unsigned.
12.10	The comma operator shall not be used.
12.11	Evaluation of constant unsigned expression should not lead to wraparound.
12.12	The underlying bit representations of floating-point values shall not be used.
12.13	The increment (`++`) and decrement (`--`) operators should not be mixed with other operators in an expression

Control Statement Expressions

Rule	Description
13.1	Assignment operators shall not be used in expressions that yield Boolean values.
13.2	Tests of a value against zero should be made explicit, unless the operand is effectively Boolean.
13.3	Floating-point expressions shall not be tested for equality or inequality.
13.4	The controlling expression of a `for` statement shall not contain any objects of floating type.
13.5	The three expressions of a `for` statement shall be concerned only with loop control.
13.6	Numeric variables being used within a `for` loop for iteration counting should not be modified in the body of the loop.

Control Flow

Rule	Description
14.3	All non-null statements shall either • have at least one side effect however executed, or • cause control flow to change.
14.4	The `goto` statement shall not be used.
14.5	The `continue` statement shall not be used.
14.6	For any iteration statement, there shall be at most one `break` statement used for loop termination.
14.7	A function shall have a single point of exit at the end of the function.
14.8	The statement forming the body of a `switch`, `while`, `do while` or `for` statement shall be a compound statement.
14.9	An `if` (expression) construct shall be followed by a compound statement. The `else` keyword shall be followed by either a compound statement, or another `if` statement.
14.10	All `if else if` constructs should contain a final `else` clause.

Switch Statements

Rule	Description
15.0	Unreachable code is detected between `switch` statement and first `case`.
15.1	A `switch` label shall only be used when the most closely-enclosing compound statement is the body of a `switch` statement
15.2	An unconditional `break` statement shall terminate every non-empty `switch` clause.
15.3	The final clause of a `switch` statement shall be the `default` clause.
15.4	A `switch` expression should not represent a value that is effectively Boolean.
15.5	Every `switch` statement shall have at least one `case` clause.

Functions

Rule	Description
16.1	Functions shall not be defined with variable numbers of arguments.
16.3	Identifiers shall be given for all of the parameters in a function prototype declaration.
16.4*	The identifiers used in the declaration and definition of a function shall be identical.
16.5	Functions with no parameters shall be declared with parameter type `void`.
16.6	The number of arguments passed to a function shall match the number of parameters.
16.8	All exit paths from a function with non-`void` return type shall have an explicit return statement with an expression.
16.9	A function identifier shall only be used with either a preceding &, or with a parenthesized parameter list, which may be empty.

Pointers and Arrays

Rule	Description
17.4	Array indexing shall be the only allowed form of pointer arithmetic.
17.5	A type should not contain more than 2 levels of pointer indirection.

Structures and Unions

Rule	Description
18.1	All structure or union types shall be complete at the end of a translation unit.
18.4	Unions shall not be used.

Preprocessing Directives

Rule	Description
19.1	`#include` statements in a file shall only be preceded by other preprocessors directives or comments.
19.2	Nonstandard characters should not occur in header file names in `#include` directives.
19.3	The `#include` directive shall be followed by either a <filename> or "filename" sequence.
19.4	C macros shall only expand to a braced initializer, a constant, a parenthesized expression, a type qualifier, a storage class specifier, or a do-while-zero construct.
19.5	Macros shall not be `#define`d and `#undefd` within a block.
19.6	`#undef` shall not be used.
19.7	A function should be used in preference to a function like-macro.
19.8	A function-like macro shall not be invoked without all of its arguments.
19.9	Arguments to a function-like macro shall not contain tokens that look like preprocessing directives.
19.10	In the definition of a function-like macro, each instance of a parameter shall be enclosed in parentheses unless it is used as the operand of # or ##.
19.11	All macro identifiers in preprocessor directives shall be defined before use, except in `#ifdef` and `#ifndef` preprocessor directives and the `defined()` operator.
19.12	There shall be at most one occurrence of the # or ## preprocessor operators in a single macro definition.
19.13	The # and ## preprocessor operators should not be used.
19.14	The defined preprocessor operator shall only be used in one of the two standard forms.
19.15	Precautions shall be taken in order to prevent the contents of a header file being included twice.
19.16	Preprocessing directives shall be syntactically meaningful even when excluded by the preprocessor.
19.17	All `#else`, `#elif` and `#endif` preprocessor directives shall reside in the same file as the `#if` or `#ifdef` directive to which they are related.

Standard Libraries

Rule	Description
20.1	Reserved identifiers, macros and functions in the standard library, shall not be defined, redefined or undefined.
20.2	The names of standard library macros, objects and functions shall not be reused.
20.4	Dynamic heap memory allocation shall not be used.
20.5	The error indicator `errno` shall not be used.
20.6	The macro `offsetof`, in library `<stddef.h>`, shall not be used.
20.7	The `setjmp` macro and the `longjmp` function shall not be used.
20.8	The signal handling facilities of `<signal.h>` shall not be used.
20.9	The input/output library `<stdio.h>` shall not be used in production code.
20.10	The library functions `atof`, `atoi` and `atoll` from library `<stdlib.h>` shall not be used.
20.11	The library functions `abort`, `exit`, `getenv` and `system` from library `<stdlib.h>` shall not be used.
20.12	The time handling functions of library `<time.h>` shall not be used.

The rules that are checked at a system level and appear only in the `system-decidable-rules` subset are indicated by an asterisk.

MISRA C:2012 Rules

The software checks the following rules early in the analysis. The rules that are checked at a system level and appear only in the `system-decidable-rules` subset are indicated by an asterisk.

Standard C Environment

Rule	Description
1.1	The program shall contain no violations of the standard C syntax and constraints, and shall not exceed the implementation's translation limits.
1.2	Language extensions should not be used.

Unused Code

Rule	Description
2.3*	A project should not contain unused type declarations.
2.4*	A project should not contain unused tag declarations.
2.5*	A project should not contain unused macro declarations.
2.6	A function should not contain unused label declarations.
2.7	There should be no unused parameters in functions.

Comments

Rule	Description
3.1	The character sequences `/*` and `//` shall not be used within a comment.
3.2	Line-splicing shall not be used in `//` comments.

Character Sets and Lexical Conventions

Rule	Description
4.1	Octal and hexadecimal escape sequences shall be terminated.
4.2	Trigraphs should not be used.

Identifiers

Rule	Description
5.1*	External identifiers shall be distinct.
5.2	Identifiers declared in the same scope and name space shall be distinct.
5.3	An identifier declared in an inner scope shall not hide an identifier declared in an outer scope.
5.4	Macro identifiers shall be distinct.
5.5	Identifiers shall be distinct from macro names.
5.6*	A typedef name shall be a unique identifier.
5.7*	A tag name shall be a unique identifier.
5.8*	Identifiers that define objects or functions with external linkage shall be unique.
5.9*	Identifiers that define objects or functions with internal linkage should be unique.

Types

Rule	Description
6.1	Bit-fields shall only be declared with an appropriate type.
6.2	Single-bit named bit fields shall not be of a signed type.

Literals and Constants

Rule	Description
7.1	Octal constants shall not be used.
7.2	A "u" or "U" suffix shall be applied to all integer constants that are represented in an unsigned type.
7.3	The lowercase character "l" shall not be used in a literal suffix.
7.4	A string literal shall not be assigned to an object unless the object's type is "pointer to const-qualified char".

Declarations and Definitions

Rule	Description
8.1	Types shall be explicitly specified.
8.2	Function types shall be in prototype form with named parameters.
8.3*	All declarations of an object or function shall use the same names and type qualifiers.
8.4	A compatible declaration shall be visible when an object or function with external linkage is defined.
8.5*	An external object or function shall be declared once in one and only one file.
8.6*	An identifier with external linkage shall have exactly one external definition.
8.7*	Functions and objects should not be defined with external linkage if they are referenced in only one translation unit.
8.8	The `static` storage class specifier shall be used in all declarations of objects and functions that have internal linkage.
8.9*	An object should be defined at block scope if its identifier only appears in a single function.
8.10	An inline function shall be declared with the `static` storage class.
8.11	When an array with external linkage is declared, its size should be explicitly specified.
8.12	Within an enumerator list, the value of an implicitly-specified enumeration constant shall be unique.
8.14	The `restrict` type qualifier shall not be used.

Initialization

Rule	Description
9.2	The initializer for an aggregate or union shall be enclosed in braces.
9.3	Arrays shall not be partially initialized.
9.4	An element of an object shall not be initialized more than once.
9.5	Where designated initializers are used to initialize an array object the size of the array shall be specified explicitly.

The Essential Type Model

Rule	Description
10.1	Operands shall not be of an inappropriate essential type.
10.2	Expressions of essentially character type shall not be used inappropriately in addition and subtraction operations.
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.
10.4	Both operands of an operator in which the usual arithmetic conversions are performed shall have the same essential type category.
10.5	The value of an expression should not be cast to an inappropriate essential type.
10.6	The value of a composite expression shall not be assigned to an object with wider essential type.
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.
10.8	The value of a composite expression shall not be cast to a different essential type category or a wider essential type.

Pointer Type Conversion

Rule	Description
11.1	Conversions shall not be performed between a pointer to a function and any other type.
11.2	Conversions shall not be performed between a pointer to an incomplete type and any other type.
11.3	A cast shall not be performed between a pointer to object type and a pointer to a different object type.
11.4	A conversion should not be performed between a pointer to object and an integer type.
11.5	A conversion should not be performed from pointer to void into pointer to object.
11.6	A cast shall not be performed between pointer to void and an arithmetic type.
11.7	A cast shall not be performed between pointer to object and a non-integer arithmetic type.
11.8	A cast shall not remove any const or volatile qualification from the type pointed to by a pointer.
11.9	The macro `NULL` shall be the only permitted form of integer null pointer constant.

Expressions

Rule	Description
12.1	The precedence of operators within expressions should be made explicit.
12.3	The comma operator should not be used.
12.4	Evaluation of constant expressions should not lead to unsigned integer wrap-around.

Side Effects

Rule	Description
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.
13.4	The result of an assignment operator should not be used.
13.6	The operand of the `sizeof` operator shall not contain any expression which has potential side effects.

Control Statement Expressions

Rule	Description
14.4	The controlling expression of an `if` statement and the controlling expression of an iteration-statement shall have essentially Boolean type.

Control Flow

Rule	Description
15.1	The `goto` statement should not be used.
15.2	The `goto` statement shall jump to a label declared later in the same function.
15.3	Any label referenced by a `goto` statement shall be declared in the same block, or in any block enclosing the `goto` statement.
15.4	There should be no more than one `break` or `goto` statement used to terminate any iteration statement.
15.5	A function should have a single point of exit at the end
15.6	The body of an iteration-statement or a selection-statement shall be a compound statement.
15.7	All `if … else if` constructs shall be terminated with an `else` statement.

Switch Statements

Rule	Description
16.1	All `switch` statements shall be well-formed.
16.2	A `switch` label shall only be used when the most closely-enclosing compound statement is the body of a `switch` statement.
16.3	An unconditional `break` statement shall terminate every `switch`-clause.
16.4	Every `switch` statement shall have a `default` label.
16.5	A `default` label shall appear as either the first or the last `switch` label of a `switch` statement.
16.6	Every `switch` statement shall have at least two `switch`-clauses.
16.7	A `switch`-expression shall not have essentially Boolean type.

Functions

Rule	Description
17.1	The features of `<starg.h>` shall not be used.
17.3	A function shall not be declared implicitly.
17.4	All exit paths from a function with non-`void` return type shall have an explicit return statement with an expression.
17.6	The declaration of an array parameter shall not contain the `static` keyword between the `[ ]`.
17.7	The value returned by a function having non-`void` return type shall be used.

Pointers and Arrays

Rule	Description
18.4	The `+`, `-`, `+=` and `-=` operators should not be applied to an expression of pointer type.
18.5	Declarations should contain no more than two levels of pointer nesting.
18.7	Flexible array members shall not be declared.
18.8	Variable-length array types shall not be used.

Overlapping Storage

Rule	Description
19.2	The `union` keyword should not be used.

Preprocessing Directives

Rule	Description
20.1	`#include` directives should only be preceded by preprocessor directives or comments.
20.2	The `'`, `"`, or `\` characters and the `/*` or `//` character sequences shall not occur in a header file name.
20.3	The `#include` directive shall be followed by either a <filename> or \"filename\" sequence.
20.4	A macro shall not be defined with the same name as a keyword.
20.5	`#undef` should not be used.
20.6	Tokens that look like a preprocessing directive shall not occur within a macro argument.
20.7	Expressions resulting from the expansion of macro parameters shall be enclosed in parentheses.
20.8	The controlling expression of a `#if` or `#elif` preprocessing directive shall evaluate to 0 or 1.
20.9	All identifiers used in the controlling expression of `#if` or `#elif` preprocessing directives shall be `#define`'d before evaluation.
20.10	The # and ## preprocessor operators should not be used.
20.11	A macro parameter immediately following a # operator shall not immediately be followed by a ## operator.
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.
20.13	A line whose first token is # shall be a valid preprocessing directive.
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.

Standard Libraries

Rule	Description
21.1	`#define` and `#undef` shall not be used on a reserved identifier or reserved macro name.
21.2	A reserved identifier or macro name shall not be declared.
21.3	The memory allocation and deallocation functions of `<stdlib.h>` shall not be used.
21.4	The standard header file `<setjmp.h>` shall not be used.
21.5	The standard header file `<signal.h>` shall not be used.
21.6	The Standard Library input/output functions shall not be used.
21.7	The `atof`, `atoi`, `atol`, and `atoll` functions of `<stdlib.h>` shall not be used.
21.8	The library functions `abort`, `exit`, `getenv` and `system` of `<stdlib.h>` shall not be used.
21.9	The library functions `bsearch` and `qsort` of `<stdlib.h>` shall not be used.
21.10	The Standard Library time and date functions shall not be used.
21.11	The standard header file `<tgmath.h>` shall not be used.
21.12	The exception handling features of `<fenv.h>` should not be used.

The rules that are checked at a system level and appear only in the `system-decidable-rules` subset are indicated by an asterisk.

See Also

`Check MISRA AC AGC (-misra-ac-agc)` | `Check MISRA C:2004 (-misra2)` | `Check MISRA C:2012 (-misra3)`

More About

- “Check for Coding Standard Violations” on page 8-2

Create Custom Coding Rules

This example shows how to create a custom coding rules file. You can use this file to check names or text patterns in your source code against custom rules that you specify. For each rule, you specify a pattern in the form of a regular expression. The software compares the pattern against identifiers in the source code and determines whether the custom rule is violated.

The tutorial uses the following code stored in a file `printInitialValue.c`:

```
#include <stdio.h>

typedef struct {
    int a;
    int b;
} collection;

void main()
{
    collection myCollection= {0,0};
    printf("Initial values in the collection are %d and %d.",
           myCollection.a,myCollection.b);
}
```

User Interface (Desktop Products Only)

1 Create a Polyspace project. Add `printInitialValue.c` to the project.

2 On the **Configuration** pane, select **Coding Standards & Code Metrics**. Select the **Check custom rules** box.

3 Click Edit.

The **Findings selection** window opens, displaying in the left pane all the coding standards Polyspace supports, and with the **Custom** node highlighted.

4 Specify the rules to check for in the right pane.

Expand the **4 Structs** node. For the option **4.3 All struct fields must follow the specified pattern**:

Column Title	Action
Status	Select ✓.
Convention	Enter `All struct fields must begin with s_ and have capital letters or digits`
Pattern	Enter `s_[A-Z0-9_]+`
Comment	Leave blank. This column is for comments that appear in the coding rules file alone.

5 Save the file and run the analysis. On the **Results List** pane, you see two violations of rule 4.3. Select the first violation.

   a. On the **Source** pane, the line `int a;` is marked.
   b. On the **Result Details** pane, you see the error message that you had entered, `All struct fields must begin with s_ and have capital letters`
6. Right-click the **Source** pane and select **Open Editor**. The file `printInitialValue.c` opens in the **Code Editor** pane or an external text editor depending on your **Preferences**.
7. In the file, replace all instances of `a` with `s_A` and `b` with `s_B`. Rerun the analysis.

   The custom rule violations no longer appear on the **Results List** pane.

Command Line

With the Polyspace desktop products, you can create a coding standard XML file in the user interface and then use this file for command-line analysis. Provide this XML file with the option `Set checkers by file (-checkers-selection-file)`.

With the Polyspace Server products, you have to create a coding standard XML from scratch. Make a writable copy of the file `custom_rules.xml` in *`polyspaceserverroot`*`\help\toolbox\polyspace_bug_finder_server\examples\coding_standards_XML` and turn off rules using entries in the XML file (all rules from a standard are enabled in the template). Here, *`polyspaceserverroot`* is the root installation folder for the Polyspace Server products, for instance, `C:\Program Files\Polyspace Server\R2019a`.

For instance, for custom rule 4.3 to be disabled, the configuration file must contain these lines:

```
<standard name="CUSTOM RULES">
  ...
  <section name="4 Structs">
      ...
      <check id="4.3" state="off">
      </check>
      ...
  </section>
  ...
</standard>
```

Provide this file as argument for the option `Set checkers by file (-checkers-selection-file)` during analysis, along with the option `Check custom rules (-custom-rules)`. For instance, for custom rules checking with Polyspace Code Prover Server, enter:

```
polyspace-code-prover-server -sources file -custom-rules from-file
                             -checkers-selection-file custom_rules.xml
```

See Also

`Check custom rules (-custom-rules)`

Compute Code Complexity Metrics

This example shows how to review the code complexity metrics that Polyspace computes. For information on the individual metrics, see “Code Metrics” (Polyspace Bug Finder Access).

Polyspace does not compute code complexity metrics by default. To compute them during analysis, use the option `Calculate code metrics (-code-metrics)`.

After analysis, the software displays project, file and function metrics on the **Results List** pane. You can compare the computed metric values against predefined limits. If a metric value exceeds limits, you can redesign your code to lower the metric value. For instance, if the number of called functions is high and several of those functions are always called together, you can write one function that fuses the bodies of those functions. Call that one function instead of the group of functions that are called together.

Impose Limits on Metrics (Desktop Products Only)

In the user interface of the Polyspace desktop products, open some results with metrics computations. Then impose limits on the metric values and update results on the **Results List** pane to show only metric values that exceed the limits.

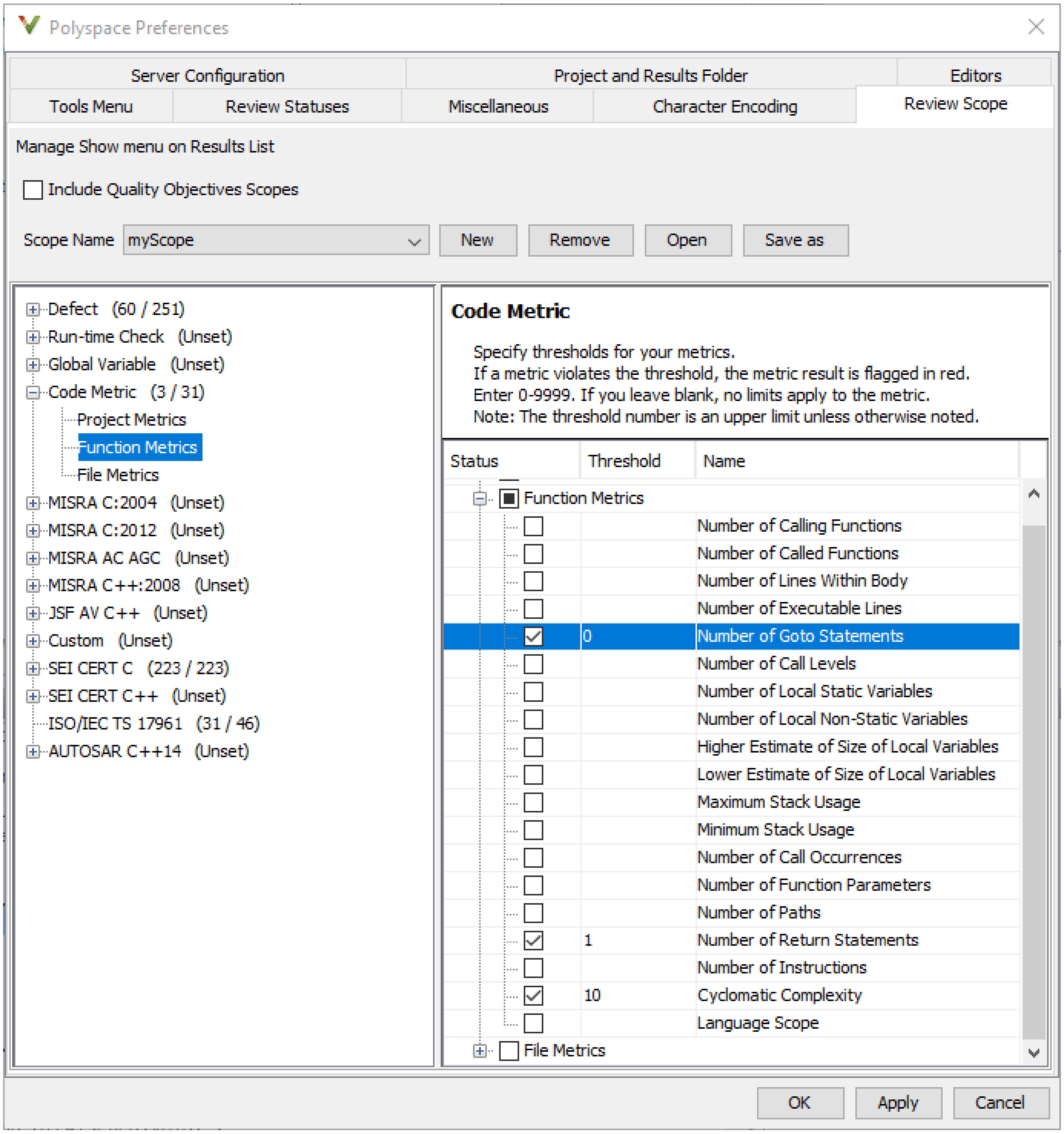
1 Select **Tools** > **Preferences**.
2 On the **Review Scope** tab, do one of the following:

   - To use a predefined limit, select **Include Quality Objectives Scopes**.

     The **Scope Name** list shows the additional option `HIS`. The option `HIS` displays the HIS code metrics on page 8-52 only. Select the option to see the limit values.
   - To define your own limits, select **New**. Save your limits file.

     On the left pane, select **Code Metric**. On the right, select a metric and specify a limit value for the metric. Other than **Comment Density**, limit values are upper limits.

     To select all metrics in a category such as **Function Metrics**, select the box next to the category name. For more information on the metrics categories, see “Code Metrics” (Polyspace Bug Finder Access). If only a some metrics in a category are selected, the check box next to the category name displays a ▣ symbol.


Polyspace Preferences

Server Configuration | Project and Results Folder | Editors
Tools Menu | Review Statuses | Miscellaneous | Character Encoding | Review Scope

Manage Show menu on Results List

☐ Include Quality Objectives Scopes

Scope Name: myScope — New | Remove | Open | Save as

- Defect (60 / 251)
- Run-time Check (Unset)
- Global Variable (Unset)
- Code Metric (3 / 31)
  - Project Metrics
  - Function Metrics
  - File Metrics
- MISRA C:2004 (Unset)
- MISRA C:2012 (Unset)
- MISRA AC AGC (Unset)
- MISRA C++:2008 (Unset)
- JSF AV C++ (Unset)
- Custom (Unset)
- SEI CERT C (223 / 223)
- SEI CERT C++ (Unset)
- ISO/IEC TS 17961 (31 / 46)
- AUTOSAR C++14 (Unset)

Code Metric

Specify thresholds for your metrics.
If a metric violates the threshold, the metric result is flagged in red.
Enter 0-9999. If you leave blank, no limits apply to the metric.
Note: The threshold number is an upper limit unless otherwise noted.

Status	Threshold	Name
■		Function Metrics
☐		Number of Calling Functions
☐		Number of Called Functions
☐		Number of Lines Within Body
☐		Number of Executable Lines
✓	0	Number of Goto Statements
☐		Number of Call Levels
☐		Number of Local Static Variables
☐		Number of Local Non-Static Variables
☐		Higher Estimate of Size of Local Variables
☐		Lower Estimate of Size of Local Variables
☐		Maximum Stack Usage
☐		Minimum Stack Usage
☐		Number of Call Occurrences
☐		Number of Function Parameters
☐		Number of Paths
✓	1	Number of Return Statements
☐		Number of Instructions
✓	10	Cyclomatic Complexity
☐		Language Scope
☐		File Metrics

OK | Apply | Cancel

3 Select **Apply** or **OK**.

The drop-down list in the left of the **Results List** pane toolbar displays additional options.

- If you use predefined limits, the option `HIS` appears. This option displays code metrics only.

- If you define your own limits, the option corresponding to your limits file name appears.

4 Select the option corresponding to the limits that you want. Only metric values that violate your limits appear on the **Results List** pane.

5 Review each violation and decide how to rework your code to avoid the violation.

Note To enforce coding standards across your organization, share your limits file that you saved in XML format.

People in your organization can use the **Open** button on the **Review Scope** tab and navigate to the location of the XML file.

Impose Limits on Metrics (Server and Access products)

In the Polyspace Access web interface, limits on code complexity metrics are predefined. In the **Dashboard** perspective, if you select **Code Metric**, a **Code Metrics** window shows the metric values and limits.

To find the limits used, see “HIS Code Complexity Metrics” on page 8-52.

See Also

`Calculate code metrics (-code-metrics)`

More About

- “Code Metrics” (Polyspace Bug Finder Access)
- “HIS Code Complexity Metrics” on page 8-52

HIS Code Complexity Metrics

The following list shows the Hersteller Initiative Software (HIS) standard metrics that Polyspace evaluates. These metrics and the recommended limits for their values are part of a standard defined by a major group of Original Equipment Manufacturers or OEMs. For more information on how to focus your review to this subset of code metrics, see “Compute Code Complexity Metrics” on page 8-49.

Project

Polyspace evaluates the following HIS metrics at the project level.

Metric	Recommended Upper Limit
Number of direct recursions	0
Number of recursions	0

File

Polyspace evaluates the HIS metric, comment density, at the file level. The recommended lower limit is 20.

Function

Polyspace evaluates the following HIS metrics at the function level.

Metric	Recommended Upper Limit
Cyclomatic complexity	10
Language scope	4
Number of call levels	4
Number of calling functions	5
Number of called functions	7
Number of function parameters	5
Number of goto statements	0
Number of instructions	50
Number of paths	80
Number of return statements	1

See Also

More About

- “Compute Code Complexity Metrics” on page 8-49
- “Code Metrics” (Polyspace Bug Finder Access)

Configure Bug Finder Checkers

Choose Specific Bug Finder Defect Checkers

You can check your C/C++ code using the predefined subsets of defect checkers in Bug Finder. However, you can also customize which defects to check for during the analysis.

You can use a spreadsheet to keep track of the defect checkers that you enable and add notes explaining why you do not enable the other checkers. A spreadsheet of checkers is provided in `polyspaceroot\polyspace\resources`. Here, *`polyspaceroot`* is the Polyspace installation folder, such as `C:\Program Files\Polyspace\R2019a`.

User Interface (Desktop Products Only)

1. On the **Configuration** pane, select **Bug Finder Analysis**.
2. From the **Find defects** menu, select a set of defects. The options are:

   - `default` for the default list of defects. This list contains defects that are applicable to most coding projects.

     See “Polyspace Bug Finder Defects Checkers Enabled by Default” on page 9-48.
   - `all` for all defects.
   - `CWE` for defects related to CWE coding standard.

     For more information, see “CWE Coding Standard and Polyspace Results” on page 9-78.
   - `custom` to add defects to the default list or remove defects from it.

To standardize the bug finding across your organization, you can save your list of defect checkers as a configuration template and share with others. See “Create Project Using Configuration Template” (Polyspace Bug Finder).

Command Line

Use the option `Find defects (-checkers)`. Specify a comma-separated list of checkers as arguments. For instance, to run a Bug Finder analysis on a server with only the data race checkers enabled, enter:

```
polyspace-bug-finder-server -sources filename -checkers DATA_RACE,DATA_RACE_STD_LIB
```

Use short names for the Bug Finder checkers instead of their full names. See “Short Names of Bug Finder Defect Checkers” on page 9-26.

See Also
`Find defects (-checkers)`

More About
- “Bug Finder Defect Groups” on page 9-40

- “Short Names of Bug Finder Defect Checkers” on page 9-26

Modify Default Behavior of Bug Finder Checkers

A Polyspace Bug Finder analysis checks C/C++ code for bugs and external coding standard violations. By default, the Bug Finder checkers are designed to:

- Show as few false positives as possible.
- Require minimal setup upfront.

However, for specific projects, you might want to modify the default behavior of some checkers. For instance, you might want to treat some user defined data types as effectively boolean or detect data races involving operations that Bug Finder considers as atomic by default.

Use this topic to find the modifications allowed for Bug Finder checkers. Alternatively, you can search for these options in the analysis report to see if the default behavior of checkers were modified.

Note that:

- The options do not enable or disable a checker.

  To enable or disable specific checkers, see “Choose Specific Bug Finder Defect Checkers” on page 9-2.
- You can use these options solely to modify the behavior of an existing checker.

  Options such as target processor type, multitasking options and external constraints can also modify the behavior of a checker. However, the modification happens as a side effect. You typically specify these options to accurately reflect your target environment.

Defect Checkers

Option	Option Value	Checkers Modified	Modification
`Find defects (-checkers)`	**Data race including atomic operations** (user interface) or `DATA_RACE_ALL` (command line)	`Data race`	By default, the checker flags data races involving non-atomic operations. If an operation is atomic, it cannot be interrupted by operations in another task or thread. If you use this option, all operations are considered when flagging data races. See also “Define Atomic Operations in Multitasking Code” on page 7-24.

Option	Option Value	Checkers Modified	Modification
`Run stricter checks considering all values of system inputs (-checks-using-system-input-values)`		Checkers that rely on numerical values of system inputs	See "Extend Bug Finder Checkers to Find Defects from Specific System Input Values" on page 9-13.
`-code-behavior-specifications`	XML file. Entries in the XML file map user-defined functions to functions from the Standard Library.	Checkers that detect issues with Standard Library functions	See "Extend Bug Finder Checkers for Standard Library Functions to Custom Libraries" on page 9-11.
	XML file. Entries in the XML file map user-defined concurrency primitives to ones that Bug Finder can automatically detect.	Concurrency defects	See "Extend Concurrency Defect Checkers to Unsupported Multithreading Environments" on page 9-16.
	XML file. Entries in the XML file list functions that you want to prohibit from your source code.	`Use of a forbidden function`	See "Flag Deprecated or Unsafe Functions Using Bug Finder Checkers" on page 9-9.
	XML file. Entries in the XML file list functions whose pointer arguments must point to initialized buffers.	`Non-initialized variable`	See "Extend Checkers for Initialization to Check Function Arguments Passed by Pointers" on page 9-19.
`-detect-bad-float-op-on-zero`		`Floating point comparison with equality operators`	By default, the checker ignores floating point comparisons with equality operators if one of the operands is 0.0. If you use this option, comparisons with 0.0 are also flagged.

Option	Option Value	Checkers Modified	Modification
`-consider-analysis-perimeter-as-trust-boundary`		Tainted Data Defects	By default, the tainted data defects consider externally obtained data as tainted. By using this option, the following are also considered as tainted data: • Formal parameters of externally visible function that do not have a visible caller. • Return values of stubbed functions. • Global variables external to the unit.

Coding Standard Checkers

Coding standards checkers can also be extended or modified with appropriate options.

Option	Option Value	Checkers Modified	Modification
`Effective boolean types (-boolean-types)`	Data types	• MISRA C:2004 rules 12.6, 13.2, 15.4 • MISRA C:2012 rules 10.1, 10.3, 10.5, 14.4, 16.7	The rules covered by these checkers involve boolean types. If you use this option, you can treat user-defined types as effectively boolean.
`Allowed pragmas (-allowed-pragmas)`	Names of pragmas	MISRA C:2004 rule 3.4 and MISRA C++ rule 16-6-1	These rules require that all pragma directives must be documented within the compiler documentation. If you use this option, the analysis considers the pragmas specified as documented pragmas.

