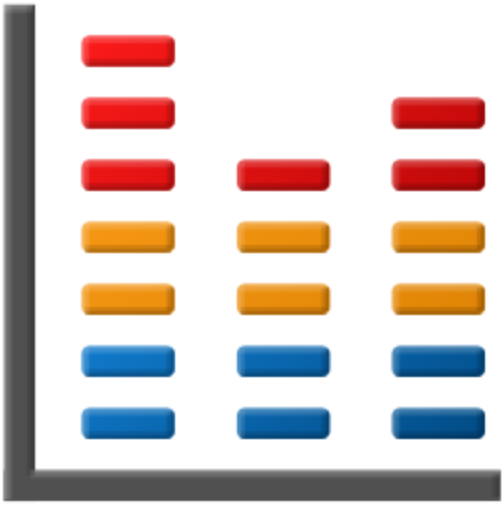


Performance Validator

by

Software Verify

Software Verify

Troubleshoot your software

Performance Validator

Performance profiling for Windows applications built using .Net, .Net Core, C#, VB.Net, C, C++, Delphi, Fortran 95 and Visual Basic 6.

by Software Verify Limited

Welcome to the Performance Validator software tool. Performance Validator is a performance analysis software tool that you can use to profile your software application. Performance Validator can provide performance metrics for functions and individual code lines.

Performance Validator provides multiple timing methods and a variety of realtime views onto the performance data collected including an instantaneous callstack, call tree view and call graph view. We have provided a variety of ways to display the data with the intention of providing multiple insights into the performance of your application.

We hope you will find this document useful.

Performance Validator Help

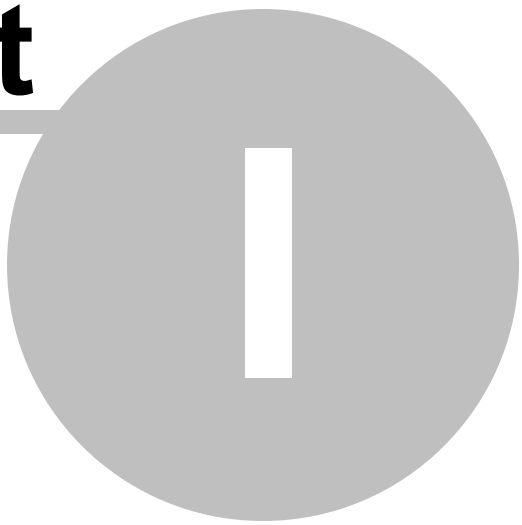
Printed: July 2025 in United Kingdom.

Table of Contents

Foreword

This is just another title page
placed between table of contents
and topics

Part



1 Overview

Hi, welcome to the Performance Validator help manual.

This help manual is available in Compiled HTML Help (Windows Help files), PDF, and online.

Windows Help	https://www.softwareverify.com/documentation/chm/performanceValidator.chm
PDF	https://www.softwareverify.com/documentation/pdfs/performanceValidator.pdf
Online	https://www.softwareverify.com/documentation/html/performanceValidator/index.html

Tutorials for Performance Validator are available at https://www.softwareverify.com/tutorial/performance-validator-tutorial/.

Before reading this manual, it's worth taking a quick look at the notation used.

Read background information

The overview section covers things like:

- the capabilities of Performance Validator
- how it works
- what's supported
- how to purchase.

  If you've already purchased, thank you!

Learn about getting started

You *can* skip the background information, but do make sure you're aware of how to prepare your target program in the getting started section.

Dive right in

The quick start section shows how to launch your application.

To find your way around the rest of the features and settings then read about the user interface, or browse the examples.

If you're already feeling confident you can learn about some of the advanced features such as comparing sessions, or the command line interface.

1.1 Notation used in this help

› Instruction › steps
Menu action › steps

Throughout the help you'll find instruction steps like this:

- **Filter...** › shows the session comparison private filters dialog

or

Settings Menu › **Edit Settings...** › **Data Collection** in the list › **Trace Hooks**

This is a shorthand notation for performing consecutive steps in the user interface.

The first example indicates that the action of clicking the **Filter...** will result in showing the dialog described.

The second example directs you to open the Settings menu (from the menu bar in this case), and then choose the Edit Settings item, and in the dialog that appears, open the Data Collection option via the list and select the Trace Hooks child entry.

Right mouse button menu

Where you see this mouse menu the instruction is to use the right mouse button menu (a.k.a. popup menu or context menu) and select the menu option that follows this symbol.

For example: use **Edit Source Code...**

Interactive images

Shown next to a picture, the hand symbol indicates the image is interactive and can be clicked on in order to jump directly to the help section most relevant to the part of the image under the cursor.

External Links

You may see this symbol after some links. Those links lead to an external website (shown in your default browser), as opposed to jumping to another section in the help. Naturally, if you have no internet access, these links will be unavailable.

For example: Software Verify Limited

Notes

Warning notes

Notes pertaining to the current topic are indicated by the symbol. Notes may include exceptions to a rule, items to watch out for, or other asides to the main topic.

Notes that act as warnings will use the similar symbol, for example where there's a danger of crashing your application. Don't panic though - there aren't many of these!

See also

Where there are other pages in the help that have more detail on the topic at hand, or if there is additional reading that is not already linked within the content, you will find these sections linked after the ➜ symbol.

1.2 Introducing Performance Validator

What is Performance Validator?

C++ Performance Validator is an **automatic performance analyzer** for Windows.

It works with versions of Windows from NT® 4.0 and above, running on the Intel i386 (and compatible) family of processors.

For the purposes of this documentation, we'll call C++ Performance Validator just 'Performance Validator'.

What does Performance Validator do?

Performance Validator can:

- automatically calculate performance data for your application as it executes
- detect performance hotspots

The results are displayed as a variety of comprehensive but easily explorable tabulated and hierarchical formats.

Source code editing is provided with colour coded lines so that you can see at a glance which functions consume more time than others.

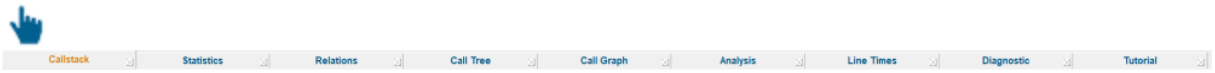
The performance overhead is very low and there is no need to recompile or relink the target program.

The only requirement is PDB files with debug information and/or MAP files with line number information.

Performance Validator can also be used for unit testing and as part of a regression testing strategy by Quality Assurance teams.

The main sections of Performance Validator

The user interface is split into tabbed report sections (plus Tutorials), each presenting or analysing performance in the target program at different levels of granularity.



Here's a summary of those sections, each of which is covered in full in The User Interface section.

Callstack	Shows a callstack of the selected thread as the program executes. This view is useful for an 'at a glance' summary of where the program is currently executing.
Statistics	Collates statistics per function, identifying those that are taking the most time, or which are visited more than others. The columns of data can be sorted, removed or added to show as little or as much as needed.
Relations	Identifies the top N time-consuming functions or most called functions. Shows the relationships between each function, the functions which it calls, and the functions which call it.
Call Tree	Displays an explorable call tree of the performance hotspots in the application.
Call Graph	For very simple applications the Call Tree and Call Graph might be identical. For more complex applications the Call Graph will be smaller as duplicate function calls will link to the first instance in the tree.
Analysis	Enables queries on the collected data, displaying results similar to the call tree. Useful for finding the top most visited functions, most time-consuming functions, functions with a particular name or class, etc.
Line Times	Displays execution times per line of the application. The hierarchical data is organised by file, function and line.
Diagnostic	Logs diagnostic information collected by the stub, including functions that could not be hooked.

Where functions are shown in tables or trees, selecting a function shows the relevant source code, and double clicking displays the function on the Relations tab.

1.3 Why Performance Validator?

Adapts to everyone's workflow

Performance Validator allows you to detect which parts of your software are consuming more processor time than other parts of the software, using an intuitive colour-coded user interface.

Data can be collected using a variety of different performance monitoring methods.

If you want to see the source code for a particular entry in the statistics or hotspot displays, it's simple. Just double click on the entry to view source code in the adjacent window.

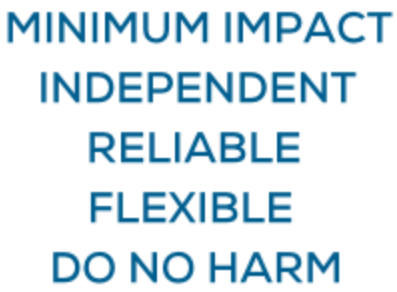
Alternatively, to edit the code, double click on a code fragment shown and the appropriate source code file will be loaded into Performance Validator's colour-coded editor, or into Microsoft® Visual Studio®, or you can choose your preferred awesome editor.

You can save sessions, reload them at a later date, and compare them or interact with the analysis data.

You can also export to HTML or XML which can be used to create reports targeted to the appropriate audience: the management team; quality assurance team; or to create detailed stack trace reports for the software engineers.

Designed with principles

Performance Validator and the other products in our suite of tools have been created with the following principles in mind:



- **must not adversely effect the program's behaviour**

  Any hooks placed into the target program's code must not affect the registers or the condition code flags of that program. The program must behave in the same way when being inspected by Performance Validator as without.

- **must be reliable and avoid causing the target program to crash**

  Since we can't know exactly which DLLs and other components are present on every computer that Performance Validator is installed on, every hook can be enabled or disabled, and/or installed or not installed.

  Thus if a new DLL is released in the future that causes problems with certain functions, you can disable the hooks for those functions, and continue using Performance Validator until a fix for the new DLL's behaviour is available.

- **must have as little impact on the target program's performance as possible**

  Performance Validator has very little effect on the target applications performance, but you can also enable and disable as many or as few function hooks as you wish.

  For example:

If you are only interested in monitoring performance of a particular area of code you can pick only that directory to be hooked.

If you're only interested in a selection of in-house DLLs, choose only those modules to be hooked.

- **must have a user interface independent of the target program**

Performance Validator's user interface is independent of the target program.

This means:

If the target program crashes, the user interface will not crash - you will still have data to work with.

If the target program is stopped in the debugger, Performance Validator's user interface will continue to work.

In the unlikely event that the Performance Validator's own user interface crashes, your target program will not crash.

- **must be flexible**

We know our users like choices! Where there are multiple ways of presenting the data, the user is given a choice over how that display works, so that not all users have to work with the same settings.

1.4 What do you need to run Performance Validator?

Compilers

The following makes of compiler are supported:

- Microsoft® Visual Studio®
- C++ Builder
- Delphi
- Intel
- Metrowerks
- MinGW
- QtCreator
- Fortran (various)

➔ Supported compilers for more details regarding versions and caveats.

User Privileges

Performance Validator uses the `CreateRemoteThread()` Win32 function. You must have access privileges that allow you to create threads in other programs.

Typically **Administrator** and **Power User** user types have the appropriate privileges. Ordinary user accounts can be easily modified to have the required privileges.

➡ Learn more about user privileges in the section on User Permissions.

Registry Access Privileges

Performance Validator requires read and write access to:

- `HKEY_CURRENT_USER\Software\SoftwareVerification\PerformanceValidator`
- `HKEY_USERS\.DEFAULT\Software\SoftwareVerification\PerformanceValidator`.

  This is used when working with services

If read and write access is *not* allowed:

- Performance Validator will use default settings (thus any user selections will not apply)
- Error messages will be displayed when Performance Validator tries to access the registry key

  These error messages can be suppressed if they are not desired. For example, if you're not working with services, then there's no requirement to access the second registry key, and all error messages relating to it can be ignored.

➡ The question relating to creating Power User accounts for Windows XP.

Operating System

Any 'modern' windows machine is suitable to run Performance Validator.

At a minimum, Performance Validator requires Windows XP or better.

1.5 Buying Performance Validator and support

The best way to purchase Performance Validator is online from Software Verify Limited - just click the ***Purchasing*** link at the top of the website.

Purchase options

There are options for single or multiple licenses, per-user or floating licenses, and although you can of course purchase it as a single product, you can save significantly by buying Performance Validator as part of a suite of products. All the details are online.

Pre-purchase questions?

