HP Code Advisor C.02.25 User Guide
HP-UX 11i on HP Integrity and HP 9000 Systems

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Contents

About this document

This document discusses the invocation and usage of HP Code Advisor.

Intended audience

This document is intended for programmers who want to detect the potential errors or warnings in C, C++ applications by using HP Code Advisor.

Document conventions and symbols

Table 1 (page 5) lists the conventions and symbols used in this white paper.

Table 1 Document conventions

Convention	Element
Medium blue text:	Cross-reference links and email addresses
Medium blue, underlined text (http://www.hp.com)	Website addresses
Bold font	• Key names • Text typed into a GUI element, such as into a box • GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes
Italic font	Text emphasis
`Monospace font`	• File and directory names • System output • Code • Text typed at the command line
`Monospace, italic font`	• Code variables • Command-line variables
`Monospace, bold font`	Emphasis of file and directory names, system output, code, and text typed at the command line

△ **CAUTION:** Indicates that failure to follow directions can result in damage to equipment or data.

ⓘ **IMPORTANT:** Provides clarifying information or specific instructions.

NOTE: Provides additional information.

Related information

The following documents provide additional information about HP Code Advisor:

- *HP Code Advisor Release Notes*
- *HP Code Advisor Diagnostics Reference Guide*
- *Using HP Code Advisor in Application Builds: [HP Code Advisor] White Paper*
- *HP C/aC++ Features to Improve Developer Productivity - Whitepaper*

For additional information, see the HP Code Advisor web page:

http://www.hp.com/go/cadvise

HP encourages your comments

HP encourages your comments concerning this document. We are committed to providing documentation that meets your needs. Send any errors found, suggestions for improvement, or compliments to:

cadvise-help@lists.hp.com

1 Introduction

HP Code Advisor (cadvise) is a static analysis tool for C and C++ programs. Cadvise reports various programming errors in the source code. This tool enables programmers to identify potential coding errors, porting issues, and security vulnerabilities. Cadvise leverages the advanced analysis capabilities of HP C and HP aC++ compilers available on the HP Integrity systems.

This chapter addresses the following topics:

- "Cadvise user interface" (page 7)
- "Features" (page 7)

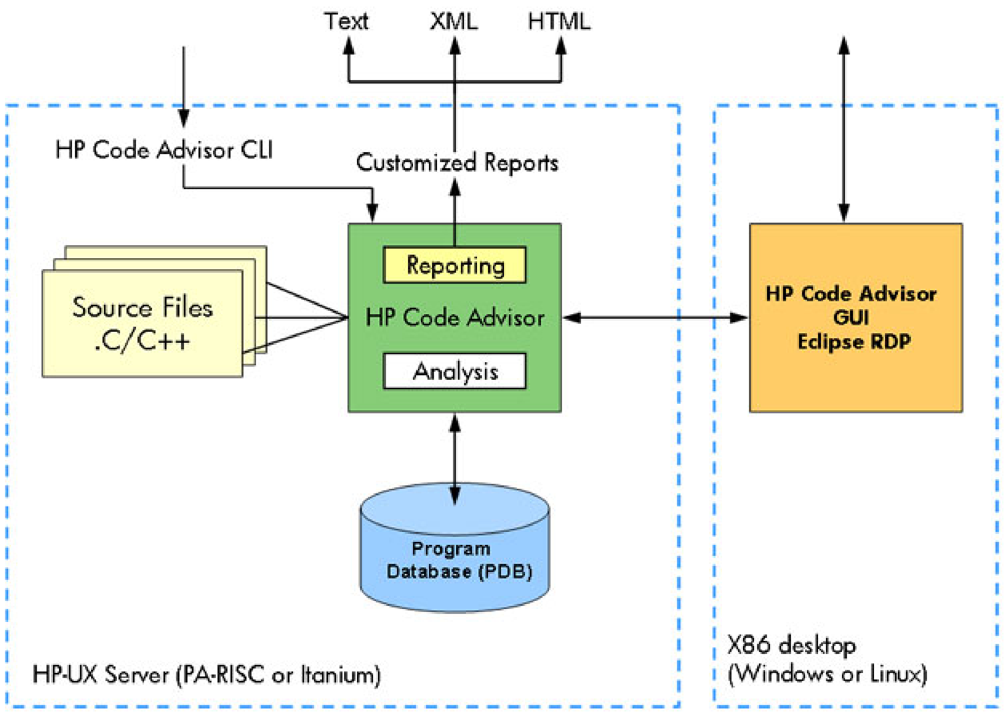
1.1 Cadvise user interface

You can use cadvise through the CLI. Also, you can use the HP Code Advisior GUI, which is part of the Eclipse Remote Development Plugin run remotely on MS-Windows x86 platforms. For more information, see http://www.hp.com/go/eclipse-remotedevplugin.

Cadvise takes C or C++source files as inputs for finding potential errors, security violations, and so on and then stores this information in a Program Database (PDB). The reporting utility helps you generate reports from the PDB in various formats, such as Text, XML, and HTML.

Figure 1 shows the HP Code Advisor components.

Figure 1 Cadvise Components (User Interfaces)



1.2 Features

This section discusses the following major features and benefits of cadvise:

- "Advanced static code analysis" (page 8)
- "Defect detection" (page 8)
- "Security vulnerability checks" (page 8)
- "Porting and migration" (page 8)

- "Detection of pre-defined or user-defined coding guideline violation" (page 8)
- "Easy to integrate and use" (page 8)

1.2.1 Advanced static code analysis

Cadvise is a powerful static code analysis tool that automatically diagnoses various issues in a source program. It improves developer productivity by finding defects at code development time, and leads to more robust and secure software because of fewer escaped defects.

Cadvise leverages advanced cross-file analysis technology from HP compilers. It stores the diagnosed information in a program database. With the built-in knowledge of system APIs, cadvise looks deep into the code and provides helpful warnings with fewer false positives.

1.2.2 Defect detection

Cadvise detects a wide range of coding errors and potential problems such as memory leaks, used after free, double free, array/buffer out of bounds access, illegal pointer access, uninitialized variables, unused variables, format string checks, suspicious conversion and casts, out of range operations, C++ coding style warnings, and so on.

1.2.3 Security vulnerability checks

Security flaws are not only very costly to fix, they can lead to a bad reputation and potential loss of customers. Cadvise detects security vulnerabilities in the source code such as buffer overflows, use of unsafe APIs, use of unsafe file path, unsafe data length argument, unsafe loop exit condition, unsafe use of tainted data, and so on.

1.2.4 Porting and migration

The cadvise also helps you to identify the potential problems in converting applications from 32-bit to 64-bit. The porting help is also available in 32-bit mode. This enables you to evaluate the porting effort before the actual porting begins.

While porting from Linux or Windows? to HP-UX you might encounter problems converting from little-endian to big-endian. cadvise identifies instances where different endianness might produce different results. These instances are very difficult to find manually.

Further, migrating your applications from PA-RISC to HP Integrity systems is much easier with the help of cadvise, which helps you identify the differences between the two compilers and begin porting the code to HP Integrity systems without leaving the familiar PA-RISC environment.

1.2.5 Detection of pre-defined or user-defined coding guideline violation

Cadvise has a built-in coding guidelines checker which diagnoses violations to the coding guidelines and emits appropriate diagnostic messages. You can modify the default set of rules or write your own set of rules to enforce coding guidelines. Cadvise has the appropriate API header files and a set of sample files along with the corresponding Makefile to rebuild the rules library.

1.2.6 Easy to integrate and use

Cadvise is available for HP-UX developers on both HP Integrity and PA-RISC systems as part of C and C++ compiler bundles or as a direct download. The default installation location is `/opt/cadvise`. Cadvise can be seamlessly integrated with the build process and makefiles. The reporting tool, cadvise report helps you to filter the important warnings without getting lost in tons of trivial warnings.

For example, to use cadvise for a single file, you can simply use the following command:

```
$ cadvise cc -c hello.c
```

You can also specify the program database and other options at the command line, as in the following example:

```
$ cadvise -pdb ./mypdb +wlint aCC hello.cpp
```

1.2.7 Supported compilers

Cadvise is shipped and supported with the HP aC++ and HP C compilers on the latest HP Integrity and PA-RISC HP-UX platforms. Cadvise can also be used with GNU gcc and g++ compilers, however it does not support all gcc/g++ built-ins and extensions. Cadvise will emit a parsing error if it comes across an unsupported built-in or extension. If you need support for a specific built-in or extension please send an email to **cadvise-help@lists.hp.com**.

2 Using Cadvise

This chapter addresses the following topics:

2.1 Getting started

This section addresses the following topics:

2.1.1 Supported platforms

You can install and use cadvise on the following platforms:

- HP-UX 11i v3 (B.11.31) PA-RISC (HP 9000) and HP Integrity systems
- HP-UX 11i v2 (B.11.23) PA-RISC (HP 9000) and HP Integrity systems
- HP-UX 11i v1 (B.11.11) PA-RISC (HP 9000) systems

2.1.2 Installing Cadvise

To install cadvise, complete the following steps:

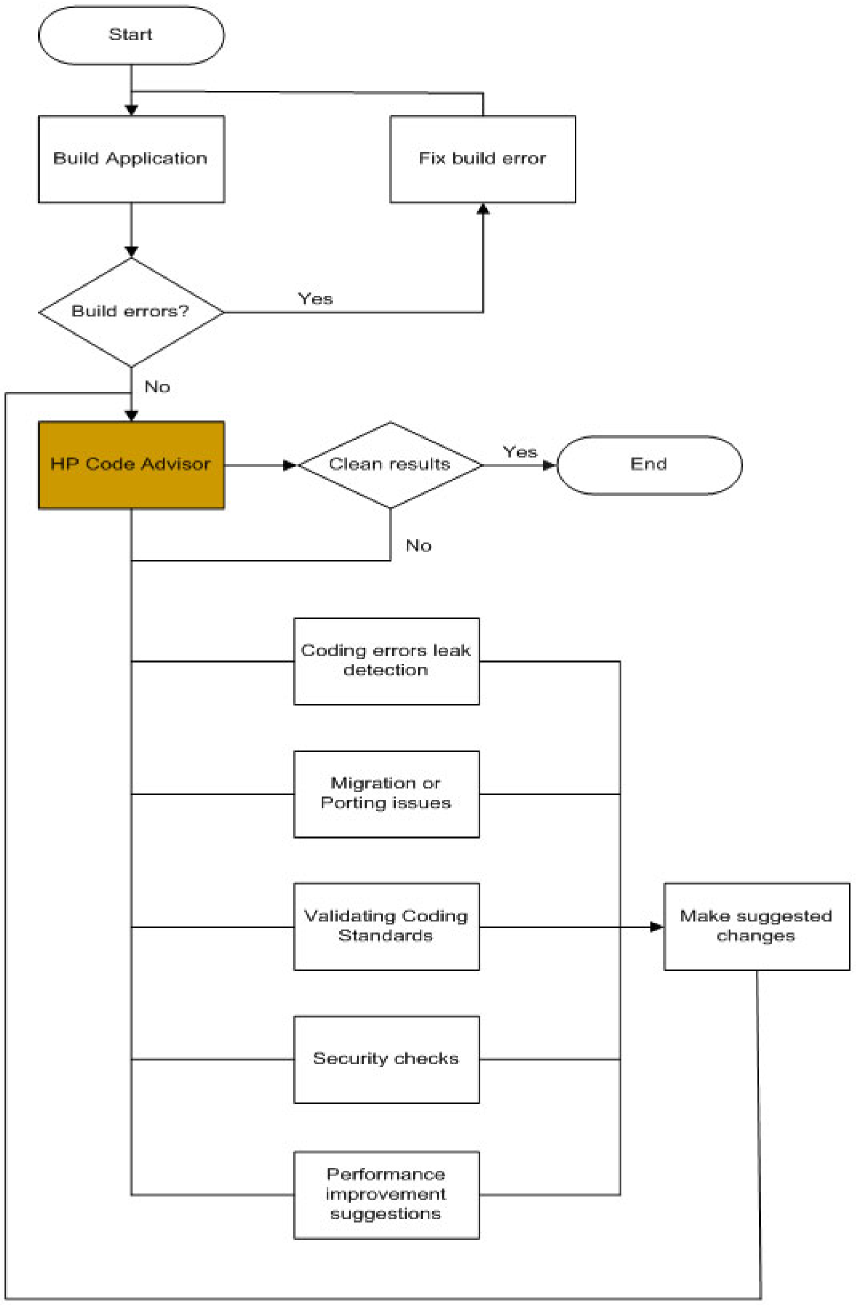
1. Download cadvise for your platform through the website http://www.hp.com/go/cadvise.
2. Install cadvise using the `swinstall` command. For more information on using the `swinstall` command, see *Software Distributor Administration Guide*.