Option	Option Value	Checkers Modified	Modification
`-code-behavior-specifications`	XML file. Entries in the XML file define limits on global aspects of your program such as maximum depth of nesting in control flow statements.	MISRA C: 2012 Rule 1.1	You can increase or decrease these parameters of the rule checker: • Maximum depth of nesting allowed in control flow statements • Maximum levels of inclusion allowed using include files • Maximum number of constants allowed in an enumeration • Maximum number of macros allowed in a translation unit • Maximum number of members allowed in a structure • Maximum levels of nesting allowed in a structure
	XML file. Entries in the XML file define how many characters are compared before considering two identifiers as distinct.	MISRA C: 2012 Rules 5.1 to 5.5	These rules require uniqueness of certain types of identifiers. For instance, rule 5.1 requires that external identifiers be distinct. If the difference between two identifiers occurs beyond the first *`num`* characters, the rule checker considers the identifiers as identical. You can modify the parameter *`num`* separately for external and internal identifiers.
`Check Guidelines (-guidelines)`	Thresholds for software complexity checkers	Software Complexity	See “Reduce Software Complexity by Using Polyspace Checkers” on page 8-12

See Also

More About

- “Choose Specific Bug Finder Defect Checkers” on page 9-2
- “Bug Finder Defect Groups” on page 9-40

Flag Deprecated or Unsafe Functions Using Bug Finder Checkers

This topic shows how to create a custom list of functions and check for use of these functions in your code using Polyspace Bug Finder.

Identify Need for Extending Checker

Before creating or extending a checker, identify if an existing checker meets your requirements. These checkers flag the use of specific functions:

- `Use of dangerous standard function`: The checker flags functions that introduce the risk of buffer overflows and have safer alternatives.
- `Use of obsolete standard function`: The checker flags functions that are deprecated by the C/C++ standard.
- `,` `Unsafe standard encryption function`, `Unsafe standard function`: The checkers flag functions that are unsafe to use in security-sensitive contexts.
- `Inefficient string length computation`, `std::endl may cause an unnecessary flush`: The checkers flag functions that can impact performance and have more efficient alternatives.

However, you might want to blacklist functions that are not covered by an existing checker. For instance, you might want to forbid the use of signal handling functions such as `std::signal`:

```
#include <csignal>
#include <iostream>

namespace
{
  volatile std::sig_atomic_t gSignalStatus;
}

void signal_handler(int signal)
{
  gSignalStatus = signal;
}

int main()
{
  // Install a signal handler
  std::signal(SIGINT, signal_handler);

  std::cout << "SignalValue: " << gSignalStatus << '\n';
  std::cout << "Sending signal " << SIGINT << '\n';
  std::raise(SIGINT);
  std::cout << "SignalValue: " << gSignalStatus << '\n';
}
```

Extend Checker

If the functions that you want to blacklist are not covered by the above checkers, use the checker `Use of a forbidden function`. To create a blacklist for the checker:

1. List functions in an XML file in a specific syntax.

   Copy the template file `code-behavior-specifications-template.xml` from the folder *`polyspaceroot`*`\polyspace\verifier\cxx` to a writable location and modify the file. Enter each function in the file using the following syntax after existing similar entries:

   ```
   <function name="funcname">
       <behavior name="FORBIDDEN_FUNC"/>
   </function>
   ```

   where *`funcname`* is the name of the function you want to blacklist. Remove previously existing entries in the file to avoid warnings.
2. Specify this XML file as argument for the option `-code-behavior-specifications`.

Checkers That Can Be Extended

The only checker that can be used to blacklist specified functions is the checker `Use of a forbidden function`.

See Also

`-code-behavior-specifications` | `Use of a forbidden function`

More About

- "Modify Default Behavior of Bug Finder Checkers" on page 9-4

Extend Bug Finder Checkers for Standard Library Functions to Custom Libraries

This topic shows how to create checkers for your custom library functions by mapping them to equivalent functions from the Standard Library.

Identify Need for Extending Checker

If you identify a Bug Finder checker that applies to a Standard Library function and can be extended to your custom library function, use this technique.

For instance, you might define a math function that has the same domain as a Standard Library math function. If Bug Finder checks for domain errors when using the Standard Library function, you can perform the same checks for the equivalent custom function.

Suppose that you define a function `acos32` that expects values in the range [-1,1]. You might want to detect if the function argument falls outside this range at run time, for instance, in this code snippet:

```
#include<math.h>
#include<float.h>

double acos32(double);
const int periodicity = 1.0;

int isItPeriodic() {
   return(abs(func(0.5) - func(0.5 + periodicity)) < DBL_MIN);
}

double func(double val) {
  return acos32(val);
}
```

One of the arguments to `acos32` is outside its allowed domain. If you do not provide the implementation of `acos32` or if the analysis of the `acos32` implementation is not precise, Bug Finder might not detect the issue. However, the function has the same domain as the Standard Library function `acos`. You can extend the checker `Invalid use of standard library floating point routine` that detects domain errors in uses of `acos` to detect the same kinds of errors with `acos32`.

If your custom function does not have a constrained domain but returns values in a constrained range, you can still map the function to an equivalent Standard Library function (if one exists) for more precise results on other checkers. For instance, you can map a function `cos32` that returns values in the range [-1,1] to the Standard Library function `cos`.

Extend Checker

You can extend checkers on functions from the Standard Library by mapping those functions to your custom library functions. For instance, in the preceding example, you can map the function `acos32` to the Standard Library function `acos`.

To perform the mapping:

1. List each mapping in an XML file in a specific syntax.

Copy the template file `code-behavior-specifications-template.xml` from the folder *`polyspaceroot`*`\polyspace\verifier\cxx` to a writable location and modify the file. Enter the mapping in the file using the following syntax after existing similar entries:

```
<function name="acos32" std="acos"> </function>
```

Remove previously existing entries in the file to avoid warnings.

2 Specify this XML file as argument for the option `-code-behavior-specifications`.

Checkers That Can Be Extended

The following checkers can be extended in this way:

- `Invalid use of standard library floating point routine`
- `Invalid use of standard library integer routine`

See Also

`-code-behavior-specifications`

More About

- "Modify Default Behavior of Bug Finder Checkers" on page 9-4

Extend Bug Finder Checkers to Find Defects from Specific System Input Values

This topic shows how to find possible defects from specific values of system inputs. Unlike Code Prover, Bug Finder does not exhaustively check for run-time errors for all combinations of system inputs. However, you can extend some Bug Finder checkers and find if there are specific system input values that can lead to run-time errors.

Identify Need for Extending Checker

First identify if an existing checker is sufficient for your requirements.

For instance, the Bug Finder checker `Integer division by zero` detects if a division operation can have a zero denominator. Suppose, a library function has the possibility of a division by zero following several numerical operations. For instance, consider the function `speed` here:

```
#include <assert.h>

int speed(int k) {
    int i,j,v;
    i=2;
    j=k+5;
    while (i <10) {
            i++;
            j+=3;
    }

    v = 1 / (i-j);
    return v+k;
}
```

Suppose you see a sporadic run-time error when your program execution enters this function and the default Bug Finder analysis does not detect the issue. To minimize false positives, the default analysis might suppress issues from specific values of an unknown input (what if this value did not occur in practice at run time?). See also “Inputs in Polyspace Bug Finder” (Polyspace Bug Finder Access). To find the root cause of the sporadic error, you can run a stricter Bug Finder analysis for just this function.

Note that even after extending the checkers, Bug Finder does not provide the sound and exhaustive analysis of Code Prover. For instance, if Bug Finder does not detect errors after extending the checkers, this absence of detected errors does not have the same guarantees as green checks in Code Prover.

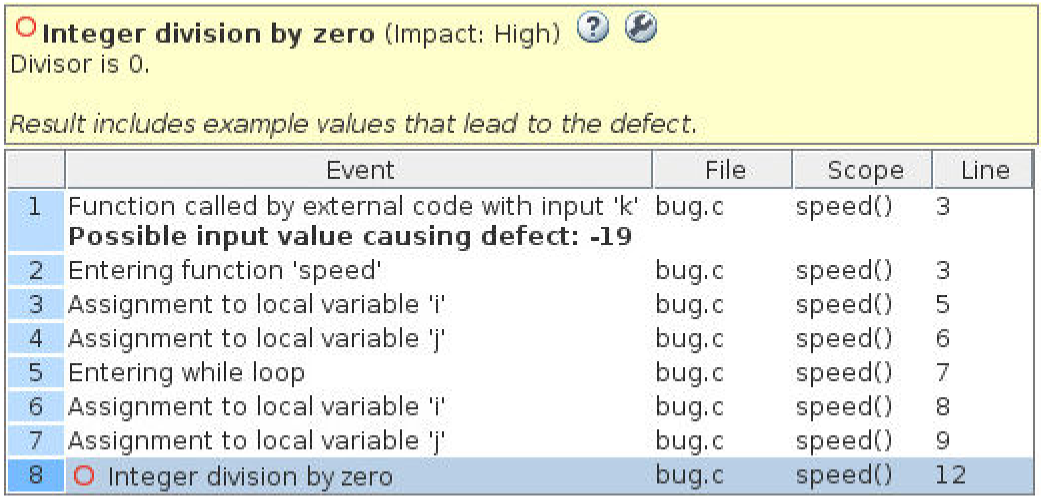
Extend Checker

To extend the checker and detect the above issue, use these options:

- `Run stricter checks considering all values of system inputs (-checks-using-system-input-values)`: Enable this option. Checkers that rely on numerical values can now consider all input values for functions with at least one callee. You can change which functions are considered with the next option.

- `Consider inputs to these functions (-system-inputs-from)`: Use the value `custom` and enter the name of the function whose inputs must be considered, in this case, `speed`. At the command line, use the option argument `custom=speed`.

When you run a Bug Finder analysis, you see a possible integer division by zero on the division operation. The result shows an example of an input value to the function `speed` that eventually leads to the current defect (zero value of the denominator).

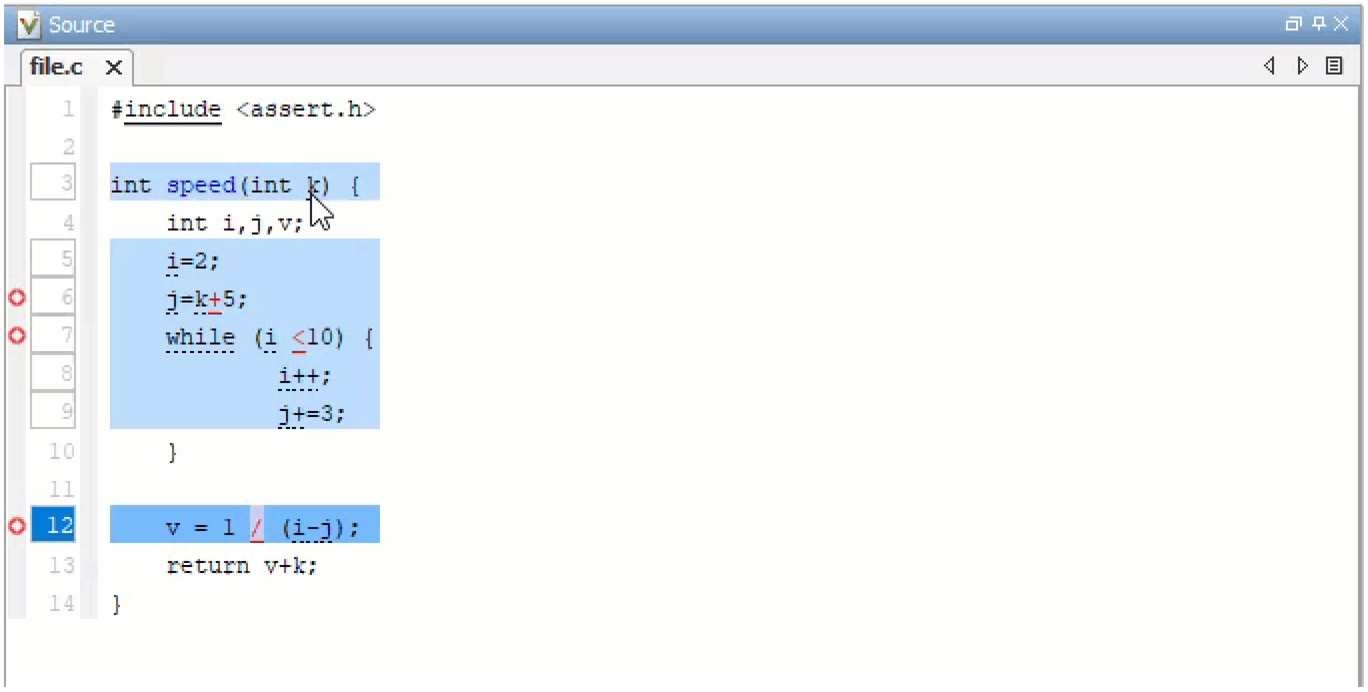


Integer division by zero (Impact: High)
Divisor is 0.

Result includes example values that lead to the defect.

	Event	File	Scope	Line
1	Function called by external code with input 'k' **Possible input value causing defect: -19**	bug.c	speed()	3
2	Entering function 'speed'	bug.c	speed()	3
3	Assignment to local variable 'i'	bug.c	speed()	5
4	Assignment to local variable 'j'	bug.c	speed()	6
5	Entering while loop	bug.c	speed()	7
6	Assignment to local variable 'i'	bug.c	speed()	8
7	Assignment to local variable 'j'	bug.c	speed()	9
8	Integer division by zero	bug.c	speed()	12

The tooltips on the defect show how the input value propagates through the code to eventually lead to one set of values that cause the defect.



```
#include <assert.h>

int speed(int k) {
    int i,j,v;
    i=2;
    j=k+5;
    while (i <10) {
            i++;
            j+=3;
    }

    v = 1 / (i-j);
    return v+k;
}
```

Checkers That Can Be Extended

The following checkers are affected by numerical values of inputs and can be extended using the preceding options:

- `Array access out of bounds`
- `Bitwise operation on negative value`
- `Float conversion overflow`
- `Float overflow`
- `Float division by zero`
- `Integer conversion overflow`
- `Integer division by zero`
- `Integer overflow`
- `Invalid use of standard library floating point routine`
- `Invalid use of standard library integer routine`
- `Null pointer`
- `Shift of a negative value`
- `Shift operation overflow`
- `Sign change integer conversion overflow`
- `Unsigned integer conversion overflow`
- `Unsigned integer overflow`
- `Assertion`

See Also

More About

- "Modify Default Behavior of Bug Finder Checkers" on page 9-4

Extend Concurrency Defect Checkers to Unsupported Multithreading Environments

This topic shows how to adapt concurrency defect checkers to unsupported multithreading environments, for instance, when a new thread creation is not detected automatically.

Identify Need for Extending Checker

By default, Bug Finder can detect concurrency primitives in certain families only (in Code Prover, the same automatic detection is available on an option). See “Auto-Detection of Thread Creation and Critical Section in Polyspace” on page 7-5. If you use primitives that do not belong to one of the supported families but have similar syntaxes, you can map your thread creation and other concurrency-related functions to the supported functions.

For instance, the following example uses:

- The function `createTask` to create a new thread.
- The function `takeLock` to begin a critical section.
- The function `releaseLock` to end the critical section.

```
typedef void* (*FUNT) (void*);

extern int takeLock(int* t);
extern int releaseLock(int* t);
// First argument is the function, second the id
extern int createTask(FUNT,int*,int*,void*);

int t_id1,t_id2;
int lock;

int var1;
int var2;

void* task1(void* a) {
    takeLock(&lock);
    var1++;
    var2++;
    releaseLock(&lock);
    return 0;
}

void* task2(void* a) {
    takeLock(&lock);
    var1++;
    releaseLock(&lock);
    var2++;
    return 0;
}

void main() {
    createTask(task1,&t_id1,0,0);
    createTask(task2,&t_id2,0,0);
}
```

Bug Finder does not detect the invocation of `createTask` as the creation of a new thread where control flow goes to the start function of the thread (first argument of `createTask`). The incorrect placement of the function `releaseLock` in `task2` and the possibility of a data race on the unprotected shared variable `var2` remains undetected.

However, the signature of `createTask`, `takeLock` and `releaseLock` are similar to the corresponding POSIX functions, `pthread_create`, `pthread_mutex_lock` and `pthread_mutex_unlock`. The order of arguments of these functions might be different from their POSIX equivalents.

Extend Checker

Since a POSIX thread creation can be detected automatically, map your thread creation and other concurrency-related functions to their POSIX equivalents. For instance, in the preceding example, perform the following mapping:

- `createTask` → `pthread_create`
- `takeLock` → `pthread_mutex_lock`
- `releaseLock` → `pthread_mutex_unlock`

To perform the mapping:

1. List each mapping in an XML file in a specific syntax.

   Copy the template file `code-behavior-specifications-template.xml` from the folder *`polyspaceroot`*`\polyspace\verifier\cxx` to a writable location and modify the file. Enter each mapping in the file using the following syntax after existing similar entries:

   ```
   <function name="createTask" std="pthread_create" >
       <mapping std_arg="1" arg="2"></mapping>
       <mapping std_arg="3" arg="1"></mapping>
       <mapping std_arg="2" arg="3"></mapping>
       <mapping std_arg="4" arg="4"></mapping>
   </function>
   <function name="takeLock" std="pthread_mutex_lock" >
   </function>
   <function name="releaseLock" std="pthread_mutex_unlock" >
   </function>
   ```

   Note that when mapping `createTask` to `pthread_create`, argument remapping is required, because the arguments do not correspond exactly. For instance, the thread start routine is the third argument of `pthread_create` but the first argument of `createTask`.

   Remove previously existing entries in the file to avoid warnings.
2. Specify this XML file as argument for the option `-code-behavior-specifications`.

If you cannot perform a mapping to one of the supported families of concurrency primitives, you have to set up the multitasking analysis manually. See “Configuring Polyspace Multitasking Analysis Manually” on page 7-16.

Checkers That Can Be Extended

The concurrency defect checkers that can be extended in this way are:

- `Data race`
- `Double lock` and `Double unlock`
- `Missing lock` and `Missing unlock`
- `Deadlock`

See Also

`-code-behavior-specifications`

More About

- "Modify Default Behavior of Bug Finder Checkers" on page 9-4

Extend Checkers for Initialization to Check Function Arguments Passed by Pointers

This topic shows how to extend checkers for initialization to check function arguments passed by pointers. By default, Bug Finder does not check these arguments for initialization at the point of function call because you might perform the initialization in the function body. However, for specific functions, you can extend the checkers to check arguments passed by pointers for initialization at the point of function call.

Identify Need for Existing Checker

Suppose that you consider some function calls as part of the system boundary and you want to make sure that you pass initialized buffers across the boundary. For instance, the Run-Time environment or `Rte_` functions in AUTOSAR allow a software component to communicate with other software components. You might want to ensure that pointer arguments to these functions point to initialized buffers.

For instance, consider this code snippet:

```
extern void Rte_Write_int(unsigned int, int*);

void writeValueToAddress() {
    const unsigned int module_id = 0xfe;
    int x;
    Rte_Write_int(module_id, &x);
}
```

The argument `x` is passed by pointer to the `Rte_Write_int` function. Bug Finder does not check `x` for initialization at the point of function call. In the body of `Rte_Write_int`, if you attempt to read `x`, Bug Finder flags the non-initialized variable. However, you might not be able to provide the module containing the function body for analysis and might want to detect that `x` is non-initialized at the point of function call itself.

Extend Checker

You can specify that pointer arguments to some functions must point to initialized buffers. For instance, to specify that `Rte_Write_int` is one such function:

1. List the function in an XML file in a specific syntax.

   Copy the template file `code-behavior-specifications-template.xml` from the folder *`polyspaceroot`*`\polyspace\verifier\cxx` to a writable location and modify the file. Enter the function in the file using the following syntax after existing similar entries:

   ```
   <function name="Rte_Write_int">
      <check name="ARGUMENT_POINTS_TO_INITIALIZED_VALUE" arg="2"/>
   </function>
   ```

   This syntax indicates that Bug Finder must check the second argument of the `Rte_Write_int` function to determine if the argument points to an initialized buffer. Remove previously existing entries in the file to avoid warnings.

   You can also use the wildcard * to cover a group of functions. To specify all functions beginning with `Rte_Write_`, enter:

```
<function name="Rte_Write_*">
   <check name="ARGUMENT_POINTS_TO_INITIALIZED_VALUE" arg="2"/>
</function>
```

2 Specify this XML file as argument for the option `-code-behavior-specifications`.

If you rerun the analysis, you see a **Non-initialized variable** defect on `&x` when the function `Rte_Write_int` is called.

Checkers That Can Be Extended

The `Non-initialized variable` checker is extended using this option.

See Also

`-code-behavior-specifications`

More About

- "Modify Default Behavior of Bug Finder Checkers" on page 9-4

Prepare Checkers Configuration for Polyspace Bug Finder Analysis

Before you incorporate Polyspace as a tool in the software development process of your organization, first decide how you plan on using Polyspace to improve your code. Choose which source components to analyze, which issues to check for, and so on. You can then prepare analysis configuration files that reflect your choices.

Broadly speaking, a Bug Finder analysis configuration consists of two parts:

- Build configuration including sources and target
- Checkers configuration

This topic describes a workflow for creating your checkers configuration in a typical deployment scenario. You can adapt this workflow to the specific requirements of your project or organization.

Identify Checkers to Enable

Suppose that you want to establish certain coding standards across your organization. You might follow one of several approaches:

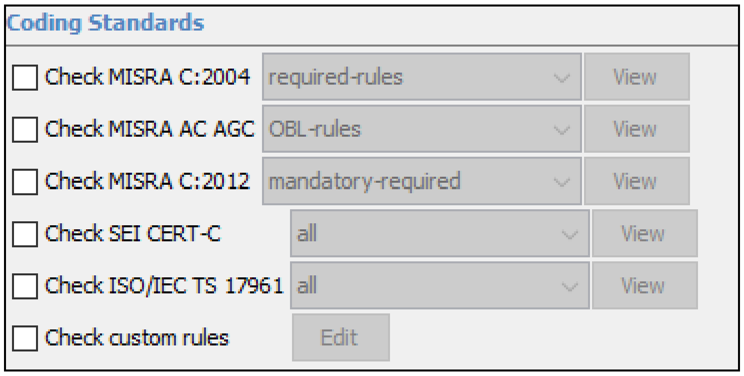
- Adhere to an external coding standard.

  If Bug Finder supports the coding standard, you can select the standard and a predefined or custom set of rules from the standard.

  Polyspace supports these external standards directly. For these standards, simply enable the standard in your configuration and start analysis.

  - MISRA C:2004
  - MISRA C:2012
  - MISRA C++
  - JSF AV C++
  - AUTOSAR C++14 *(Bug Finder only)*
  - CERT C *(Bug Finder only)*
  - CERT C++ *(Bug Finder only)*
  - ISO/IEC TS 17961 *(Bug Finder only)*
  - Guidelines *(Bug Finder only)*

  See “Check for Coding Standard Violations” on page 8-2.


Coding Standards

☐ Check MISRA C:2004	required-rules	View
☐ Check MISRA AC AGC	OBL-rules	View
☐ Check MISRA C:2012	mandatory-required	View
☐ Check SEI CERT-C	all	View
☐ Check ISO/IEC TS 17961	all	View
☐ Check custom rules	Edit	

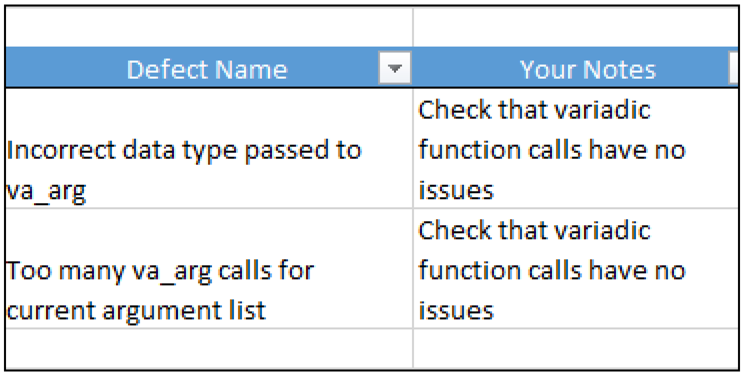
- Develop a set of in-house coding rules based on external standards and prior issues found.

  See if you can automate checking of those rules through Bug Finder defect checkers and/or external coding standard checkers.

  One way to locate a potential checker is to search by keywords in the documentation. Suppose you want to detect issues that can arise from use of variadic functions.

  1. Search for keywords such as `variadic` or `va_arg` and refine search results by product to Bug Finder and then by category to **Review Analysis Results > Polyspace Bug Finder Results**.
  2. Identify all checkers related to variadic functions. Note down the checkers that you want to enable. See if there is an overlap between checkers and eliminate duplicates.

  You can record each defect checker that you enabled or disabled for your process requirements. You can start from the spreadsheet of checkers in *`polyspaceroot`*`\polyspace\resources\`. In the **Your Notes** column, note down your rationale for enabling or disabling a checker.



Defect Name	Your Notes
Incorrect data type passed to va_arg	Check that variadic function calls have no issues
Too many va_arg calls for current argument list	Check that variadic function calls have no issues

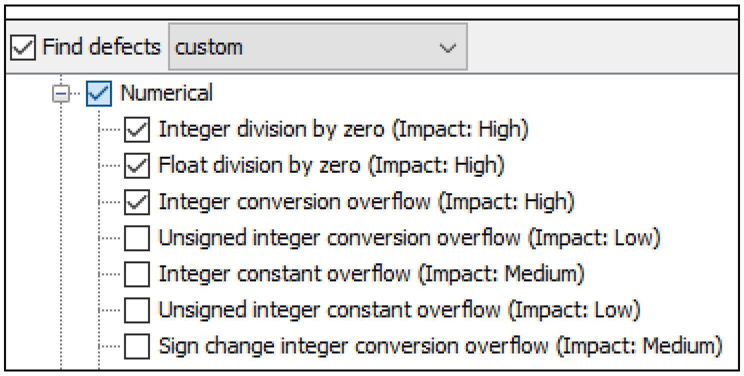
- Check only for defects (bugs) that are most likely to cause errors at run time.

  You might not be following standard coding practices in your organization and you might find external coding standards too sweeping for your preferences.

Start from the Bug Finder defect checkers and identify a subset of checkers for which you want to have zero unjustified defects. One way to identify this subset can be the following:

- First select defect checkers with high impact. These checkers can find issues that are likely to have serious consequences.

  See also “Classification of Defects by Impact” (Polyspace Bug Finder Access).
- Run a first pass of Bug Finder analysis with high impact checkers and identify checkers that produce too much noise that you do not want to address immediately. You can disable these checkers for your initial deployment.



- [✓] Find defects: custom
  - [✓] Numerical
    - [✓] Integer division by zero (Impact: High)
    - [✓] Float division by zero (Impact: High)
    - [✓] Integer conversion overflow (Impact: High)
    - [ ] Unsigned integer conversion overflow (Impact: Low)
    - [ ] Integer constant overflow (Impact: Medium)
    - [ ] Unsigned integer constant overflow (Impact: Low)
    - [ ] Sign change integer conversion overflow (Impact: Medium)

See also “Choose Specific Bug Finder Defect Checkers” on page 9-2.

You can follow a similar strategy with checkers for external coding standards. For instance, for MISRA C:2012, you can start from the mandatory or required guidelines and then choose to expand later.

At the end of this process, you have identified some checkers to enable in a Polyspace analysis. These checkers can be all defect (bug) checkers, or all checkers from external coding standards, or a mix of the two. The next section describes how to create checkers configuration files that you can deploy to your developers.

Create Checkers Configuration Files

A Polyspace Bug Finder analysis configuration is a list of analysis options specified using command-line flags. You can store the entire configuration in one options file, for instance, a text file named `allOptions.txt`, and specify the file using `-options-file` like this:

```
polyspace-bug-finder -options-file allOptions.txt
```

Or like this:

```
polyspace-bug-finder-server -options-file allOptions.txt
```

For your convenience, you can split the configuration into three parts:

- Build configuration (sources, targets, and so on).

  Suppose that you save all options related to your build in a file `buildOptions.txt`. You can create this file manually or automatically from your build command (makefile).

  For more information on how to create this file, see “Prepare Scripts for Polyspace Analysis” on page 1-2.
- Defect checkers configuration.

  Suppose that you specify defect checkers in a file `defectCheckers.txt`.
- External coding standard configuration.

  Suppose that you specify a coding standard and associated checkers in a file `externalRuleCheckers.txt`.

You can string the files together in a run command like this:

```
polyspace-bug-finder
  -options-file buildOptions.txt
  -options-file defectCheckers.txt
  -options-file externalRuleCheckers.txt
```

This command combines the contents of all options files into one file. The splitting of one options file into several files has some advantages. By splitting into separate options files, you can, for instance, reuse the defect checkers configuration across projects while creating a build configuration individually for each project.

You have to then create the text files that specify the checkers that you choose to enable:

- The file `defectCheckers.txt` contains `-checkers` followed by a comma-separated list of the defect checkers that you choose to enable. For instance:

  ```
  -checkers
    INT_ZERO_DIV,
    FLOAT_ZERO_DIV,
  ...
  ```

  See also:

  - `Find defects (-checkers)`
  - “Short Names of Bug Finder Defect Checkers” on page 9-26
- The file `externalRuleCheckers.txt` contains the coding standards that you want to enable and then refers to a separate XML file for specific rules from the standards.

  For instance, a text file that enables specific rules from the MISRA C:2012 and AUTOSAR C++14 standard contains these options:

  ```
  -misra3 from-file
  -autosar-cpp14 from-file
  -checkers-selection-file externalRuleCheckers.xml
  ```

  The XML file `externalRuleCheckers.xml` that enables or disables checkers for rules from specific standards has this structure:

```
<polyspace_checkers_selection>
  <standard name="MISRA C:2004" state="off"/>
  <standard name="MISRA AC AGC" state="off"/>
  <standard name="MISRA C:2012" state="off"/>
  <standard name="MISRA C++:2008" state="off"/>
  <standard name="JSF AV C++" state="off"/>
  <standard name="SEI CERT C" state="off"/>
  <standard name="SEI CERT C++" state="off"/>
  <standard name="ISO/IEC TS 17961" state="off"/>
  <standard name="AUTOSAR C++14">
    <section name="0 Language independent issues">
      <check id="M0-1-1" state="on"/>
      <check id="M0-1-2" state="on"/>
      <check id="M0-1-3" state="off"/>
      <check id="M0-1-4" state="on">
        <comment>Not implemented</comment>
      </check>
      <check id="A0-1-1" state="on">
        <comment>Not implemented</comment>
      </check>
      <check id="A0-1-2" state="on"/>
      <check id="M0-1-8" state="on">
        <comment>Not implemented</comment>
      </check>
        .
        .
         </section>
      </standard>
</polyspace_checkers_selection>
```

For more information on how to create the XML file, see “Check for Coding Standard Violations” on page 8-2.

You can create these files and use the final Polyspace run command in scripts. For instance:

- In a Jenkins build, you can specify the run command in a build script, along with other tools that you are running. After code submission, the Polyspace analysis can run on newly submitted code through the build scripts.
- In developer IDEs, you can specify the run command through a menu item that runs external tools. Developers can run the Polyspace analysis during coding by using the external tools.

Creating these options files by hand can be prone to errors. If you have a license of the desktop product, Polyspace Bug Finder, you can generate these files from the Polyspace user interface. See also “Configure Polyspace Analysis Options in User Interface and Generate Scripts” on page 1-14.

See Also

More About

- “Choose Specific Bug Finder Defect Checkers” on page 9-2
- “Check for Coding Standard Violations” on page 8-2

Short Names of Bug Finder Defect Checkers

To justify defects through code annotations, use the command-line names, or short names, listed in the following table.

You can also enable the detection of a specific defect by using its short name as argument of the `-checkers` option. Instead of listing individual defects, you can also specify groups of defects by the group name, for instance, `numerical`, `data_flow`, and so on. See `Find defects (-checkers)`.