If you have any pre-purchase questions not answered in this help manual, or niggling little doubts about something, we can be contacted as below.

email: sales@softwareverify.com *(recommended)*

web: https://www.softwareverify.com

or by old fashioned post:

Software Verify Limited
Suffolk Business Park
Eldo House
Kempson Way
Bury Saint Edmunds
IP32 7AR
United Kingdom

After sales support

If you need support after purchase, check our frequently asked questions and then drop us a line below with as much detail as possible about your problem.

email: support@softwareverify.com

1.6 How does Performance Validator work?

The Stub and the UI - more than the sum of its parts

Performance Validator has two main parts - the *stub* and the *user interface*.

The **stub** is typically injected into the target program and communicates with the Performance Validator user interface.

The stub is injected into the target program using the `CreateProcess()` or `CreateRemoteThread()` Win32 function. Communication between the stub and the user interface is via named pipes. There is no human readable data sent between the two parts of the program. Both the stub and the user interface are multi-threaded.

The stub walks the entire program image detecting the start of each source code line using PDB and/or MAP files.

Each function is checked to see if it can safely be hooked without corrupting the code for another line or function, or changing the function of the program. The line is hooked if possible, otherwise the user interface is informed of the function hook failure.

As your program executes, the hooks on each function record the performance data for the function and communicates this to the user interface. The user interface calculates statistics based on the performance data and provides a colour coded display for the user to inspect.

1.7 Supported Compilers

Performance Validator will work with any portable executable (PE) file format and supports .Net, .Net Core, C#, VB.Net, C, C++, Delphi, Fortran 95 and Visual Basic.

Microsoft .Net, .Net Core

Both .Net and .Net Core technologies are supported as well all the native compilers listed below.

The following compilers are supported by Performance Validator.

Microsoft http://www.microsoft.com

Performance Validator requires your application to be built using Microsoft® Visual Studio® 6.0 service pack 3 or later.
In practice, you may find that applications built with Developer Studio 4.2 and later can be used with Performance Validator.

- **Microsoft Developer Studio 4.0**
- **Microsoft Developer Studio 5.0**
- **Microsoft Developer Studio 6.0**
- **Microsoft Visual Basic 6.0**
- **Microsoft Visual Studio 6.0 -** service pack 3 or later
- **Microsoft Visual Studio 7.0 / .net 2002**
- **Microsoft Visual Studio 7.1 / .net 2003**
- **Microsoft Visual Studio 8.0 / .net 2005**
- **Microsoft Visual Studio 9.0 / .net 2008**
- **Microsoft Visual Studio 10.0 / .net 2010**
- **Microsoft Visual Studio 11.0 / .net 2012**
- **Microsoft Visual Studio 12.0 / .net 2013**
- **Microsoft Visual Studio 14.0 / .net 2015**
- **Microsoft Visual Studio 15.0 / .net 2017**
- **Microsoft Visual Studio 16.0 / .net 2019**
- **Microsoft Visual Studio 17.0 / .net 2022**
- **etc...**
- **Microsoft Visual Studio Express -** supported, but see also: building the examples for Visual Studio Express

Microsoft Developer Studio and Microsoft Visual Studio products support both C++ and Visual Basic.

➡ Visual Studio and Visual Basic 6 in the *Getting Started* section.

Intel http://www.intel.com

- **Intel performance compiler** - The Intel compiler uses the Microsoft runtime already installed on your computer rather than supply its own

- **Intel Fortran**

Intel use Microsoft's PDB proprietary symbol information format. If your compiler uses PDB symbol information Performance Validator will be able to use it.

Metrowerks

- **Metrowerks CodeWarrior for Windows Version 8.0**
- **Metrowerks CodeWarrior for Windows Version 9.0**

You will need to ensure the debug information is stored as *CodeView* information and not a custom Metrowerks debug format. Metrowerks symbolic information is embedded in the .exe/.dll as CodeView information. Please consult the documentation for CodeWarrior to include debug information (including filenames and line numbers) in the CodeView information.

Embarcadero https://www.embarcadero.com/

This includes compilers formerly produced by Borland.

- **C++ Builder 5.0 to C++ Builder 12**
- **Delphi 6.0 to Delphi 12**
- **Rad Studio**

➔ C++ Builder and Delphi in the *Getting Started* section.

MinGW http://www.mingw.org

- **MinGW** (Minimalist GNU for Windows)

MinGW can create symbols in a variety of formats. If you configure MinGW to produce DWARF symbols, STABS symbols or COFF symbols Performance Validator can read them.

➔ MinGW compiler in the *Getting Started* section.

Qt (Digia, Nokia, Trolltech) http://qt.io

- **QtCreator**

  Ensure that debug information is created in DWARF, STABS or COFF formats.

Salford Software now maintained by SilverFrost

- **Salford Software Fortran 95**

Salford Software Fortran 95 uses COFF symbol information. If your compiler uses COFF symbol information Performance Validator will be able to use that information.

Compaq

- **Compaq Visual Fortran 6.6**

The Compaq Visual Fortran product may be compatible with Performance Validator. If you are using Compaq Visual Fortran and wish to use Performance Validator please contact us.

Other...?

If the compiler you are using is not listed here, please contact us for advice. We add compilers as we receive requests for them. In fact, the C++ Builder, Delphi, Metrowerks CodeWarrior, Salford Software's Fortran 95 compiler, and Intel Fortran support were all added at the request of customers.

1.8 User Permissions

This section details the privileges a user requires to successfully run Performance Validator.

 Typically, *Administrator* and *Power User* user types will already have the appropriate privileges.

Why do user privileges matter?

Debugging tools such as Performance Validator are intrusive tools - they require specific privileges not normally granted to typical applications.

Performance Validator requires specific privileges to write to the default user profile in the registry.

This is so that when Performance Validator is working with services (or any application run on an account which is not the current user's account) it can read the registry and the correct configuration data.

If the account upon which a service or application is running is *not* the user's account, the fallback position is the DEFAULT account in `HKEY_USERS\.DEFAULT`.

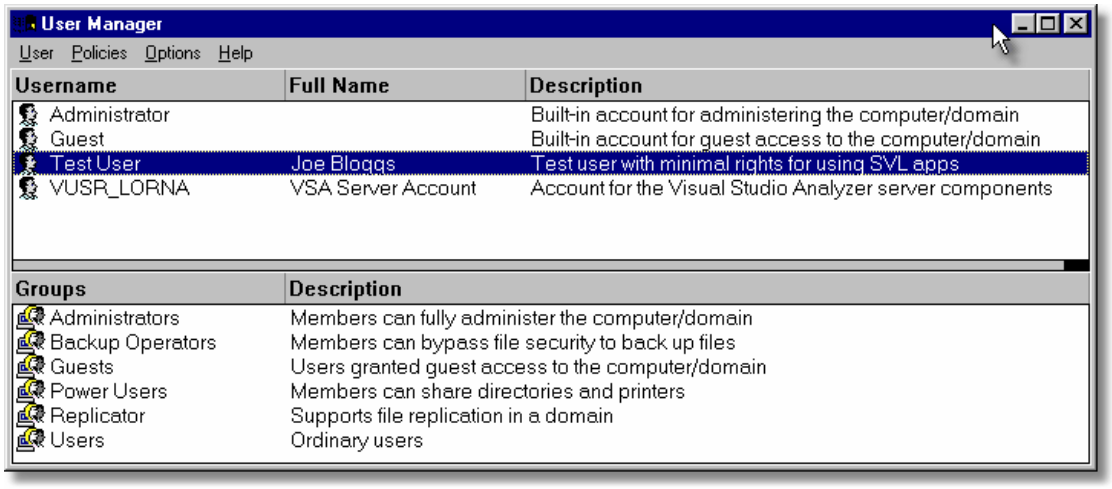
You can enable and disable various warnings using the User Permissions Warnings dialog.

User privileges

Performance Validator requires the following privilege to allow debugging of applications and services:

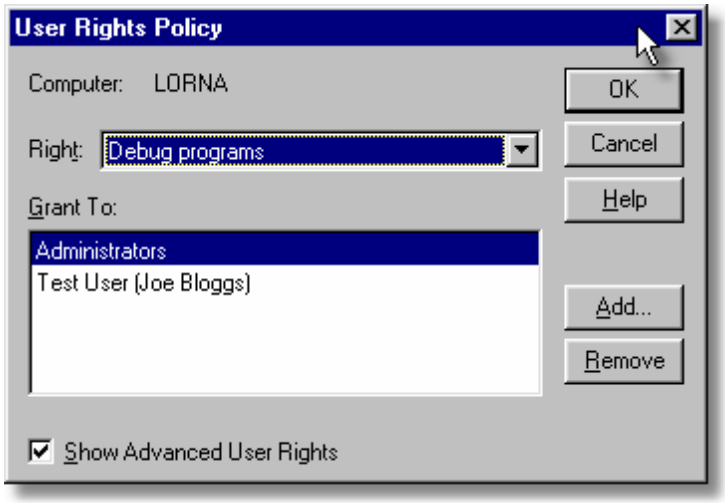
Debug Programs (SE_DEBUG_NAME)

Ordinary users will need to be granted these permissions using the Administrative *User Manager* tool. The example below shows the NT4 User Manager - the Windows 2000 User Manager and Windows XP User Manager will be different but similar in principle.

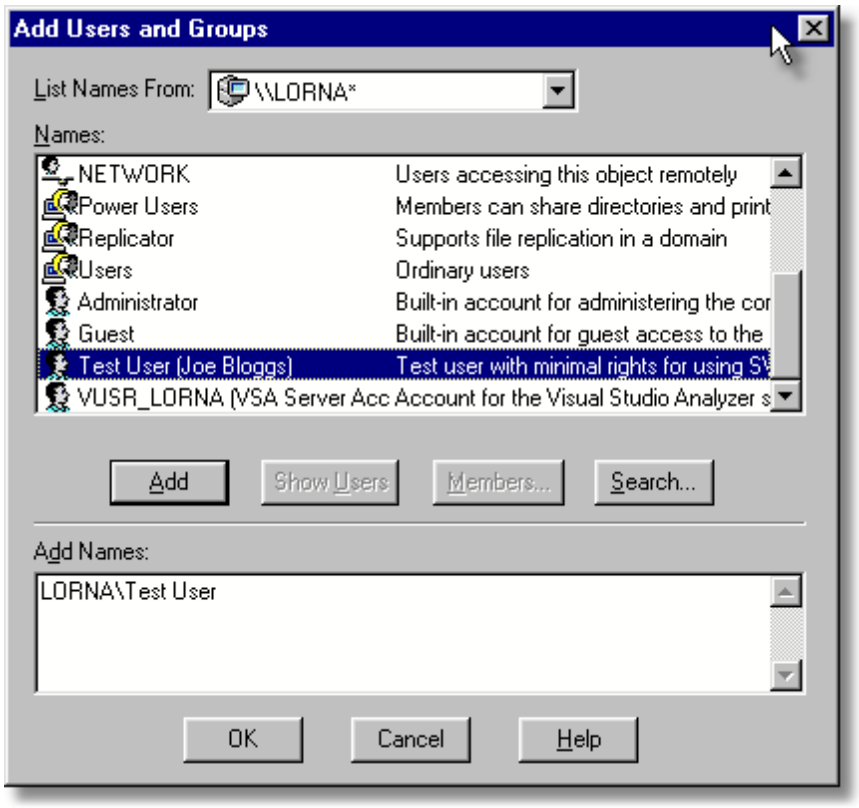


In the User Manager select the user - in this case "Test User".

Choose: **Policies** Menu › **User Rights** › check **Show Advanced User Rights** › select **Debug Programs** in the **Right** combo box



Click **Add....** › **Show Users**



Select **[ComputerName]\Test User** in the top list. Click **Add** › **OK** › **OK** › Close the User Manager.

Registry access privileges

Performance Validator requires read and write access to:

- `HKEY_CURRENT_USER\Software\SoftwareVerification\PerformanceValidator`
- `HKEY_USERS\.DEFAULT\Software\SoftwareVerification\PerformanceValidator`.