Cadvise is installed in the `/opt/cadvise/bin/cadvise` directory by default.

2.2 Steps in using cadvise

Cadvise is part of an iterative process of building, analyzing, reporting, and removing the potential coding errors in an application, as shown in Figure 2.

Figure 2 Steps in Using Cadvise



To use cadvise, you perform the following steps:

1. Build the application with the set of compiler or linker options. Ensure that the application builds successfully.
2. Run cadvise with desired options and create the PDB.
3. Use the reporting utility for generated reports from the PDB in various formats.
4. Make suggested changes based on generated reports. The suggested changes are for defect prevention, memory leaks, secutity issues, coding guideline violation, and so on.
5. Re-run cadvise on modified sources and generate new reports. Continue making source changes as long as you receive meaningful data.

2.3 Invoking Cadvise

To invoke cadvise, enter the following command at the HP-UX prompt:

```
/opt/cadvise/bin/cadvise
```

The cadvise command has the following modes of operation:

- **Analysis mode**

  Used to analyze and create the Program Database (PDB). To invoke cadvise in this mode, enter the `cadvise` command in the following format:

  ```
  cadvise [cadvise-options] compile-cmd [compile-options]
  ```

- **Report mode**

  Used to create reports. To invoke cadvise in this mode, enter the `cadvise` command in the following format:

  ```
  cadvise report [report-options] [-pdb <pdb-name> | logfile]
  ```

For information on PDB, see Using the Program Database (PDB) (page 19).

The `cadvise` command is used as a wrapper around the compiler or linker. The `cadvise report` option is used to generate reports.

2.4 Using Cadvise as a wrapper around Compiler or Linker

Cadvise is used with the HP C and HP aC++ compilers; GNU gcc and g++ compilers or HP-UX linker. The `cadvise` command is used as a wrapper around the compile and link command-line options (hereafter referred to as build line). The `cadvise` command and options are prefixed to the build line as command line arguments.

For example

The following command lines show how to invoke cadvise:

Regular command line: `$ cc -c abc.c def.c`

Cadvise command line: `$ cadvise -pdb mypdb +wlint cc -c abc.c def.c`

```
$ cadvise -pdb mypdb +wlint cc -c abc.c def.c
$ cadvise -pdb mypdb +wlint ld -r abc.o def.o -o abcdef.o
```

The `cadvise` command first executes the user's regular build line, and then analyzes the source code. Cadvise also analyzes the build line and automatically determines the include paths, defines, and language dialect needed for the source code analysis. The `-nobuild` option allows you to skip the regular build process, and perform only the source code analysis.

The result of the cadvise analysis can be stored in a program database using the `-pdb` option. In this case, the PDB also stores the summary information used for cross-file analysis. For more information on PDB, see Using the Program Database (PDB) (page 19).

2.5 Integrating Cadvise with the makefiles and build process

Cadvise can be easily integrated with the makefiles and the build scripts. If a makefile variable is used to define the C and C++ compilers, you can redefine it to include the cadvise invocation.

Example 1 Updating the makefile to integrate cadvise

See the following makefile content:

```
CADVISE_OPTS= -pdb mypdb +wlint
CADVISE= /opt/cadvise/bin/cadvise
CC= $(CADVISE) $(CADVISE_OPTS) /opt/ansic/bin/cc
CXX= $(CADVISE) $(CADVISE_OPTS) /opt/aCC/bin/aCC
```

You may also define a wrapper script instead of the standard compiler commands. For example, see the following sample wrapper script:

Example 2 Sample wrapper script

```
$ cat cadvise_cc
#!/bin/sh
#
# wrapper script to invoke cadvise
#
exec /opt/cadvise/bin/cadvise -pdb mypdb +wlint /opt/ansic/bin/cc "$@"
```

Now `cadvise_cc` can be used instead of `cc` in the build line to invoke cadvise analysis in addition to the compilation process.

NOTE: You need not create separate dependency rules for cadvise in the makefiles. Cadvise must be invoked only when the existing dependency rules in the makefile lead to a compile.

The addition of cadvise analysis to the build process increases the total build time. You can either invoke cadvise automatically whenever compiled, or launch cadvise as a separate build process by invoking it explicitly. For large projects where a lot of cross-file analysis is required, it is better to separate the analysis process. You can use the `-crossfile` option to manage the cross-file analysis.

2.6 Enabling different categories of diagnostic messages

By default, a limited number of diagnostic messages are enabled in cadvise.

Additionally, the following options can be used to enable various types of diagnostic messages.

+w	Enables all the warnings about potentially questionable constructs in the compiler.
+wall	Enables all the compile time checks.
"+wendian" (page 51)	Detects code fragments which are endian dependent.
"+wlint" (page 45)	Provides compile-time diagnostics which detect potential errors in the source code.
"+wlock" (page 53)	Detects multi-threaded programming issues.
"+wsecurity[=1|2|3|4]" (page 52)	Enables compile time diagnostic messages for potential security vulnerabilities.
"+w64bit " (page 51)	Enables warnings that help detection of potential problems in converting 32-bit applications to 64-bit.
"+wperfadvice[=1|2|3|4] " (page 54)	Generates performance advisory diagnostics.

The best method is to use `+wall` to enable all possible diagnostic messages. Then, use the `cadvise report -pdb <pdbname> -summary` command to see a quick summary of the various diagnostic messages generated by cadvise, sorted by severity. For more information, see Generating Reports (page 27).

2.7 Generating code complexity metrics

Cadvise can generate code complexity metrics to gauge the complexity of the code being developed or migrated. The `+metrics` option generates program complexity metrics.

Syntax:

```
$cadvise +metrics[=ict][:out=pdb]
```

OR

```
$cadvise +metrics[=ict][:out=[+]<filename>]
```

Following command shows the examples for generating code complexity metrics.

Example 3 Generating code complexity metrics

To store the code complexity metrics in the PDB with Indirect Call Targets, use the following command.

```
$cadvise +metrics=ict -pdb test.pdb aCC -c example.c
```

To get the metrics in the my.metrics file, use the following command.

```
$cadvise +metrics :out=my.metrics aCC -c example.c
```

To store the metrics in the my.metrics file without Indirect Call Targets, use the following command.

```
$cadvise +metrics :out=pdb -pdb test.pdb aCC -c example.c
```

The program complexity metrics are stored in a specified output location. The output location can either be specified as the pdb (out=pdb) or a file `<filename>(out=<filename>)`. Inserting a + before the `<filename>` appends the metrics to the file `<filename>`. If the output location is not specified, then these metrics are written either to a PDB, if a PDB is present, or to the file `<objfile>.metrics`.

Cadvise emits the following metrics for determining program complexity:

- **For a source file**
  - Number of header files included
  - Total number of lines in the source file
  - Number of comment lines
  - Number of blank lines
  - Number of lines of code
  - Number of mixed lines (lines have both code and comments)
  - Number of global variables
  - Number of static variables
  - Total number of functions defined
  - Number of externally visible functions defined
  - Number of global Thread Local Storage (TLS) Variables
  - Number of static Thread Local Storage (TLS) Variables
  - Number of global mutexes
  - Number of static mutexes
  - Program complexity metrics for each of the functions
- **For a function**
  - Function Signature
  - Total number of lines
  - Function Start Line Number
  - Function End Line Number
  - Number of comment lines

    - Number of blank lines
    - Number of lines of code
    - Number of mixed lines
    - Number of macros used
    - Number of local variables defined
    - Number of static variables defined
    - Number of if statements
    - Number of return statements
    - Number of loop nests
    - Nesting level of each loop nest
    - Number of indirect calls
    - Number of direct calls
    - Targets of direct calls
    - Cyclomatic complexity
    - Cyclomatic complexity without switch
    - Cyclomatic complexity without exception handling
    - Cyclomatic complexity without switch and exception handling
    - Number of Thread Local Storage (TLS) variables
    - Number of mutexes
    - Number of lock calls
    - Number of unlock calls

For each indirect call site, cadvise emits the list of possible call targets.

- **Cyclomatic Complexity**

  Cyclomatic complexity metric, developed by Thomas McCabe in 1976 ,measures the number of linearly-independent paths through a program module. It is an indicator for understandability and testability of a module. A lower value indicates more understandable and testable code. The `+metrics` option emits cyclomatic complexity by default.

- **Indirect Call Targets**

  This refers to the list of functions that can be called at an indirect call site. Calculation of this metric leads to an increase in analysis time and so the `+metrics` option does not emit Indirect Call Targets by default. You need to specify `ict` as a suboption to the `+metrics` option for emission of indirect call targets. This causes emission of Indirect Call Targets in addition to all other default metrics.

The following example shows the code complexity metrics.

Example 4 Code complexity metrics

```
$ cat /tmp/example.c

#include <stdio.h>
#include <pthread.h>

#define INDEX 500

pthread_mutex_t mutex;

int mata[INDEX][INDEX], matb[INDEX][INDEX], matres[INDEX][INDEX] ;
void print_output();
void matrix_multiply() {
  int i, j, k ;
  /* Matrix-Matrix multiply */
  for (i = 0 ; i < INDEX ; i++) {
    for (k = 0 ; k < INDEX ; k++) {
      for (j = 0 ; j < INDEX ; j++) {
        matres[i][j] =
          matres[i][j] +
            mata[i][k] * matb[k][j] ;
      }
    }
  }
  print_output(); /* print the result of multiplication */
  return;
}
```

```
$ cadvise +metrics aCC -c /tmp/example.c
```

```
$ cat example.metrics

 ========================================================================
 Begin program complexity data for /tmp/example.c
 ========================================================================
File level program complexity data :
------------------------------------

Include Files: 2
Total Lines: 23
Blank Lines: 3
Comment Lines: 1
Lines Of Code: 19
Mixed Lines: 1
No. of Globals: 4
No. of Statics: 0
No. of Functions: 1
No. of ExternFunctions: 1
No. of Global Thread Local Variables: 0
No. of Static Thread Local Variables: 0
No. of Global Mutexes: 1
No. of Static Mutexes: 0

Function level program complexity data :
----------------------------------------

Begin Function: matrix_multiply
Signature: void matrix_multiply()
Total Lines: 15
Blank Lines: 1
Start Line: 10
End Line: 24
Comment Lines: 1
```

```
Lines of Code: 13
Mixed Lines: 1
No. of Macros Used: 3
No. of Locals: 3
No. of Statics: 0
No. of Ifs: 0
No. of Returns: 1
No. of Loops: 1
Loop Nesting Levels:
3
No. of Indirect Calls: 0
No. of Direct Calls: 1
Functions called:
print_output()
Cyclomatic Complexity: 4
Cyclomatic complexity without switches: 4
Cyclomatic complexity without eh: 4
Cyclomatic complexity without switches and eh: 4
No. of Thread Local Variables: 0
No. of Mutexes: 0
No. of Lock Calls: 0
No. of Unlock Calls: 0
End Function: matrix_multiply
==================================================================
End program complexity data for /tmp/example.c
==================================================================
```

NOTE: The `+metrics` option can be used with the cadvise reporting option for reporting program complexity metrics from the PDB.

2.8 Detecting violation of pre-defined or user-defined coding guidelines

The coding guidelines checker diagnoses violations to the coding guidelines and emits appropriate diagnostic messages.

Syntax:

`+wcodeguide[=<rules-library>]`

Where:

`rules-library` denotes the library that defines the coding guideline rules.

You can modify the default set of rules or write your own set of rules to enforce coding guidelines. Cadvise has the appropriate API header files and a set of sample files along with the corresponding makefile to rebuild the rules library.

Table 2 lists the source structure provided for (re)building the rules library.