Defect	Command-line Name
`*this not returned in copy assignment operator`	`RETURN_NOT_REF_TO_THIS`
`A move operation may throw`	`MOVE_OPERATION_MAY_THROW`
`Abnormal termination of exit handler`	`EXIT_ABNORMAL_HANDLER`
`Absorption of float operand`	`FLOAT_ABSORPTION`
`Accessing object with temporary lifetime`	`TEMP_OBJECT_ACCESS`
`Alignment changed after memory reallocation`	`ALIGNMENT_CHANGE`
`Alternating input and output from a stream without flush or positioning call`	`IO_INTERLEAVING`
`Ambiguous declaration syntax`	`MOST_VEXING_PARSE`
`Arithmetic operation with NULL pointer`	`NULL_PTR_ARITH`
`Array access out of bounds`	`OUT_BOUND_ARRAY`
`Array access with tainted index`	`TAINTED_ARRAY_INDEX`
`Assertion`	`ASSERT`
`Asynchronously cancellable thread`	`ASYNCHRONOUSLY_CANCELLABLE_THREAD`
`Atomic load and store sequence not atomic`	`ATOMIC_VAR_SEQUENCE_NOT_ATOMIC`
`Atomic variable accessed twice in an expression`	`ATOMIC_VAR_ACCESS_TWICE`
`Automatic or thread local variable escaping from a thread`	`LOCAL_ADDR_ESCAPE_THREAD`
`Bad file access mode or status`	`BAD_FILE_ACCESS_MODE_STATUS`
`Bad order of dropping privileges`	`BAD_PRIVILEGE_DROP_ORDER`

Defect	Command-line Name
Base class assignment operator not called	MISSING_BASE_ASSIGN_OP_CALL
Base class destructor not virtual	DTOR_NOT_VIRTUAL
Bitwise and arithmetic operation on the same data	BITWISE_ARITH_MIX
Bitwise operation on negative value	BITWISE_NEG
Blocking operation while holding lock	BLOCKING_WHILE_LOCKED
Buffer overflow from incorrect string format specifier	STR_FORMAT_BUFFER_OVERFLOW
Bytewise operations on nontrivial class object	MEMOP_ON_NONTRIVIAL_OBJ
C++ reference to const-qualified type with subsequent modification	WRITE_REFERENCE_TO_CONST_TYPE
C++ reference type qualified with const or volatile	CV_QUALIFIED_REFERENCE_TYPE
Call through non-prototyped function pointer	UNPROTOTYPED_FUNC_CALL
Call to memset with unintended value	MEMSET_INVALID_VALUE
Character value absorbed into EOF	CHAR_EOF_CONFUSED
Closing a previously closed resource	DOUBLE_RESOURCE_CLOSE
Code deactivated by constant false condition	DEACTIVATED_CODE
Command executed from externally controlled path	TAINTED_PATH_CMD
Const parameter values may cause unnecessary data copies	CONST_PARAMETER_VALUE
Const return values may cause unnecessary data copies	CONST_RETURN_VALUE
Const rvalue reference parameter may cause unnecessary data copies	CONST_RVALUE_REFERENCE_PARAMETER

Defect	Command-line Name
Const std::move input may cause a more expensive object copy	EXPENSIVE_STD_MOVE_CONST_OBJECT
Constant block cipher initialization vector	CRYPTO_CIPHER_CONSTANT_IV
Constant cipher key	CRYPTO_CIPHER_CONSTANT_KEY
Context initialized incorrectly for cryptographic operation	CRYPTO_PKEY_INCORRECT_INIT
Context initialized incorrectly for digest operation	CRYPTO_MD_BAD_FUNCTION
Conversion or deletion of incomplete class pointer	INCOMPLETE_CLASS_PTR
Copy constructor not called in initialization list	MISSING_COPY_CTOR_CALL
Copy of overlapping memory	OVERLAPPING_COPY
Copy operation modifying source operand	COPY_MODIFYING_SOURCE
Data race	DATA_RACE
Data race including atomic operations	DATA_RACE_ALL
Data race on adjacent bit fields	DATA_RACE_BIT_FIELDS
Data race through standard library function call	DATA_RACE_STD_LIB
Dead code	DEAD_CODE
Deadlock	DEADLOCK
Deallocation of previously deallocated pointer	DOUBLE_DEALLOCATION
Declaration mismatch	DECL_MISMATCH
Delete of void pointer	DELETE_OF_VOID_PTR
Destination buffer overflow in string manipulation	STRLIB_BUFFER_OVERFLOW
Destination buffer underflow in string manipulation	STRLIB_BUFFER_UNDERFLOW
Destruction of locked mutex	DESTROY_LOCKED
Deterministic random output from constant seed	RAND_SEED_CONSTANT
Double lock	DOUBLE_LOCK
Double unlock	DOUBLE_UNLOCK

Defect	Command-line Name
Empty destructors may cause unnecessary data copies	EMPTY_DESTRUCTOR_DEFINED
Environment pointer invalidated by previous operation	INVALID_ENV_POINTER
Errno not checked	ERRNO_NOT_CHECKED
Errno not reset	MISSING_ERRNO_RESET
Exception caught by value	EXCP_CAUGHT_BY_VALUE
Exception handler hidden by previous handler	EXCP_HANDLER_HIDDEN
Execution of a binary from a relative path can be controlled by an external actor	RELATIVE_PATH_CMD
Execution of externally controlled command	TAINTED_EXTERNAL_CMD
Expensive c_str() to std::string construction	EXPENSIVE_C_STR_STD_STRING_CONSTRUCTION
Expensive constant std::string construction	EXPENSIVE_CONSTANT_STD_STRING
Expensive copy in a range-based for loop iteration	EXPENSIVE_RANGE_BASED_FOR_LOOP_ITERATION
Expensive local variable copy	EXPENSIVE_LOCAL_VARIABLE
Expensive logical operation	EXPENSIVE_LOGICAL_OPERATION
Expensive pass by value	EXPENSIVE_PASS_BY_VALUE
Expensive return by value	EXPENSIVE_RETURN_BY_VALUE
Expensive use of non-member std::string operator+() instead of a simple append	EXPENSIVE_STD_STRING_APPEND
Expensive use of std::string methods instead of more efficient overload	EXPENSIVE_USE_OF_STD_STRING_METHODS
Expensive use of std::string with empty string literal	UNNECESSARY_EMPTY_STRING_LITERAL
File access between time of check and use (TOCTOU)	TOCTOU
File descriptor exposure to child process	FILE_EXPOSURE_TO_CHILD
File does not compile	file_does_not_compile
File manipulation after chroot without chdir	CHROOT_MISUSE

Defect	Command-line Name
Float conversion overflow	FLOAT_CONV_OVFL
Float division by zero	FLOAT_ZERO_DIV
Floating point comparison with equality operators	BAD_FLOAT_OP
Float overflow	FLOAT_OVFL
Format string specifiers and arguments mismatch	STRING_FORMAT
Function called from signal handler not asynchronous-safe	SIG_HANDLER_ASYNC_UNSAFE
Function called from signal handler not asynchronous-safe (strict)	SIG_HANDLER_ASYNC_UNSAFE_STRICT
Function pointer assigned with absolute address	FUNC_PTR_ABSOLUTE_ADDR
Function that can spuriously fail not wrapped in loop	SPURIOUS_FAILURE_NOT_WRAPPED_IN_LOOP
Function that can spuriously wake up not wrapped in loop	SPURIOUS_WAKEUP_NOT_WRAPPED_IN_LOOP
Hard-coded buffer size	HARD_CODED_BUFFER_SIZE
Hard-coded loop boundary	HARD_CODED_LOOP_BOUNDARY
Hard-coded object size used to manipulate memory	HARD_CODED_MEM_SIZE
Hard-coded sensitive data	HARD_CODED_SENSITIVE_DATA
Host change using externally controlled elements	TAINTED_HOSTID
Improper array initialization	IMPROPER_ARRAY_INIT
Inappropriate I/O operation on device files	INAPPROPRIATE_IO_ON_DEVICE
Incompatible padding for RSA algorithm operation	CRYPTO_RSA_BAD_PADDING
Incompatible types prevent overriding	VIRTUAL_FUNC_HIDING
Inconsistent cipher operations	CRYPTO_CIPHER_BAD_FUNCTION
Incorrect data type passed to va_arg	VA_ARG_INCORRECT_TYPE
Incorrect key for cryptographic algorithm	CRYPTO_PKEY_INCORRECT_KEY
Incorrect order of network connection operations	BAD_NETWORK_CONNECT_ORDER

Defect	Command-line Name
Incorrect pointer scaling	BAD_PTR_SCALING
Incorrect type data passed to va_start	VA_START_INCORRECT_TYPE
Incorrect use of offsetof in C++	OFFSETOF_MISUSE
Incorrect use of va_start	VA_START_MISUSE
Incorrect value forwarding	INCORRECT_VALUE_FORWARDING
Incorrect syntax of flexible array member size	FLEXIBLE_ARRAY_MEMBER_INCORRECT_SIZE
Incorrectly indented statement	INCORRECT_INDENTATION
Inefficient string length computation	INEFFICIENT_BASIC_STRING_LENGTH
Information leak via structure padding	PADDING_INFO_LEAK
Inline constraint not respected	INLINE_CONSTRAINT_NOT_RESPECTED
Integer constant overflow	INT_CONSTANT_OVFL
Integer conversion overflow	INT_CONV_OVFL
Integer division by zero	INT_ZERO_DIV
Integer overflow	INT_OVFL
Integer precision exceeded	INT_PRECISION_EXCEEDED
Invalid assumptions about memory organization	INVALID_MEMORY_ASSUMPTION
Invalid deletion of pointer	BAD_DELETE
Invalid file position	INVALID_FILE_POS
Invalid free of pointer	BAD_FREE
Invalid use of = (assignment) operator	BAD_EQUAL_USE
Invalid use of == (equality) operator	BAD_EQUAL_EQUAL_USE
Invalid use of standard library floating point routine	FLOAT_STD_LIB
Invalid use of standard library integer routine	INT_STD_LIB
Invalid use of standard library memory routine	MEM_STD_LIB
Invalid use of standard library routine	OTHER_STD_LIB

Defect	Command-line Name
Invalid use of standard library string routine	STR_STD_LIB
Invalid va_list argument	INVALID_VA_LIST_ARG
Join or detach of a joined or detached thread	DOUBLE_JOIN_OR_DETACH
Lambda used as typeid operand	LAMBDA_TYPE_MISUSE
Library loaded from externally controlled path	TAINTED_PATH_LIB
Line with more than one statement	MORE_THAN_ONE_STATEMENT
Load of library from a relative path can be controlled by an external actor	RELATIVE_PATH_LIB
Loop bounded with tainted value	TAINTED_LOOP_BOUNDARY
Macro terminated with a semicolon	SEMICOLON_TERMINATED_MACRO
Macro with multiple statements	MULTI_STMT_MACRO
Member not initialized in constructor	NON_INIT_MEMBER
Memory allocation with tainted size	TAINTED_MEMORY_ALLOC_SIZE
Memory comparison of float-point values	MEMCMP_FLOAT
Memory comparison of padding data	MEMCMP_PADDING_DATA
Memory comparison of strings	MEMCMP_STRINGS
Memory leak	MEM_LEAK
Mismatch between data length and size	DATA_LENGTH_MISMATCH
Mismatched alloc/dealloc functions on Windows	WIN_MISMATCH_DEALLOC
Missing blinding for RSA algorithm	CRYPTO_RSA_NO_BLINDING
Missing block cipher initialization vector	CRYPTO_CIPHER_NO_IV
Missing break of switch case	MISSING_SWITCH_BREAK
Missing byte reordering when transferring data	MISSING_BYTESWAP

Defect	Command-line Name
Missing case for switch condition	MISSING_SWITCH_CASE
Missing certification authority list	CRYPTO_SSL_NO_CA
Missing cipher algorithm	CRYPTO_CIPHER_NO_ALGORITHM
Missing cipher data to process	CRYPTO_CIPHER_NO_DATA
Missing cipher final step	CRYPTO_CIPHER_NO_FINAL
Missing cipher key	CRYPTO_CIPHER_NO_KEY
Missing constexpr specifier	MISSING_CONSTEXPR
Missing data for encryption, decryption or signing operation	CRYPTO_PKEY_NO_DATA
Missing explicit keyword	MISSING_EXPLICIT_KEYWORD
Missing final step after hashing update operation	CRYPTO_MD_NO_FINAL
Missing hash algorithm	CRYPTO_MD_NO_ALGORITHM
Missing lock	BAD_UNLOCK
Missing null in string array	MISSING_NULL_CHAR
Missing or double initialization of thread attribute	BAD_THREAD_ATTRIBUTE
Missing overload of allocation or deallocation function	MISSING_OVERLOAD_NEW_DELETE_PAIR
Missing padding for RSA algorithm	CRYPTO_RSA_NO_PADDING
Missing parameters for key generation	CRYPTO_PKEY_NO_PARAMS
Missing peer key	CRYPTO_PKEY_NO_PEER
Missing private key	CRYPTO_PKEY_NO_PRIVATE_KEY
Missing private key for X.509 certificate	CRYPTO_SSL_NO_PRIVATE_KEY
Missing public key	CRYPTO_PKEY_NO_PUBLIC_KEY
Missing reset of a freed pointer	MISSING_FREED_PTR_RESET
Missing return statement	MISSING_RETURN
Missing salt for hashing operation	CRYPTO_MD_NO_SALT
Missing unlock	BAD_LOCK
Missing virtual inheritance	MISSING_VIRTUAL_INHERITANCE

Defect	Command-line Name
Missing X.509 certificate	CRYPTO_SSL_NO_CERTIFICATE
Misuse of a FILE object	FILE_OBJECT_MISUSE
Misuse of errno	ERRNO_MISUSE
Misuse of errno in a signal handler	SIG_HANDLER_ERRNO_MISUSE
Misuse of narrow or wide character string	NARROW_WIDE_STR_MISUSE
Misuse of readlink()	READLINK_MISUSE
Misuse of return value from nonreentrant standard function	NON_REENTRANT_STD_RETURN
Misuse of sign-extended character value	CHARACTER_MISUSE
Misuse of structure with flexible array member	FLEXIBLE_ARRAY_MEMBER_STRUCT_MISUSE
Modification of internal buffer returned from nonreentrant standard function	WRITE_INTERNAL_BUFFER_RETURNED_FROM_STD_FUNC
Move operation on const object	MOVE_CONST_OBJECT
Multiple mutexes used with same conditional variable	MULTI_MUTEX_WITH_ONE_COND_VAR
Multiple threads waiting on same condition variable	SIGNALED_COND_VAR_NOT_UNIQUE
No data added into context	CRYPTO_MD_NO_DATA
Noexcept function exits with exception	NOEXCEPT_FUNCTION_THROWS
Non-compliance with AUTOSAR specification	autosar_lib_non_compliance
Non-initialized pointer	NON_INIT_PTR
Non-initialized variable	NON_INIT_VAR
Nonsecure hash algorithm	CRYPTO_MD_WEAK_HASH
Nonsecure parameters for key generation	CRYPTO_PKEY_WEAK_PARAMS
Nonsecure RSA public exponent	CRYPTO_RSA_LOW_EXPONENT
Nonsecure SSL/TLS protocol	CRYPTO_SSL_WEAK_PROTOCOL
Null pointer	NULL_PTR
Object slicing	OBJECT_SLICING

Defect	Command-line Name
Opening previously opened resource	DOUBLE_RESOURCE_OPEN
Operator new not overloaded for possibly overaligned class	MISSING_OVERLOAD_NEW_FOR_ALIGNED_OBJ
Overlapping assignment	OVERLAPPING_ASSIGN
Partially accessed array	PARTIALLY_ACCESSED_ARRAY
Partial override of overloaded virtual functions	PARTIAL_OVERRIDE
Pointer access out of bounds	OUT_BOUND_PTR
Pointer dereference with tainted offset	TAINTED_PTR_OFFSET
Pointer or reference to stack variable leaving scope	LOCAL_ADDR_ESCAPE
Pointer to non-initialized value converted to const pointer	NON_INIT_PTR_CONV
Possible invalid operation on boolean operand	INVALID_OPERATION_ON_BOOLEAN
Possible misuse of sizeof	SIZEOF_MISUSE
Possibly inappropriate data type for switch expression	INAPPROPRIATE_TYPE_IN_SWITCH
Possibly unintended evaluation of expression because of operator precedence rules	OPERATOR_PRECEDENCE
Precision loss in integer to float conversion	INT_TO_FLOAT_PRECISION_LOSS
Predefined macro used as an object	MACRO_USED_AS_OBJECT
Predictable block cipher initialization vector	CRYPTO_CIPHER_PREDICTABLE_IV
Predictable cipher key	CRYPTO_CIPHER_PREDICTABLE_KEY
Predictable random output from predictable seed	RAND_SEED_PREDICTABLE
Preprocessor directive in macro argument	PRE_DIRECTIVE_MACRO_ARG
Privilege drop not verified	MISSING_PRIVILEGE_DROP_CHECK
Qualifier removed in conversion	QUALIFIER_MISMATCH
Redundant expression in sizeof operand	SIZEOF_USELESS_OP

Defect	Command-line Name
Resource leak	RESOURCE_LEAK
Returned value of a sensitive function not checked	RETURN_NOT_CHECKED
Return from computational exception signal handler	SIG_HANDLER_COMP_EXCP_RETURN
Return of non const handle to encapsulated data member	BREAKING_DATA_ENCAPSULATION
Self assignment not tested in operator	MISSING_SELF_ASSIGN_TEST
Semicolon on same line as if, for or while statement	SEMICOLON_CTRL_STMT_SAME_LINE
Sensitive data printed out	SENSITIVE_DATA_PRINT
Sensitive heap memory not cleared before release	SENSITIVE_HEAP_NOT_CLEARED
Server certificate common name not checked	CRYPTO_SSL_HOSTNAME_NOT_CHECKED
Shared data access within signal handler	SIG_HANDLER_SHARED_OBJECT
Shift of a negative value	SHIFT_NEG
Shift operation overflow	SHIFT_OVFL
Side effect in arguments to unsafe macro	SIDE_EFFECT_IN_UNSAFE_MACRO_ARG
Side effect of expression ignored	SIDE_EFFECT_IGNORED
Signal call from within signal handler	SIG_HANDLER_CALLING_SIGNAL
Signal call in multithreaded program	SIGNAL_USE_IN_MULTITHREADED_PROGRAM
Sign change integer conversion overflow	SIGN_CHANGE
Standard function call with incorrect arguments	STD_FUNC_ARG_MISMATCH
Static uncalled function	UNCALLED_FUNC
std::endl may cause an unnecessary flush	STD_ENDL_USE
std::move called on an unmovable type	STD_MOVE_UNMOVABLE_TYPE
Stream argument with possibly unintended side effects	STREAM_WITH_SIDE_EFFECT

Defect	Command-line Name
Subtraction or comparison between pointers to different arrays	PTR_TO_DIFF_ARRAY
Tainted division operand	TAINTED_INT_DIVISION
Tainted modulo operand	TAINTED_INT_MOD
Tainted NULL or non-null-terminated string	TAINTED_STRING
Tainted sign change conversion	TAINTED_SIGN_CHANGE
Tainted size of variable length array	TAINTED_VLA_SIZE
Tainted string format	TAINTED_STRING_FORMAT
Thread-specific memory leak	THREAD_MEM_LEAK
Throw argument raises unexpected exception	THROW_ARGUMENT_EXPRESSION_THROWS
TLS/SSL connection method not set	CRYPTO_SSL_NO_ROLE
TLS/SSL connection method set incorrectly	CRYPTO_SSL_BAD_ROLE
Too many va_arg calls for current argument list	TOO_MANY_VA_ARG_CALLS
Typedef mismatch	TYPEDEF_MISMATCH
Umask used with chmod-style arguments	BAD_UMASK
Uncleared sensitive data in stack	SENSITIVE_STACK_NOT_CLEARED
Universal character name from token concatenation	PRE_UCNAME_JOIN_TOKENS
Unmodified variable not const-qualified	UNMODIFIED_VAR_NOT_CONST
Unnamed namespace in header file	UNNAMED_NAMESPACE_IN_HEADER
Unprotected dynamic memory allocation	UNPROTECTED_MEMORY_ALLOCATION
Unreachable code	UNREACHABLE
Unreliable cast of function pointer	FUNC_CAST
Unreliable cast of pointer	PTR_CAST
Unsafe call to a system function	UNSAFE_SYSTEM_CALL

Defect	Command-line Name
Unsafe conversion between pointer and integer	BAD_INT_PTR_CAST
Unsafe conversion from string to numerical value	UNSAFE_STR_TO_NUMERIC
Unsafe standard encryption function	UNSAFE_STD_CRYPT
Unsafe standard function	UNSAFE_STD_FUNC
Unsigned integer constant overflow	UINT_CONSTANT_OVFL
Unsigned integer conversion overflow	UINT_CONV_OVFL
Unsigned integer overflow	UINT_OVFL
Unused parameter	UNUSED_PARAMETER
Use of a forbidden function	FORBIDDEN_FUNC
Useless if	USELESS_IF
Use of automatic variable as putenv-family function argument	PUTENV_AUTO_VAR
Use of dangerous standard function	DANGEROUS_STD_FUNC
Use of externally controlled environment variable	TAINTED_ENV_VARIABLE
Use of indeterminate string	INDETERMINATE_STRING
Use of new or make_unique instead of more efficient make_shared	MISSING_MAKE_SHARED
Use of memset with size argument zero	MEMSET_INVALID_SIZE
Use of non-secure temporary file	NON_SECURE_TEMP_FILE
Use of obsolete standard function	OBSOLETE_STD_FUNC
Use of path manipulation function without maximum sized buffer checking	PATH_BUFFER_OVERFLOW
Use of plain char type for numerical value	BAD_PLAIN_CHAR_USE
Use of previously closed resource	CLOSED_RESOURCE_USE
Use of previously freed pointer	FREED_PTR
Use of tainted pointer	TAINTED_PTR

Defect	Command-line Name
Use of setjmp/longjmp	SETJMP_LONGJMP_USE
Use of undefined thread ID	UNDEFINED_THREAD_ID
Use of signal to kill thread	THREAD_KILLED_WITH_SIGNAL
Variable length array with nonpositive size	NON_POSITIVE_VLA_SIZE
Variable shadowing	VAR_SHADOWING
Vulnerable path manipulation	PATH_TRAVERSAL
Vulnerable permission assignments	DANGEROUS_PERMISSIONS
Vulnerable pseudo-random number generator	VULNERABLE_PRNG
Weak cipher algorithm	CRYPTO_CIPHER_WEAK_CIPHER
Weak cipher mode	CRYPTO_CIPHER_WEAK_MODE
Weak padding for RSA algorithm	CRYPTO_RSA_WEAK_PADDING
Write without a further read	USELESS_WRITE
Writing to const qualified object	CONSTANT_OBJECT_WRITE
Writing to read-only resource	READ_ONLY_RESOURCE_WRITE
Wrong allocated object size for cast	OBJECT_SIZE_MISMATCH
Wrong type used in sizeof	PTR_SIZEOF_MISMATCH
X.509 peer certificate not checked	CRYPTO_SSL_CERT_NOT_CHECKED

See Also

More About

- “Choose Specific Bug Finder Defect Checkers” on page 9-2

Bug Finder Defect Groups

In this section...

For convenience, the defect checkers in Bug Finder are classified into various groups.

- In certain projects, you can choose to focus only on specific groups of defects. Specify the group name for the option `Find defects (-checkers)`.
- When reviewing results, you can review all results of a certain group together. Filter out other results during review. See "Manage Results" (Polyspace Bug Finder Access).

This topic gives an overview of the various groups.

C++ Exceptions

These defects are related to C++ exception handling. The defects include:

- Unhandled exception emitting from a `noexcept` function
- Unexpected exception arising during constructing the argument object of a `throw` statement
- `catch` statements catching exceptions by value instead of by reference
- `catch` statements hiding subsequent `catch` statements.

For more details about specific defects, see

Command-Line Parameter: `cpp_exceptions`

Concurrency

These defects are related to multitasking code.

Data Race Defects

The data race defects occur when multiple tasks operate on a shared variable or call a nonreentrant standard library function without protection.

For the specific defects, see “Concurrency Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `concurrency`

Locking Defects

The locking defects occur when the critical sections are not set up appropriately. For example:

- The critical sections are involved in a deadlock.
- A lock function does not have the corresponding unlock function.
- A lock function is called twice without an intermediate call to an unlock function.

Critical sections protect shared variables from concurrent access. Polyspace expects critical sections to follow a certain format. The critical section must lie between a call to a lock function and a call to an unlock function.

For the specific defects, see “Concurrency Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `concurrency`

Cryptography

These defects are related to incorrect use of cryptography routines from the OpenSSL library. For instance:

- Use of cryptographically weak algorithms
- Absence of essential elements such as cipher key or initialization vector
- Wrong order of cryptographic operations

For the specific defects, see “Cryptography Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `cryptography`

Data flow

These defects are errors relating to how information moves throughout your code. The defects include:

- Dead or unreachable code
- Unused code
- Non-initialized information

For the specific defects, see “Data Flow Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `data_flow`

Dynamic Memory

These defects are errors relating to memory usage when the memory is dynamically allocated. The defects include:

- Freeing dynamically allocated memory
- Unprotected memory allocations

For specific defects, see “Dynamic Memory Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `dynamic_memory`

Good Practice

These defects allow you to observe good coding practices. The defects by themselves might not cause a crash, but they sometimes highlight more serious logic errors in your code. The defects also make your code vulnerable to attacks and hard to maintain.

The defects include:

- Hard-coded constants such as buffer size and loop boundary
- Unused function parameters

For specific defects, see “Good Practice Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `good_practice`

Numerical

These defects are errors relating to variables in your code; their values, data types, and usage. The defects include:

- Mathematical operations
- Conversion overflow
- Operational overflow

For specific defects, see “Numerical Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `numerical`

Object Oriented

These defects are related to the object-oriented aspect of C++ programming. The defects highlight class design issues or issues in the inheritance hierarchy.

The defects include:

- Data member not initialized or incorrectly initialized in constructor
- Incorrect overriding of base class methods
- Breaking of data encapsulation

For specific defects, see “Object Oriented Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `object_oriented`

Performance

These defects detect issues such as unnecessary data copies and inefficient C++ standard functions that can lead to performance bottlenecks in C++ code.

The defects include:

- `const` parameters or return values forcing copy instead of move operations
- Inefficient functions for newline insertion and string length computation

For specific defects, see “Performance Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `performance`

Programming

These defects are errors relating to programming syntax. These defects include:

- Assignment versus equality operators
- Mismatches between variable qualifiers or declarations
- Badly formatted strings

For specific defects, see “Programming Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `programming`

Resource Management

These defects are related to file handling. The defects include:

- Unclosed file stream
- Operations on a file stream after it is closed

For specific defects, see “Resource Management Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `resource_management`

Static Memory

These defects are errors relating to memory usage when the memory is statically allocated. The defects include:

- Accessing arrays outside their bounds
- Null pointers
- Casting of pointers

For specific defects, see “Static Memory Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `static_memory`

Security

These defects highlight places in your code which are vulnerable to hacking or other security attacks. Many of these defects do not cause runtime errors, but instead point out risky areas in your code. The defects include:

- Managing sensitive data
- Using dangerous or obsolete functions
- Generating random numbers
- Externally controlled paths and commands

For more details about specific defects, see “Security Defects” (Polyspace Bug Finder Access).

Command-Line Parameter: `security`

Tainted data

These defects highlight elements in your code which are from unsecured sources. Attackers can use input data or paths to attack your program and cause failures. These defects highlight elements in your code that are vulnerable. Defects include:

- Use of tainted variables or pointers
- Externally controlled paths

For more details about specific defects, see “Tainted Data Defects” (Polyspace Bug Finder Access). You can modify the behavior of the tainted data defects by using the optional command `-consider-analysis-perimeter-as-trust-boundary`. See `-consider-analysis-perimeter-as-trust-boundary`.

Command-Line Parameter: `tainted_data`

See Also

`Find defects (-checkers)`

Sources of Tainting in a Polyspace Analysis

Generally, any code element that can be modified from outside of the code is considered tainted data. An attacker might pass values to tainted variables to cause program failure, inject malicious code, or leak resources. The results of operations that use tainted data are also considered tainted.. For instance, if you calculate a path to a file by using tainted variable, the file also becomes tainted. To mitigate risks associated with tainted data, validate the content of the data before you use it.

Enhance the security of your code by using the Polyspace tainted data defect checkers to identify sources of tainted data and then validating data from those sources.

Sources of Tainted Data

Polyspace considers data from these sources as tainted data:

- Volatile objects: Objects declared by using the keyword `volatile` can be modified by the hardware during program execution. Using volatile objects without checking their content might lead to segmentation errors, memory leak or security threat. Polyspace flags operations that use volatile objects without validating them.
- Functions that obtains a user input: Library functions such as `getenv`, `gets`, `read`, `scanf`, or `fopen` return user inputs such as an environment variable, a string, a data stream, formatted data or a file. The `main()` might also take input arguments directly from the user. User dependent inputs are unpredictable. Before using these input, validate them by checking their format, length, or content.
- Functions that interacts with hardware: Library functions such as `RegQueryValueEx` interacts with hardware like registers and peripherals. These functions return hardware dependent data that might be unpredictable. Before using data obtained from hardware, validate them by checking their format, length, or content.
- Functions that returns the current time: Library functions such as `ctime` returns the current time of the system as a formatted string. The format of the string depends on the environment. Before using such strings, validate them by checking their format.
- Functions that return a random number: Before using random numbers, validate them by checking their format and range.

To consider any data that does not originate in the current scope of Polyspace analysis as tainted, use the command line option `-consider-analysis-perimeter-as-trust-boundary`. See “Modify Default Behavior of Bug Finder Checkers” on page 9-4

Impact of Tainted Data Defects

An attacker might exploit tainted data defects by deliberately feeding unexpected input to the program to expose the stack or execute commands that access or delete sensitive data. Consider this code which uses input from the user to modify the system.

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 128
void Echo(char* string, int n) {
    printf("Argument %d is; ",n);
    printf(string); //Tainted operation
}
```

```
void SystemCaller(char* string){
    printf("Calling System...");
    char cmd[MAX] = "/usr/bin/cat ";
    strcat(cmd, string);
    system(cmd);//Tainted operation
}

int main(int argc, char** argv) {
    int i = 0;
    for(i = 0;i<argc;++i){
        Echo(argv[i],i);
        SystemCaller(argv[i]);
    }
    return (0);
}
```

The input from the user is tainted. Polyspace flags two tainted data defects in this code.

- In the function `Echo`, the line `printf(string)` print a user input string without validating the string. This defect enables an attacker to expose the stack by manipulating the input string. For instance, if the user input is `"%d"`, function prints the integer in the stack after `n` is printed.
- In the function `SystemCaller`, a user input string is used to call an operating system command. Malicious users can execute commands to access or delete sensitive data, and even crash the system by exploiting this defect.

To prevent such attacks, validate the tainted data by checking their format, length, or content. For instance, in this code, the tainted inputs are validated before they are used.