  This is used when working with services

If read and write access is *not* allowed:

- Performance Validator will use default settings (thus any user selections will not apply)
- Error messages will be displayed when Performance Validator tries to access the registry key

  These error messages can be suppressed if they are not desired. For example, if you're not working with services, then there's no requirement to access the second registry key, and all error messages relating to it can be ignored.

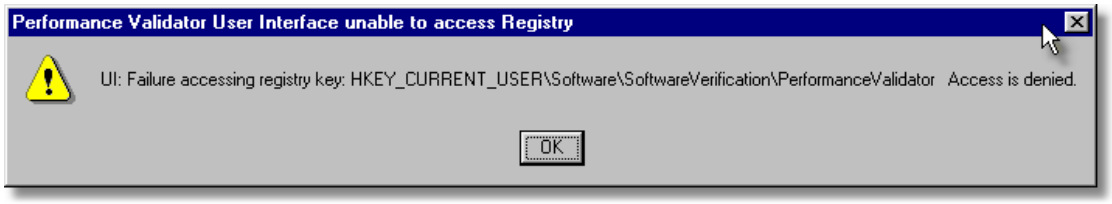
You can modify the registry access permissions using the **regedt32.exe** tool Security menu (or similar). Ask your administrator to modify your registry access permissions if you can't do this yourself.

➔ What's the difference between Regedit and Regedt32?

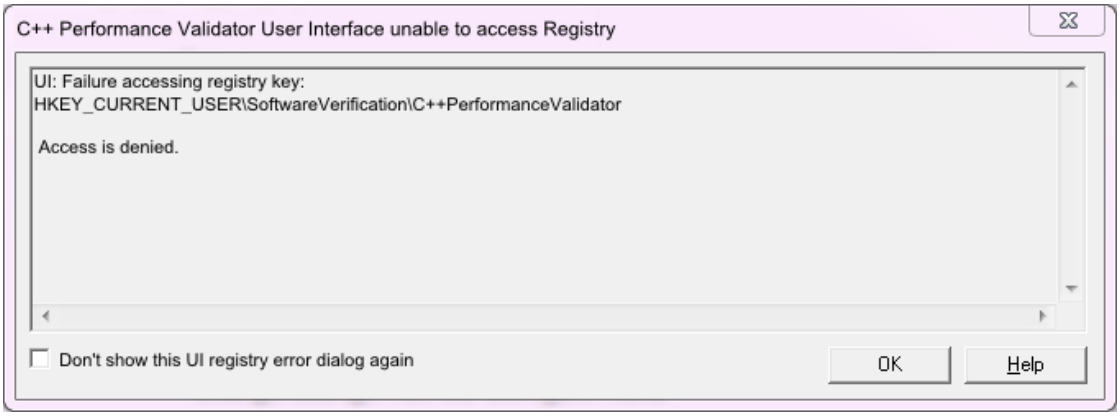
Error notifications

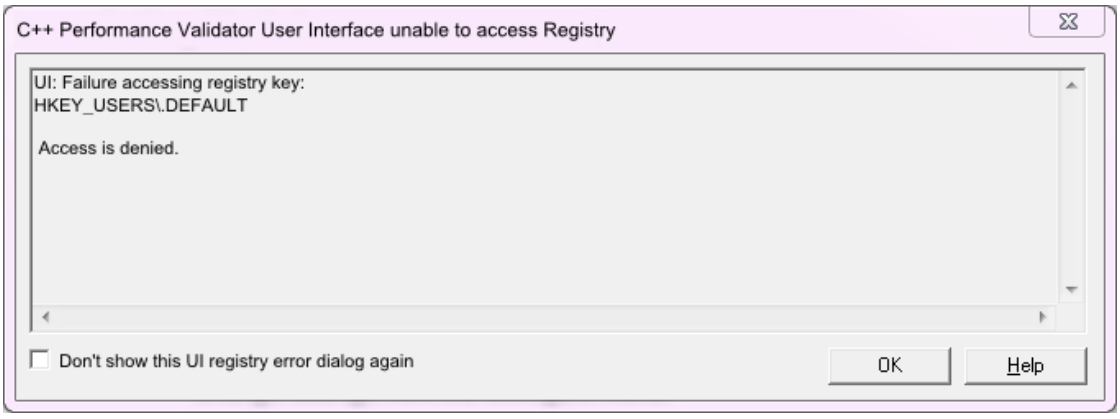
When Performance Validator fails to gain access for read or write to the registry a message box is displayed indicating if the error is for the user interface (UI) or Services. The message indicates the name of the registry key that failed and the failure reason.

This simple message box is displayed during early startup and late close-down of Performance Validator:



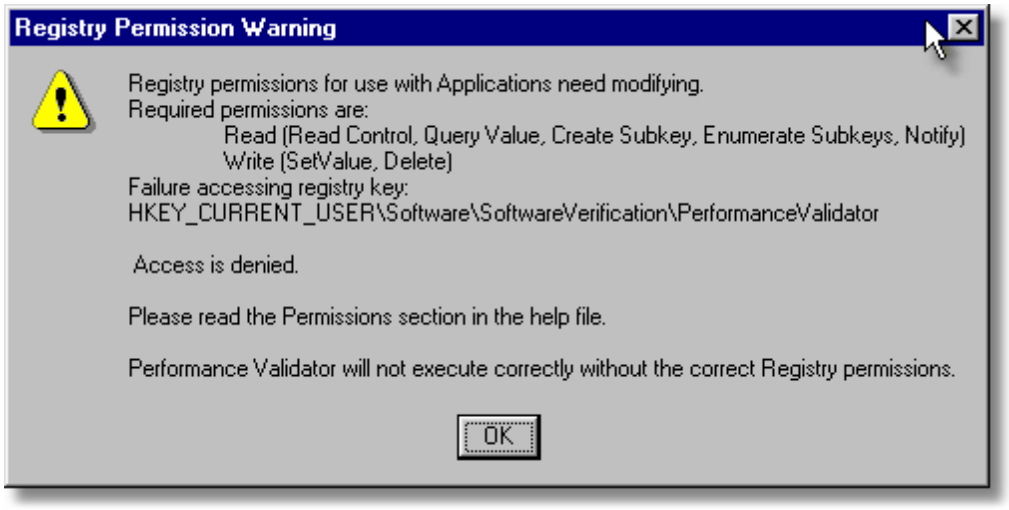
Message boxes like the following are displayed when Performance Validator is not starting up or closing down. The messages differ in the registry key.





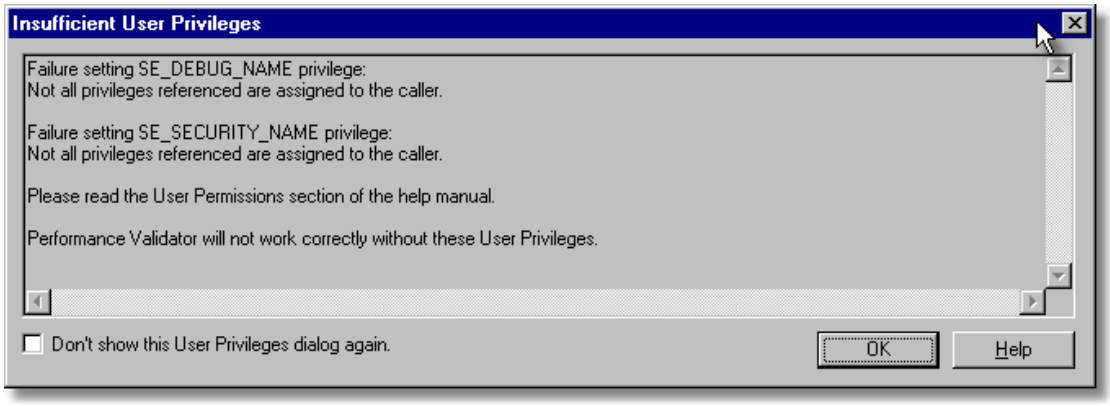
Detailed registry access error messages

The following detailed registry access error message is also displayed when failing to gain access to the registry keys.



Insufficient user privileges

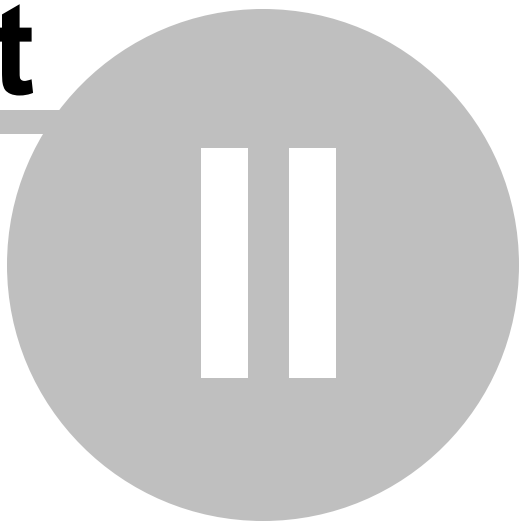
The following dialog is displayed if a user has insufficient privileges to use the software correctly.



Without the **Debug Programs** privilege, Performance Validator will not work correctly with *Services*, and may not work correctly with *Applications*.

➜ How to create Power User accounts for Windows XP.

Part



2 Getting Started

For those that wish to 'dive in', this section will make you aware of how to prepare your target program before giving a quick start introduction.

Otherwise skip right on to the next chapter - The User Interface.

Diving in?

You're probably wanting to 'dive in' and start analysing the performance of your application, looking for hotspots right away.

However, if you choose to read this manual first, you'll find out more about Performance Validator and how to leverage it to its full advantage.

For new users of Performance Validator, a configuration wizard appears the first time you run the application. This ends with a brief overview video.

We also recommend watching the tutorials online - it's an easy way to explore the functionality available.

2.1 Enabling Debugging

To get the best from our tools you will need to enable debugging information for your compiler and your linker.

Detailed instructions are available for these IDEs / compilers:

- Visual Studio
- Visual Basic 6
- C++ Builder
- Delphi
- MingW, gcc, g++
- Dev C++
- Salford Software FORTRAN 95
- Metrowerks Code Warrior

Debug Information Formats

Performance Validator can understand debugging information in the following formats:

- Microsoft Program Database (PDB)
- Turbo Debugger Symbols (TDS)
- COFF
- DWARF
- STABS

The Intel Performance Compiler and Intel Fortran compilers produce symbols in Microsoft's PDB format.

2.2 Quick Start

If you are:

- an admin level user
- using Microsoft compilers
- on a modern OS
- already know that you create debug info in your debug and release product

...then you're more than likely good to go and dive in!

Otherwise, we recommend reading these topics from the Overview section before starting:

- What do you need to run Performance Validator?
- Supported Compilers
- User Permissions

Testing on the Example Program

You can test drive the capabilities of Performance Validator by launching the example program supplied with Performance Validator - **nativeExample.exe**.

The example program can be used in conjunction with the Performance Validator tutorials.

Ensure you have debugging information

Your application needs to be compiled to produce debugging information and linked to make that debugging information available.

If you have no PDB debugging information but you do have a Microsoft format MAP file available, it *must* contain line number information by using the /MAPINFO:LINES linker directive.