Table 2 Source structure in the rules library

`include/`	• `HPCodeGuideConstructs.h` Contains the APIs required for (re)writing the rules to enforce coding guidelines. • `HPCodeGuideDiagnosticTags.h` Contains the various diagnostic tags that you can use to emit the diagnostics from the rules library.
`lib/`	• `libcodeguide.a` This is provided to fill in the implementation stubs for recompilation of the rules' library, and must be linked in while compiling the rules' library. • `librules.s[lo]` This is the default rules' library that is available with cadvise.
`src/`	• `HPCodeGuideRules.C` The file where all rules are implemented. You can modify this file to incorporate more rules and/or modify the existing ones. • `HPCodeGuideRulesDriver.C` The driver from where the rules are invoked on the various program constructs. • `Makefile` The default makefile for rebuilding the rules' library from the above sources.

The sample rules towards naming convention that are available with the current release are as follows:

1. Functions that returns a bool must start with `is`.
2. Names of abstract classes should begin with Interface.
3. Class names should start with a capital letter.
4. Names of global variables should start with a capital letter.
5. Names of local variables should start with a small letter.

An example of writing a rule to enforce the naming convention of private data members being suffixed with an '_' is as follows:

Example 5 Writing a rule to enforce naming convention

```
void Field::checkNamingConventions() {
          //Private data members of class should end with "_"
          if(name() && isPrivate()) {
            char ch = *name() + strlen(name());
            if(ch != '_')
            warning("Private data member \"%s\" not suffixed with \"_\"", 2000053, name());
          }
        }
```

NOTE: Cadvise reports do not currently have support for Coding Guideline diagnostics. Use the `-tee` option to view these messages.

3 Using the Program Database (PDB)

The PDB is a repository of errors, warnings, diagnostic messages, and metrics generated while analyzing the application. The HP Code Advisor uses the PDB also to store the information required for the analysis. If you want to perform cross-file analysis of the application, you need to use a PDB. During the compilation phase of your application, the HP Code Advisor stores an intermediate representation of the application in the PDB and uses it during the application link phase to perform the cross-file analysis. You can use the reporting tool to see different kinds of reports from the information stored in the PDB without having to repeat the analysis phase. A single PDB can be used to store the analysis information of multiple applications. In such cases, the cross-file analysis for each application is performed when cadvise is invoked with the link command for each application.

NOTE: This does not work with the `-crossfile=pdb` option. Instead, the analysis logs are combined into a single report when cadvise report is used on such a PDB.

The size of the PDB is proportional to the total size of the object files created while building the application. It also depends on the number of errors and the diagnostic messages found during the analysis of the application. The size of the PDB can be three to four times more than the total size of the object files. Therefore, ensure that there is enough space in the volume or the ClearCase VOB where the PDB resides. You can also locate the PDB within a ClearCase VOB. The ClearMake dependency checking and wink-in mechanisms work with the PDB in the VOB. If the PDB is created in a View, then it is winked-in by other Views that have the matching configuration spec and build rules.

NOTE: Due to limitations in ClearCase, cadvise cannot access a PDB located on a clearcase VOB via a NFS mounted directory from a non-ClearCase machine. If you access the VOB from a non-ClearCase machine, ensure that the PDB is located on a local file system or use the `-pdb_no_locking` option. For more information, see the *Problems with NFS locking* section in *Administrator's Guide: Rational Clearcase and Rational Clearcase LT*.

The internal format of the PDB has been changed in preparation for creating PDBs in other platforms. This means that this version of cadvise is not compatible with PDBs generated by older versions of cadvise. As an example, users cannot use this version of cadvise to generate reports on PDBs generated by previous versions of cadvise. Ensure you remove the older PDBs with the`-pdb_destroy` option (`cadvise -pdb <location> -pdb_destroy`) before you use this version of cadvise. Alternately, you can use a different location for the PDBs generated with this newer version of Cadvise. One of the following errors appear if you use Cadvise with an incompatible PDB:

```
cannot open PDB collection "<name>" (Error: Incompatible PDB version)
cannot open PDB element "<name>" (Error: Incompatible PDB version)
found problem while traversing PDB (Error: Incompatible PDB version)
```

NOTE: We try to make changes to the PDB format in a way that preserves forward compatibility (ie: a PDB generated by an older version of cadvise can be used by a new version of cadvise). However, it is not guaranteed that all the format changes will be forward compatible. In some cases we are forced to break such forward compatibility in order to support new features.

The organization and the internal format of the PDB may change from release to release. Hence, it is not advisable to directly manipulate the content of the PDB. However, the PDB can be safely copied to different directory by using a recursive copy command (`cp -R`).

3.1 PDB options table

The following options help you manage the PDB:

“-pdb location” (page 20)	Enables you to specify the location (path) of the PDB.
“-pdb_destroy” (page 20)	Removes the PDB specified with the –pdb option.
“-pdb_no_locking” (page 20)	Allows you to not to use locks in PDB operations.
“-remove” (page 20)	Removes information related to the specified object files from the PDB.
“-snapshot location” (page 21)	Creates a snapshot of the PDB at the specified location (path).
“-pdb_version” (page 21)	Prints the PDB version and checks for compatibility.

3.2 Specifying the PDB location

The path specified may be relative or absolute, but you must ensure that the whole application build creates only one PDB. If the build of your application is done across multiple machines, you must ensure that the path specified is accessible from all the machines involved in creating the build.

Following is the syntax for changing the location of the PDB:

```
 $cadvise <location> -pdb <pdbname>
```

Following is an example to specify the location of the PDB:

Example 6 Specifying the PDB Location

```
$cadvise -pdb testpdb /opt/aCC/bin/aCC 1.c
```

Where: `testpdb` is the location of the PDB.

3.3 Deleting PDB

This option enables you to delete the PDB when it is no longer required.

Following is the syntax for deleting PDB:

```
 $cadvise -pdb_destroy -pdb <pdbname>
```

Following is an example to delete the PDB:

Example 7 Destroying PDB

```
 $cadvise -pdb_destroy -pdb testpdb
```

Where: `testpdb` is the location of the pdb, to be deleted.

3.4 Disabling locks in PDB operations

The `-pdb_no_locking` option ensures that cadvise does not use locks in PDB operations. Cadvise uses locks implemented with lockf during some PDB operations, by default. If the user machine does not use lockd, or if there are any name resolution issues between the PDB host and client machines, the `lockf` calls do not execute for an indefinite period of time. Use the `-pdb_no_locking` option to workaround `lockf` related-issues in user systems. Locks are important if the user has to run cadvise analysis and reports simultaneously. If you do not use locks and run cadvise analysis in parallel with the reports, then there is a potential for incomplete or truncated reports. *See also* : `manpages on lockf(2); lockd(1M).`

3.5 Removing object file information from the PDB

The `-remove` option removes from the PDB, any information such as logs, internal representation, and metrics related to the specified object files.

Following is the syntax for removing information from the PDB:

```
$cadvise -pdb <pdbname> -remove:objs/<objectfile name>
```

Following is an example to remove object file information from the PDB:

Example 8 Removing object file information from the PDB

```
$cadvise -pdb testpdb /opt/aCC/bin/aCC foo.c -c -o objs/foo.o
  $cadvise -pdb testpdb -remove:objs/foo.o
```

NOTE: For information on how cadvise searches for object files, see Example 15 “Specifying the location of object files”.

3.6 Creating a PDB snapshot at a specified location

The PDB created at a specified location is significantly smaller in size than the original PDB. A snapshot PDB can be used only for reporting purposes and not for cross-file analysis. The `-pdb location` option must be used to specify the location of the PDB from where you are taking the snapshot. When the `-snapshot` option is used, the other cadvise options are ignored.

Following is the syntax for creating a PDB snapshot at a specified location or path:

```
$cadvise -pdb <pdbname> -snapshot <location>
```

Following is an example to create a PDB snapshot:

Example 9 Creating a PDB snapshot

```
$cadvise -pdb testpdb -snapshot snappdb
```

Where: `testpdb` is the location of the PDB and `snappdb` is the location where the snapshot needs to be created. This location is relative or absolute.

3.7 Displaying PDB version

This option checks the PDB internal format when cadvise is invoked, and prints the PDB version along with the compatibility status. If the version is not supported, cadvise prints an error message and exits.

Following is the syntax for displaying the version of the PDB:

```
$cadvise -pdb <pdbname> -pdb_version
```

Following are the examples for displaying the version of the PDB:

Example 10 Displaying PDB version

```
$ cadvise -pdb 2a.pdb -pdb_version
cadvise: PDB version 04.01 (Compatible)

$ cadvise -pdb 2b.pdb -pdb_version
cadvise: PDB version 03.01 (Incompatible)
```

4 Using cross-file analysis

Cadvise provides different operating modes for performing cross-file analysis of the application. The cross-file analysis can be performed along with the regular build of the application, or separated from the regular build. You can also initiate it either on all the files or only on a selected group of files or modules. It can also be disabled completely. The default and recommended mode is to enable cross-file analysis at link time. Cadvise fetches all the recorded information from the PDB for all the object files specified at the link command line and performs cross-file analysis.

Usage:

```
-crossfile = option
```

Table 3 Cross-file analysis options

Option	Description
`none`	Disables cross-file analysis. If a PDB location is specified using the –pdb option, the logs of errors and the diagnostic messages found during the compile time of the application are stored in the PDB.
`auto`	Directs the cross-file analysis to be automatically done at the link time of the application. This is the default mode.
`defer`	Does not initiate the cross-file analysis at the link time of the application. When you use this option, a PDB location must be specified using the –pdb option. During the compile time of the application, logs and intermediate representation files are stored in the PDB so that the cross-file analysis can be initiated later with either of the `-crossfile=[pdb|module|list|listfile]` options.
`pdb`	Initiates cross-file analysis on all the intermediate representation files stored in the PDB. When you use this option, a PDB location must be specified using the –pdb option.
`module:<module_name>`	Enables cross-file analysis of object files in a PDB corresponding to a particular module(shared library or executable). During the build, cadvise records the list of files that make up the module. So, for cross-file analysis,you can use the name of the module instead of specifying the list of object files.
`list:<file1:file2:.. ..:fileN>`	Enables cross-file analysis of object files in a PDB corresponding to the listed object files. File1, File2,..., FileN are object files. For more information, see .
`listfile:<file_name>`	Enables cross-file analysis of object files in a PDB corresponding to the object files listed in the specified file. The list of object files in `<file_name>` must be separated by space or newline characters. For more information, see Example 15 (page 24).

The following examples illustrate the equivalent usage of different cross-file options to perform cross-file analysis:

Example 11 Using cross-file analysis automatically during linking

```
-crossfile=auto
```

The default cross-file option is `-crossfile=auto`. The cross-file analysis occurs automatically when you invoke cadvise during linking.

```
$cadvise -pdb testpdb cc a.c b.c -c
$cadvise -pdb testpdb cc a.o b.o -o test.exe
```

Example 12 Delaying cross-file analysis till the specification of crossfile=pdb option

```
-crossfile=defer and -crossfile=pdb
```

If `-crossfile=defer` and `-crossfile=pdb` are used, cadvise delays the cross-file analysis till the specification of `-crossfile=pdb` option.

```
$cadvise -pdb testpdb cc a.c b.c -c
$cadvise -pdb testpdb -crossfile=defer cc a.o b.o -o test.exe
$cadvise -pdb testpdb -crossfile=pdb
```

Example 13 Delaying cross-file analysis till the specification of crossfile=module option

```
-crossfile=defer and -crossfile=module
```

If `-crossfile=defer` and `-crossfile=module` are used, cadvise delays the cross-file analysis till the specification of `-crossfile=module` option.

```
$cadvise -pdb testpdb cc a.c b.c -c
$cadvise -pdb testpdb -crossfile=defer cc a.o b.o -o test.exe
$cadvise -pdb testpdb -crossfile=module:test.exe
```

Example 14 Delaying cross-file analysis till the specification of crossfile=list option

```
-crossfile=defer and -crossfile=list
```

If `-crossfile=defer` and `-crossfile=list` are used, cadvise delays the cross-file analysis till the specification of `-crossfile=list` option.

```
$cadvise -pdb testpdb cc a.c b.c -c
$cadvise -pdb testpdb -crossfile=defer cc a.o b.o -o test.exe
$cadvise -pdb testpdb -crossfile=list:a.o:b.o
```

NOTE: The combined use of the `-crossfile=defer` and `-crossfile=[pdb|module|list|listfile]` options are useful in the following situations:

- *If you want to perform cross-file analysis on a set of object files that is bigger than the set of object files linked during the application build process*, for example, if the application build creates multiple shared libraries, the default automatic cross-file analysis is done only across the files specified for each shared-library link command. In such cases, you can also force the analysis to be done on all the files by deferring the analysis using the `-crossfile=defer` option until the whole application is built and then invoking the analysis on all the files in the PDB, by using the `-crossfile=pdb` option. Alternatively, you can use -crossfile=list option to specify object files from a subset of the shared libraries to perform `cross-file` analysis.
- *If you want to perform cross-file analysis on a set of object files that is smaller than the set of object files linked during the application build process*, for example, if you want to perform cross-file analysis on a few object files, you can compile only those object files, get a PDB with the intermediate representation and then use the `-crossfile=pdb` option to perform cross-file analysis. Alternately, compile the whole application with the `-crossfile=defer` option and then use `-crossfile=list` option to do the cross-file analysis on a subset of object files.