```
#include <stdio.h>
#include <stdlib.h>
#define MAX 128
extern char** LIST_OF_COMMANDS;
int isAllowd(char*);
void Echo(char* string, int n) {
    printf("Argument %d is; ",n);
    printf("%s",string); //Validated
}
void SystemCaller(char* string){
    printf("Calling System...");
    char cmd[MAX] = "/usr/bin/cat ";
    if(isallowed(string)==1){
    strcat(cmd, string);
    system(cmd);//Validated
    }
}

int main(int argc, char** argv) {
    int i = 0;
    for(i = 0;i<argc|| i<10;++i){
        Echo(argv[i],i);
        SystemCaller(argv[i]);
    }
    return (0);
}
```

By specifying the format as `%s` in `printf`, the tainted input `string` is validated. Now, the program prints the content of the string and the stack is no longer exposed. In `SystemCaller`, the program executes an operating system command only if the input matches an allowed command.

For details about the tainted data defects in Polyspace, see

See Also

`-consider-analysis-perimeter-as-trust-boundary` | `Find defects (-checkers)`

More About

- “Modify Default Behavior of Bug Finder Checkers” on page 9-4

Polyspace Bug Finder Defects Checkers Enabled by Default

When you start a Bug Finder analysis, these checkers are enabled by default:

Defect	Command-line Name
Absorption of float operand	FLOAT_ABSORPTION
Accessing object with temporary lifetime	TEMP_OBJECT_ACCESS
Alignment changed after memory reallocation	ALIGNMENT_CHANGE
Alternating input and output from a stream without flush or positioning call	IO_INTERLEAVING
Array access out of bounds	OUT_BOUND_ARRAY
Assertion	ASSERT
Atomic load and store sequence not atomic	ATOMIC_VAR_SEQUENCE_NOT_ATOMIC
Atomic variable accessed twice in an expression	ATOMIC_VAR_ACCESS_TWICE
Base class assignment operator not called	MISSING_BASE_ASSIGN_OP_CALL
Base class destructor not virtual	DTOR_NOT_VIRTUAL
Buffer overflow from incorrect string format specifier	STR_FORMAT_BUFFER_OVERFLOW
Call through non-prototyped function pointer	UNPROTOTYPED_FUNC_CALL
Character value absorbed into EOF	CHAR_EOF_CONFUSED
Closing a previously closed resource	DOUBLE_RESOURCE_CLOSE
Conversion or deletion of incomplete class pointer	INCOMPLETE_CLASS_PTR
Copy constructor not called in initialization list	MISSING_COPY_CTOR_CALL
Copy operation modifying source operand	COPY_MODIFYING_SOURCE
Data race	DATA_RACE
Data race on adjacent bit fields	DATA_RACE_BIT_FIELDS
Data race through standard library function call	DATA_RACE_STD_LIB
Dead code	DEAD_CODE
Deadlock	DEADLOCK
Deallocation of previously deallocated pointer	DOUBLE_DEALLOCATION

Defect	**Command-line Name**
Declaration mismatch	DECL_MISMATCH
Destination buffer overflow in string manipulation	STRLIB_BUFFER_OVERFLOW
Destination buffer underflow in string manipulation	STRLIB_BUFFER_UNDERFLOW
Double lock	DOUBLE_LOCK
Double unlock	DOUBLE_UNLOCK
Environment pointer invalidated by previous operation	INVALID_ENV_POINTER
Errno not reset	MISSING_ERRNO_RESET
Exception caught by value	EXCP_CAUGHT_BY_VALUE
Exception handler hidden by previous handler	EXCP_HANDLER_HIDDEN
Float conversion overflow	FLOAT_CONV_OVFL
Float division by zero	FLOAT_ZERO_DIV
Format string specifiers and arguments mismatch	STRING_FORMAT
Improper array initialization	IMPROPER_ARRAY_INIT
Incompatible types prevent overriding	VIRTUAL_FUNC_HIDING
Incorrect data type passed to va_arg	VA_ARG_INCORRECT_TYPE
Incorrect pointer scaling	BAD_PTR_SCALING
Incorrect type data passed to va_start	VA_START_INCORRECT_TYPE
Incorrect use of offsetof in C++	OFFSETOF_MISUSE
Incorrect use of va_start	VA_START_MISUSE
Incorrect value forwarding	INCORRECT_VALUE_FORWARDING
Inline constraint not respected	INLINE_CONSTRAINT_NOT_RESPECTED
Integer conversion overflow	INT_CONV_OVFL
Integer division by zero	INT_ZERO_DIV
Invalid assumptions about memory organization	INVALID_MEMORY_ASSUMPTION
Invalid deletion of pointer	BAD_DELETE
Invalid free of pointer	BAD_FREE
Invalid use of = (assignment) operator	BAD_EQUAL_USE
Invalid use of == (equality) operator	BAD_EQUAL_EQUAL_USE
Invalid use of standard library floating point routine	FLOAT_STD_LIB
Invalid use of standard library integer routine	INT_STD_LIB

Defect	Command-line Name
Invalid use of standard library memory routine	MEM_STD_LIB
Invalid use of standard library routine	OTHER_STD_LIB
Invalid use of standard library string routine	STR_STD_LIB
Invalid va_list argument	INVALID_VA_LIST_ARG
Lambda used as typeid operand	LAMBDA_TYPE_MISUSE
Memory comparison of padding data	MEMCMP_PADDING_DATA
Memory comparison of strings	MEMCMP_STRINGS
Missing lock	BAD_UNLOCK
Missing null in string array	MISSING_NULL_CHAR
Missing return statement	MISSING_RETURN
Missing unlock	BAD_LOCK
Misuse of a FILE object	FILE_OBJECT_MISUSE
Misuse of errno	ERRNO_MISUSE
Misuse of errno in a signal handler	SIG_HANDLER_ERRNO_MISUSE
Misuse of sign-extended character value	CHARACTER_MISUSE
Misuse of structure with flexible array member	FLEXIBLE_ARRAY_MEMBER_STRUCT_MISUSE
Move operation on const object	MOVE_CONST_OBJECT
Noexcept function exits with exception	NOEXCEPT_FUNCTION_THROWS
Non-initialized pointer	NON_INIT_PTR
Non-initialized variable	NON_INIT_VAR
Null pointer	NULL_PTR
Object slicing	OBJECT_SLICING
Opening previously opened resource	DOUBLE_RESOURCE_OPEN
Operator new not overloaded for possibly overaligned class	MISSING_OVERLOAD_NEW_FOR_ALIGNED_OBJ
Partial override of overloaded virtual functions	PARTIAL_OVERRIDE
Partially accessed array	PARTIALLY_ACCESSED_ARRAY
Pointer access out of bounds	OUT_BOUND_PTR
Pointer or reference to stack variable leaving scope	LOCAL_ADDR_ESCAPE
Possible misuse of sizeof	SIZEOF_MISUSE

Defect	Command-line Name
Possibly unintended evaluation of expression because of operator precedence rules	OPERATOR_PRECEDENCE
Predefined macro used as an object	MACRO_USED_AS_OBJECT
Preprocessor directive in macro argument	PRE_DIRECTIVE_MACRO_ARG
Resource leak	RESOURCE_LEAK
Return from computational exception signal handler	SIG_HANDLER_COMP_EXCP_RETURN
Self assignment not tested in operator	MISSING_SELF_ASSIGN_TEST
Shared data access within signal handler	SIG_HANDLER_SHARED_OBJECT
Side effect of expression ignored	SIDE_EFFECT_IGNORED
Sign change integer conversion overflow	SIGN_CHANGE
Signal call from within signal handler	SIG_HANDLER_CALLING_SIGNAL
Standard function call with incorrect arguments	STD_FUNC_ARG_MISMATCH
Stream argument with possibly unintended side effects	STREAM_WITH_SIDE_EFFECT
Subtraction or comparison between pointers to different arrays	PTR_TO_DIFF_ARRAY
Throw argument raises unexpected exception	THROW_ARGUMENT_EXPRESSION_THROWS
Too many va_arg calls for current argument list	TOO_MANY_VA_ARG_CALLS
Typedef mismatch	TYPEDEF_MISMATCH
Universal character name from token concatenation	PRE_UCNAME_JOIN_TOKENS
Unnamed namespace in header file	UNNAMED_NAMESPACE_IN_HEADER
Unreachable code	UNREACHABLE
Unreliable cast of function pointer	FUNC_CAST
Unreliable cast of pointer	PTR_CAST
Unsigned integer conversion overflow	UINT_CONV_OVFL
Use of automatic variable as putenv-family function argument	PUTENV_AUTO_VAR
Use of previously closed resource	CLOSED_RESOURCE_USE
Use of previously freed pointer	FREED_PTR
Useless if	USELESS_IF

Defect	Command-line Name
Variable length array with nonpositive size	NON_POSITIVE_VLA_SIZE
Variable shadowing	VAR_SHADOWING
Write without a further read	USELESS_WRITE
Writing to const qualified object	CONSTANT_OBJECT_WRITE
Writing to read-only resource	READ_ONLY_RESOURCE_WRITE
Wrong type used in sizeof	PTR_SIZEOF_MISMATCH

To enable other checkers and coding rule, configure checkers selections. See “Prepare Checkers Configuration for Polyspace Bug Finder Analysis” on page 9-21.

Bug Finder Results Found in Fast Analysis Mode

In fast analysis mode, Bug Finder checks for a subset of defects and coding rules only. The tables below list the results that can be found in a fast analysis. See also `Use fast analysis mode for Bug Finder (-fast-analysis)`.

These defects and coding standard violations are either found earlier in the analysis or leverage archived information from a previous analysis. The analysis results are comparatively easier to review and fix because most results can be understood by focusing on two or three lines of code (the line with the defect and one or two previous lines).

Because of the simplified nature of the analysis, you might see fewer defects in the fast analysis mode compared to a regular Bug Finder analysis.

Polyspace Bug Finder Defects

Static Memory

Name	Description
Buffer overflow from incorrect string format specifier (`str_format_buffer_overflow`)	String format specifier causes buffer argument of standard library functions to overflow
Unreliable cast of function pointer (`func_cast`)	Function pointer cast to another function pointer with different argument or return type
Unreliable cast of pointer (`ptr_cast`)	Pointer implicitly cast to different data type

Programming

Name	Description
Copy of overlapping memory (`overlapping_copy`)	Source and destination arguments of a copy function have overlapping memory
Exception caught by value (`excp_caught_by_value`)	`catch` statement accepts an object by value
Exception handler hidden by previous handler (`excp_handler_hidden`)	`catch` statement is not reached because of an earlier catch statement for the same exception
Format string specifiers and arguments mismatch (`string_format`)	String specifiers do not match corresponding arguments
Improper array initialization (`improper_array_init`)	Incorrect array initialization when using initializers
Invalid use of == (equality) operator (`bad_equal_equal_use`)	Equality operation in assignment statement
Invalid use of = (assignment) operator (`bad_equal_use`)	Assignment in conditional statement
Invalid use of floating point operation (`bad_float_op`)	Imprecise comparison of floating point variables
Missing null in string array (`missing_null_char`)	String does not terminate with null character
Overlapping assignment (`overlapping_assign`)	Memory overlap between left and right sides of an assignment
Possibly unintended evaluation of expression because of operator precedence rules (`operator_precedence`)	Operator precedence rules cause unexpected evaluation order in arithmetic expression
Unsafe conversion between pointer and integer (`bad_int_ptr_cast`)	Misaligned or invalid results from conversions between pointer and integer types
Wrong type used in sizeof (`ptr_sizeof_mismatch`)	`sizeof` argument does not match pointed type

Data Flow

Name	Description
Code deactivated by constant false condition (`deactivated_code`)	Code segment deactivated by `#if 0` directive or `if(0)` condition
Missing return statement (`missing_return`)	Function does not return value though return type is not void
Static uncalled function (`uncalled_func`)	Function with static scope not called in file
Variable shadowing (`var_shadowing`)	Variable hides another variable of same name with nested scope

Object Oriented

Name	Description
`*this` not returned in copy assignment operator (`return_not_ref_to_this`)	operator= method does not return a pointer to the current object
Base class assignment operator not called (`missing_base_assign_op_call`)	Copy assignment operator does not call copy assignment operators of base subobjects
Base class destructor not virtual (`dtor_not_virtual`)	Class cannot behave polymorphically for deletion of derived class objects
Copy constructor not called in initialization list (`missing_copy_ctor_call`)	Copy constructor does not call copy constructors of some members or base classes
Incompatible types prevent overriding (`virtual_func_hiding`)	Derived class method hides a virtual base class method instead of overriding it
Member not initialized in constructor (`non_init_member`)	Constructor does not initialize some members of a class
Missing explicit keyword (`missing_explicit_keyword`)	Constructor missing the explicit specifier
Missing virtual inheritance (`missing_virtual_inheritance`)	A base class is inherited virtually and nonvirtually in the same hierarchy
Object slicing (`object_slicing`)	Derived class object passed by value to function with base class parameter
Partial override of overloaded virtual functions (`partial_override`)	Class overrides fraction of inherited virtual functions with a given name
Return of non const handle to encapsulated data member (`breaking_data_encapsulation`)	Method returns pointer or reference to internal member of object
Self assignment not tested in operator (`missing_self_assign_test`)	Copy assignment operator does not test for self-assignment

Security

Name	Description
Function pointer assigned with absolute address (`func_ptr_absolute_addr`)	Constant expression is used as function address is vulnerable to code injection

Good Practice

Name	Description
Bitwise and arithmetic operation on the same data (`bitwise_arith_mix`)	Statement with mixed bitwise and arithmetic operations
Delete of void pointer (`delete_of_void_ptr`)	delete operates on a `void*` pointer pointing to an object
Hard-coded buffer size (`hard_coded_buffer_size`)	Size of memory buffer is a numerical value instead of symbolic constant
Hard-coded loop boundary (`hard_coded_loop_boundary`)	Loop boundary is a numerical value instead of symbolic constant
Large pass-by-value argument (`pass_by_value`)	Large argument passed by value between functions
Line with more than one statement (`more_than_one_statement`)	Multiple statements on a line
Missing break of switch case (`missing_switch_break`)	No comments at the end of switch case without a break statement
Missing reset of a freed pointer (`missing_freed_ptr_reset`)	Pointer free not followed by a reset statement to clear leftover data
Unused parameter (`unused_parameter`)	Function prototype has parameters not read or written in function body

MISRA C:2004 and MISRA AC AGC Rules

The software checks the following rules early in the analysis.

Language Extensions

Rule	Description
2.1	Assembly language shall be encapsulated and isolated.
2.2	Source code shall only use `/* */` style comments.
2.3	The character sequence `/*` shall not be used within a comment.

Documentation

Rule	Description
3.4	All uses of the `#pragma` directive shall be documented and explained.

Character Sets

Rule	Description
4.1	Only those escape sequences which are defined in the ISO C standard shall be used.
4.2	Trigraphs shall not be used.

Identifiers

Rule	Description
5.2	Identifiers in an inner scope shall not use the same name as an identifier in an outer scope, and therefore hide that identifier.

Types

Rule	Description
6.1	The plain char type shall be used only for the storage and use of character values.
6.2	Signed and unsigned char type shall be used only for the storage and use of numeric values.
6.3	`typedefs` that indicate size and signedness should be used in place of the basic types.
6.4	Bit fields shall only be defined to be of type `unsigned int` or `signed int`.
6.5	Bit fields of type `signed int` shall be at least 2 bits long.

Constants

Rule	Description
7.1	Octal constants (other than zero) and octal escape sequences shall not be used.

Declarations and Definitions

Rule	Description
8.1	Functions shall have prototype declarations and the prototype shall be visible at both the function definition and call.
8.2	Whenever an object or function is declared or defined, its type shall be explicitly stated.
8.3	For each function parameter the type given in the declaration and definition shall be identical, and the return types shall also be identical.
8.5	There shall be no definitions of objects or functions in a header file.
8.6	Functions shall always be declared at file scope.
8.7	Objects shall be defined at block scope if they are only accessed from within a single function.
8.8	An external object or function shall be declared in one file and only one file.
8.9	An identifier with external linkage shall have exactly one external definition.
8.11	The `static` storage class specifier shall be used in definitions and declarations of objects and functions that have internal linkage
8.12	When an array is declared with external linkage, its size shall be stated explicitly or defined implicitly by initialization.

Initialization

Rule	Description
9.2	Braces shall be used to indicate and match the structure in the nonzero initialization of arrays and structures.
9.3	In an enumerator list, the = construct shall not be used to explicitly initialize members other than the first, unless all items are explicitly initialized.

Arithmetic Type Conversion

Rule	Description
10.1	The value of an expression of integer type shall not be implicitly converted to a different underlying type if: • It is not a conversion to a wider integer type of the same signedness, or • The expression is complex, or • The expression is not constant and is a function argument, or • The expression is not constant and is a return expression
10.2	The value of an expression of floating type shall not be implicitly converted to a different type if • It is not a conversion to a wider floating type, or • The expression is complex, or • The expression is a function argument, or • The expression is a return expression
10.3	The value of a complex expression of integer type may only be cast to a type that is narrower and of the same signedness as the underlying type of the expression.
10.4	The value of a complex expression of float type may only be cast to narrower floating type.
10.5	If the bitwise operator ~ and << are applied to an operand of underlying type `unsigned char` or `unsigned short`, the result shall be immediately cast to the underlying type of the operand
10.6	The "U" suffix shall be applied to all constants of `unsigned` types.

Pointer Type Conversion

Rule	Description
11.1	Conversion shall not be performed between a pointer to a function and any type other than an integral type.
11.2	Conversion shall not be performed between a pointer to an object and any type other than an integral type, another pointer to a object type or a pointer to `void`.
11.3	A cast should not be performed between a pointer type and an integral type.
11.4	A cast should not be performed between a pointer to object type and a different pointer to object type.
11.5	A cast shall not be performed that removes any `const` or `volatile` qualification from the type addressed by a pointer

Expressions

Rule	Description
12.1	Limited dependence should be placed on C's operator precedence rules in expressions.
12.3	The `sizeof` operator should not be used on expressions that contain side effects.
12.5	The operands of a logical && or `||` shall be primary-expressions.
12.6	Operands of logical operators (&&, `||` and `!`) should be effectively Boolean. Expression that are effectively Boolean should not be used as operands to operators other than (&&, `||` or `!`).
12.7	Bitwise operators shall not be applied to operands whose underlying type is signed.
12.9	The unary minus operator shall not be applied to an expression whose underlying type is unsigned.
12.10	The comma operator shall not be used.
12.11	Evaluation of constant unsigned expression should not lead to wraparound.
12.12	The underlying bit representations of floating-point values shall not be used.
12.13	The increment (++) and decrement (`--`) operators should not be mixed with other operators in an expression

Control Statement Expressions

Rule	Description
13.1	Assignment operators shall not be used in expressions that yield Boolean values.
13.2	Tests of a value against zero should be made explicit, unless the operand is effectively Boolean.
13.3	Floating-point expressions shall not be tested for equality or inequality.
13.4	The controlling expression of a `for` statement shall not contain any objects of floating type.
13.5	The three expressions of a `for` statement shall be concerned only with loop control.
13.6	Numeric variables being used within a `for` loop for iteration counting should not be modified in the body of the loop.

Control Flow

Rule	Description
14.3	All non-null statements shall either • have at least one side effect however executed, or • cause control flow to change.
14.4	The `goto` statement shall not be used.
14.5	The `continue` statement shall not be used.
14.6	For any iteration statement, there shall be at most one `break` statement used for loop termination.
14.7	A function shall have a single point of exit at the end of the function.
14.8	The statement forming the body of a `switch`, `while`, `do while` or `for` statement shall be a compound statement.
14.9	An `if` (expression) construct shall be followed by a compound statement. The `else` keyword shall be followed by either a compound statement, or another `if` statement.
14.10	All `if else if` constructs should contain a final `else` clause.

Switch Statements

Rule	Description
15.0	Unreachable code is detected between `switch` statement and first `case`.
15.1	A `switch` label shall only be used when the most closely-enclosing compound statement is the body of a `switch` statement
15.2	An unconditional `break` statement shall terminate every non-empty `switch` clause.
15.3	The final clause of a `switch` statement shall be the `default` clause.
15.4	A `switch` expression should not represent a value that is effectively Boolean.
15.5	Every `switch` statement shall have at least one `case` clause.

Functions

Rule	Description
16.1	Functions shall not be defined with variable numbers of arguments.
16.3	Identifiers shall be given for all of the parameters in a function prototype declaration.
16.5	Functions with no parameters shall be declared with parameter type `void`.
16.6	The number of arguments passed to a function shall match the number of parameters.
16.8	All exit paths from a function with non-`void` return type shall have an explicit return statement with an expression.
16.9	A function identifier shall only be used with either a preceding &, or with a parenthesized parameter list, which may be empty.

Pointers and Arrays

Rule	Description
17.4	Array indexing shall be the only allowed form of pointer arithmetic.
17.5	A type should not contain more than 2 levels of pointer indirection.

Structures and Unions

Rule	Description
18.1	All structure or union types shall be complete at the end of a translation unit.
18.4	Unions shall not be used.

Preprocessing Directives

Rule	Description
19.1	`#include` statements in a file shall only be preceded by other preprocessors directives or comments.
19.2	Nonstandard characters should not occur in header file names in `#include` directives.
19.3	The `#include` directive shall be followed by either a <filename> or "filename" sequence.
19.4	C macros shall only expand to a braced initializer, a constant, a parenthesized expression, a type qualifier, a storage class specifier, or a do-while-zero construct.
19.5	Macros shall not be `#define`-d and `#undef`-d within a block.
19.6	`#undef` shall not be used.
19.7	A function should be used in preference to a function like-macro.
19.8	A function-like macro shall not be invoked without all of its arguments.
19.9	Arguments to a function-like macro shall not contain tokens that look like preprocessing directives.
19.10	In the definition of a function-like macro, each instance of a parameter shall be enclosed in parentheses unless it is used as the operand of # or ##.
19.11	All macro identifiers in preprocessor directives shall be defined before use, except in `#ifdef` and `#ifndef` preprocessor directives and the `defined()` operator.
19.12	There shall be at most one occurrence of the # or ## preprocessor operators in a single macro definition.
19.13	The # and ## preprocessor operators should not be used.
19.14	The defined preprocessor operator shall only be used in one of the two standard forms.
19.15	Precautions shall be taken in order to prevent the contents of a header file being included twice.
19.16	Preprocessing directives shall be syntactically meaningful even when excluded by the preprocessor.
19.17	All `#else`, `#elif` and `#endif` preprocessor directives shall reside in the same file as the `#if` or `#ifdef` directive to which they are related.

Standard Libraries

Rule	Description
20.1	Reserved identifiers, macros and functions in the standard library, shall not be defined, redefined or undefined.
20.2	The names of standard library macros, objects and functions shall not be reused.
20.4	Dynamic heap memory allocation shall not be used.
20.5	The error indicator `errno` shall not be used.
20.6	The macro `offsetof`, in library `<stddef.h>`, shall not be used.
20.7	The `setjmp` macro and the `longjmp` function shall not be used.
20.8	The signal handling facilities of `<signal.h>` shall not be used.
20.9	The input/output library `<stdio.h>` shall not be used in production code.
20.10	The library functions `atof`, `atoi` and `atoll` from library `<stdlib.h>` shall not be used.
20.11	The library functions `abort`, `exit`, `getenv` and `system` from library `<stdlib.h>` shall not be used.
20.12	The time handling functions of library `<time.h>` shall not be used.

MISRA C:2012 Rules

Standard C Environment

Rule	Description
1.1	The program shall contain no violations of the standard C syntax and constraints, and shall not exceed the implementation's translation limits.
1.2	Language extensions should not be used.

Unused Code

Rule	Description
2.6	A function should not contain unused label declarations.
2.7	There should be no unused parameters in functions.

Comments

Rule	Description
3.1	The character sequences `/*` and `//` shall not be used within a comment.
3.2	Line-splicing shall not be used in `//` comments.

Character Sets and Lexical Conventions

Rule	Description
4.1	Octal and hexadecimal escape sequences shall be terminated.
4.2	Trigraphs should not be used.

Identifiers

Rule	Description
5.2	Identifiers declared in the same scope and name space shall be distinct.
5.3	An identifier declared in an inner scope shall not hide an identifier declared in an outer scope.
5.4	Macro identifiers shall be distinct.
5.5	Identifiers shall be distinct from macro names.

Types

Rule	Description
6.1	Bit-fields shall only be declared with an appropriate type.
6.2	Single-bit named bit fields shall not be of a signed type.

Literals and Constants

Rule	Description
7.1	Octal constants shall not be used.
7.2	A "u" or "U" suffix shall be applied to all integer constants that are represented in an unsigned type.
7.3	The lowercase character "l" shall not be used in a literal suffix.
7.4	A string literal shall not be assigned to an object unless the object's type is "pointer to const-qualified char".

Declarations and Definitions

Rule	Description
8.1	Types shall be explicitly specified.
8.2	Function types shall be in prototype form with named parameters.
8.4	A compatible declaration shall be visible when an object or function with external linkage is defined.
8.5	An external object or function shall be declared once in one and only one file.
8.6	An identifier with external linkage shall have exactly one external definition.
8.8	The `static` storage class specifier shall be used in all declarations of objects and functions that have internal linkage.
8.10	An inline function shall be declared with the `static` storage class.
8.11	When an array with external linkage is declared, its size should be explicitly specified.
8.12	Within an enumerator list, the value of an implicitly-specified enumeration constant shall be unique.
8.14	The `restrict` type qualifier shall not be used.

Initialization

Rule	Description
9.2	The initializer for an aggregate or union shall be enclosed in braces.
9.3	Arrays shall not be partially initialized.
9.4	An element of an object shall not be initialized more than once.
9.5	Where designated initializers are used to initialize an array object the size of the array shall be specified explicitly.

The Essential Type Model

Rule	Description
10.1	Operands shall not be of an inappropriate essential type.
10.2	Expressions of essentially character type shall not be used inappropriately in addition and subtraction operations.
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.
10.4	Both operands of an operator in which the usual arithmetic conversions are performed shall have the same essential type category.
10.5	The value of an expression should not be cast to an inappropriate essential type.
10.6	The value of a composite expression shall not be assigned to an object with wider essential type.
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.
10.8	The value of a composite expression shall not be cast to a different essential type category or a wider essential type.

Pointer Type Conversion

Rule	Description
11.1	Conversions shall not be performed between a pointer to a function and any other type.
11.2	Conversions shall not be performed between a pointer to an incomplete type and any other type.
11.3	A cast shall not be performed between a pointer to object type and a pointer to a different object type.
11.4	A conversion should not be performed between a pointer to object and an integer type.
11.5	A conversion should not be performed from pointer to void into pointer to object.
11.6	A cast shall not be performed between pointer to void and an arithmetic type.
11.7	A cast shall not be performed between pointer to object and a non-integer arithmetic type.
11.8	A cast shall not remove any const or volatile qualification from the type pointed to by a pointer.
11.9	The macro `NULL` shall be the only permitted form of integer null pointer constant.

Expressions

Rule	Description
12.1	The precedence of operators within expressions should be made explicit.
12.3	The comma operator should not be used.
12.4	Evaluation of constant expressions should not lead to unsigned integer wrap-around.

Side Effects

Rule	Description
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.
13.4	The result of an assignment operator should not be used.
13.6	The operand of the `sizeof` operator shall not contain any expression which has potential side effects.

Control Statement Expressions

Rule	Description
14.4	The controlling expression of an `if` statement and the controlling expression of an iteration-statement shall have essentially Boolean type.

Control Flow

Rule	Description
15.1	The `goto` statement should not be used.
15.2	The `goto` statement shall jump to a label declared later in the same function.
15.3	Any label referenced by a `goto` statement shall be declared in the same block, or in any block enclosing the `goto` statement.
15.4	There should be no more than one `break` or `goto` statement used to terminate any iteration statement.
15.5	A function should have a single point of exit at the end
15.6	The body of an iteration-statement or a selection-statement shall be a compound statement.
15.7	All `if … else if` constructs shall be terminated with an `else` statement.

Switch Statements

Rule	Description
16.1	All `switch` statements shall be well-formed.
16.2	A `switch` label shall only be used when the most closely-enclosing compound statement is the body of a `switch` statement.
16.3	An unconditional `break` statement shall terminate every `switch`-clause.
16.4	Every `switch` statement shall have a `default` label.
16.5	A `default` label shall appear as either the first or the last `switch` label of a `switch` statement.
16.6	Every `switch` statement shall have at least two `switch`-clauses.
16.7	A `switch`-expression shall not have essentially Boolean type.

Functions

Rule	Description
17.1	The features of `<starg.h>` shall not be used.
17.3	A function shall not be declared implicitly.
17.4	All exit paths from a function with non-`void` return type shall have an explicit return statement with an expression.
17.6	The declaration of an array parameter shall not contain the `static` keyword between the `[ ]`.
17.7	The value returned by a function having non-`void` return type shall be used.

Pointers and Arrays

Rule	Description
18.4	The `+`, `-`, `+=` and `-=` operators should not be applied to an expression of pointer type.
18.5	Declarations should contain no more than two levels of pointer nesting.
18.7	Flexible array members shall not be declared.
18.8	Variable-length array types shall not be used.

Overlapping Storage

Rule	Description
19.2	The `union` keyword should not be used.

Preprocessing Directives

Rule	Description
20.1	`#include` directives should only be preceded by preprocessor directives or comments.
20.2	The `'`, `"`, or `\` characters and the `/*` or `//` character sequences shall not occur in a header file name.
20.3	The `#include` directive shall be followed by either a <filename> or \"filename\" sequence.
20.4	A macro shall not be defined with the same name as a keyword.
20.5	`#undef` should not be used.
20.6	Tokens that look like a preprocessing directive shall not occur within a macro argument.
20.7	Expressions resulting from the expansion of macro parameters shall be enclosed in parentheses.
20.8	The controlling expression of a `#if` or `#elif` preprocessing directive shall evaluate to 0 or 1.
20.9	All identifiers used in the controlling expression of `#if` or `#elif` preprocessing directives shall be `#define`'d before evaluation.
20.10	The # and ## preprocessor operators should not be used.
20.11	A macro parameter immediately following a # operator shall not immediately be followed by a ## operator.
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.
20.13	A line whose first token is # shall be a valid preprocessing directive.
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.

Standard Libraries

Rule	Description
21.1	`#define` and `#undef` shall not be used on a reserved identifier or reserved macro name.
21.2	A reserved identifier or macro name shall not be declared.
21.3	The memory allocation and deallocation functions of `<stdlib.h>` shall not be used.
21.4	The standard header file `<setjmp.h>` shall not be used.
21.5	The standard header file `<signal.h>` shall not be used.
21.6	The Standard Library input/output functions shall not be used.
21.7	The `atof`, `atoi`, `atol`, and `atoll` functions of `<stdlib.h>` shall not be used.
21.8	The library functions `abort`, `exit`, `getenv` and `system` of `<stdlib.h>` shall not be used.
21.9	The library functions `bsearch` and `qsort` of `<stdlib.h>` shall not be used.
21.10	The Standard Library time and date functions shall not be used.
21.11	The standard header file `<tgmath.h>` shall not be used.
21.12	The exception handling features of `<fenv.h>` should not be used.

MISRA C++ 2008 Rules

Language Independent Issues

Rule	Description
0-1-7	The value returned by a function having a non-void return type that is not an overloaded operator shall always be used.
0-1-11	There shall be no unused parameters (named or unnamed) in non- virtual functions.
0-1-12	There shall be no unused parameters (named or unnamed) in the set of parameters for a virtual function and all the functions that override it.
0-2-1	An object shall not be assigned to an overlapping object.

General

Rule	Description
1-0-1	All code shall conform to ISO/IEC 14882:2003 "The C++ Standard Incorporating Technical Corrigendum 1".

Lexical Conventions

Rule	Description
2-3-1	Trigraphs shall not be used.
2-5-1	Digraphs should not be used.
2-7-1	The character sequence /* shall not be used within a C-style comment.
2-10-1	Different identifiers shall be typographically unambiguous.
2-10-2	Identifiers declared in an inner scope shall not hide an identifier declared in an outer scope.
2-10-3	A typedef name (including qualification, if any) shall be a unique identifier.
2-10-4	A class, union or enum name (including qualification, if any) shall be a unique identifier.
2-10-6	If an identifier refers to a type, it shall not also refer to an object or a function in the same scope.
2-13-1	Only those escape sequences that are defined in ISO/IEC 14882:2003 shall be used.
2-13-2	Octal constants (other than zero) and octal escape sequences (other than "\0") shall not be used.
2-13-3	A "U" suffix shall be applied to all octal or hexadecimal integer literals of unsigned type.
2-13-4	Literal suffixes shall be upper case.
2-13-5	Narrow and wide string literals shall not be concatenated.

Basic Concepts

Rule	Description
3-1-1	It shall be possible to include any header file in multiple translation units without violating the One Definition Rule.
3-1-2	Functions shall not be declared at block scope.
3-1-3	When an array is declared, its size shall either be stated explicitly or defined implicitly by initialization.
3-3-1	Objects or functions with external linkage shall be declared in a header file.
3-3-2	If a function has internal linkage then all re-declarations shall include the static storage class specifier.
3-4-1	An identifier declared to be an object or type shall be defined in a block that minimizes its visibility.
3-9-1	The types used for an object, a function return type, or a function parameter shall be token-for-token identical in all declarations and re-declarations.
3-9-2	Typedefs that indicate size and signedness should be used in place of the basic numerical types.
3-9-3	The underlying bit representations of floating-point values shall not be used.

Standard Conversions

Rule	Description
4-5-1	Expressions with type bool shall not be used as operands to built-in operators other than the assignment operator =, the logical operators &&, ||, !, the equality operators == and !=, the unary & operator, and the conditional operator.
4-5-2	Expressions with type enum shall not be used as operands to built- in operators other than the subscript operator [ ], the assignment operator =, the equality operators == and !=, the unary & operator, and the relational operators <, <=, >, >=.
4-5-3	Expressions with type (plain) char and wchar_t shall not be used as operands to built-in operators other than the assignment operator =, the equality operators == and !=, and the unary & operator.

Expressions

Rule	Description
5-0-1	The value of an expression shall be the same under any order of evaluation that the standard permits.
5-0-2	Limited dependence should be placed on C++ operator precedence rules in expressions.
5-0-3	A cvalue expression shall not be implicitly converted to a different underlying type.
5-0-4	An implicit integral conversion shall not change the signedness of the underlying type.
5-0-5	There shall be no implicit floating-integral conversions.
5-0-6	An implicit integral or floating-point conversion shall not reduce the size of the underlying type.
5-0-7	There shall be no explicit floating-integral conversions of a cvalue expression.
5-0-8	An explicit integral or floating-point conversion shall not increase the size of the underlying type of a cvalue expression.