Launching

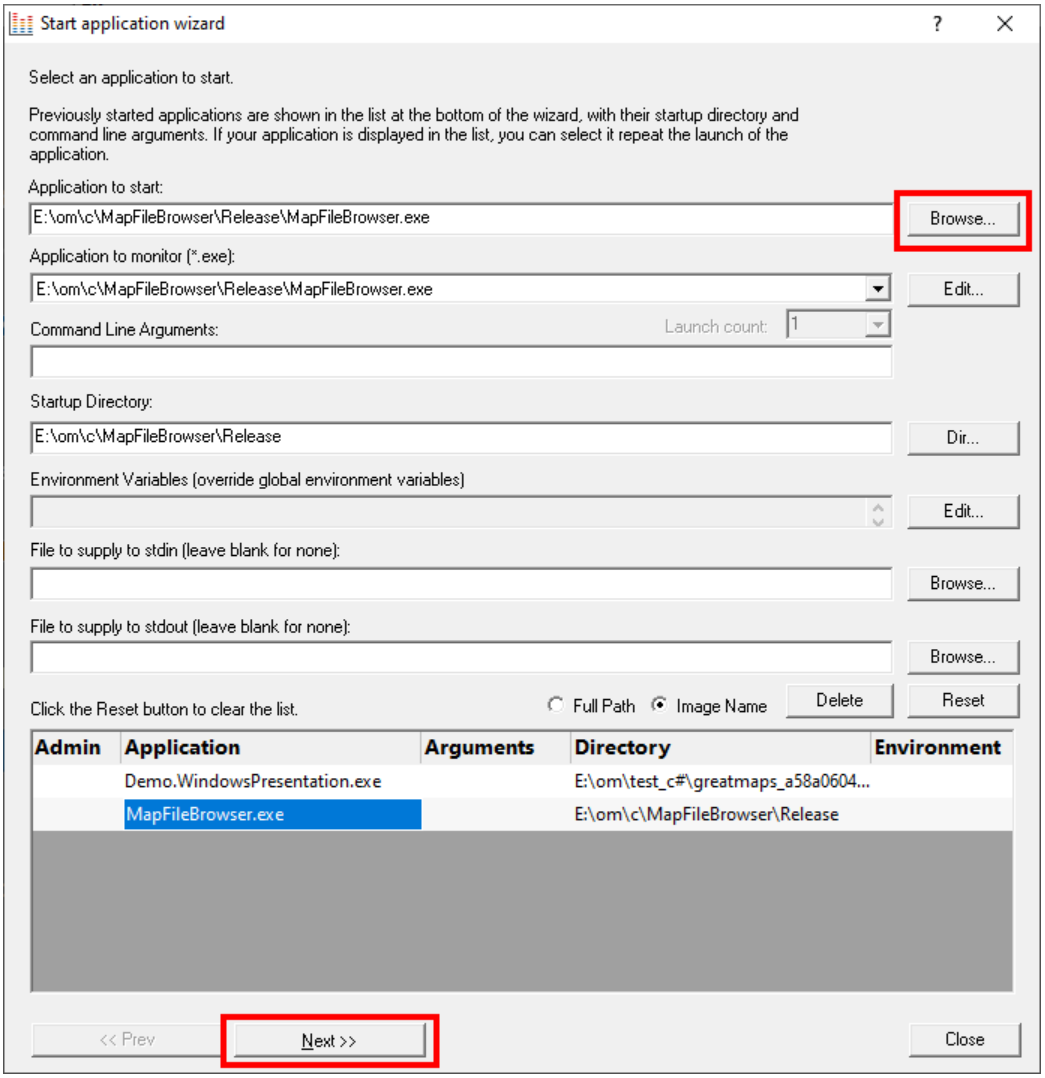
To start your program click on the launch icon on the Session toolbar.

What you see next depends on the user interface mode (wizard or dialog style).

The Launch Wizard...

If you have just installed the software you will be shown the launch wizard:

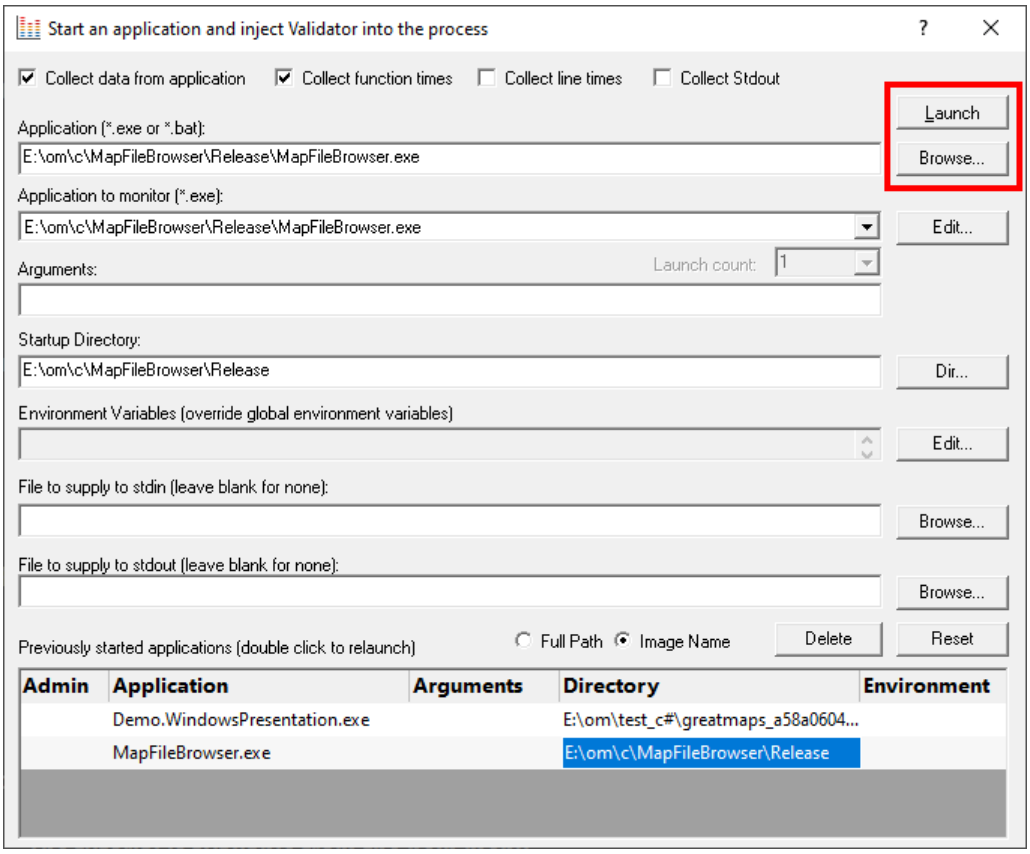
Click **Browse...** to choose a program to launch › **Next** › **Next** › **Next** › **Start Application...**



...or the Launch Dialog

If you have switched to Dialog mode you will be shown the launch dialog:

Click **Browse...** to choose a program to launch › **Launch**



During launch

Performance Validator will start and inject the stub into the target program. Progress during this phase is displayed in the title header of the main window.

Once correctly installed in the target program, the stub will establish communications with Performance Validator and data can be collected and viewed until the target program exits.

The Statistics Tab and the Callstack Tab will update at intervals (unless set otherwise) to show data collected so far. Other tabs need manually refreshing.

After exit - examining the output

When the target program exits, Performance Validator closes the session. The data collection icons on the session toolbar are disabled, and the launch icons are enabled again.

The Statistics display is automatically updated to reflect the final data, and the other tabs also continue to let you explore the data until the session is closed.

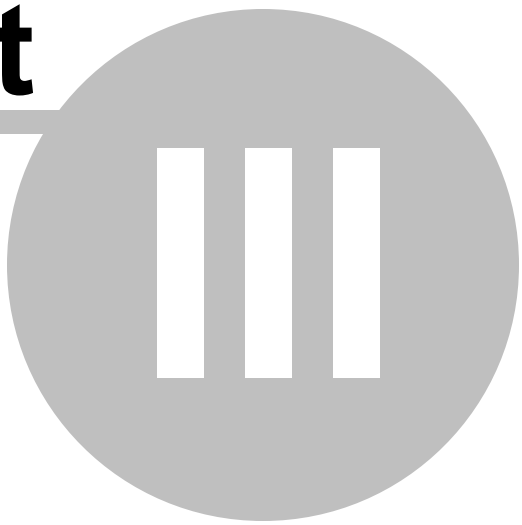
Ending the session

Even though the target program has exited, the session is still active and can be examined or saved until the session is closed:

 **File** menu › **Close Session**

You can have more than one session open at a time.

Part



3 The User Interface

The part of Performance Validator that you get to see and interact with, is the user interface, but that's only one half of the story.

Behind the scenes, the stub installs and controls the data hooks in the target program and interacts with the user interface.

This section describes the various functions of the user interface so that you can get the most from using Performance Validator.

Typical workflow

Typical usage of Performance Validator is very simple:

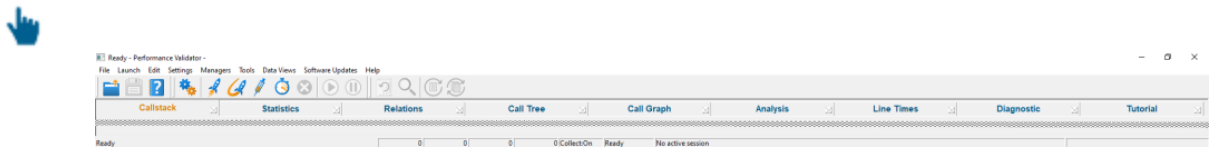
- Start your target program
- Collect and monitor the performance data for the program
- Close the program
- Analyse final data - saving or exporting data if needed

However, there is much more to Performance Validator than this simple workflow. For example, whilst your program is running, you can display data and gain insight into a specific bug you are looking at in the debugger, or you can monitor the program as a whole, looking out for hotspots and other time consuming functions.

The user interface

The user interface consists of the menus, toolbars, status bar and the main display tabs.

Read on to find out about all those features, or click parts of the image below to jump directly to any of the menus, tabs or other sections of interest.