However, do not use the `-crossfile=pdb` option if the PDB contains diagnostic information of multiple applications because HP Code Advisor can misinterpret multiple definitions for the same symbols.In this scenario it is better to use the `-crossfile=list` or `-crossfile=module` option to perform cross-file analysis on a subset of object files in the PDB.

For the `-crossfile=list` or `-crossfile=listfile` options, the location of each object file specified must be one of the following:

- Location of an existing object file build during the application compilation.
- Location of the object file as it would have been created during the application compilation.

Therefore, an object file does not need to exist (it may have been removed or you may have used the "-nobuild" option) as long as cadvise and the PDB are used to monitor the compilation that creates the object file.

Example 15 Specifying the location of object files

```
cd /tmp
$cadvise -pdb testpdb -crossfile=defer aCC 1.c 2.c 3.c -o objdir/testexec
```

For cross-file analysis on all the files used to build `testexec`, run the following commands:

```
$cadvise -pdb testpdb -crossfile=module:objdir/testexec
Or
$cadvise -pdb testpdb -crossfile=module:/tmp/objdir/testexec
```

NOTE: To specify the module name as specified with the`-o` option you must be in the same directory where the first command was invoked. To invoke cadvise from any other location you must specify the absolute path of the module. For cross-file analysis on object files `1.o` and `2.o`, run the following command:

```
$cadvise -pdb testpdb -crossfile=list:1.o:2.o
OR
$cadvise -pdb testpdb -crossfile=list:/tmp/1.o:/tmp/2.o
```

5 Configuring diagnostic messages

You may want to limit the cadvise diagnostic messages depending on the need, such as the following cases:

- Generate all possible messages to ensure that you get the maximum information about potential problems detected by cadvise.
- Reduce the number of messages so that you are not overwhelmed by the sheer magnitude of the warnings.
- Eliminate or reduce the number of benign or misleading messages.

Your requirement may vary depending on the size of the application, resources allotted to eliminate warnings by changing source code, total number of messages generated, new or ported code, coding standards, and so on. The recommended way is to use options like, `+wlint`, `+w64bit` and `+w` to enable only the required warnings, and then use the options to disable specific warnings that are not of interest or that are too arbitrary. Each distinct type of diagnostic message generated by cadvise has a number associated with it. You can generate separate reports of diagnostics messages for each of these numbers. This allows you to ignore warnings that you do not want and focus on those you want.

5.1 Diagnostic configuration options table

The following options and pragmas help you to manage the diagnostics:

"+Warg1[,arg2,...,argn]" (page 25)	Selectively suppresses warnings.
"+Wwarg1[,arg2,..,argn]" (page 25)	Selectively enables warnings.
"+Wearg1[,arg2,..,argn]" (page 26)	Selectively interprets warnings as errors.
"+Wmacro:MACRONAME:d1,d2,d3,..dn" (page 26)	Disables warnings in a macro.

5.2 Suppressing warnings selectively

The `+Warg1[,arg2,...,argn]` option selectively suppresses any specified warning messages.

NOTE: `arg1` through `argn` must be valid warning message numbers.

Following is the syntax for selectively suppressing warnings.

```
$cadvise +wall -pdb <pdbname> +Warg1[,arg2,...,argn] compile-cmd <filename>
```

Following is an example for selectively suppressing warnings.

Example 16 Suppressing warnings selectively

```
$cadvise +wall -pdb testpdb +W600 cc -c foo.c
```

5.3 Enabling warnings selectively

The `+Wwarg1[,arg2,..,argn]` option selectively enables generation of cadvise warning messages that are not enabled by default.

NOTE: `arg1` through `argn` must be valid warning message numbers.

Following is the syntax for selectively enabling warnings.

```
$cadvise +wall -pdb <pdbname> +Wwarg1[,arg2,...,argn] compile-cmd <filename>
```

Following is an example for selectively enabling warnings.

Example 17 Enabling warnings selectively

```
$cadvise +wall -pdb testpdb +Ww600 cc -c foo.c
```

5.4 Interpreting selective warnings as errors

The `+Wearg1[,arg2,..,argn]` option selectively interprets specified warning messages as errors. `arg1` through `argn` must be valid warning message numbers. This option allows you to enforce a policy to disallow specific warnings by forcing an error at compile time.

```
+Wearg1[,arg2,..,argn]
```

Following is the syntax for selectively enabling warnings.

```
$cadvise +wall -pdb <pdbname> +Wearg1[,arg2,...,argn] compile-cmd <filename>
```

Following is an example for selectively enabling warnings.

Example 18 Interpreting selective warnings as errors

```
$cadvise +wall -pdb testpdb +We600 cc -c foo.c
```

5.5 Disabling warnings in a macro

The `+Wmacro:MACRONAME:d1,d2,d3,..dn` option disables specified warnings in a macro. `MACRONAME` is the name of the macro and `d1, d2, d3, ..., dn` are warning numbers. Specifying -1 suppresses all warnings. This option is not applicable to warning numbers greater than 20000.

NOTE: Conflicts between `+W`, `+Ww` and `+We` options are resolved based on the severity. The `+We` option is the highest and `+W` is the lowest.

Following is the syntax for disabling warnings in a macro.

```
$cadvise +wall -pdb <pdbname> +Wmacro:INITIAL:d1,d2,d3,..dn compile-cmd <filename>
```

Following is an example for disabling warnings in a macro.

Example 19 Disabling warnings in a macro

```
$cadvise +wall -pdb testpdb +Wmacro:INITIAL:600,610 cc -c foo.c
```

5.6 Managing warnings in a source file

```
#pragma diag_suppress | diag_warning | diag_error NNNN
#pragma diag_default NNNN
```

Command line options help you to generate diagnostic messages for the entire build or for a specific source file. There are several pragmas available to manage warnings for a specific region within a source file. The use of `#pragma diag_suppress` within the source code disables generation of warning `N` after the pragma in the source file. The pragma `diag_default` restores the default handling for the diagnostic message `N`. Similarly, `diag_warning` enables generation of a diagnostic message and `diag_error` converts a warning to an error. The following example disables warning #2549-D locally:

Example 20 Disabling a warning locally

```
int i;
#pragma diag_suppress 2549
printf ("i = %d\n", i);
#pragma diag_default 2549
```

NOTE: These pragmas are not applicable to warning numbers greater than 20000.

6 Generating reports

Cadvise either stores the diagnostic messages in the PDB or outputs them into the `stderr`. To analyze these diagnostic messages, you can generate a report using the cadvise report command. Cadvise report provides multiple options for filtering the diagnostic messages stored in the log files. These reports can also be viewed and saved as HTML files. Using these options, you can view a selected set of diagnostic messages. The cadvise reports can be generated from the following:

- **The PDB**

  Cadvise builds that use the `-pdb` option store the diagnostic messages in the program database. The following command generates report from the PDB:

  ```
  cadvise report <report-options> -pdb pdbdir
  ```

- **The log files**

  Cadvise builds that do not use the `-pdb` option, output them into `stderr`. You can redirect these to a log file for later analysis. The following command generates the report from log files:

  ```
  cadvise report <report-options> logfile
  ```

6.1 Report generation options table

You can use the following options to generate reports:

"-summary" (page 28)	Prints the summary information of all messages in the log file.
"-file_summary" (page 28)	Prints the summary information for each source file.
"-func_summary" (page 28)	Prints the summary information for each function having diagnostics in source file.
"-all" (page 29)	Prints all the messages in the log file.
"-html[=<dir>]" (page 29)	Displays the reports in HTML.
"-xml[=<filename>]" (page 30)	Generates the specified cadvise reports in XML format.
"-diag N1,N2,N3,...,Nn" (page 30)	Prints only those diagnostics with specified diagnostic numbers, N1,N2..Nn.
"-severity N" (page 31)	Prints the messages with severity greater than or equal to (>=) to N.
"-exclude <string1:string2:...:stringN>" (page 31)	Suppresses diagnostics or metrics from source files that have any of the specified strings in the filename path.
"-include <string1:string2:...:stringN>" (page 32)	Generates diagnostics or metrics from source files that contain the any of the specified string in the file name path. Messages from any other files are suppressed.
"+metrics" (page 32)	Prints program complexity data for all or selected source files.
"-migration" (page 39)	Print only those messages that are related to migration, such as endian and 32-bit to 64-bit migration related diagnostics.
"-module <name>" (page 33)	Generates report only for source files that make up the module <name>.
"-noheader" (page 34)	Suppresses the report header in cadvise reports.
"-chseverity <DN1:SL1,DN2:SL2,...,DNn:SLn>" (page 34)	Enables you to modify the severity of diagnostic DNn to SLn.

"-basepdb <basepdbname>" (page 34)	Enables you to compare PDB <pdb-name> with the PDB specified using -pdb option.
"+opts <file>" (page 38)	Reads the report options from the specified file.

6.2 Generating summary reports

The `-summary` option prints the summary information about all messages in the log file in the order of security level. This is the default.

The following example shows the summary report.

Example 21 Generating summary reports

```
$cadvise report -summary -pdb testpdb -noheader

=============================== SUMMARY REPORT ================================
Unique warnings:    2
Duplicate warnings: 0
Sev. Count  Diagnostic Message
--------------------------------------------------------------------------------
 5     1   warning #4228-D: 64 bit migration: conversion from %t1 to a more strictly aligned type %t2 may cause
 misaligned access
 5     1   warning #4230-D: 64 bit migration: conversion from %t1 to %t2 may cause target of pointers to have
 a different size
```

NOTE: When the `-all` option is used along with `-summary` option, cadvise report first prints the summary followed by the `-all` output.

6.3 Generating file summary report

The `-file_summary` option prints the summary information for each source file. All the diagnostic messages generated for a file are considered and the count for each file is reported. The following example shows the summary for a source file.

Example 22 Generating file summary report

```
$cadvise report -file_summary -pdb testpdb

-------------------------------------------------------------------
Count                  Duplicate                      Filename
--------------------------------------------------------------------
  2                       0                           example.C
--------------------------------------------------------------------
```

6.4 Generating function summary report

The `-func_summary` option prints the summary information for each function in a source file, if it has any diagnostic. All the diagnostic messages generated for a function are considered and the count for each function is reported. The following example shows the summary for a function.

Example 23 Generating function summary report

```
$cadvise report -func_summary -pdb testpdb
========================== FUNCTION SUMMARY REPORT ============================

Count Duplicate  Funcname
-------------------------------------------------------------------------
 1         0  /user/rajen/cadvise/Doc_release_tests/example.C::foo
 1         0  /user/rajen/cadvise/Doc_release_tests/example.C::main
__________________________________________________________
```

6.5 Generating detailed report

The `-all` option prints all messages in the log-file that are above the specified severity level, sorted by severity. If no severity level is specified then all messages with severity >= 5 are printed. The following example shows the usage of `-all` report:

Example 24 Generating detailed report

```
$ cadvise report -pdb testpdb -all

============================== SEVERITY LEVEL 8 ===============================
"example.C", line 13: warning #2549-D: variable "i" is used before its value is set
  i++;
  ^
```

6.6 Generating HTML report

The `-html [=<dir>]` option generates report in HTML format from specified PDB. This option can be used in the following ways:

- To only view the HTML reports in the web browser, run the following command:
  ```
  $ cadvise report -pdb mypdb -html
  ```
  The HTML report will be displayed on the browser. The browser is invoked as specified in the `BROWSER` environment variable. If this environment variable is not specified, it uses the default web browser (`/opt/mozilla/mozilla`). You can also save the generated HTML reports.
- To save reports, run the following command:

  NOTE: This command saves the html report in a specified directory. The web browser is not invoked with this option.
  ```
  $ cadvise report -pdb mypdb -html=dirname
  ```
- In addition, the HTML Report in cadvise filters diagnostics on the basis of:
  - Severity number
  - Diagnostic number
  - Filename path

  To invoke the HTML reports page with filters, use the following command:
  ```
  $ cadvise <cadvise-options> report <fitering_options> -html -pdb <pdb-name>
  ```
- To generate a detailed HTML report, use the following command:
  ```
  $ cadvise report -pdb mypdb -html=dirname -all
  ```
  This command creates detailed HTML reports and saves it to the specified directory. To view these reports, open the `index.htm` file available inside the directory name specified with `-html` option.