5-0-9	An explicit integral conversion shall not change the signedness of the underlying type of a cvalue expression.
5-0-10	If the bitwise operators ~ and << are applied to an operand with an underlying type of unsigned char or unsigned short, the result shall be immediately cast to the underlying type of the operand.
5-0-11	The plain char type shall only be used for the storage and use of character values.
5-0-12	signed char and unsigned char type shall only be used for the storage and use of numeric values.
5-0-13	The condition of an if-statement and the condition of an iteration-statement shall have type bool.
5-0-14	The first operand of a conditional-operator shall have type bool.
5-0-15	Array indexing shall be the only form of pointer arithmetic.
5-0-18	>, >=, <, <= shall not be applied to objects of pointer type, except where they point to the same array.
5-0-19	The declaration of objects shall contain no more than two levels of pointer indirection.
5-0-20	Non-constant operands to a binary bitwise operator shall have the same underlying type.
5-0-21	Bitwise operators shall only be applied to operands of unsigned underlying type.
5-2-1	Each operand of a logical && or || shall be a postfix - expression.
5-2-2	A pointer to a virtual base class shall only be cast to a pointer to a derived class by means of dynamic_cast.
5-2-3	Casts from a base class to a derived class should not be performed on polymorphic types.
5-2-4	C-style casts (other than void casts) and functional notation casts (other than explicit constructor calls) shall not be used.
5-2-5	A cast shall not remove any const or volatile qualification from the type of a pointer or reference.
5-2-6	A cast shall not convert a pointer to a function to any other pointer type, including a pointer to function type.
5-2-7	An object with pointer type shall not be converted to an unrelated pointer type, either directly or indirectly.
5-2-8	An object with integer type or pointer to void type shall not be converted to an object with pointer type.
5-2-9	A cast should not convert a pointer type to an integral type.

Rule	Description
5-2-10	The increment (++) and decrement (--) operators should not be mixed with other operators in an expression.
5-2-11	The comma operator, && operator and the || operator shall not be overloaded.
5-2-12	An identifier with array type passed as a function argument shall not decay to a pointer.
5-3-1	Each operand of the ! operator, the logical && or the logical || operators shall have type bool.
5-3-2	The unary minus operator shall not be applied to an expression whose underlying type is unsigned.
5-3-3	The unary & operator shall not be overloaded.
5-3-4	Evaluation of the operand to the sizeof operator shall not contain side effects.
5-8-1	The right hand operand of a shift operator shall lie between zero and one less than the width in bits of the underlying type of the left hand operand.
5-14-1	The right hand operand of a logical && or || operator shall not contain side effects.
5-18-1	The comma operator shall not be used.
5-19-1	Evaluation of constant unsigned integer expressions should not lead to wrap-around.

Statements

Rule	Description
6-2-1	Assignment operators shall not be used in sub-expressions.
6-2-2	Floating-point expressions shall not be directly or indirectly tested for equality or inequality.
6-2-3	Before preprocessing, a null statement shall only occur on a line by itself; it may be followed by a comment, provided that the first character following the null statement is a white - space character.
6-3-1	The statement forming the body of a switch, while, do ... while or for statement shall be a compound statement.
6-4-1	An if (condition) construct shall be followed by a compound statement. The else keyword shall be followed by either a compound statement, or another if statement.
6-4-2	All if ... else if constructs shall be terminated with an else clause.
6-4-3	A switch statement shall be a well-formed switch statement.
6-4-4	A switch-label shall only be used when the most closely-enclosing compound statement is the body of a switch statement.
6-4-5	An unconditional throw or break statement shall terminate every non - empty switch-clause.
6-4-6	The final clause of a switch statement shall be the default-clause.
6-4-7	The condition of a switch statement shall not have bool type.
6-4-8	Every switch statement shall have at least one case-clause.
6-5-1	A for loop shall contain a single loop-counter which shall not have floating type.
6-5-2	If loop-counter is not modified by -- or ++, then, within condition, the loop-counter shall only be used as an operand to <=, <, > or >=.
6-5-3	The loop-counter shall not be modified within condition or statement.
6-5-4	The loop-counter shall be modified by one of: --, ++, -=n, or +=n ; where n remains constant for the duration of the loop.
6-5-5	A loop-control-variable other than the loop-counter shall not be modified within condition or expression.
6-5-6	A loop-control-variable other than the loop-counter which is modified in statement shall have type bool.
6-6-1	Any label referenced by a goto statement shall be declared in the same block, or in a block enclosing the goto statement.
6-6-2	The goto statement shall jump to a label declared later in the same function body.
6-6-3	The continue statement shall only be used within a well-formed for loop.
6-6-4	For any iteration statement there shall be no more than one break or goto statement used for loop termination.
6-6-5	A function shall have a single point of exit at the end of the function.

Declarations

Rule	Description
7-3-1	The global namespace shall only contain main, namespace declarations and extern "C" declarations.
7-3-2	The identifier main shall not be used for a function other than the global function main.
7-3-3	There shall be no unnamed namespaces in header files.
7-3-4	using-directives shall not be used.
7-3-5	Multiple declarations for an identifier in the same namespace shall not straddle a using-declaration for that identifier.
7-3-6	using-directives and using-declarations (excluding class scope or function scope using-declarations) shall not be used in header files.
7-4-2	Assembler instructions shall only be introduced using the asm declaration.
7-4-3	Assembly language shall be encapsulated and isolated.

Declarators

Rule	Description
8-0-1	An init-declarator-list or a member-declarator-list shall consist of a single init-declarator or member-declarator respectively.
8-3-1	Parameters in an overriding virtual function shall either use the same default arguments as the function they override, or else shall not specify any default arguments.
8-4-1	Functions shall not be defined using the ellipsis notation.
8-4-2	The identifiers used for the parameters in a re-declaration of a function shall be identical to those in the declaration.
8-4-3	All exit paths from a function with non- void return type shall have an explicit return statement with an expression.
8-4-4	A function identifier shall either be used to call the function or it shall be preceded by &.
8-5-2	Braces shall be used to indicate and match the structure in the non- zero initialization of arrays and structures.
8-5-3	In an enumerator list, the = construct shall not be used to explicitly initialize members other than the first, unless all items are explicitly initialized.

Classes

Rule	Description
9-3-1	const member functions shall not return non-const pointers or references to class-data.
9-3-2	Member functions shall not return non-const handles to class-data.
9-5-1	Unions shall not be used.
9-6-2	Bit-fields shall be either bool type or an explicitly unsigned or signed integral type.
9-6-3	Bit-fields shall not have enum type.
9-6-4	Named bit-fields with signed integer type shall have a length of more than one bit.

Derived Classes

Rule	Description
10-1-1	Classes should not be derived from virtual bases.
10-1-2	A base class shall only be declared virtual if it is used in a diamond hierarchy.
10-1-3	An accessible base class shall not be both virtual and non-virtual in the same hierarchy.
10-2-1	All accessible entity names within a multiple inheritance hierarchy should be unique.
10-3-1	There shall be no more than one definition of each virtual function on each path through the inheritance hierarchy.
10-3-2	Each overriding virtual function shall be declared with the virtual keyword.
10-3-3	A virtual function shall only be overridden by a pure virtual function if it is itself declared as pure virtual.

Member Access Control

Rule	Description
11-0-1	Member data in non- POD class types shall be private.

Special Member Functions

Rule	Description
12-1-1	An object's dynamic type shall not be used from the body of its constructor or destructor.
12-1-2	All constructors of a class should explicitly call a constructor for all of its immediate base classes and all virtual base classes.
12-1-3	All constructors that are callable with a single argument of fundamental type shall be declared explicit.
12-8-1	A copy constructor shall only initialize its base classes and the non- static members of the class of which it is a member.
12-8-2	The copy assignment operator shall be declared protected or private in an abstract class.

Templates

Rule	Description
14-5-2	A copy constructor shall be declared when there is a template constructor with a single parameter that is a generic parameter.
14-5-3	A copy assignment operator shall be declared when there is a template assignment operator with a parameter that is a generic parameter.
14-6-1	In a class template with a dependent base, any name that may be found in that dependent base shall be referred to using a qualified-id or this->.
14-6-2	The function chosen by overload resolution shall resolve to a function declared previously in the translation unit.
14-7-3	All partial and explicit specializations for a template shall be declared in the same file as the declaration of their primary template.
14-8-1	Overloaded function templates shall not be explicitly specialized.
14-8-2	The viable function set for a function call should either contain no function specializations, or only contain function specializations.

Exception Handling

Rule	Description
15-0-2	An exception object should not have pointer type.
15-0-3	Control shall not be transferred into a try or catch block using a goto or a switch statement.
15-1-2	NULL shall not be thrown explicitly.
15-1-3	An empty throw (throw;) shall only be used in the compound- statement of a catch handler.
15-3-2	There should be at least one exception handler to catch all otherwise unhandled exceptions
15-3-3	Handlers of a function-try-block implementation of a class constructor or destructor shall not reference non-static members from this class or its bases.
15-3-5	A class type exception shall always be caught by reference.
15-3-6	Where multiple handlers are provided in a single try-catch statement or function-try-block for a derived class and some or all of its bases, the handlers shall be ordered most-derived to base class.
15-3-7	Where multiple handlers are provided in a single try-catch statement or function-try-block, any ellipsis (catch-all) handler shall occur last.
15-5-1	A class destructor shall not exit with an exception.
15-5-2	Where a function's declaration includes an exception-specification, the function shall only be capable of throwing exceptions of the indicated type(s).

Preprocessing Directives

Rule	Description
16-0-1	#include directives in a file shall only be preceded by other preprocessor directives or comments.
16-0-2	Macros shall only be #define 'd or #undef 'd in the global namespace.
16-0-3	#undef shall not be used.
16-0-4	Function-like macros shall not be defined.
16-0-5	Arguments to a function-like macro shall not contain tokens that look like preprocessing directives.
16-0-6	In the definition of a function-like macro, each instance of a parameter shall be enclosed in parentheses, unless it is used as the operand of # or ##.
16-0-7	Undefined macro identifiers shall not be used in #if or #elif preprocessor directives, except as operands to the defined operator.
16-0-8	If the # token appears as the first token on a line, then it shall be immediately followed by a preprocessing token.
16-1-1	The defined preprocessor operator shall only be used in one of the two standard forms.
16-1-2	All #else, #elif and #endif preprocessor directives shall reside in the same file as the #if or #ifdef directive to which they are related.
16-2-1	The pre-processor shall only be used for file inclusion and include guards.
16-2-2	C++ macros shall only be used for: include guards, type qualifiers, or storage class specifiers.
16-2-3	Include guards shall be provided.
16-2-4	The ', ", /* or // characters shall not occur in a header file name.
16-2-5	The \ character should not occur in a header file name.
16-2-6	The #include directive shall be followed by either a <filename> or "filename" sequence.
16-3-1	There shall be at most one occurrence of the # or ## operators in a single macro definition.
16-3-2	The # and ## operators should not be used.
16-6-1	All uses of the #pragma directive shall be documented.
17-0-1	Reserved identifiers, macros and functions in the standard library shall not be defined, redefined or undefined.
17-0-2	The names of standard library macros and objects shall not be reused.
17-0-5	The setjmp macro and the longjmp function shall not be used.

Language Support Library

Rule	Description
18-0-1	The C library shall not be used.
18-0-2	The library functions atof, atoi and atol from library <cstdlib> shall not be used.
18-0-3	The library functions abort, exit, getenv and system from library <cstdlib> shall not be used.
18-0-4	The time handling functions of library <ctime> shall not be used.
18-0-5	The unbounded functions of library <cstring> shall not be used.
18-2-1	The macro offsetof shall not be used.
18-4-1	Dynamic heap memory allocation shall not be used.
18-7-1	The signal handling facilities of <csignal> shall not be used.

Diagnostic Library

Rule	Description
19-3-1	The error indicator errno shall not be used.

Input/Output Library

Rule	Description
27-0-1	The stream input/output library <cstdio> shall not be used.

CWE Coding Standard and Polyspace Results

Common Weakness Enumeration (CWE) is a dictionary of common software weakness types that can occur in software architecture, design, code, or implementation. These weaknesses can lead to security vulnerabilities.

CWE and Polyspace Bug Finder

The CWE dictionary assigns a unique identifier to each software weakness type. These identifiers serve as a common language for describing software security weaknesses and a standard for software security tools targeting these weaknesses. For more information, see Common Weakness Enumeration.

Polyspace Bug Finder results can be mapped to CWE identifiers. Using Bug Finder, you can check and document if your software has weaknesses listed in the CWE dictionary. Bug Finder supports the following aspects of the CWE Compatibility and Effectiveness Program:

- **CWE Searchable**: For each supported CWE identifier, you can see all instances in your code that have weaknesses corresponding to the identifier.
- **CWE Output**: For each Polyspace Bug Finder defect:
  - You can view the associated CWE identifier.
  - You can report the associated CWE identifier.

Bug Finder results are mapped to CWE identifiers (IDs). Using the Bug Finder results, you can evaluate your code against the CWE standard. For instance, CWE ID 119 (Improper restriction of operations within the bounds of a memory buffer) maps to the Bug Finder defects, **Array access out of bounds** and **Pointer access out of bounds**.

For more information on the CWE Compatibility and Effectiveness Program, see CWE Compatibility.

Find CWE IDs from Polyspace Results

Use the following workflow if you want to focus your Bug Finder analysis on the CWE standard.

- *Analysis*: Check your code only for those Bug Finder defects that correspond to the standard. Use the option `Find defects (-checkers)` with value `CWE`.
- *Results*: If you enable only the defect checkers corresponding to the CWE standard, you see only the defects that correspond to the standard. Fix or justify each defect.

  Along with defects, you can see the CWE IDs mapped to each defect in the **CWE ID** column on the **Results List** pane. If the column is not enabled by default, right-click any column header and select **CWE ID**.
- *Report*: When you generate a report, choose the `SecurityCWE` template tailored for the CWE standard. The report shows the CWE ID-s corresponding to each result.

Mapping Between CWE Identifiers and Polyspace Results

The following table lists the CWE IDs (version 3.3) addressed by Polyspace Bug Finder with its corresponding defect checkers. Using Polyspace Bug Finder defect checkers, you can check for 133 CWE IDs.

There are three types of CWE identifiers: Class, Base and Variant. Identifiers of type Class define security weaknesses at an abstract level independent of a specific language or technology, while identifiers of type Base and Variant are more concrete. On the other hand, Polyspace Bug Finder results are designed to be specific so that users can have a precise diagnosis of the defect in their code and understand the defect quickly. Therefore:

- The Bug Finder results are mapped to the specific identifiers of type Base and Variant rather than the generic identifiers of type Class.

  Only when a result covers more ground than a specific CWE identifier is the result mapped to its more general parent type. For instance, the defect checker **Array access out of bounds** covers many kinds of buffer overflows, while CWE-788 refers only to “Access of Memory Location After End of Buffer”. Therefore, the defect checker is mapped to its parent, CWE-119, which refers to “Improper Restriction of Operations within the Bounds of a Memory Buffer”. However, to keep the mapping precise, an attempt is made to map to specific CWE identifiers.
- Often, more than one Bug Finder result is mapped to a certain CWE identifier.

  For instance, CWE-908 refers to “Use of Uninitialized Resource”. To highlights specific kinds of uninitialized resources, Bug Finder has three different checkers: **Member not initialized in constructor**, **Non-initialized pointer**, and **Non-initialized variable**.

For mapping to the subsets CWE-658 and CWE-659, see “Mapping Between CWE-658 or 659 and Polyspace Results” on page 9-103.

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

15	External control of system or configuration setting	`Host change using externally controlled elements`
		
		`Use of externally controlled environment variable`

20	Improper input validation	`Unsafe conversion from string to numerical value`
22	Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')	`Vulnerable path manipulation`
23	Relative path traversal	`Vulnerable path manipulation`
36	Absolute path traversal	`Vulnerable path manipulation`
67	Improper Handling of Windows Device Names	`Inappropriate I/O operation on device files`

77	Improper neutralization of special elements used in a command	`Execution of externally controlled command`
		
		`Unsafe call to a system function`

78	Improper neutralization of special elements used in an OS command	`Execution of externally controlled command`
		
		`Unsafe call to a system function`

88	Argument injection or modification	`Execution of externally controlled command`
		
		`Unsafe call to a system function`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

114	Process control	`Command executed from externally controlled path`
		
		`Execution of a binary from a relative path can be controlled by an external actor`
		
		`Execution of externally controlled command`
		
		`Library loaded from externally controlled path`
		
		`Load of library from a relative path can be controlled by an external actor`

119	Improper restriction of operations within the bounds of a memory buffer	`Array access out of bounds`
		
		`Pointer access out of bounds`

120	Buffer copy without checking size of input ('Classic buffer overflow')	`Invalid use of standard library memory routine`
		
		`Invalid use of standard library string routine`
		
		`Tainted NULL or non-null-terminated string`

121	Stack-based buffer overflow	`Array access with tainted index`
		
		`Destination buffer overflow in string manipulation`

122	Heap-based buffer overflow	`Pointer dereference with tainted offset`

124	Buffer underwrite ('Buffer underflow')	`Array access with tainted index`
		
		`Buffer overflow from incorrect string format specifier`
		
		`Destination buffer underflow in string manipulation`
		
		`Pointer dereference with tainted offset`

125	Out-of-bounds read	`Array access with tainted index`
		
		`Buffer overflow from incorrect string format specifier`
		
		`Destination buffer overflow in string manipulation`

126	Buffer over-read	`Buffer overflow from incorrect string format specifier`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
127	Buffer under-read	`Buffer overflow from incorrect string format specifier`

128	Wrap-around error	`Integer constant overflow`
		`Integer conversion overflow`
		`Integer overflow`
		`Memory allocation with tainted size`
		`Tainted sign change conversion`
		`Tainted size of variable length array`
		`Unsigned integer constant overflow`
		`Unsigned integer conversion overflow`
		`Unsigned integer overflow`

129	Improper validation of array index	`Array access with tainted index`
		`Pointer dereference with tainted offset`

130	Improper handling of length parameter inconsistency	`Mismatch between data length and size`

131	Incorrect calculation of buffer size	`Array access out of bounds`
		`Memory allocation with tainted size`
		`Pointer access out of bounds`
		`Tainted sign change conversion`
		`Tainted size of variable length array`
		`Unsigned integer conversion overflow`
		`Unsigned integer overflow`

134	Uncontrolled format string	`Tainted string format`

135	Incorrect Calculation of Multi-Byte String Length	`Destination buffer overflow in string manipulation`
		`Misuse of narrow or wide character string`
		`Unreliable cast of pointer`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

170	Improper null termination	`Missing null in string array`
		
		`Misuse of readlink()`
		
		`Tainted NULL or non-null-terminated string`

188	Reliance on data/ memory layout	`Invalid assumptions about memory organization`
		
		`Memory comparison of padding data`
		
		`Memory comparison of strings`
		
		`Missing byte reordering when transferring data`
		
		`Pointer access out of bounds`

189	Numeric Errors	`Absorption of float operand`
		
		`Float conversion overflow`
		
		`Float division by zero`
		
		`Float overflow`
		
		`Integer constant overflow`
		
		`Integer conversion overflow`
		
		`Integer division by zero`
		
		`Integer overflow`
		
		`Precision loss in integer to float conversion`
		
		`Shift of a negative value`
		
		`Shift operation overflow`
		
		`Tainted division operand`
		
		`Unsigned integer constant overflow`
		
		`Unsigned integer conversion overflow`
		
		`Unsigned integer overflow`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

190	Integer overflow or wraparound	`Integer conversion overflow`
		`Integer constant overflow`
		`Integer overflow`
		`Integer precision exceeded`
		`Possible invalid operation on boolean operand`
		`Shift operation overflow`
		`Tainted division operand`
		`Unsigned integer conversion overflow`
		`Unsigned integer overflow`
		`Unsigned integer constant overflow`

191	Integer underflow (Wrap or wraparound)	`Integer constant overflow`
		`Integer conversion overflow`
		`Integer overflow`
		`Unsigned integer constant overflow`
		`Unsigned integer conversion overflow`
		`Unsigned integer overflow`

192	Integer coercion error	`Integer conversion overflow`
		`Integer overflow`
		`Sign change integer conversion overflow`
		`Tainted sign change conversion`
		`Unsigned integer conversion overflow`
		`Unsigned integer overflow`

194	Unexpected sign extension	`Sign change integer conversion overflow`
		`Tainted sign change conversion`

195	Signed to unsigned conversion error	`Sign change integer conversion overflow`
		`Tainted sign change conversion`

196	Unsigned to signed conversion error	`Sign change integer conversion overflow`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

197	Numeric truncation error	`Float conversion overflow`
		
		`Integer conversion overflow`
		
		`Unsigned integer conversion overflow`

198		`Missing byte reordering when transferring data`
226	Sensitive information uncleared before release	`Uncleared sensitive data in stack`

227	Improper fulfillment of API contract	`Invalid use of standard library floating point routine`
		
		`Invalid use of standard library integer routine`
		
		`Invalid use of standard library memory routine`
		
		`Invalid use of standard library routine`
		
		`Invalid use of standard library string routine`
		
		`Writing to const qualified object`

240	Improper handling of inconsistent structural elements	`Mismatch between data length and size`
242	Use of inherently dangerous function	`Use of dangerous standard function`
243	Creation of chroot jail without changing working directory	`File manipulation after chroot without chdir`
244	Improper clearing of heap memory before release	`Sensitive heap memory not cleared before release`

250	Execution with unnecessary privileges	`Bad order of dropping privileges`
		
		`Privilege drop not verified`

251	Often misused: string management	`Destination buffer overflow in string manipulation`
252	Unchecked return value	`Returned value of a sensitive function not checked`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

253	Incorrect Check of Function Return Value	`Errno not checked`
		
		`Errno not reset`
		
		`Returned value of a sensitive function not checked`
		
		`Unprotected dynamic memory allocation`
		
		`Unsafe conversion from string to numerical value`

273	Improper check for dropped privileges	`Privilege drop not verified`
287	Improper Authentication	`X.509 peer certificate not checked`
297	Improper Validation of Certificate with Host Mismatch	`Server certificate common name not checked`
304	Missing Critical Step in Authentication	`TLS/SSL connection method not set`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

310	Cryptographic issues	`Constant block cipher initialization vector`
		
		`Constant cipher key`
		
		`Context initialized incorrectly for cryptographic operation`
		
		`Context initialized incorrectly for digest operation`
		
		`Incompatible padding for RSA algorithm operation`
		
		`Incorrect key for cryptographic algorithm`
		
		`Missing blinding for RSA algorithm`
		
		`Missing block cipher initialization vector`
		
		`Missing certification authority list`
		
		`Missing cipher algorithm`
		
		`Missing cipher key`
		
		`Missing data for encryption, decryption or signing operation`
		
		`Missing padding for RSA algorithm`
		
		`Missing parameters for key generation`
		
		`Missing peer key`
		
		`Missing private key`
		
		`Missing public key`
		
		`Missing X.509 certificate`
		
		`Nonsecure hash algorithm`
		
		`Nonsecure parameters for key generation`
		
		`Nonsecure RSA public exponent`
		
		`Nonsecure SSL/TLS protocol`
		
		`Predictable block cipher initialization vector`
		
		`Predictable cipher key`
		
		`Weak cipher algorithm`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

		`Weak cipher mode`
		
		`Weak padding for RSA algorithm`

311	Missing encryption of sensitive data	`Missing cipher data to process`
		
		`Missing cipher final step`

312	Cleartext Storage of Sensitive Information	`Sensitive heap memory not cleared before release`
		
		`Uncleared sensitive data in stack`

316	Cleartext Storage of Sensitive Information in Memory	`Sensitive heap memory not cleared before release`
		
		`Uncleared sensitive data in stack`

320	Key management errors	`Constant cipher key`
		
		`Missing cipher key`
		
		`Missing peer key`
		
		`Missing private key`
		
		`Missing public key`

321	Use of hard-coded cryptographic key	`Constant cipher key`
322	Key Exchange without Entity Authentication	`TLS/SSL connection method not set`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

325	Missing required cryptographic step	`Context initialized incorrectly for cryptographic operation`
		
		`Incorrect key for cryptographic algorithm`
		
		`Missing block cipher initialization vector`
		
		`Missing cipher data to process`
		
		`Missing cipher final step`
		
		`Missing cipher algorithm`
		
		`Missing cipher key`
		
		`Missing data for encryption, decryption or signing operation`
		
		`Missing parameters for key generation`
		
		`No data added into context`
		
		`Weak cipher algorithm`
		
		`Weak cipher mode`

326	Inadequate encryption strength	`Constant block cipher initialization vector`
		
		`Constant cipher key`
		
		`Missing blinding for RSA algorithm`
		
		`Missing block cipher initialization vector`
		
		`Missing padding for RSA algorithm`
		
		`Nonsecure parameters for key generation`
		
		`Nonsecure RSA public exponent`
		
		`Predictable cipher key`
		
		`Weak cipher algorithm`
		
		`Weak cipher mode`
		
		`Weak padding for RSA algorithm`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

327	Use of a broken or risky cryptographic algorithm	`Missing padding for RSA algorithm`
		
		`Nonsecure hash algorithm`
		
		`Nonsecure parameters for key generation`
		
		`Nonsecure RSA public exponent`
		
		`Nonsecure SSL/TLS protocol`
		
		`Unsafe standard encryption function`
		
		`Weak cipher algorithm`
		
		`Weak cipher mode`
		
		`Weak padding for RSA algorithm`

328	Reversible one-way hash	`Nonsecure hash algorithm`

329	Not using a random IV with CBC mode	`Constant block cipher initialization vector`
		
		`Missing block cipher initialization vector`
		
		`Predictable block cipher initialization vector`

330	Use of insufficiently random values	`Deterministic random output from constant seed`
		
		`Predictable block cipher initialization vector`
		
		`Predictable cipher key`
		
		`Predictable random output from predictable seed`
		
		`Vulnerable pseudo-random number generator`

336	Same seed in PRNG	`Deterministic random output from constant seed`
337	Predictable seed in PRNG	`Predictable random output from predictable seed`

338	Use of cryptographically weak pseudo-random number generator (PRNG)	`Predictable block cipher initialization vector`
		
		`Predictable cipher key`
		
		`Vulnerable pseudo-random number generator`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

353	Missing Support for Integrity Check	`Context initialized incorrectly for digest operation`
		
		`Nonsecure hash algorithm`

354	Improper Validation of Integrity Check Value	`Context initialized incorrectly for digest operation`

362	Concurrent execution using shared resource with improper synchronization ('Race Condition')	`File descriptor exposure to child process`
		
		`Opening previously opened resource`

364	Signal handler race condition	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`
		
		`Shared data access within signal handler`

366	Race condition within a thread	`Data race including atomic operations`
		
		`Data race through standard library function call`
		
		`Data race`

367	Time-of-check time-of-use (TOCTOU) race condition	`File access between time of check and use (TOCTOU)`

369	Divide by zero	`Float division by zero`
		
		`Integer division by zero`
		
		`Invalid use of standard library floating point routine`
		
		`Invalid use of standard library integer routine`
		
		`Tainted division operand`
		
		`Tainted modulo operand`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

372	Incomplete internal state distinction	`Context initialized incorrectly for cryptographic operation`
		
		`Context initialized incorrectly for digest operation`
		
		`Incompatible padding for RSA algorithm operation`
		
		`Inconsistent cipher operations`
		
		`Missing cipher data to process`
		
		`Missing cipher final step`
		
		`Missing data for encryption, decryption or signing operation`
		
		`Missing parameters for key generation`

375	Returning a mutable object to an untrusted caller	`Return of non const handle to encapsulated data member`
377	Insecure temporary file	`Use of non-secure temporary file`

387	Signal errors	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`
		
		`Return from computational exception signal handler`
		
		`Signal call from within signal handler`

391	Unchecked error condition	`Errno not checked`
398	Indicator of poor code quality	`Write without a further read`

401	Improper release of memory before removing last reference	`Memory leak`
		
		`Thread-specific memory leak`

404	Improper resource shutdown or release	`Invalid deletion of pointer`
		
		`Invalid free of pointer`
		
		`Memory leak`
		
		`Mismatched alloc/dealloc functions on Windows`
		
		`Thread-specific memory leak`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

413	Improper Resource Locking	`Data race`
		
		`Data race including atomic operations`
		
		`Data race through standard library function call`
		
		`Function called from signal handler not asynchronous-safe`
		
		`Function called from signal handler not asynchronous-safe (strict)`
		
		`Opening previously opened resource`
		
		`Shared data access within signal handler`

415	Double free	`Deallocation of previously deallocated pointer`
		
		`Missing reset of a freed pointer`

416	Use after free	`Missing reset of a freed pointer`
		
		`Use of previously freed pointer`

426	Untrusted search path	`Command executed from externally controlled path`
		
		`Library loaded from externally controlled path`

427	Uncontrolled search path element	`Execution of a binary from a relative path can be controlled by an external actor`
		
		`Library loaded from externally controlled path`
		
		`Load of library from a relative path can be controlled by an external actor`
		
		`Use of externally controlled environment variable`

456	Missing initialization of a variable	`Errno not reset`
		
		`Member not initialized in constructor`
		
		`Non-initialized pointer`
		
		`Non-initialized variable`

457	Use of uninitialized variable	`Member not initialized in constructor`
		
		`Non-initialized pointer`
		
		`Non-initialized variable`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
465	Pointer Issues	`Unsafe conversion between pointer and integer`

466	Return of pointer value outside of expected range	`Array access out of bounds`
		
		`Pointer access out of bounds`
		
		`Unsafe conversion between pointer and integer`

467	Use of sizeof() on a pointer type	`Possible misuse of sizeof`
		
		`Wrong type used in sizeof`

468	Incorrect pointer scaling	`Incorrect pointer scaling`
469	Use of pointer subtraction to determine size	`Subtraction or comparison between pointers to different arrays`
471	Modification of assumed-immutable data	`Writing to const qualified object`

474	Use of function with inconsistent implementations	`Signal call from within signal handler`
		
		`Use of obsolete standard function`

475	Undefined behavior for input to API	`Copy of overlapping memory`

476	NULL pointer dereference	`Null pointer`
		
		`Tainted NULL or non-null-terminated string`

477	Use of obsolete functions	`Use of obsolete standard function`
478	Missing default case in switch statement	`Missing case for switch condition`

479	Signal handler use of a non-reentrant function	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`

480	Use of incorrect operator	`Invalid use of = (assignment) operator`
		
		`Invalid use of == (equality) operator`

481	Assigning instead of comparing	`Invalid use of = (assignment) operator`
482	Comparing instead of assigning	`Invalid use of == (equality) operator`

483	Incorrect block delimitation	`Incorrectly indented statement`
		
		`Semicolon on same line as if, for or while statement`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
484	Omitted break statement in switch	`Missing break of switch case`

522	Insufficiently Protected Credentials	`Constant cipher key`
		
		`Nonsecure hash algorithm`
		
		`Nonsecure parameters for key generation`
		
		`Nonsecure RSA public exponent`
		
		`Nonsecure SSL/TLS protocol`
		
		`Unsafe standard encryption function`

532	Information exposure through log files	`Sensitive data printed out`
534	Information exposure through debug log files	`Sensitive data printed out`
535	Information exposure through shell error message	`Sensitive data printed out`

547	Use of hard-coded, security-relevant constants	`Hard coded buffer size`
		
		`Hard coded loop boundary`

558	Use of getlogin() in multithreaded application	`Unsafe standard function`
560	Use of umask() with chmod-style argument	`Umask used with chmod-style arguments`

561	Dead code	`Dead code`
		
		`Static uncalled function`
		
		`Unreachable code`

562	Return of stack variable address	`Pointer or reference to stack variable leaving scope`
		
		`Use of automatic variable as putenv-family function argument`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

573	Improper following of specification by caller	`Context initialized incorrectly for cryptographic operation`
		
		`Context initialized incorrectly for digest operation`
		
		`Incompatible padding for RSA algorithm operation`
		
		`Incorrect key for cryptographic algorithm`
		
		`Missing blinding for RSA algorithm`
		
		`Missing cipher data to process`
		
		`Missing cipher final step`
		
		`Missing cipher algorithm`
		
		`Missing cipher key`
		
		`Missing data for encryption, decryption or signing operation`
		
		`Missing final step after hashing update operation`
		
		`Missing hash algorithm`
		
		`Missing parameters for key generation`
		
		`Missing peer key`
		
		`Missing private key for X.509 certificate`
		
		`Missing private key`
		
		`Missing public key`
		
		`Modification of internal buffer returned from nonreentrant standard function`
		
		`TLS/SSL connection method not set`
		
		`TLS/SSL connection method set incorrectly`

587	Assignment of a fixed address to a pointer	`Function pointer assigned with absolute address`
		
		`Unsafe conversion between pointer and integer`

590	Free of memory not on the heap	`Invalid free of pointer`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
606	Unchecked input for loop condition	`Loop bounded with tainted value`

628	Function call with incorrectly specified arguments	`Bad file access mode or status`
		
		`Copy of overlapping memory`
		
		`Invalid va_list argument`
		
		`Modification of internal buffer returned from nonreentrant standard function`
		
		`Standard function call with incorrect arguments`