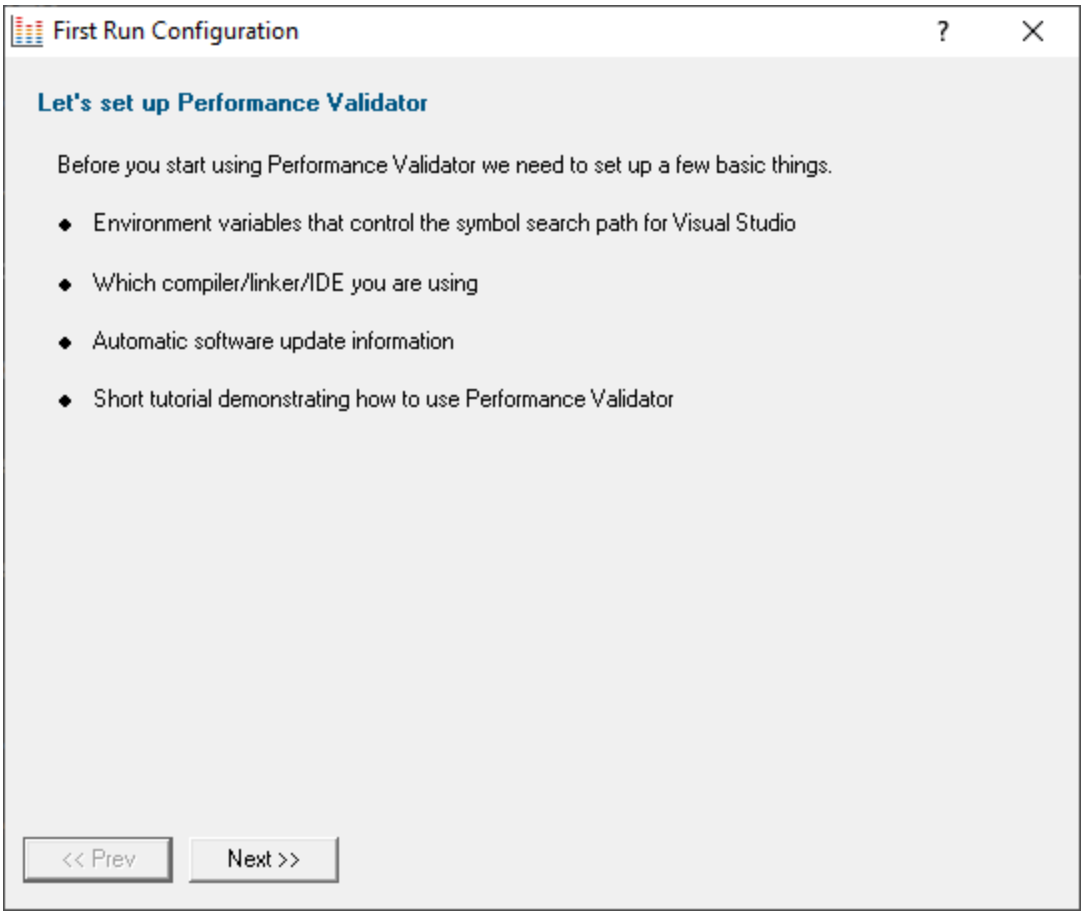


3.1 First run configuration

First run configuration

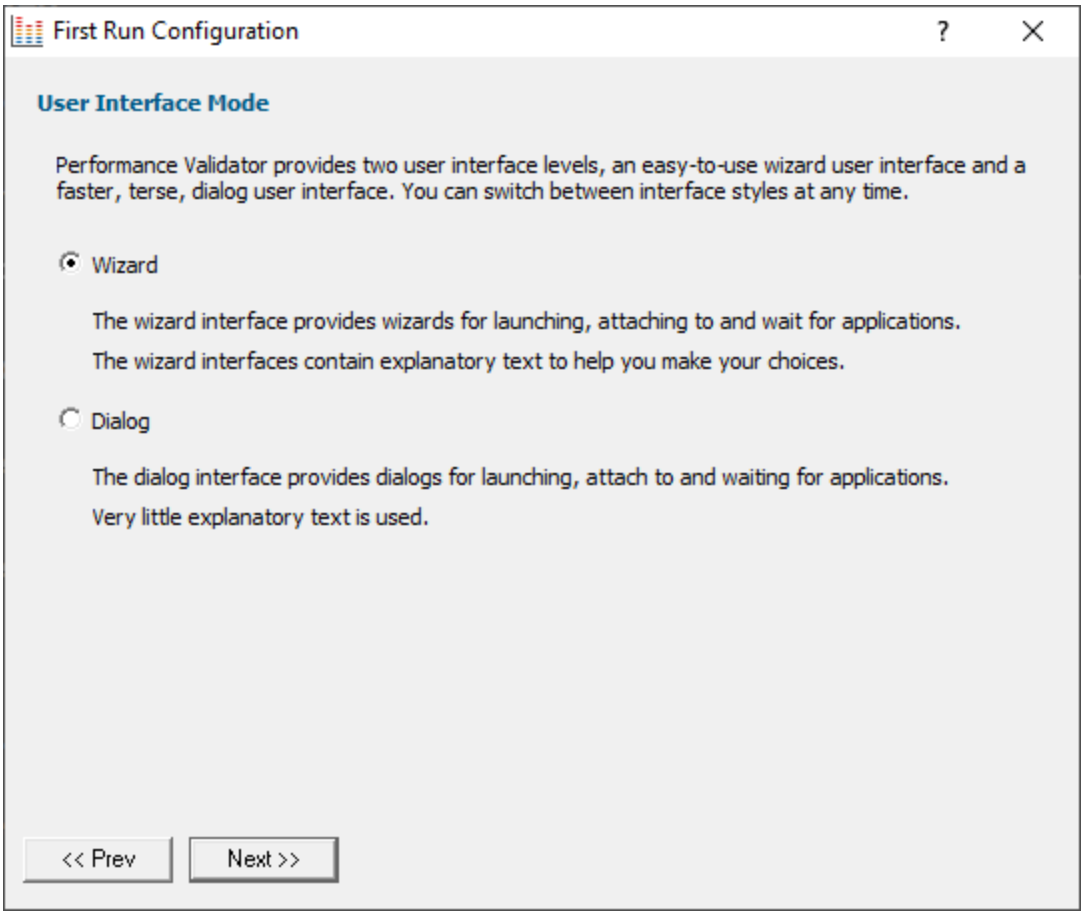
For new users of Performance Validator, a configuration wizard appears the first time you run the application.

The wizard collects a few details about environment, tools, timings, update requirements (for non-evaluation users) and ends with a short video tutorial.



User interface mode

After the introductory page, the wizard presents options for configuring the how the launch, inject and wait dialogs present information to you.



- **Wizard mode** › guides you through the tasks in a linear fashion
- **Dialog mode** › all options are contained in a single dialog

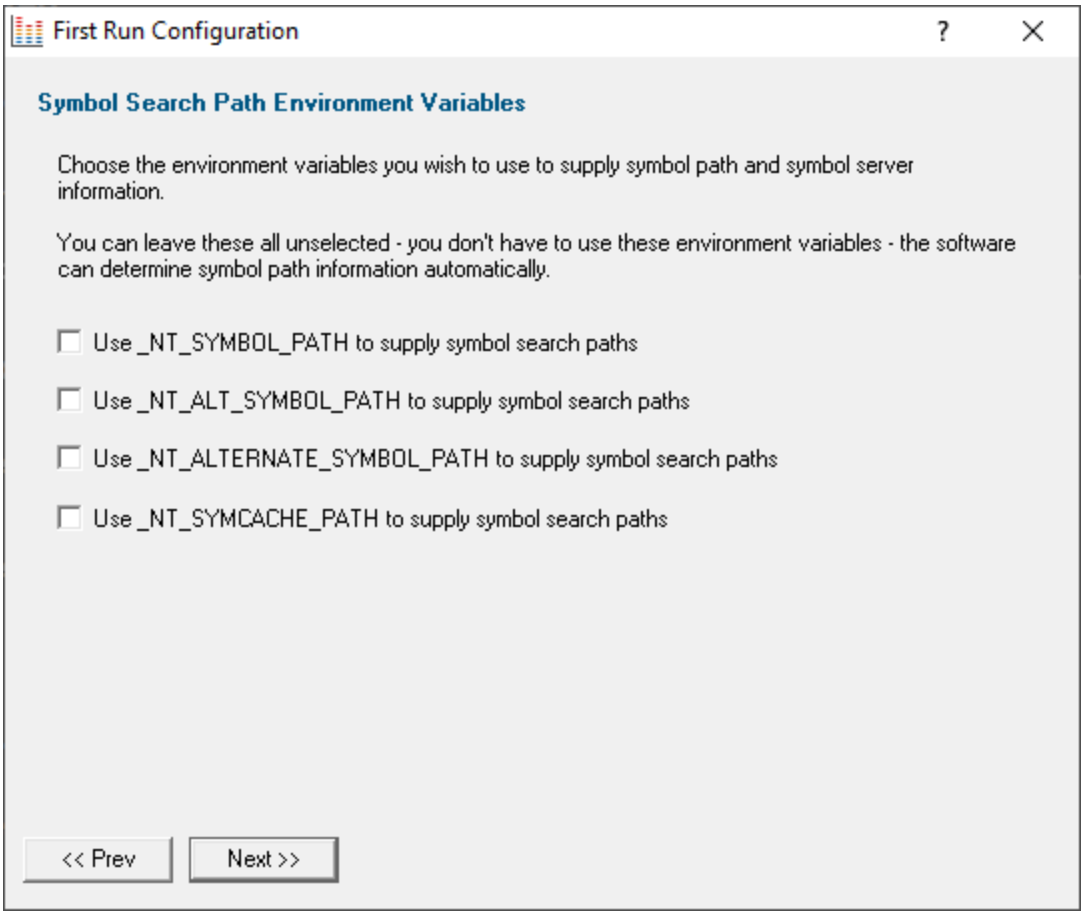
  Experienced users will find this mode quicker to use

These settings can be changed at any time via the User Interface Mode option on the Settings menu.

Symbol search path environment variables

After the introductory page, the wizard presents options for using environment variables for symbol search paths when finding PDB symbols.

You don't *have* to choose any of these options as Performance Validator will try to automatically determine symbol path information.



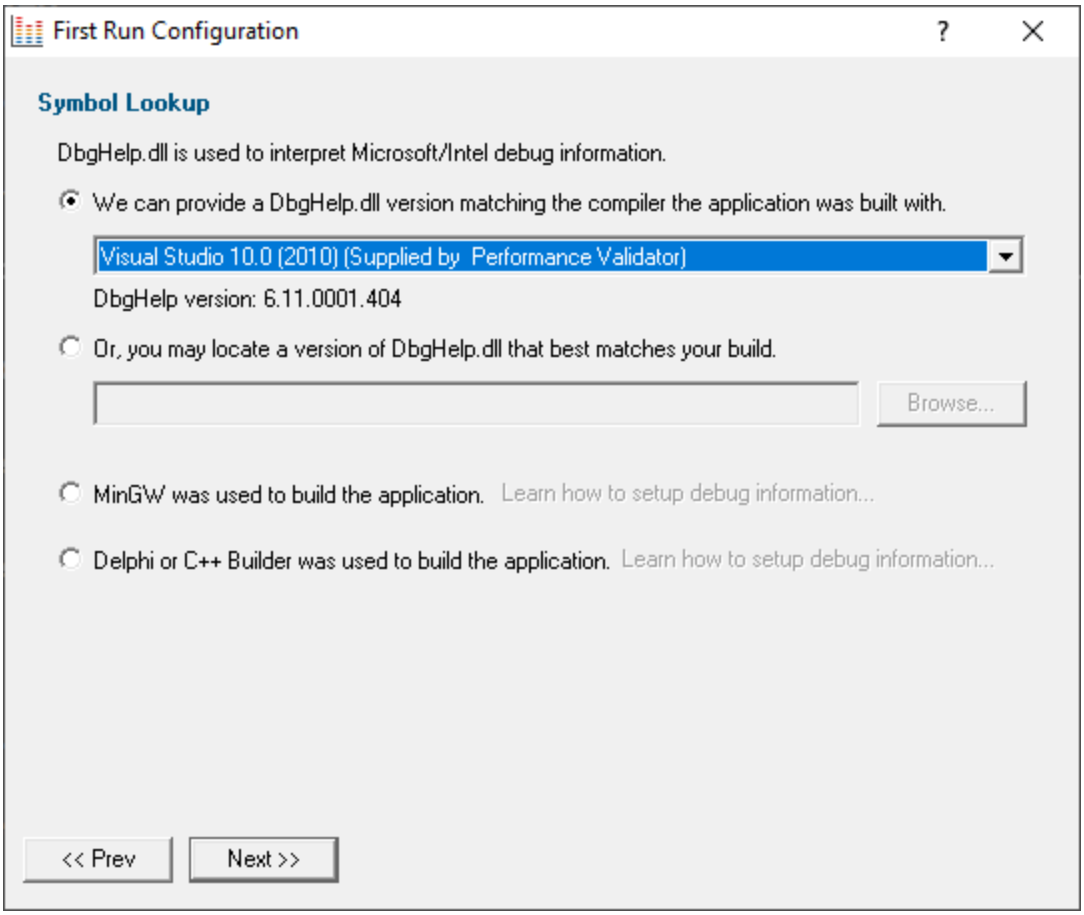
These environment settings can be changed at any time via the Configure Symbol Handling Environment Variables on the Symbol Server page of the Settings Dialog.

Symbol lookup

The next page of the wizard allows you to specify which IDE, Compiler or Linker you're using.

This is important as it affects how symbol lookup is performed. Visual Studio has various quirks in its history of symbol handling and we have to work around that.

The default settings are shown below, although the Visual Studio version may vary.