The HTML report has the following options when it is viewed from the web browser:

- **Tabbed Interface**: Summary report and warnings for each severity level are placed in different tabs, which is named according to severity level.
- **Hot Keys to Navigate Tabs**:
  - **Ctrl** + **Alt** + **0** : Shows summary tab.
  - **Ctrl** + **Alt** + (**1-9**): Shows severity tab corresponding to pressed numeric key.
- Sorting and Text filtering options are available in the severity tabs.
- **Multi Page viewing**: If the number of diagnostics messages exceeds 1000, a drop down page list is shown at top right side on the table. You can select a desired page number from the list. The selected page is loaded.

6.7 Generating XML report

The `-xml [=<filename>]` option generates the specified cadvise report in XML format and stores it in the specified filename. To generate XML reports, run the following command:

```
$ cadvise report -pdb <pdb-name> +metrics -xml=<filename>
```

If you do not specify the filename, cadvise stores the data in the `cadvise_metrics.xml` file for metrics reports and `cadvise_report.xml` for diagnostic reports, in the current directory. The Hierarchy of the XML elements for metrics report is as follows:

```
<Metrics>
   <FileLevel>
      ...
   </FileLevel>
   ...
   <FunctionLevel>
      <FileName>...</FileName>
      <Function>
        ...
      </Function>
      <Function>
        ...
      </Function>
      ....
   </FunctionLevel>
   ...
   <IndirectCallTarget>
     ...
   </IndirectCallTarget>
</Metrics>
```

Following example shows the command to generate XML report.

Example 25 Generating an XML report

```
$ cadvise report -pdb testpdb +metrics -xml=metricsreport.xml
```

6.8 Printing diagnostics with specific diagnostic numbers

Each distinct type of diagnostic message generated by cadvise has a number associated with it. The `-diag N1,N2,N3,...,Nn` option prints only those diagnostics with the specified diagnostic number(s). This allows you to focus on specific diagnostic messages.

NOTE: You can use the `-diag` option along with other filtering options, such as `-exclude`, `-include`, and `-severity`. For more information, see "Report options interoperability" (page 40).

The following example shows the report for a specific diagnostic number.

Example 26 Printing report for a specific diagnostic number(s)

```
$ cadvise report -pdb testpdb -diag 2549

Report generated using "HP Code Advisor C.XX.XX [Release Time]" on <machine> at
<Report Time>
Report command line: " cadvise report -pdb testpdb -diag 2549"
"a.c", line 14: warning #2549-D: variable "struct_obj" is used before its value
is set

LocalVar = struct_obj.a ;

^

"b.c", line 6: warning #2549-D: variable "b" is used before its value is set

c = b;

^

"b.c", line 7: warning #2549-D: variable "a" is used before its value is set

b = a;
^
```

6.9 Generating reports based on severity

The `-severity N` option is used to emit messages with severity >= N. The valid values for N are 1 to 9, where 9 indicates the highest severity. If this option is not specified, the default severity is taken as 5. This option does not affect the output of `-summary`, which still prints the complete summary.

NOTE: You can use the `-severity` option along with other filtering options, such as `-exclude`, `-diag`, and `-include`. For more information, see "Report options interoperability" (page 40).

The following example shows the command to generate report based on severity.

Example 27 Generating reports based on severity

```
 $ cadvise report -pdb test.pdb –all –severity 2.
```

This command prints all diagnostics of severity levels greater than or equal to two.

6.10 Suppressing diagnostics for specific files

The `-exclude <string1:string2:...:stringN>` option helps to eliminate diagnostics for files that contain any of the strings from `1` to `n` in the file.

NOTE: You can use the `-exclude` option along with other filtering options, such as `-diag`, `-include`, and `-severity`. For more information, see Report options interoperability.

The following example shows the elimination of strings from a file.

Example 28 Suppressing diagnostics for specific file(s)

```
$ cadvise report -pdb test.pdb -summary -exclude "inflate.c"

Report generated using "HP Code Advisor C.XX.XX [Release Time]" on <machine> at <Report Time>
Report command line: " cadvise report -pdb test.pdb -summary -exclude "inflate.c "

=============================== SUMMARY REPORT =================================
Unique warnings: 257
Duplicate warnings: 0

Sev. Count  Diagnostic Message
--------------------------------------------------------------------------------
  5     1   warning #20111-D: (SECURITY) Tainted data may be used in data length computation%s
  5     4   warning #20200-D: Potential null pointer dereference %s%s is detected %s
  5    10   warning #20118-D: Tainted value may be used in pointer arithmetic expression%s
  5    12   warning #20112-D: (SECURITY) Tainted data may be copied to the target buffer%s
  5    20   warning #20117-D: (SECURITY) Tainted value may be used in array index expression%s
  5    23   warning #20114-D: (SECURITY) Tainted value may be used in loop exit condition computation%s
  3     1   remark #2193-D: zero used for undefined preprocessing identifier
  3     2   remark #4315-D: %s loop without body, did you insert an extra ';'?

...
```

6.11 Reporting diagnostics from specific files

The `-include <string1:string2:...:stringN>` option generates diagnostics for files that contain any of the strings from `1` to `n` in the file.

NOTE: You can use the `-include` option along with other filtering options, such as `-exclude`, `-diag`, and `-severity`. For more information, see "Report options interoperability" (page 40).

The following example shows the diagnostics containing strings from `1` to `n` for a file.

Example 29 Reporting diagnostics from specific file(s).

```
$ cadvise report -pdb test.pdb -summary -include "inflate.c"

report: warning: Filtering options do not affect -summary and -file_summary

Report generated using "HP Code Advisor C.XX.XX [Release Time]" on <machine> at <Report Time>
Report command line: " cadvise report -pdb test.pdb -summary -include "inflate.c "

=============================== SUMMARY REPORT =================================

Unique warnings: 257
Duplicate warnings: 0

Sev. Count Diagnostic Message
--------------------------------------------------------------------------------
5 1 warning #20111-D: (SECURITY) Tainted data may be used in data length computation%s
5 4 warning #20200-D: Potential null pointer dereference %s%s is detected %s
5 10 warning #20118-D: Tainted value may be used in pointer arithmetic expression%s
5 12 warning #20112-D: (SECURITY) Tainted data may be copied to the target buffer%s
5 20 warning #20117-D: (SECURITY) Tainted value may be used in array index expression%s
5 23 warning #20114-D: (SECURITY) Tainted value may be used in loop exit condition computation%s
3 1 remark #2193-D: zero used for undefined preprocessing identifier
3 2 remark #4315-D: %s loop without body, did you insert an extra ';'?
```

6.12 Reporting program complexity metrics

The `+metrics` option reports the metrics in the `PDB` or metrics log file which is generated when the `+metrics` option is used during analysis. If you do not specify the `+metrics` option during analysis, cadvise displays the following warning:

```
report: warning: No metrics files specified
```

All options other than `-include` and `-exclude` are ignored. The following example shows the report for program complexity data.

Example 30 Reporting program complexity metrics

```
$ cadvise report -pdb gzip.pdb +metrics -include "inflate.c"

================================================================================
Begin program complexity data for /vws/cal-bear_2/zhang/gzip-1.2.4a/inflate.c
================================================================================

File level program complexity data :
------------------------------------

Include Files: 4
Total Lines: 954
Blank Lines: 211
Comment Lines: 248
Lines Of Code: 495
Mixed Lines: 155
No. of Globals: 6
No. of Statics: 5
No. of Functions: 8
No. of Extern Functions: 8

Function level program complexity data :
----------------------------------------

Begin Function: huft_build
Signature: int huft_build()
Total Lines: 182
Blank Lines: 40
Comment Lines: 22
Lines of Code: 120
Mixed Lines: 65
No. of Macros Used: 13
No. of Locals: 19
No. of statics: 0
No. of Ifs: 15
No. of Returns: 5
No. of Loops: 7
...
```

NOTE: A variant of the `+metrics` option is `+metrics[=ict]` that prints the number of indirect call targets. For information on the program complexity metrics emitted with this option, see "Generating code complexity metrics" (page 13).

6.13 Generating report for a module

The `-module <name>` option generates analysis report for the source files of the module `<name>`. A module is a subdirectory of the application's source files. The following example shows the report for a source file of a module.

Example 31 Generating report for a module

```
$ cadvise report -pdb test.pdb -summary -module test1

=============================== SUMMARY REPORT =================================

Report generated using "HP Code Advisor C.XX.XX [Release Time]" on <machine> at <Report Time>
Report command line: " cadvise report -pdb test.pdb -summary -module test1"

Unique warnings:29
Duplicate warnings: 0

Sev. Count  Diagnostic Message
--------------------------------------------------------------------------------
  5     1   warning #20111-D: (SECURITY) Tainted data may be used in data length computation%s
  5     4   warning #20200-D: Potential null pointer dereference %s%s is detected %s
  5    12   warning #20112-D: (SECURITY) Tainted data may be copied to the target buffer%s
  5    12   warning #20118-D: Tainted value may be used in pointer arithmetic expression%s
```

6.14 Suppressing report header

All cadvise reports contain a header with the details of the report generation.

Format of Report header:

```
Report generated using <cadvise version> on <SYSTEM> at <TIMESTAMP>
Report command line: <command line>
```

The `-noheader` option suppresses the report header in cadvise report.

Following example shows the report generation without a header.

Example 32 Suppressing Report Header

```
Report generated using "HP Code Advisor C.XX.XX [Feb 25 2009]" on shale at Mon Feb 25 01:49:11 2009
Report command line: "/opt/cadvise/bin/cadvise report -pdb /tmp/testpdb"
```

6.15 Modifying the default severity level of a diagnostic

The `-chseverity <DN1:SL1,DN2:SL2,...,DNn:SLn>` option enables you to modify the default severity level of one or more diagnostics in reports. `DNx` is the diagnostic number whose severity level is to be modified and `SLx` is the new severity level. The valid values for `DNx` and `SLx` are 1 to 9.

The following example shows the commands for modifying the default severity level of a diagnostic.