658	See “Mapping Between CWE-658 or 659 and Polyspace Results” on page 9-103.	
659	See “Mapping Between CWE-658 or 659 and Polyspace Results” on page 9-103.	

663	Use of a non-reentrant function in a concurrent context	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`
		
		`Unsafe standard encryption function`
		
		`Unsafe standard function`

664	Improper control of a resource through its lifetime	`Context initialized incorrectly for cryptographic operation`
		
		`Context initialized incorrectly for digest operation`
		
		`Incompatible padding for RSA algorithm operation`
		
		`Inconsistent cipher operations`
		
		`Incorrect key for cryptographic algorithm`
		
		`Missing cipher data to process`
		
		`Missing cipher final step`
		
		`Missing cipher key`
		
		`Missing peer key`
		
		`Missing private key`
		
		`Missing public key`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

665	Improper initialization	`Call to memset with unintended value`
		
		`Improper array initialization`
		
		`Overlapping assignment`
		
		`Use of memset with size argument zero`

666	Operation on resource in wrong phase of lifetime	`Incorrect order of network connection operations`

667	Improper locking	`Blocking operation while holding lock`
		
		`Destruction of locked mutex`
		
		`Missing unlock`

672	Operation on a resource after expiration or release	`Closing a previously closed resource`
		
		`Use of previously closed resource`

675	Duplicate operations on resource	`Opening previously opened resource`

676	Use of potentially dangerous function	`Unsafe conversion from string to numerical value`
		
		`Use of dangerous standard function`

681	Incorrect conversion between numeric types	`Float conversion overflow`
		
		`Precision loss in integer to float conversion`

682	Incorrect calculation	`Absorption of float operand`
		
		`Bitwise operation on negative value`
		
		`Float overflow`
		
		`Invalid use of standard library floating point routine`
		
		`Invalid use of standard library integer routine`
		
		`Tainted modulo operand`
		
		`Use of plain char type for numerical value`

683	Function Call With Incorrect Order of Arguments	`Call to memset with unintended value`
		
		`Format string specifiers and arguments mismatch`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

685	Function call with incorrect number of arguments	`Declaration mismatch`
		
		`Format string specifiers and arguments mismatch`
		
		`Standard function call with incorrect arguments`
		
		`Too many va_arg calls for current argument list`

686	Function call with incorrect argument type	`Bad file access mode or status`
		
		`Declaration mismatch`
		
		`Format string specifiers and arguments mismatch`
		
		`Incorrect data type passed to va_arg`
		
		`Standard function call with incorrect arguments`
		
		`Use of automatic variable as putenv-family function argument`
		
		`Writing to const qualified object`

687	Function call with incorrectly specified argument value	`Copy of overlapping memory`
		
		`Standard function call with incorrect arguments`
		
		`Variable length array with nonpositive size`

690	Unchecked return value to null pointer dereference	`Invalid use of standard library memory routine`
		
		`Invalid use of standard library routine`
		
		`Invalid use of standard library string routine`
		
		`Null pointer`
		
		`Returned value of a sensitive function not checked`
		
		`Standard function call with incorrect arguments`
		
		`Tainted NULL or non-null-terminated string`
		
		`Unprotected dynamic memory allocation`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
691	Insufficient control flow management	`Use of setjmp/longjmp`
693	Protection mechanism failure	`Nonsecure SSL/TLS protocol`
696	Incorrect behavior order	`Bad order of dropping privileges`

703	Improper check or handling of exceptional conditions	`Errno not reset`
		
		`Misuse of errno`

704	Incorrect type conversion or cast	`Character value absorbed into EOF`
		
		`Misuse of sign-extended character value`
		
		`Precision loss in integer to float conversion`
		
		`Qualifier removed in conversion`
		
		`Unreliable cast of pointer`
		
		`Wrong allocated object size for cast`

705	Incorrect control flow scoping	`Abnormal termination of exit handler`
710	Coding standard violation	`Bitwise and arithmetic operation on the same data`
732	Incorrect permission assignment for critical resource	`Vulnerable permission assignments`
754	Improper check for unusual or exceptional conditions	`Returned value of a sensitive function not checked`
755	Improper handling of exceptional conditions	`Exception handler hidden by previous handler`

758	Reliance on undefined, unspecified, or implementation-defined behavior	`Bitwise operation on negative value`
		
		`Unsafe conversion between pointer and integer`
		
		`Use of plain char type for numerical value`

759	Use of a One-Way Hash without a Salt	`Missing salt for hashing operation`

762	Mismatched memory management routines	`Invalid free of pointer`
		
		`Mismatched alloc/dealloc functions on Windows`

764	Multiple locks of a critical resource	`Double lock`
765	Multiple unlocks of a critical resource	`Double unlock`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
767	Access to critical private variable via public method	`Return of non const handle to encapsulated data member`
770	Allocation of resources without limits or throttling	`Tainted size of variable length array`
772	Missing release of resource after effective lifetime	`Resource leak`

780	Use of rsa algorithm without oaep	`Missing padding for RSA algorithm`
		
		`Weak padding for RSA algorithm`

783	Operator precedence logic error	`Possibly unintended evaluation of expression because of operator precedence rules`
785	Use of path manipulation function without maximum-sized buffer	`Use of path manipulation function without maximum sized buffer checking`
786	Access of memory location before start of buffer	`Destination buffer underflow in string manipulation`

787	Out-of-bounds write	`Destination buffer overflow in string manipulation`
		
		`Destination buffer underflow in string manipulation`

789	Uncontrolled memory allocation	`Memory allocation with tainted size`
		
		`Tainted size of variable length array`
		
		`Unprotected dynamic memory allocation`

805	Buffer access with incorrect length value	`Hard-coded object size used to manipulate memory`
822	Untrusted pointer dereference	`Tainted NULL or non-null-terminated string`

823	Use of out-of-range pointer offset	`Pointer access out of bounds`
		
		`Pointer dereference with tainted offset`

824	Access of uninitialized pointer	`Non-initialized pointer`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

825	Expired Pointer Dereference	`Accessing object with temporary lifetime`
		
		`Deallocation of previously deallocated pointer`
		
		`Environment pointer invalidated by previous operation`
		
		`Missing reset of a freed pointer`
		
		`Pointer or reference to stack variable leaving scope`
		
		`Use of automatic variable as putenv-family function argument`
		
		`Use of previously freed pointer`

826	Premature release of resource during expected lifetime	`Closing a previously closed resource`
		
		`Destruction of locked mutex`
		
		`Use of previously closed resource`

828	Signal handler with functionality that is not asynchronous-safe	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`

832	Unlock of a resource that is not locked	`Missing lock`
833	Deadlock	`Deadlock`
843	Access of resource using incompatible type ('Type confusion')	`Unreliable cast of pointer`
872	CERT C++ Secure Coding Section 04 - Integers (INT)	`Invalid use of standard library integer routine`

873	CERT C++ Secure Coding Section 05 - Floating point arithmetic (FLP)	`Absorption of float operand`
		
		`Float overflow`
		
		`Floating point comparison with equality operators`
		
		`Invalid use of standard library floating point routine`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

908	Use of uninitialized resource	`Member not initialized in constructor`
		
		`Non-initialized pointer`
		
		`Non-initialized variable`

910	Use of expired file descriptor	`Closing a previously closed resource`
		
		`Standard function call with incorrect arguments`
		
		`Use of previously closed resource`

922	Insecure Storage of Sensitive Information	`File manipulation after chroot without chdir`
		
		`Umask used with chmod-style arguments`
		
		`Use of non-secure temporary file`
		
		`Vulnerable permission assignments`

Mapping Between CWE-658 or 659 and Polyspace Results

CWE-658: Weaknesses in Software Written in C

CWE-658 is a subset of CWE IDs found in C programs that are not common to all languages. See CWE-658.

The following table lists the CWE IDs (version 3.3) from this subset that are addressed by Polyspace Bug Finder, with its corresponding defect checkers.

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

119	Improper restriction of operations within the bounds of a memory buffer	`Array access out of bounds`
		`Pointer access out of bounds`

120	Buffer copy without checking size of input ('Classic buffer overflow')	`Invalid use of standard library memory routine`
		`Invalid use of standard library string routine`
		`Tainted NULL or non-null-terminated string`

121	Stack-based buffer overflow	`Array access with tainted index`
		`Destination buffer overflow in string manipulation`

122	Heap-based buffer overflow	`Pointer dereference with tainted offset`

124	Buffer underwrite ('Buffer underflow')	`Array access with tainted index`
		`Buffer overflow from incorrect string format specifier`
		`Destination buffer underflow in string manipulation`
		`Pointer dereference with tainted offset`

125	Out-of-bounds read	`Array access with tainted index`
		`Buffer overflow from incorrect string format specifier`
		`Destination buffer overflow in string manipulation`

126	Buffer over-read	`Buffer overflow from incorrect string format specifier`
127	Buffer under-read	`Buffer overflow from incorrect string format specifier`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

128	Wrap-around error	`Integer constant overflow`
		`Integer conversion overflow`
		`Integer overflow`
		`Memory allocation with tainted size`
		`Tainted sign change conversion`
		`Tainted size of variable length array`
		`Unsigned integer constant overflow`
		`Unsigned integer conversion overflow`
		`Unsigned integer overflow`

129	Improper validation of array index	`Array access with tainted index`
		`Pointer dereference with tainted offset`

130	Improper handling of length parameter inconsistency	`Mismatch between data length and size`

131	Incorrect calculation of buffer size	`Array access out of bounds`
		`Memory allocation with tainted size`
		`Pointer access out of bounds`
		`Tainted sign change conversion`
		`Tainted size of variable length array`
		`Unsigned integer conversion overflow`
		`Unsigned integer overflow`

134	Uncontrolled format string	`Tainted string format`

135	Incorrect Calculation of Multi-Byte String Length	`Destination buffer overflow in string manipulation`
		`Misuse of narrow or wide character string`
		`Unreliable cast of pointer`

170	Improper null termination	`Missing null in string array`
		`Misuse of readlink()`
		`Tainted NULL or non-null-terminated string`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

188	Reliance on data/ memory layout	`Invalid assumptions about memory organization`
		
		`Memory comparison of padding data`
		
		`Memory comparison of strings`
		
		`Missing byte reordering when transferring data`
		
		`Pointer access out of bounds`

191	Integer underflow (Wrap or wraparound)	`Integer constant overflow`
		
		`Integer conversion overflow`
		
		`Integer overflow`
		
		`Unsigned integer constant overflow`
		
		`Unsigned integer conversion overflow`
		
		`Unsigned integer overflow`

192	Integer coercion error	`Integer conversion overflow`
		
		`Integer overflow`
		
		`Sign change integer conversion overflow`
		
		`Tainted sign change conversion`
		
		`Unsigned integer conversion overflow`
		
		`Unsigned integer overflow`

194	Unexpected sign extension	`Sign change integer conversion overflow`
		
		`Tainted sign change conversion`

195	Signed to unsigned conversion error	`Sign change integer conversion overflow`
		
		`Tainted sign change conversion`

196	Unsigned to signed conversion error	`Sign change integer conversion overflow`

197	Numeric truncation error	`Float conversion overflow`
		
		`Integer conversion overflow`
		
		`Unsigned integer conversion overflow`

242	Use of inherently dangerous function	`Use of dangerous standard function`
243	Creation of chroot jail without changing working directory	`File manipulation after chroot without chdir`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
244	Improper clearing of heap memory before release	`Sensitive heap memory not cleared before release`

362	Concurrent execution using shared resource with improper synchronization ('Race Condition')	`File descriptor exposure to child process`
		
		`Opening previously opened resource`

364	Signal handler race condition	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`
		
		`Shared data access within signal handler`

366	Race condition within a thread	`Data race including atomic operations`
		
		`Data race through standard library function call`
		
		`Data race`

375	Returning a mutable object to an untrusted caller	`Return of non const handle to encapsulated data member`

401	Improper release of memory before removing last reference	`Memory leak`
		
		`Thread-specific memory leak`

415	Double free	`Deallocation of previously deallocated pointer`
		
		`Missing reset of a freed pointer`

416	Use after free	`Missing reset of a freed pointer`
		
		`Use of previously freed pointer`

457	Use of uninitialized variable	`Member not initialized in constructor`
		
		`Non-initialized pointer`
		
		`Non-initialized variable`

466	Return of pointer value outside of expected range	`Array access out of bounds`
		
		`Pointer access out of bounds`
		
		`Unsafe conversion between pointer and integer`

467	Use of sizeof() on a pointer type	`Possible misuse of sizeof`
		
		`Wrong type used in sizeof`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
468	Incorrect pointer scaling	`Incorrect pointer scaling`
469	Use of pointer subtraction to determine size	`Subtraction or comparison between pointers to different arrays`

474	Use of function with inconsistent implementations	`Signal call from within signal handler`
		
		`Use of obsolete standard function`

476	NULL pointer dereference	`Null pointer`
		
		`Tainted NULL or non-null-terminated string`

478	Missing default case in switch statement	`Missing case for switch condition`

479	Signal handler use of a non-reentrant function	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`

480	Use of incorrect operator	`Invalid use of = (assignment) operator`
		
		`Invalid use of == (equality) operator`

481	Assigning instead of comparing	`Invalid use of = (assignment) operator`
482	Comparing instead of assigning	`Invalid use of == (equality) operator`

483	Incorrect block delimitation	`Incorrectly indented statement`
		
		`Semicolon on same line as if, for or while statement`

484	Omitted break statement in switch	`Missing break of switch case`
558	Use of getlogin() in multithreaded application	`Unsafe standard function`
560	Use of umask() with chmod-style argument	`Umask used with chmod-style arguments`

562	Return of stack variable address	`Pointer or reference to stack variable leaving scope`
		
		`Use of automatic variable as putenv-family function argument`

587	Assignment of a fixed address to a pointer	`Function pointer assigned with absolute address`
		
		`Unsafe conversion between pointer and integer`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

676	Use of potentially dangerous function	`Unsafe conversion from string to numerical value`
		
		`Use of dangerous standard function`

685	Function call with incorrect number of arguments	`Declaration mismatch`
		
		`Format string specifiers and arguments mismatch`
		
		`Standard function call with incorrect arguments`
		
		`Too many va_arg calls for current argument list`

690	Unchecked return value to null pointer dereference	`Invalid use of standard library memory routine`
		
		`Invalid use of standard library routine`
		
		`Invalid use of standard library string routine`
		
		`Null pointer`
		
		`Returned value of a sensitive function not checked`
		
		`Standard function call with incorrect arguments`
		
		`Tainted NULL or non-null-terminated string`
		
		`Unprotected dynamic memory allocation`

704	Incorrect type conversion or cast	`Character value absorbed into EOF`
		
		`Misuse of sign-extended character value`
		
		`Precision loss in integer to float conversion`
		
		`Qualifier removed in conversion`
		
		`Unreliable cast of pointer`
		
		`Wrong allocated object size for cast`

762	Mismatched memory management routines	`Invalid free of pointer`
		
		`Mismatched alloc/dealloc functions on Windows`

783	Operator precedence logic error	`Possibly unintended evaluation of expression because of operator precedence rules`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker
785	Use of path manipulation function without maximum-sized buffer	`Use of path manipulation function without maximum sized buffer checking`

787	Out-of-bounds write	`Destination buffer overflow in string manipulation`
		`Destination buffer underflow in string manipulation`

789	Uncontrolled memory allocation	`Memory allocation with tainted size`
		`Tainted size of variable length array`
		`Unprotected dynamic memory allocation`

805	Buffer access with incorrect length value	`Hard-coded object size used to manipulate memory`
843	Access of resource using incompatible type ('Type confusion')	`Unreliable cast of pointer`

910	Use of expired file descriptor	`Closing a previously closed resource`
		`Standard function call with incorrect arguments`
		`Use of previously closed resource`

CWE-659: Weaknesses in Software Written in C++

CWE-659 is a subset of CWE IDs found in C++ programs that are not common to all languages. See CWE-659.

The following table lists the CWE IDs (version 3.3) from this subset that are addressed by Polyspace Bug Finder, with its corresponding defect checkers.

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

119	Improper restriction of operations within the bounds of a memory buffer	`Array access out of bounds`
		`Pointer access out of bounds`

120	Buffer copy without checking size of input ('Classic buffer overflow')	`Invalid use of standard library memory routine`
		`Invalid use of standard library string routine`
		`Tainted NULL or non-null-terminated string`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

121	Stack-based buffer overflow	`Array access with tainted index`
		
		`Destination buffer overflow in string manipulation`

122	Heap-based buffer overflow	`Pointer dereference with tainted offset`

124	Buffer underwrite ('Buffer underflow')	`Array access with tainted index`
		
		`Buffer overflow from incorrect string format specifier`
		
		`Destination buffer underflow in string manipulation`
		
		`Pointer dereference with tainted offset`

125	Out-of-bounds read	`Array access with tainted index`
		
		`Buffer overflow from incorrect string format specifier`
		
		`Destination buffer overflow in string manipulation`

126	Buffer over-read	`Buffer overflow from incorrect string format specifier`
127	Buffer under-read	`Buffer overflow from incorrect string format specifier`

128	Wrap-around error	`Integer constant overflow`
		
		`Integer conversion overflow`
		
		`Integer overflow`
		
		`Memory allocation with tainted size`
		
		`Tainted sign change conversion`
		
		`Tainted size of variable length array`
		
		`Unsigned integer constant overflow`
		
		`Unsigned integer conversion overflow`
		
		`Unsigned integer overflow`

129	Improper validation of array index	`Array access with tainted index`
		
		`Pointer dereference with tainted offset`

130	Improper handling of length parameter inconsistency	`Mismatch between data length and size`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

131	Incorrect calculation of buffer size	`Array access out of bounds`
		
		`Memory allocation with tainted size`
		
		`Pointer access out of bounds`
		
		`Tainted sign change conversion`
		
		`Tainted size of variable length array`
		
		`Unsigned integer conversion overflow`
		
		`Unsigned integer overflow`

134	Uncontrolled format string	`Tainted string format`

135	Incorrect Calculation of Multi-Byte String Length	`Destination buffer overflow in string manipulation`
		
		`Misuse of narrow or wide character string`
		
		`Unreliable cast of pointer`

170	Improper null termination	`Missing null in string array`
		
		`Misuse of readlink()`
		
		`Tainted NULL or non-null-terminated string`

188	Reliance on data/ memory layout	`Invalid assumptions about memory organization`
		
		`Memory comparison of padding data`
		
		`Memory comparison of strings`
		
		`Missing byte reordering when transferring data`
		
		`Pointer access out of bounds`

191	Integer underflow (Wrap or wraparound)	`Integer constant overflow`
		
		`Integer conversion overflow`
		
		`Integer overflow`
		
		`Unsigned integer constant overflow`
		
		`Unsigned integer conversion overflow`
		
		`Unsigned integer overflow`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

192	Integer coercion error	`Integer conversion overflow`
		
		`Integer overflow`
		
		`Sign change integer conversion overflow`
		
		`Tainted sign change conversion`
		
		`Unsigned integer conversion overflow`
		
		`Unsigned integer overflow`

194	Unexpected sign extension	`Sign change integer conversion overflow`
		
		`Tainted sign change conversion`

195	Signed to unsigned conversion error	`Sign change integer conversion overflow`
		
		`Tainted sign change conversion`

196	Unsigned to signed conversion error	`Sign change integer conversion overflow`

197	Numeric truncation error	`Float conversion overflow`
		
		`Integer conversion overflow`
		
		`Unsigned integer conversion overflow`

242	Use of inherently dangerous function	`Use of dangerous standard function`
243	Creation of chroot jail without changing working directory	`File manipulation after chroot without chdir`
244	Improper clearing of heap memory before release	`Sensitive heap memory not cleared before release`

362	Concurrent execution using shared resource with improper synchronization ('Race Condition')	`File descriptor exposure to child process`
		
		`Opening previously opened resource`

364	Signal handler race condition	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`
		
		`Shared data access within signal handler`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

366	Race condition within a thread	`Data race including atomic operations`
		
		`Data race through standard library function call`
		
		`Data race`

375	Returning a mutable object to an untrusted caller	`Return of non const handle to encapsulated data member`

401	Improper release of memory before removing last reference	`Memory leak`
		
		`Thread-specific memory leak`

415	Double free	`Deallocation of previously deallocated pointer`
		
		`Missing reset of a freed pointer`

416	Use after free	`Missing reset of a freed pointer`
		
		`Use of previously freed pointer`

457	Use of uninitialized variable	`Member not initialized in constructor`
		
		`Non-initialized pointer`
		
		`Non-initialized variable`

466	Return of pointer value outside of expected range	`Array access out of bounds`
		
		`Pointer access out of bounds`
		
		`Unsafe conversion between pointer and integer`

467	Use of sizeof() on a pointer type	`Possible misuse of sizeof`
		
		`Wrong type used in sizeof`

468	Incorrect pointer scaling	`Incorrect pointer scaling`
469	Use of pointer subtraction to determine size	`Subtraction or comparison between pointers to different arrays`

476	NULL pointer dereference	`Null pointer`
		
		`Tainted NULL or non-null-terminated string`

478	Missing default case in switch statement	`Missing case for switch condition`

479	Signal handler use of a non-reentrant function	`Function called from signal handler not asynchronous-safe (strict)`
		
		`Function called from signal handler not asynchronous-safe`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

480	Use of incorrect operator	`Invalid use of = (assignment) operator`
		
		`Invalid use of == (equality) operator`

481	Assigning instead of comparing	`Invalid use of = (assignment) operator`
482	Comparing instead of assigning	`Invalid use of == (equality) operator`

483	Incorrect block delimitation	`Incorrectly indented statement`
		
		`Semicolon on same line as if, for or while statement`

484	Omitted break statement in switch	`Missing break of switch case`
558	Use of getlogin() in multithreaded application	`Unsafe standard function`

562	Return of stack variable address	`Pointer or reference to stack variable leaving scope`
		
		`Use of automatic variable as putenv-family function argument`

587	Assignment of a fixed address to a pointer	`Function pointer assigned with absolute address`
		
		`Unsafe conversion between pointer and integer`

676	Use of potentially dangerous function	`Unsafe conversion from string to numerical value`
		
		`Use of dangerous standard function`

690	Unchecked return value to null pointer dereference	`Invalid use of standard library memory routine`
		
		`Invalid use of standard library routine`
		
		`Invalid use of standard library string routine`
		
		`Null pointer`
		
		`Returned value of a sensitive function not checked`
		
		`Standard function call with incorrect arguments`
		
		`Tainted NULL or non-null-terminated string`
		
		`Unprotected dynamic memory allocation`

CWE ID	CWE ID Description	Polyspace Bug Finder Defect Checker

704	Incorrect type conversion or cast	`Character value absorbed into EOF`
		
		`Misuse of sign-extended character value`
		
		`Precision loss in integer to float conversion`
		
		`Qualifier removed in conversion`
		
		`Unreliable cast of pointer`
		
		`Wrong allocated object size for cast`

762	Mismatched memory management routines	`Invalid free of pointer`
		
		`Mismatched alloc/dealloc functions on Windows`

767	Access to critical private variable via public method	`Return of non const handle to encapsulated data member`
783	Operator precedence logic error	`Possibly unintended evaluation of expression because of operator precedence rules`
785	Use of path manipulation function without maximum-sized buffer	`Use of path manipulation function without maximum sized buffer checking`

787	Out-of-bounds write	`Destination buffer overflow in string manipulation`
		
		`Destination buffer underflow in string manipulation`

789	Uncontrolled memory allocation	`Memory allocation with tainted size`
		
		`Tainted size of variable length array`
		
		`Unprotected dynamic memory allocation`

805	Buffer access with incorrect length value	`Hard-coded object size used to manipulate memory`
843	Access of resource using incompatible type ('Type confusion')	`Unreliable cast of pointer`

910	Use of expired file descriptor	`Closing a previously closed resource`
		
		`Standard function call with incorrect arguments`
		
		`Use of previously closed resource`

See Also

More About

- “CWE Coding Standard and Polyspace Results” on page 9-78

Configure Comment Import from Previous Results

Import Review Information from Previous Polyspace Analysis

After you have reviewed analysis results, you can reuse information from the review for subsequent analyses. If you specify a result status or severity or add notes in your results file, they carry over to the results of the next analysis on the same project. If you add the same information as comments to your code (annotate), they carry over to any subsequent analysis of the code, whether in the same project or not. You can also hide results using code annotations. For more information on commenting, see Polyspace Bug Finder Access documentation.

This topic shows how to import review information from one result file to another. Importing the review information saves you from reviewing already justified results. For instance, after you import the information, on the **Results List** pane (user interface of desktop products), clicking the ➡ icon skips justified results. Using this icon, you can browse through unreviewed results. You can also filter the justified checks from display.

Automatic Import from Last Analysis

By default, in the Polyspace user interface (desktop products only), review information is imported automatically from the most recent analysis on the project module. You can disable this default behavior.

1. Select **Tools** > **Preferences**, which opens the Polyspace Preferences dialog box.
2. Select the **Project and Results Folder** tab.
3. Under **Import Comments**, clear **Automatically import comments from last verification**.
4. Click **OK**.

If you upload results to the Polyspace Access web interface, review information from the last run of the same project are applied to the current run. You cannot disable the automatic import.

If you run analysis at the command line (and do not upload results to the Polyspace Access web interface), you have to explicitly import from another set of results. See “Command Line” on page 10-3.

Import from Another Analysis Result

You can import review information directly from another Polyspace result to the current result.

If a result is found in both a Bug Finder and Code Prover analysis, you can add review information to the Bug Finder result and import to the Code Prover result. For instance, most coding rule checkers are common to Bug Finder and Code Prover. You can add review information to coding rule violations in Bug Finder and import to the same violations in Code Prover.

User Interface (Desktop Products Only)

To import review information from another set of results:

1. Open the current analysis results.
2. Select **Tools** > **Import Comments**.
3. Navigate to the folder containing your previous results.
4. Select the other results file (with extension `.psbf` or `.pscp`) and then click **Open**.

   The review information from the previous results are imported into the current results.

Command Line

Use the option `-import-comments` during analysis to import comments from a previous verification.

To import review information from multiple results, use the `polyspace-comments-import` command.

Import Algorithm

You can directly import review information from another set of results into the current results. However, it is possible that part of your review information is not imported to a subsequent analysis because:

- You have changed your source code so that the line with a previous result is not exactly identical to the line in the current run.

  The comment import tool accounts for additional code that simply shifts an existing line. For instance, the tool recognizes that line 10 in Run 1 and line 12 in Run 2 have the same statement. If a division by zero occurs on line 10 in Run 1 and you have not fixed the issue in Run 2, the result along with associated review information are imported to line 12 in Run 2.

  - Run 1:

    ```
    10 baseLine = min/numRecipients;
    11
    12
    ```
  - Run 2:

    ```
    10 /* Calculate a baseline per recipient
    11    based on minimum available resources */
    12 baseLine = min/numRecipients;
    ```

  However, if you change the line content itself, for instance, change `numRecipient` to `numReceiver`, the result and review information are not imported.
- You have changed your source code so that the Code Prover result color has changed.
- You entered new review information for the same result.

If the content of a line does not change and shows the same result as the previous analysis, the review information is imported. In unlikely scenarios, you might get the same result on the same line despite changing previous lines that lead to the result. Your review information from a previous analysis is then imported to the new result. If you justified the previous result with a status such as `Not a defect`, it is likely that you want to continue this justification with the new result. For instance, if you accepted an overflow previously because you accounted for a wrap-around behavior after the overflow, you are likely to accept the overflow whatever the cause. In a few cases, you might want to review the result again and might not be aware that the result merits another review. To avoid this situation:

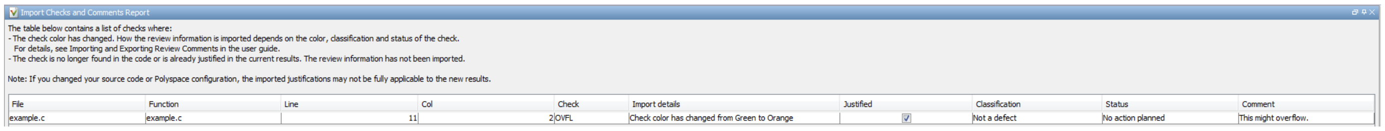
- When justifying nonlocal results that are related to previous events, use careful judgement.
- For critical components, conduct periodic assessments of justified results to see if the justifications still apply. Such assessments are useful specially for the Code Prover run-time checks.

View Imported Review Information That Does Not Apply

In the Polyspace user interface (desktop products only), the Import Checks and Comments Report highlights differences between two analysis results. When you import review information from a previous analysis, you can see this report. If you have closed the report after an import, to review the report again:

1. Select **Window > Show/Hide View > Import Comments Report**.

   The Import Checks and Comments Report opens, highlighting differences in the two results.



Import Checks and Comments Report

The table below contains a list of checks where:
- The check color has changed. How the review information is imported depends on the color, classification and status of the check.
  For details, see Importing and Exporting Review Comments in the user guide.
- The check is no longer found in the code or is already justified in the current results. The review information has not been imported.

Note: If you changed your source code or Polyspace configuration, the imported justifications may not be fully applicable to the new results.

File	Function	Line	Col	Check	Import details	Justified	Classification	Status	Comment
example.c	example.c	11	2	OVFL	Check color has changed from Green to Orange	✓	Not a defect	No action planned	This might overflow.

2. Review the differences between the two results.

Your review information can differ between two results because of the following reasons:

- In Code Prover, if the check color changes, Polyspace imports the **Comment** field but not the **Status** field. In addition, Polyspace imports the **Severity** and **Justified** fields depending on the color change.

Color Change	Severity	Justified
Orange or red to green	Not imported	Imported
Gray to green	Not imported	Imported, if the **Severity** was set to `High`, `Medium` or `Low`.
Red to orange or vice versa	Imported	Imported
Green to red/orange/gray	Not imported	Not imported

- If a result no longer appears in the code, Polyspace highlights only the change in the Import Checks and Comments Report. It does not import review information from the previous result.
- If you have already entered different review information for the same check, Polyspace highlights only the change in the Import Checks and Comments Report. It does not import review information from the previous result.

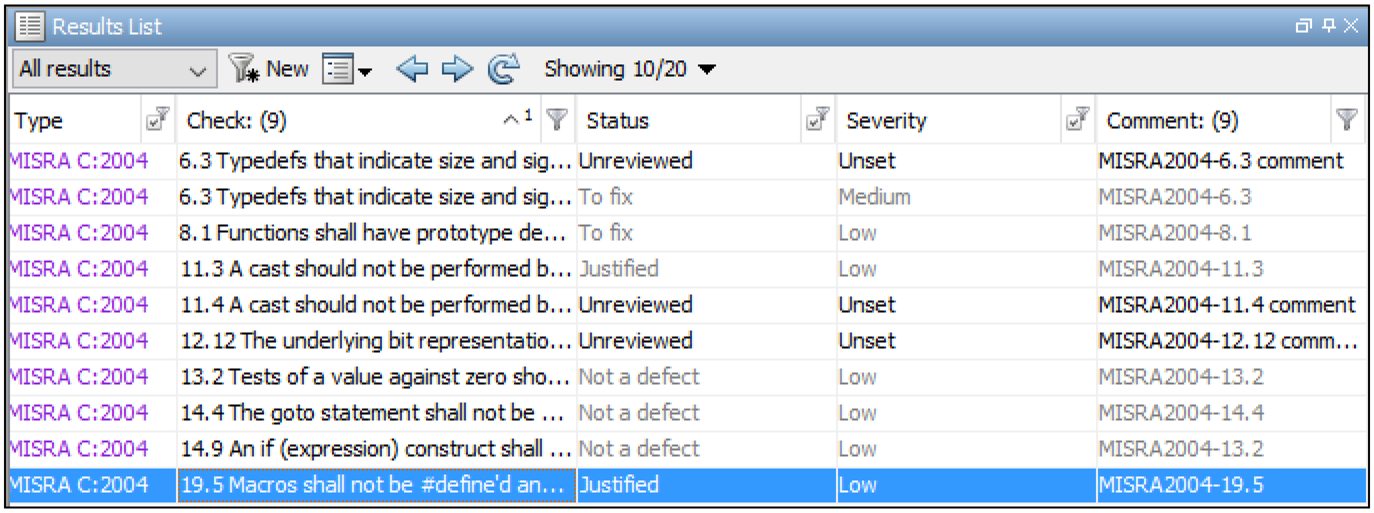
See Also

`-import-comments` | `polyspace-comments-import`

Import Existing MISRA C: 2004 Justifications to MISRA C: 2012 Results

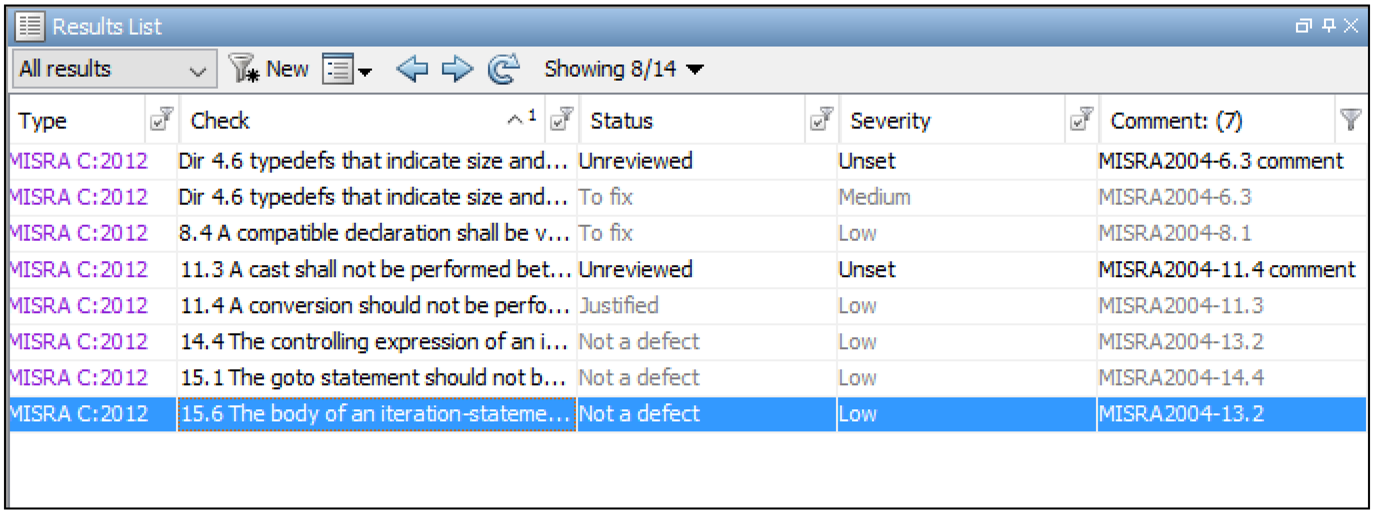
When you check your code for MISRA C: 2012 violations, Polyspace imports justifications of MISRA C: 2004 violations from previous analyses (if they exist). You can upgrade from checking of MISRA C: 2004 rules to MISRA C: 2012 rules while retaining your justifications. For general rules on comment import, see “Import Review Information from Previous Polyspace Analysis” on page 10-2.

The software maps MISRA C: 2004 **Status**, **Severity**, and **Comment** values that you added through the user interface or code annotations to the corresponding MISRA C: 2012 results, if the results exist. For more information about mapping, consult addendum one of the MISRA C: 2012 publication.



Type	Check: (9)	Status	Severity	Comment: (9)
MISRA C:2004	6.3 Typedefs that indicate size and sig…	Unreviewed	Unset	MISRA2004-6.3 comment
MISRA C:2004	6.3 Typedefs that indicate size and sig…	To fix	Medium	MISRA2004-6.3
MISRA C:2004	8.1 Functions shall have prototype de…	To fix	Low	MISRA2004-8.1
MISRA C:2004	11.3 A cast should not be performed b…	Justified	Low	MISRA2004-11.3
MISRA C:2004	11.4 A cast should not be performed b…	Unreviewed	Unset	MISRA2004-11.4 comment
MISRA C:2004	12.12 The underlying bit representatio…	Unreviewed	Unset	MISRA2004-12.12 comm…
MISRA C:2004	13.2 Tests of a value against zero sho…	Not a defect	Low	MISRA2004-13.2
MISRA C:2004	14.4 The goto statement shall not be …	Not a defect	Low	MISRA2004-14.4
MISRA C:2004	14.9 An if (expression) construct shall …	Not a defect	Low	MISRA2004-13.2
MISRA C:2004	19.5 Macros shall not be #define'd an…	Justified	Low	MISRA2004-19.5

If you are transitioning from MISRA C: 2004 to MISRA C: 2012, you do not have to review results that you have already justified.



Type	Check	Status	Severity	Comment: (7)
MISRA C:2012	Dir 4.6 typedefs that indicate size and…	Unreviewed	Unset	MISRA2004-6.3 comment
MISRA C:2012	Dir 4.6 typedefs that indicate size and…	To fix	Medium	MISRA2004-6.3
MISRA C:2012	8.4 A compatible declaration shall be v…	To fix	Low	MISRA2004-8.1
MISRA C:2012	11.3 A cast shall not be performed bet…	Unreviewed	Unset	MISRA2004-11.4 comment
MISRA C:2012	11.4 A conversion should not be perfo…	Justified	Low	MISRA2004-11.3
MISRA C:2012	14.4 The controlling expression of an i…	Not a defect	Low	MISRA2004-13.2
MISRA C:2012	15.1 The goto statement should not b…	Not a defect	Low	MISRA2004-14.4
MISRA C:2012	15.6 The body of an iteration-stateme…	Not a defect	Low	MISRA2004-13.2

Mapping Multiple MISRA C: 2004 Annotations to the Same MISRA C: 2012 Result

When you justify MISRA C: 2004 violations by using code block syntax or multiple line annotation syntax, and multiple violations map to the same MISRA C: 2012 rule, Polyspace does not import each result justification. Instead, the software imports only one set of **Status**, **Severity**, and **Comment** values and applies these values to all the instances of that particular MISRA C: 2012 rule violation.

For example, suppose that you analyze your code and find violations of MISRA C: 2004 rules 16.3 and 16.5. You can justify these results by using the annotation syntax where you enter a different status and explanatory comment for each rule.