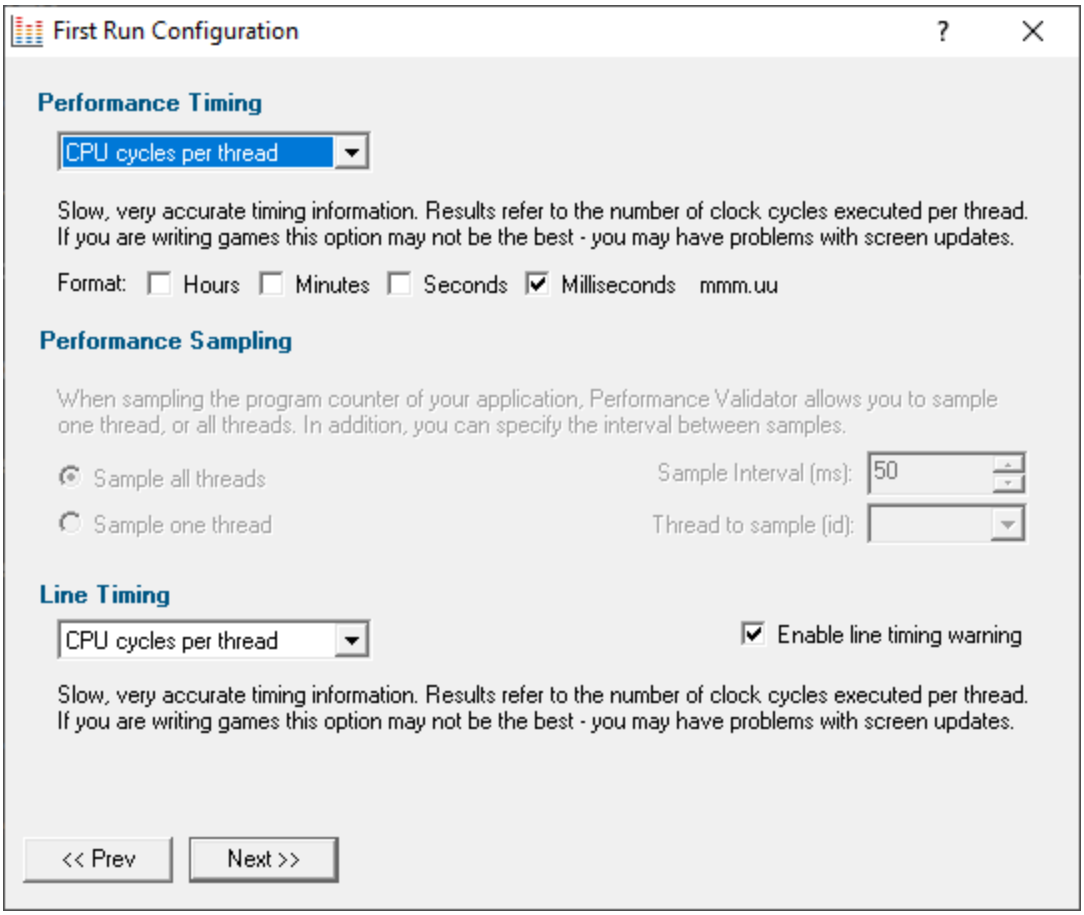


These lookup settings can be changed at any time on the Symbol Lookup page of the Settings Dialog.

Performance timing and line timing

The next page of the wizard covers methods for collecting performance data, with some of them being system dependent.

All these settings can be changed at any time on the Performance settings page of the Settings Dialog, where the options are described in more detail.



The typical default options are below. For more details of these and the other options in each section see the Performance settings.

Performance timing method:

Performance Validator uses the most appropriate timing method automatically, but you may wish to change the defaults.

The default is to be a little slower but more accurate:

- **CPU cycles per thread** › counts function visits and times them using the processor's instruction cycle counter on per-thread basis

  Only CPU cycles used by the owning thread will be counted.

  Recommended choice for Windows Vista and onwards, although we have found that some games cannot be profiled with this setting as it interferes with the screen update.

Timing format:

The format of timing information in Performance Validator is controlled by the **Format** checkboxes.

- **Milliseconds** › use the format `mmm.uu` e.g. 5,728,133.42

Performance sampling:

Not enabled unless the Sampling performance timing method is chosen above, in which case see the Performance settings for details.

Line timing:

In a similar way to Performance Timing above, the Line Timing options control how the line times are determined.

However, here there are just two relevant options of which the default is:

- **CPU cycles per thread** › Counts line visits and times them using the processor's instruction cycle counter on per-thread basis

  Only CPU cycles used by the owning thread will be counted.

  Recommended choice for Windows Vista and onwards.

Line timing warning:

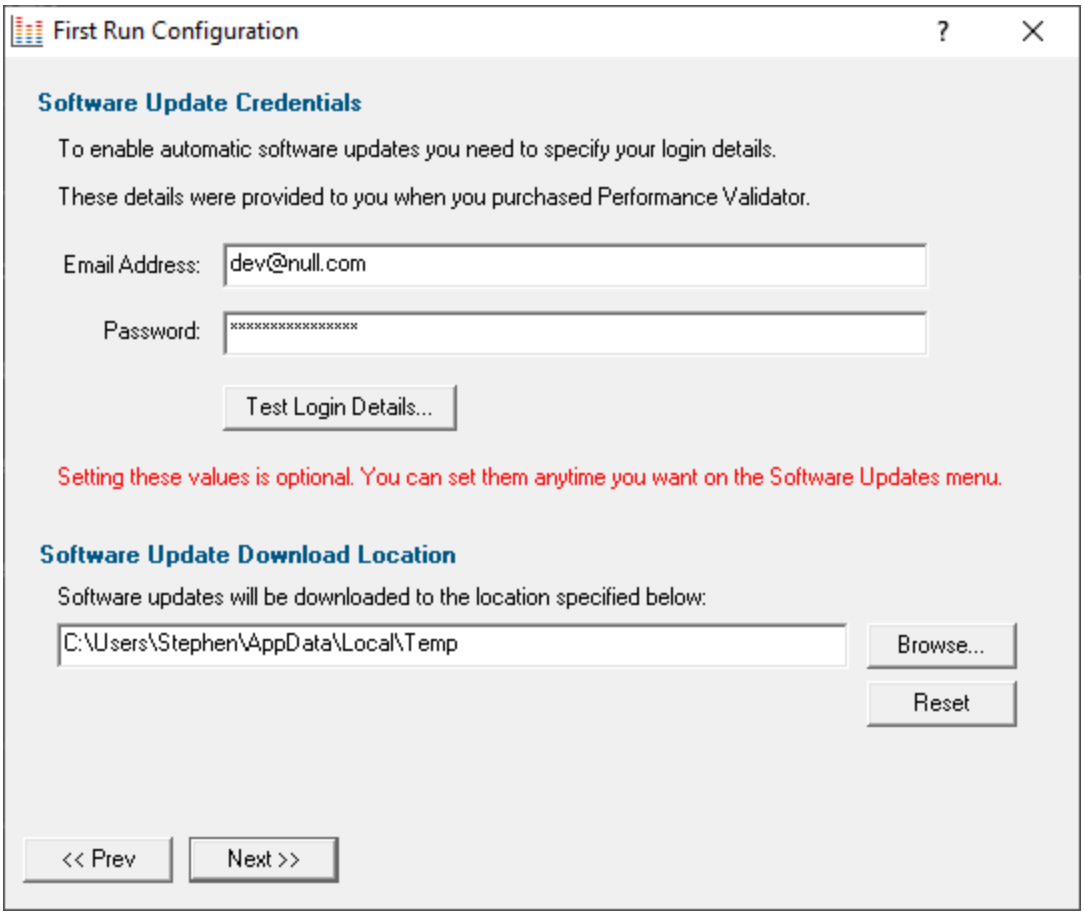
- **Enable line timing warning** › controls an optional warning displayed when you enable line timing on the launch wizard/dialog

  If enabled, a warning dialog reminds you of the possible performance slowdown when using line timing

Software update credentials

The software updates page of the wizard is only shown to non-evaluation users.

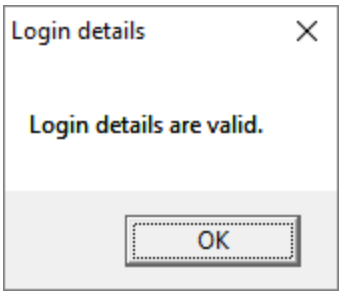
You can configure your software update credentials within the application and where updates are downloaded to.



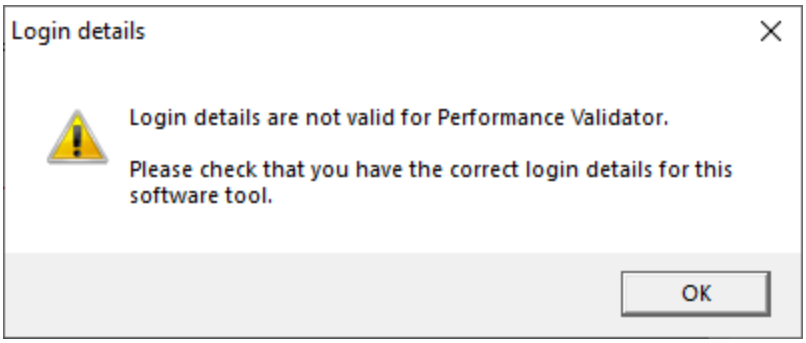
You can test the login details to ensure they are valid:

- **Test login details** › click to check your entered details are valid (requires an internet connection)

  Valid details will be confirmed:



  Invalid details may mean you entered credentials for another application in the Validator suite, or they could have been entered incorrectly.



You should have received the correct credentials when you purchased Performance Validator.

If you experience problems, check with your system administrator or contact Software Verify.

These update credentials can be changed at any time from the Software Updates menu.

Software update download location

It's important to be able to specify where software updates are downloaded to because of potential security risks that may arise from allowing the `TMP` directory to be executable.

We use the `TMP` directory as a default, but if you're not comfortable with that you can specify your preferred download directory. This allows you to set permissions for `TMP` to deny execute privileges if you wish.

An invalid directory, e.g. one that does not exist, will show text in red and will not be accepted until a valid folder is entered.

- **Reset** › reverts the download location to the user's `TMP` directory

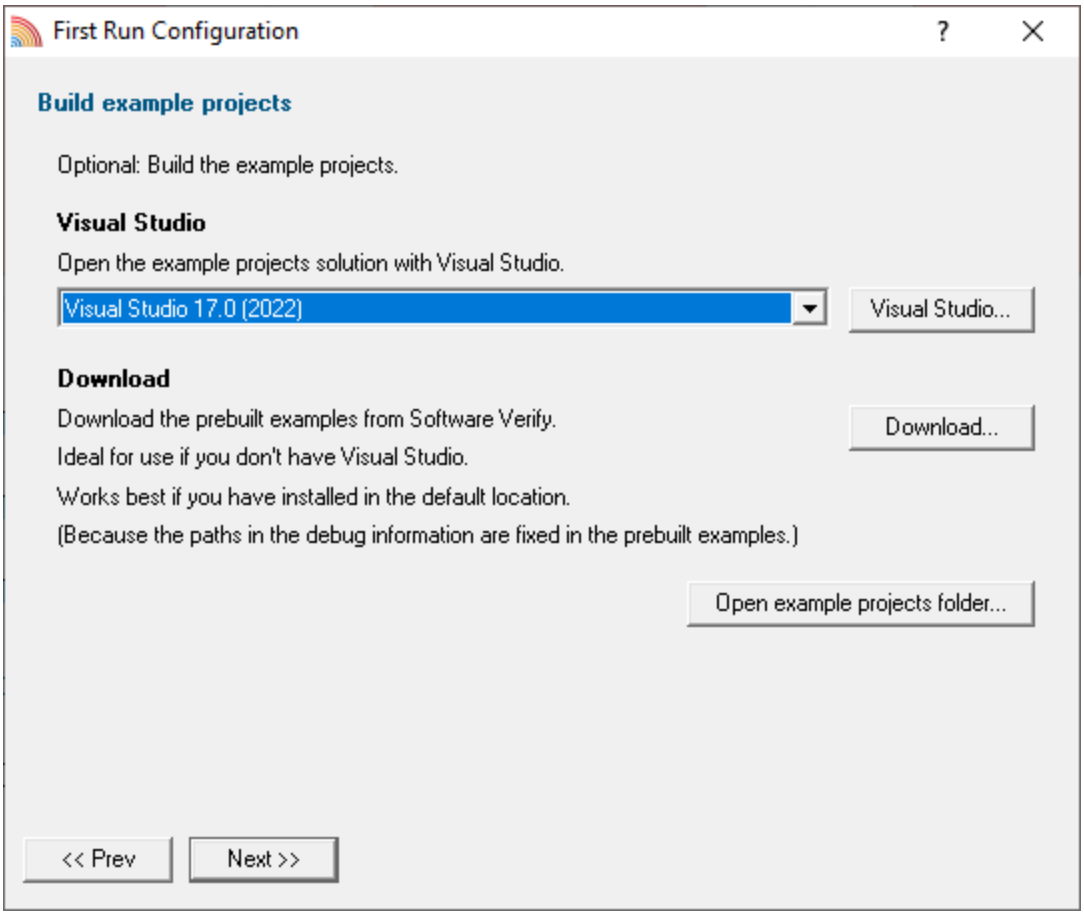
  The default location is `c:\users\[username]\AppData\Local\Temp`

The download location can be changed at any time from the Software Updates menu.