Example 33 Modifying the default severity level of diagnostic

The default severity level of diagnostic 20200 is 5. The following command line changes the severity to level 3.

```
$ cadvise -pdb testpdb -severity 1 -summary -chseverity 20200:3
```

The following command line changes the severity of 20200 to 3 and 20201 to 8.

```
$ cadvise -pdb testpdb -severity 1 -summary -chseverity 20200:3,20201:8
```

6.16 Generating PDB comparison report

The `-basepdb <basepdbname>` option enables you to compare the PDB `<basepdbname>` with the PDB specified with `-pdb` option. You can generate the following reports while comparing the PDBs:

- "Generating summary diff report" (page 35)
- "Generating detailed diff report" (page 35)

6.16.1 Generating summary diff report

Using the PDB comparison option along with the `-summary` option displays the difference between the summary reports of 2 PDBs. The following example shows the usage of `-basepdb <basepdbname>` summary difference report:

Example 34 Generating summary diff report without the header

```
$ cadvise report -pdb test.pdb -basepdb test0.pdb -summary -noheader

Sev. OldCount Count  Diagnostic Message
--------------------------------------------------------------------------------
  6     1       0    warning #20048-D:%s "%s" has incompatible type with previous declaration at line %s in
file "%s"
  5     1       1    warning #20111-D: (SECURITY) Tainted data may be used in data length computation%s
  5     4       4    warning #20200-D: Potential null pointer dereference %s%s is detected %s
  5    12      12    warning #20112-D: (SECURITY) Tainted data may be copied to the target buffer%s
  5    12      12    warning #20118-D: Tainted value may be used in pointer arithmetic expression%s
  5    30      30    warning #20117-D: (SECURITY) Tainted value may be used in array index expression%s
  5    45      45   warning #20114-D: (SECURITY) Tainted value may be used in loop exit condition computation%s

  3     1       1    remark #2193-D: zero used for undefined preprocessing identifier
  3     2       2    remark #4315-D: %s loop without body, did you insert an extra ';'?
...
```

6.16.2 Generating detailed diff report

Using the PDB comparison option along with the `-all` option displays the detailed difference between the reports of 2 PDBs. The first part of the report shows the header on top and then shows the difference in warning summary. The second part of the report displays all regressions and improvements in detail. The following example shows the usage of `-basepdb <basepdbname>` detailed diff report with the `-all` option:

Example 35 Generating detailed diff report with the header

```
$ cadvise report -pdb tmp.pdb -basepdb tmp1.pdb -all
Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>

Report command line: "Report Command Line"

New Pdb:             tmp.pdb
Base Pdb:            tmp1.pdb
Regressions:         2 =>2549(2)
Improvements:        1 =>20200(1)

=======================[ REGRESSIONS ]===========================

"/home/solankib/TESTING/b.c", line 6: warning #2549-D: variable "a" is used before its value is set
  c = a;
      ^

"/home/solankib/TESTING/b.c", line 9: warning #2549-D: variable "b" is used before its value is set
  a = b;
      ^


=======================[ IMPROVEMENTS ]===========================

"/home/solankib/TESTING/a1.c", line 11, procedure main: warning #20200-D: Potential null pointer dereference
```

You also have the flexibility of using the filtering options with this feature. If you use any filtering option in the command line, then the first step report is filtered and then the diff report is generated as shown in the following examples.

The following example shows the usage of `-basepdb <basepdbname>` detailed diff report with the `-diag` option:

Example 36 Generating diff report for any particular warning

```
$ cadvise report -pdb tmp.pdb -basepdb tmp1.pdb -diag 2549
Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>

Report command line: "Report Command Line"

New Pdb:           tmp.pdb
Base Pdb:          tmp1.pdb
Regressions:       2 =>2549(2)
Improvements:      0
=======================[ REGRESSIONS ]===========================

"/home/solankib/TESTING/b.c", line 6: warning #2549-D: variable "a" is used before its value is set
  c = a;
      ^

"/home/solankib/TESTING/b.c", line 9: warning #2549-D: variable "b" is used before its value is set
  a = b;
      ^
```

The following example shows the usage of `-basepdb <basepdbname>` detailed diff report with the `-include` option:

Example 37 Generating detailed diff report for any particular file or any group of files

```
$ cadvise report -pdb tmp.pdb -basepdb tmp1.pdb -include a1.c
Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>

Report command line: "Report Command Line"

New Pdb:           tmp.pdb
Base Pdb:          tmp1.pdb
Regressions:       0
Improvements:      1 =>20200(1)

=======================[ IMPROVEMENTS ]===========================

"/home/solankib/TESTING/a1.c", line 11, procedure main: warning #20200-D: Potential null pointer dereference
```

The following example shows the usage of `-basepdb <basepdbname>` detailed diff report with the `-exclude` option:

Example 38 Generating detailed diff report after excluding any file or any group of files

```
$ cadvise report -pdb tmp.pdb -basepdb tmp1.pdb -exclude a1.c
Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>

Report command line: "Report Command Line"

New Pdb:           tmp.pdb
Base Pdb:          tmp1.pdb
Regressions:       2 =>2549(2)
Improvements:      0
=======================[ REGRESSIONS ]===========================

"/home/solankib/TESTING/b.c", line 6: warning #2549-D: variable "a" is used before its value is set
  c = a;
      ^

"/home/solankib/TESTING/b.c", line 9: warning #2549-D: variable "b" is used before its value is set
  a = b;
      ^
```

The following example shows the usage of `-basepdb <basepdbname>` detailed diff report with the `-severity` option:

Example 39 Generating detailed diff report in the warnings greater than or equal to any particular severity

```
$ cadvise report -pdb tmp.pdb -basepdb tmp1.pdb -severity 1
Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>

Report command line: "Report Command Line"

New Pdb:            tmp.pdb
Base Pdb:           tmp1.pdb
Regressions:        2 =>2549
Improvements:       4 =>2938(1), 20119(2), 20200(1)

=======================[ REGRESSIONS ]===========================

"/home/solankib/TESTING/b.c", line 6: warning #2549-D: variable "a" is used before its value is set
  c = a;
      ^

"/home/solankib/TESTING/b.c", line 9: warning #2549-D: variable "b" is used before its value is set
  a = b;
      ^

=======================[ IMPROVEMENTS ]===========================

"/home/solankib/TESTING/a1.c", line 11, procedure main: warning #20119-D: (SECURITY) Unsafe API 'strcpy' ...

"/home/solankib/TESTING/a1.c", line 11, procedure main: warning #20200-D: Potential null pointer dereference
...

"/home/solankib/TESTING/a1.c", line 3: remark #2938-D: return type "int" omitted in declaration of function
"main"
   main()
   ^

"/home/solankib/TESTING/a1.c", line 9, procedure main: warning #20119-D: (SECURITY) Unsafe API 'strcpy' is
used...
```

6.16.2.1 Using -approot option for detailed diff report

Using the `-approot` option, you can get the difference of warnings from two PDBs by ignoring differences in file paths. This option helps you to filter those warnings which are common to both PDBs, but having different source files paths from which they get emitted.

For example, consider an application with two files one.c and two.c in the path `/tmp/path1`. Compile and analyze the code using the command:

```
$ cadvise -pdb pdb1 cc one.c two.c
```

When the same application is copied to `/tmp/path2` and one of the diagnostics fixed, a PDB diff with detailed report, between the two PDBs shows multiple improvements and regression because of the change in basepath.

This problem can be fixed with the `-approot` option, as follows:

```
$ cadvise report -pdb pdb2 -basepdb /tmp/path1/pdb1 -approot
/tmp/path1:/tmp/path2 -all
```

The `-approot` option ignores the variable part of the path when comparing diagnostics and allows correct comparison reports to be generated.

The following example demonstrates the usage of `-approot` option while generating a detailed diff report.

Example 40 Generating detailed diff report without using -approot option

```
$ cadvise report -pdb new.pdb -basepdb old.pdb -all
Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>
Report command line: "Report Command Line"

New Pdb:            new.pdb
Base Pdb:           old.pdb
Regressions:        1 =>2223(1)
Improvements:       2 =>2223(1), 2549(1)

=======================[ REGRESSIONS ]==========================
"/home/rajen/cadvise/testing/approot_cases/new/1.c", line 4: warning #2223-D: function "printf" declared
implicitly
        printf("Hi");
        ^


=======================[ IMPROVEMENTS ]==========================
"/home/rajen/cadvise/testing/approot_cases/old/1.c", line 4: warning #2223-D: function "printf" declared
implicitly
        printf("Hi");
        ^

"/home/rajen/cadvise/testing/approot_cases/old/1.c", line 5: warning #2549-D: variable "y" is used before its
value is set
        if (x = y)
                ^
```

Example 41 Generating a detailed diff report using -approot option

```
$ cadvise report -pdb new.pdb -basepdb old.pdb -approot old:new -all
Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>
Report command line: "Report Command Line"

New Pdb:            new.pdb
Base Pdb:           old.pdb
Regressions:        0 Improvements:      1 =>2549(1)

=======================[ IMPROVEMENTS ]==========================
"/home/rajen/cadvise/testing/approot_cases/new/1.c", line 5: warning #2549-D: variable "y" is used before its
value is set
        if (x = y)
                ^
As shown in above examples, warning#2223 is emitted at line 4 and is common in both PDBs. User might want to
ignore such duplicate warnings while comparing two different versions of PDBs, and hence the -approot option
serves the purpose for effective comparison of different PDBs.
```

6.17 Report options file

All the options that you want to use to generate the report can be consolidated in a single configuration file using the `+opts <file>` option. This reduces the clutter on the command line and provides a single place to specify the customized options. Comment lines can also be inserted in the `+opts` configuration file. This option is used for reading reporting options from the specified `<file>`. The following example shows the reading of report options from a specific file.

Example 42 Report options file

```
$ cat my_opts
-diag 3348

$ cadvise report -pdb test.pdb +opts my_opts
"test.c", line 1320: remark #3348-D: declaration hides variable "ifd" (declared at line 237)
      int ifd;     /* input file descriptor */
          ^


"test.c", line 1321: remark #3348-D: declaration hides variable "method" (declared at line 216)
      int method;  /* compression method */
          ^


"unlzw.c", line 337: remark #3348-D: declaration hides variable "i" (declared at line 247)
                REG1 int        i;
                                ^


"unzip.c", line 130: remark #3348-D: declaration hides variable "n" (declared at line 104)
        register ulg n = LG(inbuf + LOCLEN);
                     ^
```

6.18 Generate report for migration related warnings

You can generate a report of the migration related issues in the application using the `-migration` option. The report prints only those messages that are related to migration, such as endian and 32-bit to 64-bit migration related diagnostics. You can use the `-migration` filter along with other filtering options such as `-severity`, `-diag`, `-include`, and so on, and only diagnostics that meet all the filtering criteria will be reported.

Example 43 Generating a report using -migration option

```
$ cadvise report -pdb my.pdb -noheader
=============================== SUMMARY REPORT =================================

Unique warnings:    7
Duplicate warnings: 0

Sev. Count  Diagnostic Message
--------------------------------------------------------------------------------
  5     3   warning #2223-D: function %sq declared implicitly
  5     1   warning #4291-D: endian porting: the read/write of the buffer may be endian dependent
  3     3   remark #4242-D: no prototype or definition in scope for call to %sq
$ cadvise report -pdb my.pdb -migration -severity 5 -noheader
=============================== SUMMARY REPORT =================================

Unique warnings:    1
Duplicate warnings: 0

Sev. Count  Diagnostic Message
--------------------------------------------------------------------------------
  5     1   warning #4291-D: endian porting: the read/write of the buffer may be endian dependent
```

6.19 Generating consolidated report from multiple PDBs

You can generate a consolidated cadvise report from multiple PDBs. Multiple PDBs can be passed to report in one of the following ways:

- cadvise report -pdb pdb1:pdb2:...
- cadvise report -pdb pdb1,pdb2,...
- cadvise report -pdb pdb1 -pdb pdb2 ...

The following example demonstrates the usage of this option:

Example 44 Generating a consolidated cadvise report from multiple PDBs

```
$ cadvise report -pdb 1.pdb:2.pdb:3.pdb:4.pdb -all

Report generated using "HP Code Advisor C.XX.XX [Release Date]" on <Machine Name> at <Time>
Report command line: "Report Command Line"

============================== DETAILED REPORT ===============================
------------------------------ SEVERITY LEVEL 8 ------------------------------
"/home/rajen/cadvise/testing/1.c", line 5: warning #2549-D: variable "p" is used before its value is set
         y = *p = 1;
              ^


"/home/rajen/cadvise/testing/4.c", line 5: warning #2549-D: variable "c" is used before its value is set
        a = b = c;
                ^



------------------------------ SEVERITY LEVEL 5 ------------------------------
"/home/rajen/cadvise/testing/2.c", line 4: warning #2223-D: function "scanf" declared implicitly
        scanf("%d",&a);
        ^


"/home/rajen/cadvise/testing/3.c", line 7: warning #2223-D: function "printf" declared implicitly
       printf("%d\n", y);
       ^


"/home/rajen/cadvise/testing/1.c", line 5, procedure main: warning #20200-D: Potential null pointer dereference
 through p is detected (null definition:/home/rajen/cadvise/testing/1.c, line 2)
```

6.20 Generating PDB diffs with multiple PDBs

Just as using multiple PDBs to get a consolidated report, PDB diff can also support multiple PDBs. A sample command for PDB diff with multiple PDBs will be as follows:

```
$ cadvise report -pdb pdb1:pdb2:pdb3:... -basepdb
basepdb1:basepdb2:basepdb3:...
```

6.21 Recommended process for analyzing the diagnostic messages

The recommended process for analyzing the diagnostic messages is as mentioned below:

1. See a summary report using `cadvise report`. This gives an overview of the diagnostic messages that have been generated for the application.
2. Analyze all high severity (>= 7) diagnostic messages generated by cadvise. These diagnostic messages have a very low false positive rate and are likely to point out defects in the application.
3. Each distinct type of diagnostic message generated by the code advisor has a number associated with it. From the summary, identify particular diagnostic messages that are of importance to the application, and then generate a detailed report only for those diagnostic messages. This allows you to focus on a few selected diagnostic messages.
4. Individual developers can analyze the diagnostic messages generated for a particular portion of the code by filtering the report for a particular set of files. This can be done using `-file_summary` and `-file` options.