```
//polyspace-begin misra2004:16.3 [Status 1] "Explanatory comment 1"
//polyspace-begin misra2004:16.5 [Status 2] "Explanatory comment 2"

code block start;
/* This block of code contains violations of
MISRA C:2004 rules 16.3 and 16.5 */
code block end;

//polyspace-end misra2004:16.3
//polyspace-end misra2004:16.5
```

The previous violations map to MISRA C: 2012 rule 8.2. When you check your annotated code against MISRA C: 2012 rules, Polyspace imports only the first line of annotations (for rule 16.3) and applies it to all rule 8.2 results. The second line of annotations for rule 16.5 is ignored. In the **Results List** pane, all violations of rule 8.2 have the **Status** column set to **`Status 1`** and the **Comment** column set to **`"Explanatory comment 1"`**.

Note The **Output Summary** pane displays a warning message for every result where the imported annotation conflicts with the original annotation. After you import your MISRA C: 2004 annotations, check that a justified status has not been assigned to results you intend to investigate or fix.

See Also

`Check MISRA C:2004 (-misra2)` | `Check MISRA C:2012 (-misra3)`

Troubleshooting in Polyspace Bug Finder Server

License Error –4,0

Issue

When you try to run Polyspace, you get this error message:

```
License Error -4,0
```

Possible Cause: Another Polyspace Instance Running

You can open multiple instances of Polyspace, but you can only run one code analysis at a time.

If you try to run Polyspace processes from multiple windows, you will get a `License Error –4,0` error.

Solution

Only run one analysis at a time, including any command-line or plugin analyses.

Possible Cause: Prior Polyspace Run in Simulink or MATLAB Coder

If you run Polyspace on generated code in the Simulink user interface or in the MATLAB Coder™ app, you can get a license error if you try to run a subsequent analysis in the Polyspace user interface. You get the error even if the previous run is over.

Solution

Run the subsequent analysis using the method that you used before, that is, in the Simulink user interface or MATLAB Coder app.

If you want to run the analysis in the Polyspace user interface, close Simulink or MATLAB Coder and then rerun the analysis.

Read Error Information When Polyspace Analysis Stops

When you run a Polyspace analysis on your C/C++ code, if one or more of your files fail to compile, the analysis continues with the remaining files. You can choose to stop the analysis on compilation errors using the option `Stop analysis if a file does not compile (-stop-if-compile-error)`.

However, it is more convenient to let the analysis complete and capture all compilation errors. In a continuous integration process, you can send a notification to the build engineer with a list of compilation errors.

The compilation errors are displayed in the analysis log in addition to the options used and the various stages of analysis. The analysis log is a text file generated in your results folder and titled `Polyspace_`*`version_project_date_time`*`.txt`. The lines that indicate errors begin with the `Error:` string and the lines that indicate warnings begin with the `Warning:` string. Find these lines and extract them to another text file for easier scanning.

See Also

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

Contact Technical Support About Issues with Running Polyspace

To contact MathWorks Technical Support, use this page. You need a MathWorks Account login and password. For faster turnaround with an issue in Polyspace, besides the required system information, provide appropriate code that reproduces the issue or the verification log file.

Provide System Information

When you enter a support request, provide the following system information:

- Hardware configuration
- Operating system
- Polyspace and MATLAB license numbers
- Specific version numbers for Polyspace products
- Installed Bug Report patches

To obtain your configuration information, do one of the following:

- In the Polyspace user interface, select **Help** > **About**.
- At the command line, run the following command, replacing *`polyspaceroot`* with your Polyspace installation folder:
  - UNIX — *`polyspaceroot`*`/polyspace/bin/polyspace-code-prover -ver`
  - Windows — *`polyspaceroot`*`\polyspace\bin\polyspace-code-prover -ver`

Provide Information About the Issue

Depending on the issue, provide appropriate artifacts to help Technical Support understand and reproduce the issue.

Compilation Errors

If you face compilation issues with your project, see “Troubleshoot Compilation Errors”. If you are still having issues, contact technical support with the following information:

- The analysis log.

  The analysis log is a text file generated in your results folder and titled `Polyspace_`*`version_project_date_time`*`.log`. It contains the error message, the options used for the analysis and other relevant information.
- The source files related to the compilation error or the complete results folder if possible.

  If you cannot provide the source files:

  - Try to provide a screenshot of the source code section that causes the compilation issue.
  - Try to reproduce the issue with a different code. Provide that code to technical support.

Errors in Project Creation from Build Systems

If you face errors in creating a project from your build system, see “Troubleshoot Project Creation”.

If you are still having issues, contact technical support with debug information. To provide the debug information:

1. Run `polyspace-configure` at the command line with the option `-easy-debug`. For instance:

   ```
   polyspace-configure options -easy-debug pathToFolder buildCommand
   ```

   Here:

   - *`options`* is the list of `polyspace-configure` options that you typically use.
   - *`buildCommand`* is the build command that you use, for instance, `make`.
   - *`pathToFolder`* is the folder where you want to store debug information, for instance, `C:\Temp\BuildLogs`. After a `polyspace-configure` run, the path provided contains a zipped file ending with `pscfg-output.zip`. The zipped file contains debug information only and does not contain source files traced in the build.

   Make sure that you do not use the option `-verbose` or `-silent` after `-easy-debug`. These options reduce or modify the information logged and might make debugging difficult.
2. Send this zipped file ending with `pscfg-output.zip` to MathWorks Technical Support for further debugging.

You can also create the zipped file with debug information during every `polyspace-configure` run by creating an environment variable `PS_CONFIGURE_OPTIONS` and setting its value to:

```
-easy-debug pathToFolder
```

where *`pathToFolder`* is the folder where you want to store debug information.

Verification Result

If you are having trouble understanding a result, see “Polyspace Bug Finder Results” (Polyspace Bug Finder Access).

If you are still having trouble understanding the result, contact technical support with the following information:

- The analysis log.

  The analysis log is a text file generated in your results folder and titled `Polyspace_`*`version_project_date_time`*`.log`. It contains the options used for the analysis and other relevant information.
- The source files related to the result or the complete results folder if possible.

  If you cannot provide the source files:

  - Try provide a screenshot of the relevant source code from the **Source** pane on the Polyspace user interface.
  - Try to reproduce the problem with a different code. Provide that code to technical support.

Compiler Not Supported for Project Creation from Build Systems

Issue

Your compiler is not supported for automatic project creation from build commands.

Cause

For automatic project creation from your build system, your compiler configuration must be available to Polyspace. Polyspace provides a compiler configuration file only for certain compilers.

For information on which compilers are supported, see “Requirements for Project Creation from Build Systems” on page 5-20.

Solution

To enable automatic project creation for an unsupported compiler, you can write your own compiler configuration file.

1. Copy one of the existing configuration files from `*polyspaceroot*\polyspace\configure\compiler_configuration\`. Select the configuration that most closely corresponds to your compiler using the .
2. Save the file as *`my_compiler`*`.xml`. *`my_compiler`* can be a name that helps you identify the file.

   To edit the file, save it outside the installation folder. After you have finished editing, you must copy the file back to *`polyspaceroot`*`\polyspace\configure\compiler_configuration\`.
3. Edit the contents of the file to represent your compiler. Replace the entries between the XML elements with appropriate content.
4. After saving the edited XML file to *`polyspaceroot`*`\polyspace\configure\compiler_configuration\`, create a project automatically using your build command.

   If you see errors, for instance, compilation errors, contact MathWorks Technical Support. After tracing your build command, the software compiles certain files using the compiler specifications detected from your configuration file and build command. Compilation errors might indicate issues in the configuration file.

Tip To quickly see if your compiler configuration file works, run the automatic project setup on a sample build that does not take much time to complete. After you have set up a project with your compiler configuration file, you can use this file for larger builds.

Elements of Compiler Configuration File

The following table lists the XML elements in the compiler configuration file file with a description of what the content within the element represents.

XML Element	Content Description	Content Example for GNU C Compiler

`<compiler_names><name> ...`
 	
`</name><compiler_names>`
	Name of the compiler executable. This executable transforms your `.c` files into object files. You can add several binary names, each in a separate `<name>...</name>` element. The software checks for each of the provided names and uses the compiler name for which it finds a match.
	
	You must not specify the linker binary inside the `<name>...</name>` elements.
	
	If the name that you specify is present in an existing compiler configuration file, an error occurs. To avoid the error, use the additional option `-compiler-config` *`my_compiler`*`.xml` when tracing the build so that the software explicitly uses your compiler configuration file.
		• `gcc`
		• `gpp`

`<include_options><opt> ...`
 	
`</opt></include_options>`
	The option that you use with your compiler to specify include folders.
	
	To specify options where the argument immediately follows the option, use an `isPrefix` attribute for `opt` and set it to `true`.
		`-I`

`<system_include_options>`
 	
`<opt> ... </opt>`
 	
`</system_include_options>`
	The option that you use with your compiler to specify system headers.
	
	To specify options where the argument immediately follows the option, use an `isPrefix` attribute for `opt` and set it to `true`.
		`-isystem`

`<preinclude_options><opt> ...`
 	
`</opt></preinclude_options>`
	The option that you use with your compiler to force inclusion of a file in the compiled object.
	
	To specify options where the argument immediately follows the option, use an `isPrefix` attribute for `opt` and set it to `true`.
		`-include`

XML Element	Content Description	Content Example for GNU C Compiler

`<define_options><opt> ...`
 	
`</opt></define_options>`
	The option that you use with your compiler to predefine a macro.
	
	To specify options where the argument immediately follows the option, use an `isPrefix` attribute for `opt` and set it to `true`.
		`-D`

`<undefine_options><opt> ...`
 	
`</opt></undefine_options>`
	The option that you use with your compiler to undo any previous definition of a macro.
	
	To specify options where the argument immediately follows the option, use an `isPrefix` attribute for `opt` and set it to `true`.
		`-U`

`<semantic_options><opt> ...`
 	
`</opt></semantic_options>`
	The options that you use to modify the compiler behavior. These options specify the language settings to which the code must conform.
	
	You can use the `isPrefix` attribute to specify multiple options that have the same prefix and the `numArgs` attribute to specify options with multiple arguments. For instance:
	
	• Instead of
	`<opt>-m32</opt>`
	`<opt>-m64</opt>`
	You can write `<opt isPrefix="true">-m</opt>`.
	• Instead of
	`<opt>-std=c90</opt>`
	`<opt>-std=c99</opt>`
	You can write `<opt numArgs="1">-std</opt>`. If your makefile uses `-std c90` instead of `-std=c90`, this notation also supports that usage.
		• `-ansi`
		• `-std =C90`
		• `-std =c++11`
		• `-fun signed -char`

XML Element	Content Description	Content Example for GNU C Compiler
`<compiler> ... </compiler>`	The Polyspace compiler option that corresponds to or closely matches your compiler. The content of this element directly translates to the option **Compiler** in your Polyspace project or options file. For the complete list of compilers available, see `Compiler (-compiler)`.	`gnu4.7`

`<preprocess_options_list>`
 	
`<opt> ... </opt>`
 	
`</preprocess_options_list>`
	The options that specify how your compiler generates a preprocessed file.
	
	You can use the macro `$(OUTPUT_FILE)` if your compiler does not allow sending the preprocessed file to the standard output. Instead it defines the preprocessed file internally.
		`-E`
		
		For an example of the `$(OUTPUT_FILE)` macro, see the existing compiler configuration file `cl2000.xml`.

`<preprocessed_output_file> ... </preprocessed_output_file>`	The name of file where the preprocessed output is stored. You can use the following macros when the name of the preprocessed output file is adapted from the source file: • `$(SOURCE_FILE)`: Source file name • `$(SOURCE_FILE_EXT)`: Source file extension • `$(SOURCE_FILE_NO_EXT)`: Source file name without extension For instance, use `$(SOURCE_FILE_NO_EXT).pre` when the preprocessor file name has the same name as the source file, but with extension `.pre`.	For an example of this element, see the existing compiler configuration file `xc8.xml`.

`<src_extensions><ext> ...`
 	
`</ext></src_extensions>`
	The file extensions for source files.	• `c`
		• `cpp`
		• `c++`

XML Element	Content Description	Content Example for GNU C Compiler
`<obj_extensions><ext> ...` `</ext></obj_extensions>`	The file extensions for object files.	
`<precompiled_header_extensions> ...` `</precompiled_header_extensions>`	The file extensions for precompiled headers (if available).	
`<polyspace_extra_options_list>` `<opt> ... </opt>` `<opt> ... </opt>` `</polyspace_extra_options_list>`	Additional options that are used for the subsequent analysis. For instance, to avoid compilation errors in the subsequent analysis due to non-ANSI extension keywords, enter `-D` *`keyword`*`=`*`value`*, for example: `<polyspace_extra_options_list>` `<opt>-D MACRO1</opt>` `<opt>-D MACRO2=VALUE</opt>` `</polyspace_extra_options_list>` For more information, see `Preprocessor definitions (-D)`.	

Mapping Between Existing Configuration Files and Compiler Names

Select the configuration file in *`polyspaceroot`*`\polyspace\configure\compiler_configuration\` that most closely resembles the configuration of your compiler. Use the following table to map compilers to their configuration files.

Compiler Name	Vendor	XML File
ARM®	ARM Keil	`armcc.xml`
		`armclang.xml`
Visual C++	Microsoft	`cl.xml`
Clang	Not applicable	`clang.xml`
CodeWarrior	NXP	`cw_ppc.xml`
		`cw_s12z.xml`
`cx6808`	Cosmic	`cx6808.xml`
Diab	Wind River	`diab.xml`
gcc	Not applicable	`gcc.xml`
Green Hills	Green Hills Software	`ghs_arm.xml`
		`ghs_arm64.xml`
		`ghs_i386.xml`
		`ghs_ppc.xml`

Compiler Name	Vendor	XML File
		ghs_rh850.xml
		ghs_tricore.xml
IAR Embedded Workbench	IAR	iar.xml
		iar-arm.xml
		iar-avr.xml
		iar-msp430.xml
		iar-rh850.xml
		iar-rl78.xml
Renesas	Renesas	renesas-rh850.xml
		renesas-rl78.xml
		renesas-rx.xml
TASKING®	Altium	tasking.xml
		tasking-166.xml
		tasking-850.xml
		tasking-arm.xml
Tiny C	Not applicable	tcc.xml
TM320 and its derivatives	Texas Instruments	ti_arm.xml
		ti_c28x.xml
		ti_c6000.xml
		ti_msp430.xml
xc8 (PIC)	Microchip	xc8.xml

Slow Build Process When Polyspace Traces the Build

Issue

In some cases, your build process can run slower when Polyspace traces the build.

Cause

Polyspace caches information in files stored in the system temporary folder, such as `C:\Users\`*`User_Name`*`\AppData\Local\Temp`, in Windows. Your build can take a long time to perform read/write operations to this folder. Therefore, the overall build process is slow.

Solution

You can work around the slow build process by changing the location where Polyspace stores cache information. For instance, you can use a cache path local to the drive from which you run build tracing. To create and use a local folder `ps_cache` for storing cache information, use the advanced option `-cache-path ./ps_cache`.

- If you trace your build from the Polyspace user interface, enter this flag in the field **Add advanced configure options**.
- If you trace your build from the DOS/ UNIX or MATLAB command line, use this flag with the `polyspace-configure` command.

For more information, see `polyspace-configure`.

Check if Polyspace Supports Build Scripts

Issue

This topic is relevant only if you are creating a Polyspace project in Windows from your build scripts.

When Polyspace traces your build script in a Windows console application other than `cmd.exe`, the command fails. However, the build command by itself executes to completion.

For instance, your build script executes to completion from the Cygwin shell. However, when Polyspace traces the build, the build script throws an error.

Possible Cause

When you launch a Windows console application, your environment variables are appropriately set. Alternate console applications such as the Cygwin shell can set your environment differently from `cmd.exe`.

Polyspace attempts to trace your build script with the assumption that the script runs to completion in `cmd.exe`. Therefore, even if your script runs to completion in the alternate console application, when Polyspace traces the build, the script can fail.

Solution

Make sure that your build script executes to completion in the `cmd.exe` interface. If the build executes successfully, create a wrapper `.bat` file around your script and trace this file.

For instance, before you trace a build command that executes to completion in the Cygwin shell, do one of the following:

- Launch the Cygwin shell from `cmd.exe` and then run your build script. For instance, if you use a script `build.sh` to build your code, enter the following command at the DOS command line:

  ```
  cmd.exe /C "C:\cygwin64\bin\bash.exe" -c build.sh
  ```
- Find the full path to your build script and then run this script from `cmd.exe`.

  For instance, enter the following command at the DOS command line:

  ```
  cmd.exe /C path_to_script
  ```

  `path_to_script` is the full path to your build script. For instance, `C:\my_scripts\build.sh`.

If the steps do not execute to completion, Polyspace cannot trace your build.

If the steps complete successfully, trace the build command after launching it from `cmd.exe`. For instance, on the command-line, do the following to create a Polyspace options file.

1. Enter your build commands in a `.bat` file.

   ```
   rem @echo off
   cmd.exe /C "C:\cygwin64\bin\bash.exe" -c build.sh
   ```

   Name the file, for instance, `launching.bat`.

2. Trace the build commands in the `.bat` file and create a Polyspace options file.

   ```
   "C:\Program Files\MATLAB\R2017b\polyspace\bin\polyspace-configure.exe"
             -output-options-file myOptions.txt launching.bat
   ```

You can now run `polyspace-bug-finder-server` on the options file.

Troubleshooting Project Creation from MinGW Build

Issue

You create a project from a MinGW build, but get an error when running an analysis on the project. The error message comes from using one of these keywords: `__declspec`, `__cdecl`, `__fastcall`, `__thiscall` or `__stdcall`.

Cause

When you create a project from a MinGW build, the project uses a GNU compiler. Polyspace does not recognize these keywords for the GNU compilers.

Solution

Replace these keywords with equivalent keywords just for the purposes of analysis.

Before analysis, for the option `Preprocessor definitions (-D)`, enter:

- `__declspec(x)=__attribute__((x))`
- `__cdecl=__attribute__((__cdecl__))`
- `__fastcall=__attribute__((__fastcall__))`
- `__thiscall=__attribute__((__thiscall__))`
- `__stdcall=__attribute__((__stdcall__))`

If you are running Polyspace on the command line in a UNIX shell, add double quotes around the `-D` option. For instance, use:

```
"-D __cdecl=__attribute__((__cdecl__))"
```

Troubleshooting Project Creation from Visual Studio Build

You can run `polyspace-configure` on a Visual Studio build and extract information from the build to create a Polyspace project or options file.

You can trace your Visual Studio build in one of the following ways:

- Build your Visual Studio project completely at the command line with `msbuild` while tracing this build with `polyspace-configure`.

  In this workflow, you run `polyspace-configure` on an `msbuild` command with a Visual Studio project (`.vcxproj`) file. For instance, in a Visual Studio 2019 developer prompt, enter the following:

  ```
  polyspace-configure msbuild TestProject.vcxproj /t:Rebuild
  ```
- Build your Visual Studio project in the Visual Studio IDE while tracing this build with `polyspace-configure`.

  Run `polyspace-configure` on the `devenv.exe` executable to open the Visual Studio IDE, build your project or solution within the IDE, and then close the IDE.

If running `polyspace-configure` on the `msbuild` command does not work properly, do the following:

1. Stop the `msbuild` process.
2. Set the environment variable `MSBUILDDISABLENODEREUSE` to 1.
3. Restart `polyspace-configure` on `msbuild`, this time using the `/nodereuse:false` option. For instance:

   ```
   polyspace-configure msbuild TestProject.vcxproj /t:Rebuild /nodereuse:false
   ```

See Also
`polyspace-configure`

Polyspace Cannot Find the Server

Message

```
Error: Cannot instantiate Polyspace cluster
| Check the -scheduler option validity or your default cluster profile
| Could not contact an MJS lookup service using the host computer_name.
    The hostname, computer_name, could not be resolved.
```

Possible Cause

Polyspace uses information provided in the preferences of a Polyspace desktop product to locate the server. If this information is incorrect, the software cannot locate the server.

Solution

Open the user interface of the Polyspace desktop product. Check if the server information provided is correct.

1. Select **Tools** > **Preferences**.
2. Select the **Server Configuration** tab. Check your server information.

   For instance, the entry in **Job scheduler host name** must match the host name of the computer that forms the head node of the MATLAB Parallel Server cluster. For more information, see “Install Products for Submitting Polyspace Analysis from Desktops to Remote Server”.

Job Manager Cannot Write to Database

Message

```
Unable to write data to the job manager database
```

Possible Cause

If the computer that forms the head node of the MATLAB Parallel Server cluster cannot send data to the client computer, you see this error. The most likely reasons for the remote computer being unable to connect to the client computer are:

- Firewalls do not allow traffic from the MATLAB Job Scheduler to the client.
- The MATLAB Job Scheduler cannot resolve the short hostname of the client computer.

Workaround

Add localhost IP to configuration.

1. In the user interface of the Polyspace desktop products, select **Tools** > **Preferences**.
2. On the **Server Configuration** tab, in the **Localhost IP address** field, enter the IP address of your local computer.

To retrieve your IP address:

- Windows
  1. Open **Control Panel** > **Network and Sharing Center**.
  2. Select your active network.
  3. In the Status window, click **Details**. Your IP address is listed under **IPv4 address**.
- Linux — Run the `ifconfig` command and find the `inet addr` corresponding to your network connection.
- Mac — Open **System Preferences** > **Network**.

See Also

Related Examples

- “Install Products for Submitting Polyspace Analysis from Desktops to Remote Server”
- “Connection Problems Between the Client and MATLAB Job Scheduler” (Parallel Computing Toolbox)

Undefined Identifier Error

Issue

Polyspace verification fails during the compilation phase with a message about undefined identifiers.

The message indicates that Polyspace cannot find a variable definition. Therefore, it cannot identify the variable type.

Possible Cause: Missing Files

The source code you provided does not contain the variable definition. For instance, the variable is defined in an include file that Polyspace cannot find.

If you `#include`-d the include file in your source code but did not add it to your Polyspace project, you see a previous warning:

```
Warning: could not find include file "my_include.h"
```

Solution

If the variable definition occurs in an include file, add the folder that contains the include file.

- In the user interface of the Polyspace desktop products, add the folder to your project.

  For more information, see "Add Source Files for Analysis in Polyspace User Interface" (Polyspace Bug Finder).
- At the command line, use the flag `-I` with the `polyspace-bug-finder-server` command.

  For more information, see `-I`.

Possible Cause: Unrecognized Keyword

The variable represents a keyword that your compiler recognizes but is not part of the ANSI C standard. Therefore, Polyspace does not recognize it.

For instance, some compilers interpret `__SP` as a reference to the stack pointer.

Solution

If the variable represents a keyword that Polyspace does not recognize, replace or remove the keyword from your source code or preprocessed code.

If you remove or replace the keyword from the preprocessed code, you can avoid the compilation error while keeping your source code intact. You can do one of the following:

- Replace or remove each individual unknown keyword using an analysis option. Replace the compiler-specific keyword with an equivalent keyword from the ANSI C Standard.

  For information on the analysis option, see `Preprocessor definitions (-D)`.
- Declare the unknown keywords in a separate header file using `#define` directives. Specify that header file using an analysis option.

For information on the analysis option, see `Include (-include)`. For a sample header file, see "Gather Compilation Options Efficiently" on page 5-28.

Possible Cause: Declaration Embedded in #ifdef Statements

The variable is declared in a branch of an `#ifdef` *`macro_name`* preprocessor directive. For instance, the declaration of a variable `max_power` occurs as follows:

```
#ifdef _WIN32
  #define max_power 31
#endif
```

Your compilation toolchain might consider the macro *`macro_name`* as implicitly defined and execute the `#ifdef` branch. However, the Polyspace compilation might not consider the macro as defined. Therefore, the `#ifdef` branch is not executed and the variable `max_power` is not declared.

Solution

To work around the compilation error, do one of the following:

- Use **Target & Compiler** options to directly specify your compiler. For instance, to emulate a Visual C++ compiler, set the **Compiler** to `visual12.0`. See "Target and Compiler".
- Define the macro explicitly using the option `Preprocessor definitions (-D)`.

Note If you create a Polyspace by tracing your build commands, most **Target & Compiler** options are automatically set.

Possible Cause: Project Created from Non-Debug Build

This can be a possible cause only if the undefined identifier occurs in an `assert` statement (or an equivalent Visual C++ macro such as `ASSERT` or `VERIFY`).

Typically, you come across this error in the following way. You create a Polyspace project from a build system in non-debug mode. When you run an analysis on the project, you face a compilation error from an undefined identifier in an `assert` statement. You find that the identifier `my_identifier` is defined in a `#ifndef NDEBUG` statement, for instance as follows:

```
#ifndef NDEBUG
int my_identifier;
#endif
```

The C standard states that when the `NDEBUG` macro is defined, all assert statements must be disabled.

Most IDEs define the `NDEBUG` macro in their build systems. When you build your source code in your IDE in non-debug mode, code in a `#ifndef NDEBUG` statement is removed during preprocessing. For instance, in the preceding example, `my_identifier` is not defined. If `my_identifier` occurs only in assert statements, it is not used either, because `NDEBUG` disables assert statements. You do not have compilation errors from undefined identifiers and your build system executes successfully.

Polyspace does not disable `assert` statements even if `NDEBUG` macro is defined because the software uses `assert` statements internally to enhance verification.

When you create a Polyspace project from your build system, if your build system defines the `NDEBUG` macro, it is also defined for your Polyspace project. Polyspace removes code in a `#ifndef NDEBUG` statement during preprocessing, but does not disable `assert` statements. If `assert` statements in your code rely on the code in a `#ifndef NDEBUG` statement, compilation errors can occur.

In the preceding example:

- The definition of `my_identifier` is removed during preprocessing.
- `assert` statements are not disabled. When `my_identifier` is used in an `assert` statement, you get an error because of undefined identifier `my_identifier`.

Solution

To work around this issue, create a Polyspace project from your build system in debug mode. When you execute your build system in debug mode, `NDEBUG` is not defined. When you create a Polyspace project from this build, `NDEBUG` is not defined for your Polyspace project.

Depending on your project settings, use the option that enables building in debug mode. For instance, if your build system is `gcc`-based, you can define the `DEBUG` macro and undefine `NDEBUG`:

```
gcc -DDEBUG=1 -UNDEBUG *.c
```

Alternatively, you can disable the `assert` statements in your preprocessed code using the option `Preprocessor definitions (-D)`. However, Polyspace will not be able to emulate the `assert` statements.

Unknown Function Prototype Error

Issue

During the compilation phase, the software displays a warning or error message about unknown function prototype.