Build example projects

The next page of the wizard allows you to build the example projects that ship with Performance Validator.

The example projects demonstrate various application types containing bug you may wish to investigate with Performance Validator.



- **Visual Studio...** › opens the example projects solution with the version of Visual Studio selected
- **Download...** › downloads a prebuilt version of the example projects, unzips them and installs them in the examples folder in the Performance Validator installation directory

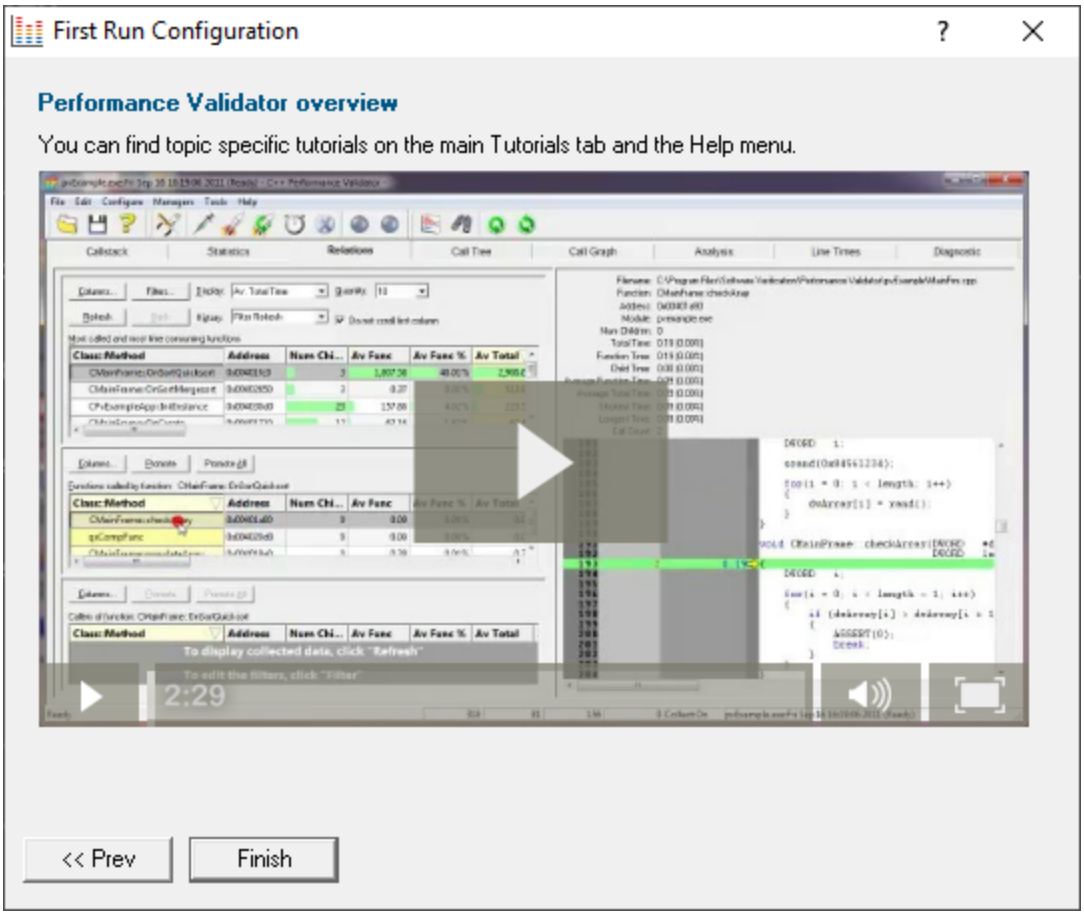
  If you choose this option and you have not installed Performance Validator in the default location (assuming a 64 bit OS) the source file paths in the debug information will be incorrect - you will need to use the File Locations settings to inform Performance Validator of the correct location(s).

- **Open example projects folder...** › opens the folder that contains all example projects

Video overview of application

The final page of the wizard presents a short video overview of Performance Validator.

The video has audio



More help is available via the Tutorials tab and the Help menu.

The video is also available on the product website. Visit https://www.softwareverify.com/products.php and find the product link for Performance Validator.

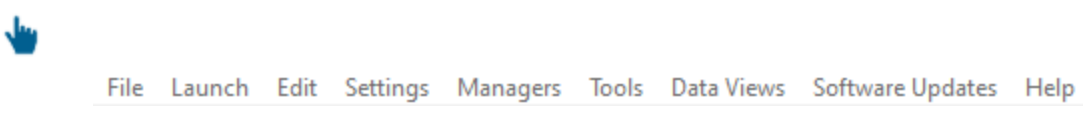
- **Finish** › closes the First Run Configuration dialog leaving the application ready to use

3.2 Menu Reference

The menus provide access to all the major features in Performance Validator. The most common ones are also directly accessible via the toolbars.

The next few pages provide a convenient collection of links to the detailed help pages on each menu item.

Click in the picture below to jump to any menu's page:



3.2.1 File menu

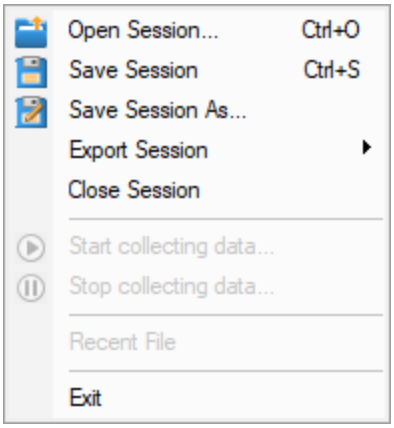
The **File** menu allows you to:

- open, close and save sessions
- manage the launching of an application
- control the collection of data
- exit the application

Most of these actions are also available via the standard or session toolbars.

Near the bottom of the menu, a list of recently used file names allows you to easily reload a previously saved session.

Click on an item in the picture below to find out more:



The last two items are not linked to topics. Exit is self explanatory, and above that is a list of recently opened files.

3.2.2 Launch menu

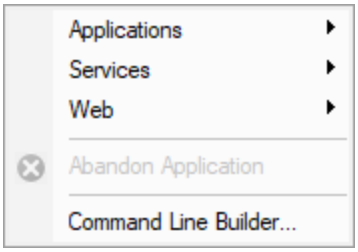
The **Launch** menu allows you to:

- start applications and restart applications
- inject into running applications
- wait for applications to start then attach to them
- monitor services and ISAPI extensions
- stop monitoring an application

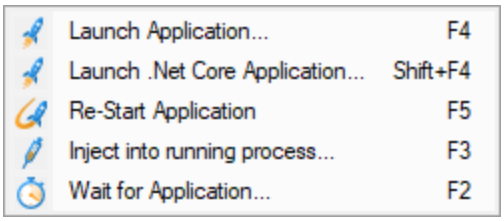
Most of these actions are also available via the standard or session toolbars.

These actions are grouped into submenus according to whether they involve applications or services.

Click on an item in the pictures below to find out more:



Applications



Services

Web

In addition to the function key short cuts shown above, you can redisplay the previously chosen launch dialog by using Ctrl + F4

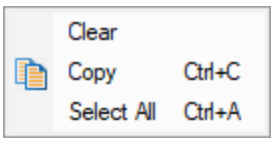
3.2.3 Edit menu

Selections and the clipboard

The **Edit** menu options can be used to:

- clear all selected items in a table or tree
- copy selected items (and relevant data where applicable) to the clipboard
- select all the items available.

Selected data is formatted into one line per row with a single space used to separate column data.



Select All will include the header row as well as the data, and **Copy** will include the column titles.

For example, after running the example application, **Select All** on the Performance Tab might show:

Class::Method	Call Count	Call Cou...	Function	Functio...	Children	Children %	Total	Total %	Module	Filename
qsCompFunc	327,778	64.74%	357.42	40.12%	0.00	0.00%	357.42	40.12%	nativeexample.exe	c:\program files (x86
CMainFrame::OnSortQuicksort	1	0.00%	239.33	26.87%	445.10	49.96%	684.44	76.83%	nativeexample.exe	c:\program files (x86
CMainFrame::populateArray	1	0.00%	42.43	4.76%	45.06	5.06%	87.49	9.82%	nativeexample.exe	c:\program files (x86
TlsGetValue	48,663	9.61%	36.76	4.13%	0.00	0.00%	36.76	4.13%	kernel32.dll	
SetLastError	29,621	5.85%	22.42	2.52%	0.00	0.00%	22.42	2.52%	kernel32.dll	
GetLastError	29,621	5.85%	21.60	2.42%	0.00	0.00%	21.60	2.42%	kernel32.dll	
EnterCriticalSection	20,560	4.06%	16.22	1.82%	0.00	0.00%	16.22	1.82%	ntdll.dll	
LeaveCriticalSection	20,560	4.06%	16.00	1.80%	0.00	0.00%	16.00	1.80%	ntdll.dll	

This would result in the following being copied to clipboard:

```
Class::Method Call Count    Call Count %  Function      Function %    Children      Children
qsCompFunc    327,778       64.74% 357.42 40.12% 0.00   0.00%  357.42 40.12% nativeexample.ex
CMainFrame::OnSortQuicksort 1      0.00%  239.33 26.87% 445.10 49.96% 684.44 76.83% nativeexa
CMainFrame::populateArray   1      0.00%  42.43  4.76%  45.06  5.06%  87.49  9.82%  nativeexa
TlsGetValue   48,663 9.61%  36.76  4.13%  0.00   0.00%  36.76  4.13%  kernel32.dll
SetLastError  29,621 5.85%  22.42  2.52%  0.00   0.00%  22.42  2.52%  kernel32.dll
GetLastError  29,621 5.85%  21.60  2.42%  0.00   0.00%  21.60  2.42%  kernel32.dll
EnterCriticalSection 20,560 4.06%  16.22  1.82%  0.00   0.00%  16.22  1.82%  ntdll.dll
LeaveCriticalSection 20,560 4.06%  16.00  1.80%  0.00   0.00%  16.00  1.80%  ntdll.dll
```

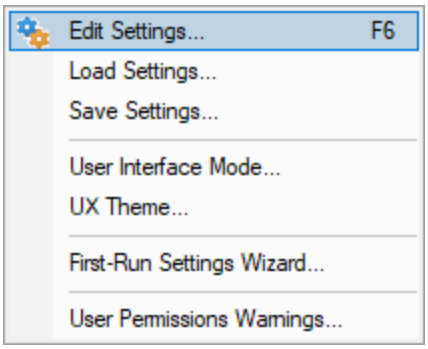
3.2.4 Settings menu

The **Settings** menu allows you to:

- choose the user interface mode (wizards or dialogs)
- change settings for global data and how it is displayed

Global settings are also accessible via the session toolbar.

Click on an item in the menu below to find out more:

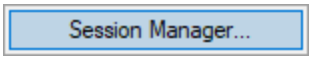


3.2.5 Managers menu

Managers

The **Managers** menu provides just one lonely (but powerful) tool to manage sessions including comparing current and previous data.

Click on the menu item in the picture to find out more:



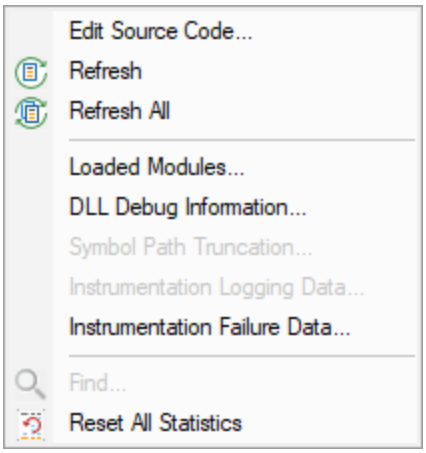
3.2.6 Tools menu

Tools

The Tools menu provides access to a few different tools including a couple not found on the Tools toolbar:

- A list of the modules loaded by your target application
- A list of the debug information status of modules loaded by your application
- A log of files, classes, functions, methods, or modules not instrumented, and reasons why not

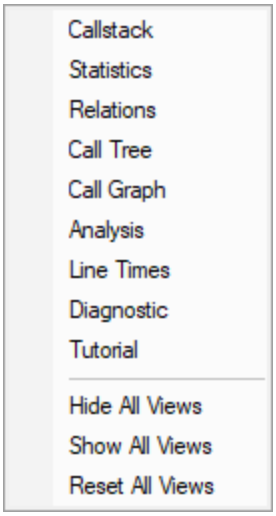
Click on a menu item in the picture of the Tools Menu below to find out more:



3.2.7 Data Views menu

Data Views

The Data Views menu provides easy control of which tabs are displayed in the main view.