6.22 Report options interoperability

Filtering options such as `-diag`, `-exclude`, `-include`, and `-severity` can be used with one another to generate a report filtered on the criterion.

NOTE: These filtering options are ignored when used with `-all`, `-summary`, and `-file_summary` options. However, the `-all` and `-severity` options can be used together to create a detailed report of diagnostics with severity above the specified severity level.

The following examples shows the usage of multiple options simultaneously.

Example 45 Reporting options interoperability

```
$ cadvise report -pdb test.pdb -diag 2549 -exclude b.c

Report generated using "HP Code Advisor C.XX.XX [Release Time]" on <machine> at <Report Time>
Report command line: " cadvise report -pdb test.pdb -diag 2549 -exclude b.c"

"a.c", line 14: warning #2549-D: variable "struct_obj" is used before its value is set LocalVar = struct_obj.a
 ;


$ cadvise report -pdb test.pdb -include "a.c:b.c"

Report generated using "HP Code Advisor C.XX.XX [Release Time]" on <machine> at <Report Time>
Report command line: " cadvise report -pdb test.pdb -summary -include a.c:b.c "

"a.c", line 14: warning #2549-D: variable "struct_obj" is used before its value is set
LocalVar = struct_obj.a ;
^

"b.c", line 6: warning #2549-D: variable "b" is used before its value is set
c = b;
^

"b.c", line 7: warning #2549-D: variable "a" is used before its value is set
b = a;
^
```

In this example if any option, such as `-summary`, `-file_summary`, or `-all` is given in the same command line, then the `-include` filtering option is ignored. The following example shows this behaviour:

Example 46 Ignoring the `-include` option

```
$ cadvise report -pdb test.pdb -summary -include "a.c:b.c"

report: warning: Filtering options do not affect -summary and -file_summary

Report generated using "HP Code Advisor C.XX.XX [Release Time]" on <machine> at <Report Time>
Report command line: " cadvise report -pdb test.pdb -summary -include "a.c:b.c"

=============================== SUMMARY REPORT=================================

Unique warnings: 257
Duplicate warnings: 0

Sev. Count   Diagnostic Message
--------------------------------------------------------------------------------
5      1     warning #20111-D: (SECURITY) Tainted data may be used in data length computation%s
5      4     warning #20200-D: Potential null pointer dereference %s%s is detected %s
5      10    warning #20118-D: Tainted value may be used in pointer arithmetic expression%s
5      12    warning #20112-D: (SECURITY) Tainted data may be copied to the target buffer%s
5      20    warning #20117-D: (SECURITY) Tainted value may be used in array index expression%s
5      23    warning #20114-D: (SECURITY) Tainted value may be used in loop exit condition computation%s
3      1     remark  #2193-D: zero used for undefined preprocessing identifier
3      2     remark  #4315-D: %s loop without body, did you insert an extra ';'?
```

7 Miscellaneous driver options

You can also use the following cadvise options to manage the static analysis and the compilation processes:

-compiler [aCC|cc|c89|c99|gcc|g++|ld]	Specifies the compiler or linker command used in the command line.
-help|-h|-H	Displays the complete list of cadvise options with a brief description for each option.
-[no]abort	Determines whether to return a non-zero exit value for cadvise errors. The default is -noabort.
-nobuild	Determines whether to invoke the compile or link command after the cadvise static analysis.
-target[=.ext|filename]	Reduces the build only to modified elements when used with -nobuild option.
-tee	Writes the errors and diagnostics found during the analysis of the application to standard error in addition to storing them in the PDB.
+opts <filename>	Enables you to consolidate all options which manage HP Code Advisor diagnostic messages in a single configuration file.

- **-compiler [aCC|cc|c89|c99|gcc|g++|ld]**

  This option helps in mapping the compile command in the build line to the standard commands recognized by cadvise. The syntax for specifying the compiler or linker command used in the command line is as mentioned below:

  ```
  $ cadvise -compiler compile-cmd <compilation path> -w <filename>
  ```

  The following example shows the usage of `-compiler [aCC|cc|c89|c99|gcc|g++|ld]` option.

  Example 47 Specifying the compiler command used in the command line

  ```
  $ cadvise -compiler cc /opt/ansic/bin/cc -w t1.c
  ```

- **-help|-h|-H**

  This option displays the complete list of cadvise options with a brief description for each option. The syntax for displaying the complete list of cadvise options is as mentioned below:

  Example 48 Displaying the list of cadvise options

  ```
  /opt/cadvise/bin/cadvise -h
  ```

- **-[no]abort**

  This option determines whether to return a non-zero exit value for cadvise errors. The default is `-noabort`. The syntax for determining the exit value for cadvise errors is as mentioned below:

  ```
  $ cadvise -abort <compilation path> -w <filename>
  ```

  The following example shows the usage of `- [no]abort` option.

  Example 49 Using -[no]abort

  ```
  $ cadvise -abort /opt/ansic/bin/cc -w t1.c
  ```

- **-nobuild**

  The cross-file analysis is disabled when you use the `-nobuild` option. You can use the `-crossfile=defer` option to enable cross-file analysis. The default is `-build`. The syntax for determining the invocation of the compile or link command after the cadvise static analysis is as mentioned below:

  ```
  $ cadvise -nobuild <compilation path> -w <filename>
  ```

  The following example shows the usage of `-[no]build` option.

  Example 50 Using -nobuild option

  ```
  $ cadvise -nobuild /opt/ansic/bin/cc -w t1.c
  ```

  This results in the compile command line `/opt/ansic/bin/cc -w t1.c` not getting executed.

- **-target[=.ext|filename]**

  This option creates an empty file called `filename` or `<objectfile>.ext` in the current directory, which is used as an updated makefile target. When cadvise is called with the `-nobuild` option from a makefile, the compiler is not invoked and hence a `.o` file is not created. When this happens, the makefile target is not updated. In the absence of a target update, a second call to `make` invokes cadvise for all the targets again, instead of only the ones that have been modified.

  NOTE: If `filename` is not specified, cadvise creates `objfile.cadv`.

  The following example shows the usage of `-target[=.ext|filename]` option.

  Example 51 Using -target[=.ext|filename] option

  The following command creates the file `foo.cadv`:

  ```
  $ cadvise -nobuild -target cc foo.c -o foo.o
  ```

  The following command creates the file `cadv_dir/foo.cad`:

  ```
  $ cadvise -nobuild -target=cadv_dir/foo.cad cc foo.c
  ```

- **-tee**

  You also have the choice of looking at the errors and the diagnostic messages immediately with the `-tee` option, or generate a report later from the PDB.

  The following example shows the usage of `-tee` option.

  Example 52 Using -tee option

  ```
  $ cadvise -compiler cc -tee +wall -pdb 1.pdb /opt/ansic/bin/cc -w t1.c
  ```

- **+opts <filename>**

  This option reduces the clutter at the command line and provides a single place to specify the customizations. Comment lines can also be inserted in the `+opts` configuration file. You can use this option to read reporting options from the specified filename.

  The following example shows the usage of `+opts <filename>` option.

Example 53 Using +opts <filename> option

```
$cat warnings_config
# warnings_config
# change warning about use of undefined variable to an error
+We2549
# enable warning about redeclaration of variable
+Ww3348
# disable warning: statement is unreachable
+W2111
```

`$ cadvise +opts warnings_config +wlint cc -c uninit.c` at the command line generates the following messages:

```
"uninit.c", line 6: warning #3348-D: declaration hides variable "i"
(declared at line 3)
    int i;
        ^
"uninit.c", line 9: error #2549-D: variable "i" is used before its
value is set
    if (i) j = 3;
        ^
1 error detected in the compilation of "uninit.c".
```

8 Categories of diagnostics with examples

Cadvise detects a wide range of coding errors and potential problems such as memory leaks, used after free, double free, array/buffer out of bounds access, illegal pointer access, un-initialized variables, unused variables, format string checks, suspicious conversion and casts, out of range operations, and C++ coding style warnings.

8.1 Categories of diagnostics table

Following are some examples of the various checks done by the HP Code Advisor:

+w	Enables all the warnings about potentially questionable constructs in the compiler.
+wall	Enables all the compile time checks.
"+wlint" (page 45)	Provides compile-time diagnostics which detect potential errors in the source code.
"+w64bit " (page 51)	Enables warnings that help detection of potential problems in converting 32-bit applications to 64-bit.
"+wendian" (page 51)	Detects code fragments which are endian dependent.
"+wsecurity[=1|2|3|4]" (page 52)	Enables compile time diagnostic messages for potential security vulnerabilities.
"+wlock" (page 53)	Detects multi-threaded programming issues.
"+wperfadvice[=1|2|3|4] " (page 54)	Generates performance advisory diagnostics.

- **+w**

  This option enables all the warnings about potentially questionable constructs in the compiler. This includes the `+wlint` and `+w64bit` warnings and many others. The number of warnings generated by this option may be up to 5-10 times more than those generated by `+wlint`.

  This option enables all the warnings about potentially questionable constructs in the compiler. This includes the `+wlint` and `+w64bit` warnings and many others. The number of warnings generated by this option may be up to 5-10 times more than those generated by `+wlint`.

  Following are some examples of warnings enabled by the `+w` option:

  ```
  - Variable is declared but never referenced
  - Comparison of unsigned integer with signed integer
  - Padding size of structure to alignment boundary
  - Argument is incompatible with corresponding format string conversion
  ```

- **+wall**

  The `+wall` option enables all the compile time checks. The `+wall` option includes security checks and requires cross-module analysis. Hence, you must specify the location of the program database using the `-pdb` option, whenever you use `+wall`.

8.2 Detecting generic programming errors

The compile time diagnostic messages generated by the `+wlint` option can be very useful in detecting potential problems in the source code. The number of warnings generated by this option may be up to 5-10 times more than those generated by default by the compiler. For example, the following warnings are enabled by this option:

```
- Argument is incompatible with formal parameter
- Function declared implicitly
- Function is re-declared after being called
```

```
- Type conversion may truncate value
- Unsigned value cannot be less than zero
- Missing return statement at end of non-void function
- Nested comment is not allowed
- Signed bitfield of length 1
- Potential memory leak detection
- Potential null pointer dereference detection
- Out of bound access
- Out of scope access
- Use of pointer after free
- Allocator/deallocator mismatch
```

The following are some detailed examples of warnings generated by +wlint checks:

Example 54 Null pointer dereference check

A null pointer may result from null assignment or from a call to the APIs that may return a null value. If a pointer that is not guarded when it is dereferenced, unexpected runtime results may occur. For example, see the following program fragment:

```
#include <stdio.h>
int process (char* filename)
{
    FILE* f;
    int count = 0;
    if (filename)
    {
        if (f = fopen(filename, "r"))
        {
            while (fgetc(f) != EOF)
                count ++;
        }
        // f can be null at this point
        fclose (f);
        return count;
     }
     return -1;
}
```

In such cases, cadvise generates the following warning:

```
"null.c", line 22, procedure process: warning #20200-D:
          Potential null pointer dereference through f is detected (null
          definition:/home/sandyam/demo/null.c, line 16)
```

Example 55 Potential memory leak check

Cadvise detects potential memory leaks in the program where the memory allocated in the program is not freed. If a dynamically allocated memory becomes unreachable from any other pointers, then the memory is leaked after that point in the program, assuming that there is no garbage collection in the allocator. Cadvise flags such situations as shown in the following example code fragment:

```
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
int leak1 (int k, int some_condition)
{
  char *p = malloc (k);
  if (p == 0) return -1;
  if (some_condition) return -1;
  strcpy (p, "hello");
  printf ("%s\n", p);
  free (p);
  return 0;
}
int* leak2(int k, char* fname)
{
     FILE* f;
     int *p = (int*) malloc(k);
     if (p == 0) return 0;
     // after return, memory pointed to by 'p' is leaked
     if ((f = fopen(fname,"r")) == 0) return 0;
     fread(p, k,1, f);
     return p;
}
```

In such cases, cadvise generates the following warnings:

```
"memleak.c", line 13, procedure leak1: warning #20202-D:
          Allocated memory may potentially be leaked  (at line 16)
"memleak.c", line 27, procedure leak2: warning #20202-D:
          Allocated memory may potentially be leaked  (at line 32)
```

However, there can be false positives flagged in certain situations because of the conservative static analysis.