```
the prototype for function 'myfunc' is unknown
```

The message indicates that Polyspace cannot find a function prototype. Therefore, it cannot identify the data types of the function argument and return value, and has to infer them from the calls to the function.

To determine the data types for such functions, Polyspace follows the C99 Standard (ISO/IEC 9899:1999, Chapter 6.5.2.2: Function calls).

- The return type is assumed to be `int`.
- The number and type of arguments are determined by the first call to the function. For instance, if the function takes one `double` argument in the first call, for subsequent calls, the software assumes that it takes one `double` argument. If you pass an `int` argument in a subsequent call, a conversion from `int` to `double` takes place.

During the linking phase, if a mismatch occurs between the number or type of arguments or the return type in different compilation units, the analysis follows an internal algorithm to resolve this mismatch and determine a common prototype.

Cause

The source code you provided does not contain the function prototype. For instance, the function is declared in an include file that Polyspace cannot find.

If you `#include`-d the include file in your source code but did not add it to your Polyspace project, you see a previous warning:

```
Warning: could not find include file "my_include.h"
```

Solution

Search for the function declaration in your source repository.

If you find the function declaration in an include file, add the folder that contains the include file.

- In the user interface of the Polyspace desktop products, add the folder to your project.

  For more information, see “Add Source Files for Analysis in Polyspace User Interface” (Polyspace Bug Finder).
- At the command line, use the flag `-I` with the `polyspace-bug-finder-server` command.

  For more information, see `-I`.

Error Related to #error Directive

Issue

The analysis stops with a message containing a `#error` directive. For instance, the following message appears: `#error directive: !Unsupported platform; stopping!`.

Cause

You typically use the `#error` directive in your code to trigger a fatal error in case certain macros are not defined. Your compiler implicitly defines the macros, therefore the error is not triggered when you compile your code. However, the default Polyspace compilation does not consider the macros as defined, therefore, the error occurs.

For instance, in the following example, the `#error` directive is reached only if the macros `__BORLANDC__`, `__VISUALC32__` or `__GNUC__` are not defined. If you use a GNU C compiler, for instance, the compiler considers the macro `__GNUC__` as defined and the error does not occur. However, if you use the default Polyspace compilation, it does not consider the macros as defined.

```
#if defined(__BORLANDC__) || defined(__VISUALC32__)
#define MYINT int
#elif defined(__GNUC__)
#define MYINT long
#else
#error !Unsupported platform; stopping!
#endif
```

Solution

For successful compilation, do one of the following:

- Specify a compiler such as `visual12.0` or `gnu4.9`. Specifying a compiler defines some of the compilation flags for the analysis.

  For more information, see `Compiler (-compiler)`.
- If the available compiler options do not match your compiler, explicitly define one of the compilation flags `__BORLANDC__`, `__VISUALC32__`, or `__GNUC__`.

  For more information, see `Preprocessor definitions (-D)`.

Large Object Error

Issue

The analysis stops during compilation with a message indicating that an object is too large.

Cause

The error happens when the software detects an object such as an array, union, structure, or class, that is too big for the pointer size of the selected target.

For instance, you get the message, `Limitation: struct or union is too large` in the following example. You specify a pointer size of 16 bits. The maximum object size allocated to a pointer, and therefore the maximum allowed size for an object, can be 2^{16}-1 bytes. However, you declare a structure as follows:

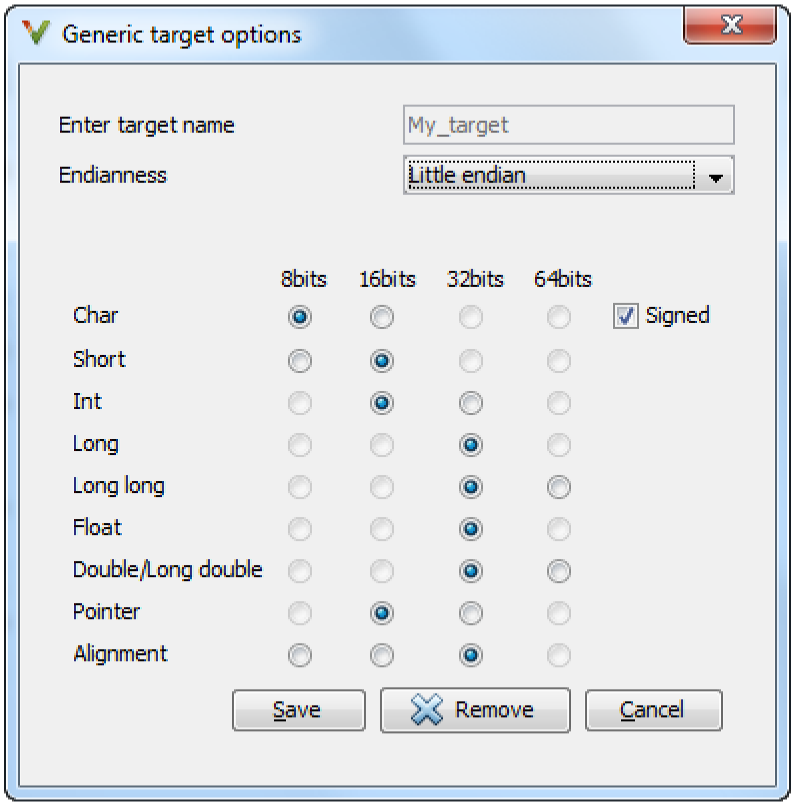
-
  ```
  struct S
  {
    char tab[65536];
  }s;
  ```

-
  ```
  struct S
  {
    char tab[65534];
    int val;
  }s;
  ```

Solution

1 Check the pointer size that you specified through your target processor type. For more information, see `Target processor type (-target)`.

   For instance, in the following, the pointer size for a custom target `My_target` is 16 bits.



Enter target name: My_target

Endianness: Little endian

	8bits	16bits	32bits	64bits	
Char	●	○	○	○	✓ Signed
Short	○	●	○	○	
Int	○	●	○	○	
Long	○	○	●	○	
Long long	○	○	●	○	
Float	○	○	●	○	
Double/Long double	○	○	●	○	
Pointer	○	●	○	○	
Alignment	○	○	●	○	

2 Change your code or specify a different pointer size.

For instance, you can:

- Declare an array of smaller size in the structure.

  If you are using a predefined target processor type, the pointer size is likely to be the same as the pointer size on your target architecture. Therefore, your declaration might cause errors on your target architecture.
- Change the pointer size of the target processor type that you specified, if possible.

  Otherwise, specify another target processor type with larger pointer size or define your own target processor type. For more information on defining your own processor type, see `Generic target options`.

Note Polyspace imposes an internal limit of 128 MB on the size of data structures. Even if your target processor type specification allows data structures of larger size, this internal limit constrains the data structure sizes.

Errors Related to Generic Compiler

If you use a generic compiler, you can encounter this issue. For more information, see `Compiler (-compiler)`.

Issue

The analysis stops with an error message related to a non-ANSI C keyword, for instance, `data` or attributes such as `__attribute__((weak))`.

Depending on the location of the keyword, the error message can vary. For instance, this line causes the error message: `expected a ";"`.

```
data int tab[10];
```

Cause

The generic Polyspace compiler supports only ANSI C keywords. If you use a language extension, the generic compiler does not recognize it and treats the keyword as a regular identifier.

Solution

Specify your compiler by using the option `Compiler (-compiler)`.

If your compiler is not directly supported or is not based on a supported compiler, you can use the generic compiler. To work around the compilation errors:

- If the keyword is related to memory modelling, remove it from the preprocessed code. For instance, to remove the `data` keyword, enter `data=` for the option `Preprocessor definitions (-D)`.
- If the keyword is related to an attribute, remove attributes from the preprocessed code. Enter `__attribute__(x)=` for the option `Preprocessor definitions (-D)`.

  If your code has this line:

  ```
  void __attribute__ ((weak)) func(void);
  ```

  And you remove attributes, the analysis reads the line as:

  ```
  void func(void);
  ```

When you use these workarounds, your source code is not altered.

Errors Related to Keil or IAR Compiler

If you use the compiler, Keil or IAR, you can encounter this issue. For more information, see `Compiler (-compiler)`.

Missing Identifiers

Issue

The analysis stops with the error message, `expected an identifier`, as if an identifier is missing. However, in your source code, you can see the identifier.

Cause

If you select Keil or IAR as your compiler, the software removes certain keywords during preprocessing. If you use these keywords as identifiers such as variable names, a compilation error occurs.

For a list of keywords that are removed, see “Supported Keil or IAR Language Extensions” on page 5-23.

Solution

Specify that Polyspace must not remove the keywords during preprocessing. Define the macros `__PST_KEIL_NO_KEYWORDS__` or `__PST_IAR_NO_KEYWORDS__`.

For more information, see `Preprocessor definitions (-D)`.

Errors Related to Diab Compiler

If you choose `diab` for the option `Compiler (-compiler)`, you can encounter this issue.

Issue

During Polyspace analysis, you see an error related to a keyword specific to the Diab compiler. For instance, you see an error related to the `restrict` keyword.

Cause

You typically use a compiler flag to enable the keyword. The Polyspace analysis does not enable these keywords by default. You have to make Polyspace aware of your compiler flags.

The Polyspace analysis does not enable these keywords by default to prevent compilation errors. Another user might not enable the keyword and instead use the keyword name as a regular identifier. If Polyspace treats the identifier as a keyword, a compilation error will occur.

Solution

Use the command-line option `-compiler-parameter` in your Polyspace analysis as follows. You use this command-line option to make Polyspace aware of your compiler flags. In the user interface of the Polyspace desktop products, you can enter the command-line option in the field `Other` (Polyspace Bug Finder). You can enter the option multiple times.

The argument of `-compiler-parameter` depends on the keyword that causes the error. Once you enable the keyword, do not use the keyword name as a regular identifier. For instance, once you enable the keyword `pixel`, do not use `pixel` as a variable name. The statement `int pixel = 1` causes a compilation error.

- `restrict` keyword:

  You typically use the compiler flag `-Xlibc-new` or `-Xc-new`. For your Polyspace analysis, use

  ```
  -compiler-parameter -Xc-new
  ```

  The following code will not compile with Polyspace unless you specify the compiler flag.

  ```
  int sscanf(const char *restrict, const char *restrict, ...);
  ```
- PowerPC AltiVec vector extensions such as the `vector` type qualifier:

  You typically use the compiler flag `-tPPCALLAV:`. For your Polyspace analysis, use

  ```
  -compiler-parameter -tPPCALLAV:
  ```

  The following code will not compile with Polyspace unless you specify the compiler flag.

  ```
  vector unsigned char vbyte;
  vector bool vbool;
  vector pixel vpx;

  int main(int argc, char** argv)
  {
  ```

```
  return 0;
}
```

- Extended keywords such as `pascal`, `inline`, `packed`, `interrupt`, `extended`, `__X`, `__Y`, `vector`, `pixel`, `bool` and others:

  You typically use the compiler flag `-Xkeywords=`. For your Polyspace analysis, use

  ```
  -compiler-parameter -Xkeywords=0xFFFFFFFF
  ```

  The following code will not compile with Polyspace unless you specify the compiler flag.

  ```
  packed(4) struct s2_t {
      char b;
      int i;
  } s2;

  packed(4,2) struct s3_t {
      char b;
  } s3;

  int pascal foo = 4;

  int main(int argc, char** argv) {
      foo++;
      return 0;
  }
  ```

Errors Related to Green Hills Compiler

If you choose `greenhills` for the option `Compiler (-compiler)`, you encounter this issue.

Issue

During Polyspace analysis, you see an error related to vector data types specific to Green Hills target `rh850`. For instance, you see an error related to identifier `__ev64_u16__`.

Cause

When compiling code using the Green Hills compiler with target `rh850`, to enable single instruction multiple data (SIMD) vector instructions, you specify two flags:

- `-rh850_simd`: You enable intrinsic functions that support SIMD vector instructions. The functions are defined in your compiler header files. These data types are available:
  - `__ev64_u16__`
  - `__ev64_s16__`
  - `__ev64_u32__`
  - `__ev64_s32__`
  - `__ev64_u64__`
  - `__ev64_s64__`
  - `__ev64_opaque__`
  - `__ev128_opaque__`
- `-rh850_fpsimd`: You enable intrinsic functions that support floating-point SIMD vector instructions. The functions are defined in your compiler header files. These data types are available:
  - `__ev128_f32__`
  - `__ev256_f32__`

The Polyspace analysis does not enable SIMD support by default. You must identify your compiler flags to Polyspace.

Solution

In your Polyspace analysis, use the command-line option `-compiler-parameter`. In the user interface, you can enter the command-line option in the `Other` (Polyspace Bug Finder) field, under the **Advanced Settings** in the **Configuration** pane.

- `-rh850_simd`: For your Polyspace analysis, use

  ```
  -compiler-parameter -rh850_simd
  ```
- `-rh850_fpsimd`: For your Polyspace analysis, use

  ```
  -compiler-parameter -rh850_fpsimd
  ```

Note

- `__ev128_opaque__` is 16 bytes aligned in Polyspace.
- `__ev256_f32__` is 32 bytes aligned in Polyspace.

Errors Related to TASKING Compiler

If you choose `tasking` for the option `Compiler (-compiler)`, you can encounter this issue.

Issue

During Polyspace analysis, you see an error related to a Special Function Register data type.

Cause

When compiling with the TASKING compiler, you typically use the following compiler flags to specify where Special Function Register (SFR) data types are declared:

- `--cpu=`*`xxx`*: The compiler implicitly `#include`s the file `sfr/reg`*`xxx`*`.sfr` in your source files. Once `#include`-ed, you can use Special Function Registers (SFR-s) declared in that `.sfr` file.
- `--alternative-sfr-file`: The compiler uses an alternative SFR file instead of the regular SFR file. You can use Special Function Registers (SFR-s) declared in that alternative SFR file.

If you specify the TASKING compiler for your Polyspace analysis, the analysis makes the following assumptions about these compiler flags:

- `--cpu=`*`xxx`*: The analysis chooses a specific value of *`xxx`*. If you use a different value with your TASKING compiler, you can encounter an error during Polyspace analysis.

  The *`xxx`* value that the Polyspace analysis uses depends on your choice of `Target processor type (-target)`:

  - `tricore`: `tc1793b`
  - `c166`: `xc167ci`
  - `rh850`: `r7f701603`
  - `arm`: `ARMv7M`
- `--alternative-sfr-file`: The analysis assumes that you do not use an alternative SFR file. If you use one, you can encounter an error.

Solution

Use the command-line option `-compiler-parameter` in your Polyspace analysis as follows. You use this command-line option to make Polyspace aware of your compiler flags. In the user interface, you can enter the command-line option in the field `Other` (Polyspace Bug Finder). You can enter the option multiple times.

- `--cpu=`*`xxx`*: For your Polyspace analysis, use

  ```
  -compiler-parameter --cpu=xxx
  ```

  Here, *`xxx`* is the value that you use when compiling with your compiler.
- `--alternative-sfr-file`: For your Polyspace analysis, use

  ```
  -compiler-parameter --alternative-sfr-file
  ```

If you still encounter an error because Polyspace is not able to locate your `.asfr` file, explicitly `#include` your `.asfr` file in the preprocessed code using the option `Include (-include)`.

Typically, the path to the file is `*Tasking_C166_INSTALL_DIR*\include\sfr\reg*CPUNAME*.asfr`. For instance, if your TASKING compiler is installed in `C:\Program Files\Tasking\C166-VX_v4.0r1\` and you use the CPU-related flag `-Cxc2287m_104f` or `--cpu=xc2287m_104f`, the path is `C:\Program Files\Tasking\C166-VX_v4.0r1\include\sfr\regxc2287m.asfr`.

You can also encounter the same issue with alternative sfr files when you trace your build command. For more information, see “Requirements for Project Creation from Build Systems” on page 5-20.

Errors from Conflicts with Polyspace Header Files

Issue

You see compilation errors from header files included by Polyspace.

For instance, the error message refers to one of the subfolders of `*polyspaceroot*\polyspace\verifier\cxx\include`.

Typically, the error message is related to a standard library function.

Cause

If your compiler defines a standard library function or another construct and you do not provide the path to your compiler header files, Polyspace uses its own implementation of the function.

If your compiler definitions differ from the corresponding Polyspace definitions, the verification stops with an error.

Solution

Specify the folder containing your compiler header files.

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

  For more information, see “Add Source Files for Analysis in Polyspace User Interface” (Polyspace Bug Finder).
- At the command line, use the flag `-I` with the `polyspace-bug-finder-server` command.

  For more information, see `-I`.

For compilation with GNU C on UNIX-based platforms, use `/usr/include`. On embedded compilers, the header files are typically in a subfolder of the compiler installation folder. Examples of include folders are given for some compilers.

- Wind River Diab: For instance, `/apps/WindRiver/Diab/5.9.4/diab/5.9.4.8/include/`.
- IAR Embedded Workbench: For instance, `C:\Program Files\IAR Systems\Embedded Workbench 7.5\arm\inc`.
- Microsoft Visual Studio: For instance, `C:\Program Files\Microsoft Visual Studio 14.0\VC\include`.

Consult your compiler documentation for the path to your compiler header files. Alternatively, see “Provide Standard Library Headers for Polyspace Analysis” on page 5-19.

Errors from Using Namespace std Without Prefix

Issue

The Polyspace analysis stops with an error message such as:

```
error: the global scope has no "modfl"
```

The line highlighted in the error uses a function from the standard library without the `std::` prefix.

Cause

Some compilers allow using members of the standard library namespace without explicitly specifying the `std::` prefix. For such compilers, your code can contain lines like this:

```
using ::mblen;
```

where `mblen` is a member of the C++ standard library. Polyspace compilation considers the members as part of the global namespace and shows an error.

Solution

It is a good practice to qualify members of the standard library with the `std::` prefix. For instance, to use the `mblen` function in the preceding example, rewrite the line as:

```
using std::mblen;
```

To continue to retain the current code and work around the Polyspace error, use the analysis option `-using-std`. If you are running the analysis in the Polyspace user interface, enter the option in the **Other** field. See `Other`.

Errors from Assertion or Memory Allocation Functions

Issue

Polyspace uses its own implementation of standard library functions for more efficient analysis. If you redefine a standard library function and provide the function body to Polyspace, the analysis uses your definition.

However, for certain standard library functions, Polyspace continues to use its own implementations, even if you redefine the function and provide the function body. The functions include `assert` and memory allocation functions such as `malloc`, `calloc` and `alloca`.

You see a warning message like the following:

```
Body of routine "malloc" was discarded.
```

Cause

These functions have special meaning for the Polyspace analysis, so you are not allowed to redefine them. For instance:

- The Polyspace implementation of the `malloc` function allows the software to check if memory allocated using `malloc` is freed later.
- The Polyspace implementation of `assert` is used internally to enhance analysis.

Solution

Unless you particularly want your own redefinitions to be used, ignore the warning. The analysis results are based on Polyspace implementations of the standard library function, which follow the original function specifications.

If you want your own redefinitions to be used and you are sure that your redefined function behaves the same as the original function, rename the functions. You can rename the function only for the purposes of analysis using the option `Preprocessor definitions (-D)`. For instance, to rename a function `malloc` to `my_malloc`, use `malloc=my_malloc` for the option argument.

Errors from In-Class Initialization (C++)

When a data member of a class is declared `static` in the class definition, it is a *static member* of the class. You must initialize static data members outside the class because they exist even when no instance of the class has been created.

```
class Test
{
public:

    static int m_number = 0;
};
```

Error message:

```
Error: a member with an in-class initializer must be const
```

Corrected code:

in file Test.h	in file Test.cpp

`class Test`
`{`
`public:`
`static int m_number;`
`};`
	`int Test::m_number = 0;`

Errors from Double Declarations of Standard Template Library Functions (C++)

Consider the following code.

```
#include <list>

void f(const std::list<int*>::const_iterator it) {}
void f(const std::list<int*>::iterator it) {}
void g(const std::list<int*>::const_reverse_iterator it) {}
void g(const std::list<int*>::reverse_iterator it) {}
```

The declared functions belong to `list` container classes with different iterators. However, the software generates the following compilation errors:

```
error: function "f" has already been defined
error: function "g" has already been defined
```

You would also see the same error if, instead of `list`, the specified container was `vector`, `set`, `map`, or `deque`.

To avoid the double declaration errors, do one of the following:

- Deactivate automatic stubbing of standard template library functions. For more information, see `No STL stubs (-no-stl-stubs)`.
- Define the following Polyspace preprocessing directives:
  - `__PST_STL_LIST_CONST_ITERATOR_DIFFER_ITERATOR__`
  - `__PST_STL_VECTOR_CONST_ITERATOR_DIFFER_ITERATOR__`
  - `__PST_STL_SET_CONST_ITERATOR_DIFFER_ITERATOR__`
  - `__PST_STL_MAP_CONST_ITERATOR_DIFFER_ITERATOR__`
  - `__PST_STL_DEQUE_CONST_ITERATOR_DIFFER_ITERATOR__`

  For example, for the given code, run analysis at the command line with the following flag. The flag defines the appropriate directive for the `list` container.

  ```
  -D __PST_STL_LIST_CONST_ITERATOR_DIFFER_ITERATOR__
  ```

  For more information on defining preprocessor directives, see `Preprocessor definitions (-D)`.

Errors Related to GNU Compiler

If you choose `gnu` for the option `Compiler (-compiler)`, you can encounter this issue.

Issue

The Polyspace analysis stops with a compilation error.

Cause

You are using certain advanced compiler-specific extensions that Polyspace does not support. See “Limitations”.

Solution

For easier portability of your code, avoid using the extensions.

If you want to use the extensions and still analyze your code, wrap the unsupported extensions in a preprocessor directive. For instance:

```
#ifdef POLYSPACE
    // Supported syntax
#else
    // Unsupported syntax
#endif
```

For regular compilation, do not define the macro `POLYSPACE`. For Polyspace analysis, enter `POLYSPACE` for the option `Preprocessor definitions (-D)`.

If the compilation error is related to assembly language code, use the option `-asm-begin -asm-end`.

Errors Related to Visual Compilers

The following messages appear if the compiler is based on a Visual compiler. For more information, see `Compiler (-compiler)`.

Import Folder

When a Visual application uses `#import` directives, the Visual C++ compiler generates a header file with extension `.tlh` that contains some definitions. To avoid compilation errors during Polyspace analysis, you must specify the folder containing those files.

Original code:

```
#include "stdafx.h"
#include <comdef.h>
#import <MsXml.tlb>
MSXML::_xml_error e ;
MSXML::DOMDocument* doc ;
int _tmain(int argc, _TCHAR* argv[])
{
    return 0;
}
```

Error message:

```
"../sources/ImportDir.cpp", line 7: catastrophic error: could not
open source file "./MsXml.tlh"
    #import <MsXml.tlb>
```

The Visual C++ compiler generates these files in its “build-in” folder (usually Debug or Release). In order to provide those files:

- Build your Visual C++ application.
- Specify your build folder for the Polyspace analysis.

pragma Pack

Using a different value with the compile flag (`#pragma pack`) can lead to a linking error message.

Original code:

test1.cpp	type.h	test2.cpp

`#pragma pack(4)`
 	
`#include "type.h"`
	`struct A`
	`{`
	`    char c ;`
	`    int i ;`
	`} ;`
		`#pragma pack(2)`
		
		`#include "type.h"`

Error message:

```
Pre-linking C++ sources ...
"../sources/type.h", line 2: error: declaration of class "A" had
a different meaning during compilation of "test1.cpp"
(class types do not match)
    struct A
```

```
          ^
          detected during compilation of secondary translation unit
"test2.cpp"
```

To continue the analysis, use the option `Ignore pragma pack directives (-ignore-pragma-pack)`.

C++/CLI

Polyspace does not support Microsoft C++/CLI, a set of language extensions for .NET programming.

You can get errors such as:

```
error: name must be a namespace name
|          using namespace System;
```

Or:

```
error: expected a declaration
|          public ref class Form1 : public System::Windows::Forms::Form
```

Error or Slow Runs from Disk Defragmentation and Anti-virus Software

Issue

In some cases, anti-virus software checks can noticeably slow down a Polyspace analysis. This reduction occurs because the software checks the temporary files produced by the Polyspace analysis.

You see noticeably slow analysis for a simple project or the analysis stops with an error message like the following:

```
Some stats on aliases use:
  Number of alias writes:      22968
  Number of must-alias writes: 3090
  Number of alias reads:       0
  Number of invisibles:        949
Stats about alias writes:
  biggest sets of alias writes: foo1:a (733), foo2:x (728), foo1:b (728)
  procedures that write the biggest sets of aliases: foo1 (2679), foo2 (2266),
                                                     foo3 (1288)
**** C to intermediate language translation - 17 (P_PT) took 44real, 44u + 0s (1.4gc)
exception SysErr(OS.SysErr(name="Directory not empty", syserror=notempty)) raised.
unhandled exception: SysErr: No such file or directory [noent]


------------------------------------------------------------------------
---                                                                  ---
---  Verifier has encountered an internal error.      ---
---  Please contact your technical support.         ---
---                                                                  ---
-------------------------------------------------------------------------
```

Possible Cause

A disk defragmentation tool or anti-virus software is running on your machine.

After starting an analysis, check the processes running and see if an anti-virus process is causing large amount of CPU usage (and possibly memory usage).

Solution

Try:

- Stopping the disk defragmentation tool.
- Deactivating the anti-virus software. Or, configuring exception rules for the anti-virus software to allow Polyspace to run without a failure.

  For instance, you can try the following:

  - Configure the anti-virus software to whitelist the Polyspace executables.

    For instance, in Windows, with the anti-virus software Windows Defender, you can add an exclusion for the Polyspace installation folder `C:\Program Files\Polyspace\R2019a`, in particular, the `.exe` files in the subfolder `polyspace\bin` and the `.exe` files starting with `ps_` in the subfolder `bin\win64`.

- Configure the anti-virus software to exclude your temporary folder, for example, `C:\Temp`, from the checking process.

SQLite I/O Error

Issue

When you try to run Polyspace, you get this error message:

Cause

Polyspace uses an SQLite database for storing results. This error can appear when SQLite databases are saved on NFS (Network File System) folders.

Solution

Check the folder where you save Polyspace results. For instance, if you run Polyspace at the command line, check the option `-results-dir`.

If the folder is an NFS folder, use a local folder instead.

Resolve -xml-annotations-description Errors

Issue

When you use the option `-xml-annotations-description` to apply custom annotations to your Polyspace results, some custom annotations are not applied and you see warnings in the console output or the desktop interface **Output Summary**.

Possible Solutions

Custom Annotation Not Found in Mapping

If you define a custom annotation syntax but you do not map it to the Polyspace annotation syntax, Polyspace detects the custom annotation but does not apply it to the analysis results. You see a warning similar to this warning in the console output or the Polyspace desktop interface **Output Summary**.

```
Verifying sources ...
Verifying zero_div.c (1/1)
Warning: rule :50 from exampleCustomAnnotation not found in the mapping (XML file).
         Skipping the annotation
```

Solution

Check the `<Mapping/>` section of the XML file that you pass to the `-xml-annotations-description` option. If the rule listed in the warning is not mapped to a Polyspace rule, add the appropriate entry to map the rule. For instance, to map rule 50 from the preceding warning to Polyspace coding rule **MISRA C: 2012 Rule 8.4**, add this entry in the `<Mapping/>` section:

```
<Result_Name_Mapping  Rule_Identifier="50" Family="MISRA-C3" Result_Name="8.4"/>
```

Polyspace Annotations Do Not Apply to Current Code

If you define a custom annotation syntax and you map it to the Polyspace annotation syntax, Polyspace might not apply some custom annotations to your source code. You see a warning similar to this warning in the console output or the Polyspace desktop interface **Output Summary**.

```
Warning: These Polyspace annotations do not apply to the current code:
|          In file D:\Polyspace\Examples\zero_div.c line 7, annotation MISRA-C3:8.4 with text
"Justified by annotation in source"
|          In file D:\Polyspace\Examples\zero_div.c line 20, annotation MISRA-C3:8.4 with text
"Justified by annotation in source"
|        Possible reasons:
|          - Issue not detected with selected configuration options.
|          - Issue is fixed.
|          - Annotation syntax is incorrect
```

Solution

Check for these possible causes:

- The issue that the annotation addresses has been fixed in the source code. Polyspace detects the custom annotation but ignores it.
- The issue that the annotation addresses was not detected by Polyspace with the analysis options that you specified. For example, if the custom annotation addresses a MISRA C: 2012 coding standard violation but Polyspace did not check for violations of this coding standard because option `Check MISRA C:2012 (-misra3)` is not specified.
- The issue that the annotation addresses was detected but Polyspace could not match the custom annotation to a corresponding Polyspace annotation. This indicates a syntax error in the

`<Mapping/>` section of the XML file that you pass to the `-xml-annotations-description` option.

See Also

`-xml-annotations-description`

Related Examples

- “Define Custom Annotation Format” (Polyspace Bug Finder)