Example 56 Out of bound access

When an array is referenced and the index is greater than the declared (or dynamically allocated) size, unexpected runtime behavior may occur. In such cases, cadvise flags it as potential array out of bound access violation. Such potential issues are flagged by cadvise, as shown in the following code:

```
int a[100];
int foo(int i)
{
     if (i < 100)
         a[i] = 0;
     else
         a[i] = 20; // potential out of bound access
    return 0;
}
```

Cadvise detects out of bound accesses on both statically and dynamically allocated arrays.

In such cases, cadvise generates the following warning:

```
"oob.c", line 7, procedure foo: warning #20206-D: Out of bound access
          (In expression "&a[i]", array "a" [oob.c:1] (type: int [100])
          has element range [0 .. 99], writing element range [100 .. ?].)
```

Example 57 Out of scope access

Cadvise flags out of scope access of variables in the application. Unexpected results may occur in the following cases:

- When the local variable address is returned and dereferenced by the caller.
- When the allocated memory is returned and dereferenced by the caller.
- When an inner block scope variable is accessed indirectly in the enclosing scope.

The Code Advisor flags such potential issues, as shown in the following code:

```
#include <stdio.h>
int foo()
{
    int *p;
    {
        int q;
        scanf("%d", &q);
        p = &q;
    }
    // out of scope reference to q
    return *p;
}
```

In such cases, cadvise generates the following warning:

```
"oos.c", line 20, procedure foo: warning #20203-D:
          Potential out of scope use of local variable q
```

Example 58 Use of pointer after free

When there is reference to a memory through a pointer that has been previously freed, cadvise detects such potential issues as Use After Free cases.

For example, see the following code:

```
void use_after_free ()
  {
      char *p = malloc (20);
      strcpy (p, "hello");
      free (p);
      *p = 'c';
  }
```

In such cases, cadvise generates the following error:

```
free.c", line 5, procedure use_after_free: warning #20205-D: Pointer is used
          after free
```

Example 59 Allocator/deallocator mismatch

Cadvise flags situations where memory has been allocated through a certain type of allocator, such as `malloc`, but is being freed with an unmatched deallocator, such as `delete`. This issue is particularly important in C++ applications where the memory is allocated using a `operator array new` but it is calling simply `delete`, instead of `array delete`.

For example, see the following code:

```
#include <malloc.h>
void free1 ()
{
  int i;
  char* p = new char(10);
  free (p);
}
```

In such cases, cadvise generates the following warning:

```
"mismatch1.cpp", line 8, procedure free1: warning #20210-D: Mismatch in
          allocation and deallocation
```

Example 60 Signed bit field of length 1

Cadvise warns cases where signed bit field of length 1 is being used and then assigned with a value, which is excessive of its size.

For example, see the tags in the following code:

```
$ cat bitfield.c
struct { int bit:1; } s;
void test()
{
  s.bit = 1;
}
```

In such cases, cadvise generates the following warnings:

```
"bitfield.c", line 1: warning #2108-D: signed bit field of length 1
  struct { int bit:1; } s;
               ^

"bitfield.c", line 5: warning #4251-D: the assignment has an excessive
size for a bit field
    s.bit = 1;
          ^
```

8.3 Detecting 32-bit to 64-bit migraton issues

The `+w64bit` option enables warnings that help detection of potential problems in converting 32-bit applications to 64-bit. The `+w64bit` option applies only to a 64-bit compile `(using +DD64)`. This option is equivalent to the `+M2` option. Following are some of the checks performed by this option:

- 64–bit value is implicitly converted to a 32 bit value, for example, `long` to `int`.
- Pointer to a 4-byte aligned object is implicitly converted to a pointer to a 8-byte aligned object.

For example, see the following code:

Example 61 Detecting 32–bit to 64–bit migraton issues

```
$ cat convert.c
int *int_to_ptr (int i)
{
  return (int *)i;
}
```

In such cases, cadvise generates the following warning:

```
"convert.c", line 3: warning #4231-D: 64 bit migration: conversion
                     between types of different sizes has occurred
         (from "int" to "int *" )
         return (int *)i;
             ^
```

8.4 Detecting endianness migration issues

The `+wendian` option helps you to detect code fragments which are endian dependent. The following example shows the detection of endian dependent code fragments.

Example 62 Detecting endian dependent code fragments

Consider the following code fragment.

```
union Endian {
        char c[4];
        int v;
      };
```

In such cases, cadvise generates the following warning:

```
"endian1.c", line 2: warning #4289-D: endian porting: the definition of the
           union may be endian dependent
     union Endian {
       ^
```

The `+wendian` option can catch various potential endian dependent data structures and usage. It helps you to locate potential problem spots while porting from little-endian to big endian architecture and vice versa.

8.5 Detecting potential security vulnerabilities

The `+wsecurity[=1|2|3|4]` option enables compile time diagnostic messages for potential security vulnerabilities. This option is useful in an environment where you are not trained to detect security vulnerabilities.

With the `+wsecurity` option, warnings are generated for cases where untrusted (tainted) data may reach a critical reference point in the program. This is based on cross-module analysis performed by the compiler, which is much more powerful compared to simple scanning and parsing tools. The `+wsecurity` option implicitly enables a limited form of cross-module analysis even if `-ipo` or `+O4` options are not specified. This may lead to a significant increase in the compile time compared to a build without the `+wsecurity` option. Using this option may result in the compiler invoking optimizations other than those which are part of the specified optimization level. If +wsecurity is used in addition to `-ipo` or `+O4`, the generated code is not affected and the compile time does not increase much. The `+wsecurity` option requires cross module analysis. Hence, you need to specify the location of the PDB using the `-pdb` option.

The problems detected include use of unsafe APIs, use of unsafe data length argument, unsafe loop exit condition, unsafe file path use, and so on.

For example, see the reference to untrusted file path in the following code:

Example 63 Enabling compile time diagnostic messages for potential security vulnerabilities

```
#include <stdio.h>
#include <stdlib.h>
char* get_path()
{
   return getenv("BLAHBLAH");
}
int  main()
{
   char* path = get_path();  // line 11
   FILE* my_pipe = popen(path, "r"); // line 13
   printf ("%p\n", my_pipe);
}
```

In this case, cadvise generates the following error:

```
"popen.c", line 13, procedure main: warning #20116-D: (SECURITY) Tainted
value may be used as path or file name
 ++ tainted value is returned from 'get_path' called by 'main' at line 11
 in file popen.c
```

For example, see the unsafe loop exit condition in the following code and the warning generated.

```
int a[100];
int loop(int i)
{
   for (int j = 0 ; j < i; j++) // line 5
       a[j] = 0;
  return a[0];
}
int main()
{
   int i;
   fread(&i, 1,4,stdin);
   loop(i);
}
```

In this case, cadvise generates the following error:

```
"loop1.c", line 5, procedure loop: warning #20114-D: (SECURITY) Tainted value
may be used in loop exit condition computation
++ 'loop' is called by 'main' at line 14 in file loop1.c
++++ Tainted value is obtained from 'main'
```

8.6 Detecting multi-threaded programming issues

The `+wlock` option detects multi-threaded programming issues and enables diagnostics for potential errors in using lock/unlock calls in multi-threaded programs that use the pthread library.

The problems detected include acquiring an already acquired lock, releasing an already released lock and unconditionally releasing a lock which has been conditionally acquired. For example, cadvise detects a potential locking error in the following code:

Example 64 Detecting multi-threaded programming issues

```
#include<PTHREAD.H>
#include <STDIO.H>
int a;
pthread_mutex_t Mutex;
void perform_operation(pthread_mutex_t* mutex1, int increment, int* global)
{
  if (increment > 10)
  {
      int status = pthread_mutex_lock(mutex1);
  }
  *global = *global + increment;
  int status = pthread_mutex_unlock(&Mutex);
}
int main(void)
{
   int i;
   scanf("%d", &i);
   perform_operation(&Mutex, i, &a);
   printf("%d is value\n", a);
}
```

Running cadvise generates the following error:

```
"1.c", line 12: warning #20223-D: Trying to unlock a lock held conditionally
```

With the `+wlock` option, warnings are generated for potential errors in using lock/unlock calls from pthread library. This is based on cross-module analysis performed by the compiler, which is much more powerful compared to simple scanning and parsing tools. The `+wlock` option implicitly enables a limited form of cross-module analysis even if `-ipo` or `+O4` options are not specified.

This may lead to a significant increase in the compile time compared to a build without the `+wlock` option.

The `+wlock` option requires cross module analysis. Hence, you need to specify the location of the PDB using the `-pdb` option.

8.7 Detecting potential performance improvement opportunities

The `+wperfadvice[=1|2|3|4]` option generates Performance Advisory diagnostics. The performance advisory diagnostics are classified within specific levels. You can specify the level of performance advisory diagnostics to be displayed. The level '1', emits the most important diagnostics and level '4' emits all diagnostics. The default level is '2'.

Example 65 Detecting potential performance improvement opportunities

```
bash-2.05b$ cat /tmp/example.c

struct X{
int i;
int arr[100];
} x;

int foo( struct X);

int main() {

  foo (x); //line 16
}

$ cadvise +wperfadvice aCC -c /example.c
"/example.c", line 16: warning #4319-D: performance advice: passing a
          large (404 bytes) parameter by value is inefficient, consider passing
          by reference
    foo (x);
        ^
```

9 Fixing the warnings by source change

The *HP Code Advisor Diagnostics Reference Guide* document enables you fix the warnings with a brief description for a partial list of diagnostics emitted by cadvise. In this document, there are four sections for each description as mentioned below:

- **The Cause section**

  Discusses the possible reasons for the diagnostic to be emitted.

- **The Example section**

  Provides relevant sample code segments that result in the specific diagnostic. The sample code segments are not complete, compilable programs - you might have to include the necessary header files, provide the code segment within main() function (if one is not provided in the code segment) and use necessary compiler options (such as +w, +wlint) to reproduce the diagnostic.

- **The Action section**

  Suggests possible solutions to avoid the diagnostic.

- **The Reference section**

  Consists of relevant section numbers from the standard document if the diagnostic pertains to any language standard.

For more information, see *HP Code Advisor Diagnostics Reference Guide* at the website:

http://www.hp.com/go/cadvise.

10 Incompatibilities on PA-RISC based systems

On PA-RISC-based systems, a few non-standard source constructs may not be accepted by cadvise. In such cases, cadvise generates an error and continues processing the next source file. For more information, see the following page:

aC++ standard conformance and compatibility changes.

In such cases, the best way is to modify the source code so that the code is more standards compliant and is compilable on platforms based on both Integrity and PA-RISC.

Some of the C99 constructs like variable length arrays, compound literals, and designated initializers are enabled by default in the HP C compiler on PA-RISC and do not require the `-AC99` flag to be used. However, these constructs result in error when cadvise is used with the HP C compiler. In such cases, the solution is to pass the `-AC99` flag to `cc`. For example, see the following source code:

```
/*vla.c*/
int dep;
int main(){
   int arr[dep];
}
```

The declaration is logically incorrect as the array would have zero size. Initialize the variable `dep` with some non-zero positive value as int `dep = 128;`

Using `/opt/cadvise/bin/cadvise cc -c vla.c` at the command line generates the following warning without the `-AC99` flag:

```
"vla.c", line 4: error #2028: expression must have a constant value int arr[dep];
```

Using `/opt/cadvise/bin/cadvise cc -c -AC99 vla.c` at the command line suppresses this warning.

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