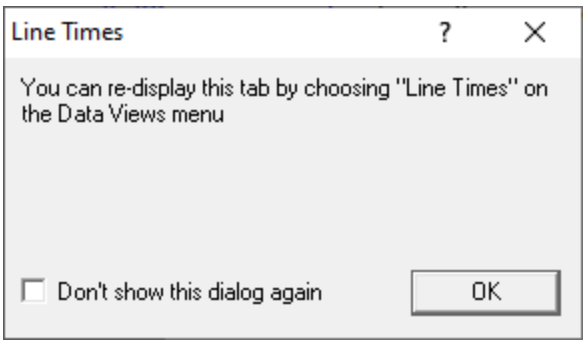


Selecting any of the items shows the relevant tab (if it's not visible already), and makes it the current selected tab.

- **Hide All Views** › hides all tabs *except* the one that's currently visible
- **Show All Views** › shows *all* the listed tabs, and in their normal order
- **Reset All Views** › shows only the most *popular* tabs, so excludes the Analysis, and the Line Times tabs

  This is the default setting when you first use the software

When you hide a tab (by clicking the cross on the right of the tab header), you'll initially be reminded of where to go to show it again, but you can choose not to keep seeing this reminder.

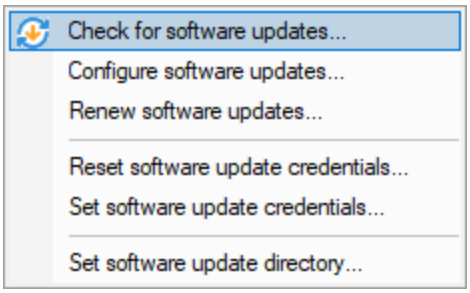


Hidden views are remembered between sessions.

3.2.8 Software Updates menu

Software Updates

All three items in this menu are covered in the Software Updates topic.

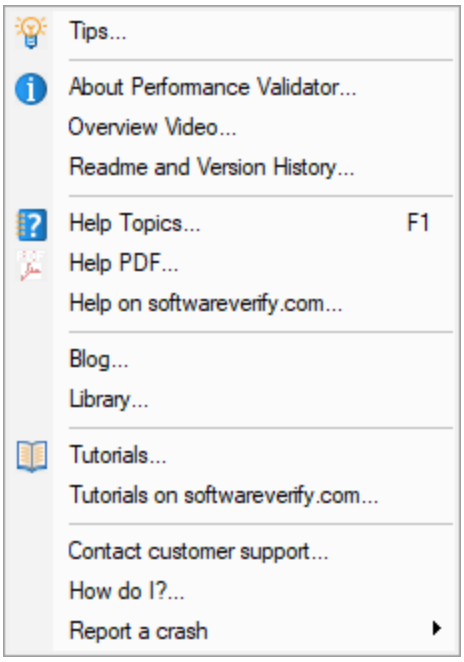


3.2.9 Help menu

Help Menu

The help menu provides access to this manual in different formats as well as tips and tutorials.

Click on an item in the picture below to find out more about each item in the Help topic:



➜ Check out the Frequently Asked Questions too!

3.3 Toolbar Reference

This reference section lists the various toolbars in Performance Validator, with quick links to their own section of the help manual.

The items are listed in left to right order.

Click on any part of the pictures below to jump straight to the topic:

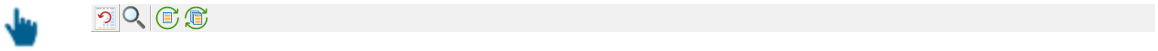
Standard toolbar

- Load session
- Save session
- Help

Session toolbar

- Settings
- Launch application using the launch chooser
- Relaunch the previously launched application
- Inject into application
- Wait for application to start
- Stop application
- Enable collecting data
- Disable collecting data

Tools



- Reset statistics
- Find
- Refresh view
- Refresh all views

3.4 The status bar

Elements of the status bar

The status bar has three main sections, from left to right:

- the message line
- data collection statistics
- program information

The message line

Most of the time, you'll just see this:

When you hover your mouse over a toolbar button or a menu item for a short time, a help message appears in the status bar describing the button's action.

Data collection statistics

The data statistics counts give a guideline indicator of how data is being collected by the stub and sent to Performance Validator.

This collection data has a few counters and a collection status:

- Data items sent from stub that have been processed
- Symbols that have been processed
- Function performance entries in the function timing tree
- Number of line count timing entries
- Status indicating whether collection is currently on or off

The boxes stay gray when the values are static, but will be coloured for a few seconds when the value changes:

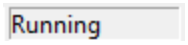
The value increased

The value decreased

Profiling status

The status of the flow trace indicates what is currently happening.

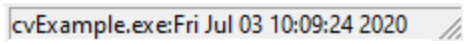
- **Ready**. Waiting to start a run, or a run has finished and is waiting for you to analyze the data.
- **Starting**. Starting a run (hooks being installed etc).
- **Running**. Target executable is hooked and running.
- **Terminating**. Target executable has entered ExitProcess but has not yet finished executing.
- **Post Processing**. Target executable has finished executing. There is data that still needs to be processed.



Target program name

This displays **No active session** when there is no session running, terminating or loaded.

When a session is running, terminated or loaded, this displays the name of the target program followed by a timestamp.



3.5 Keyboard Shortcuts

Keyboard shortcuts

The following shortcuts are available. Note the useful **F1** for contextual help.

Ctrl + A Select All

Ctrl + C Copy

Ctrl + F Find (file or function)

Ctrl + G Goto line (Source code views)

Ctrl + O Open session

Ctrl + S Save session

F1 Help (contextual for current view or dialog)

F2 Wait for application

F3 Inject into process

F4 Start application (Native / .Net)

Shift + F4 Start application (.Net Core)

F5 Restart application

F6 Monitor a Service

F7 Monitor IIS and ISAPI

F8 Monitor IIS and ASP.Net

F9 Monitor Web Development Server and ASP.Net

Ctrl + F4 Redisplay the previously chosen launch dialog.

3.6 Icons

Icons used in the main displays

Some of the displays include an icon on the left border of the scrolled list/tree to indicate the type of data that is present on that line.

Option enabled
Option disabled
Function is linked to another node in the tree
Function call is recursive
Source code line indicator
Source code
Line could not be hooked

3.7 The main display

The tab windows

The main display of Performance Validator consists of tabbed windows. Not all the tabs may be visible - see the Data Views menu to show any hidden tabs.

Each tab allows the performance data collected to be viewed, inspected and queried in different and complimentary ways.

Typical usage might be to use the Statistics, Call Tree or Call Graph tabs to monitor the most time consuming or slowest functions in the target program, and then use another view to gain insights at a different granularity or about related functions.

Click on an item in the picture below to find out more about each of the tabbed windows, or use the list further below:

Hiding and showing tabs

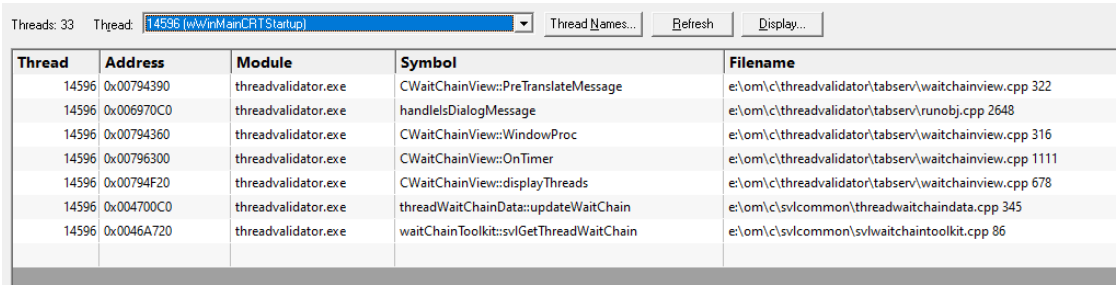
Each tabbed window can be closed by clicking the small [x] on the right hand side of the tab. The window can be redisplayed from the Data Views menu.

Icons

Most windows use a small number of icons to indicate different types of data.

3.7.1 Callstack

The **Callstack** view displays a snapshot of the callstack for a selected thread.



The callstack view

The callstack view shows a snapshot of the callstack for any thread in your application as the program runs.

The callstack is displayed in a columnar format with the following information in each level in the stack

- **Thread:** the id of the thread, or the name if one has been set
- **Address:** the address of the function
- **Module:** the DLL or executable name
- **Symbol:** the symbol of the method or function
- **Filename:** the path to the file containing the function, including line number

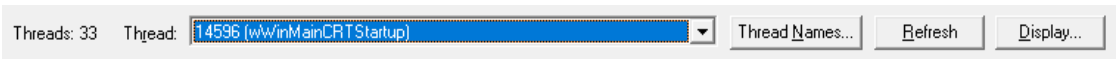
The display can be updated automatically from every 20ms to every 2s or only on demand.

If the threads in your application have been named (see how) then those names are displayed in the thread list so that you can identify them.

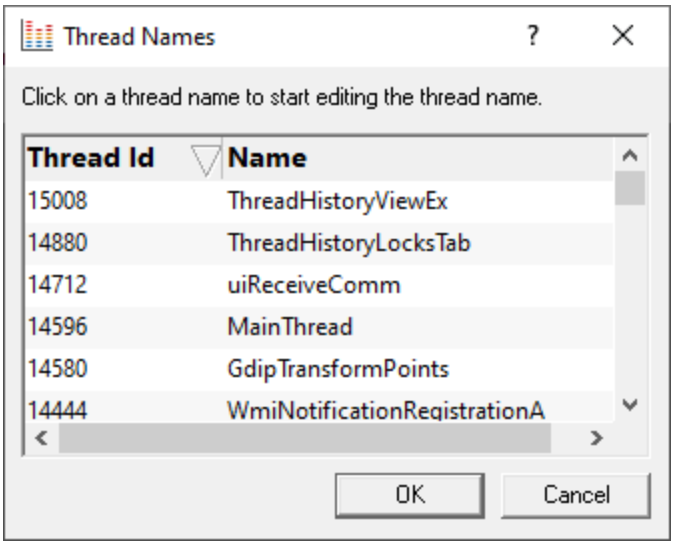
Alternatively, use the Thread Names dialog below, to assign names to the threads for the duration of the session.

Callstack display options

The callstack options let you choose which thread to monitor and how often.

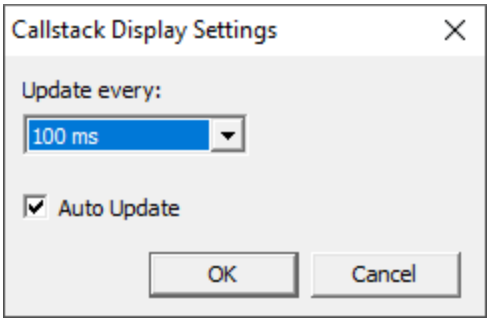


- **Thread** › select the thread which will have its callstack displayed
- **Refresh** › manually refresh the callstack of the selected thread
- **Thread Names...** › displays the Thread Names dialog



Double click the **Name** column and enter a name to associate with a **Thread Id**.

- **Display...** › displays the Callstack Display Settings dialog



  - **Update** › set the display update frequency, from every 20ms to every 2s
  - **Auto Update** › uncheck to disable the automatic callstack updates

Thread names

If a thread has been named using the Win32 `RaiseException` method, the Win32 `SetThreadDescription()`, or using `pvSetThreadName()` its name is shown in the list. See the link below for more details.

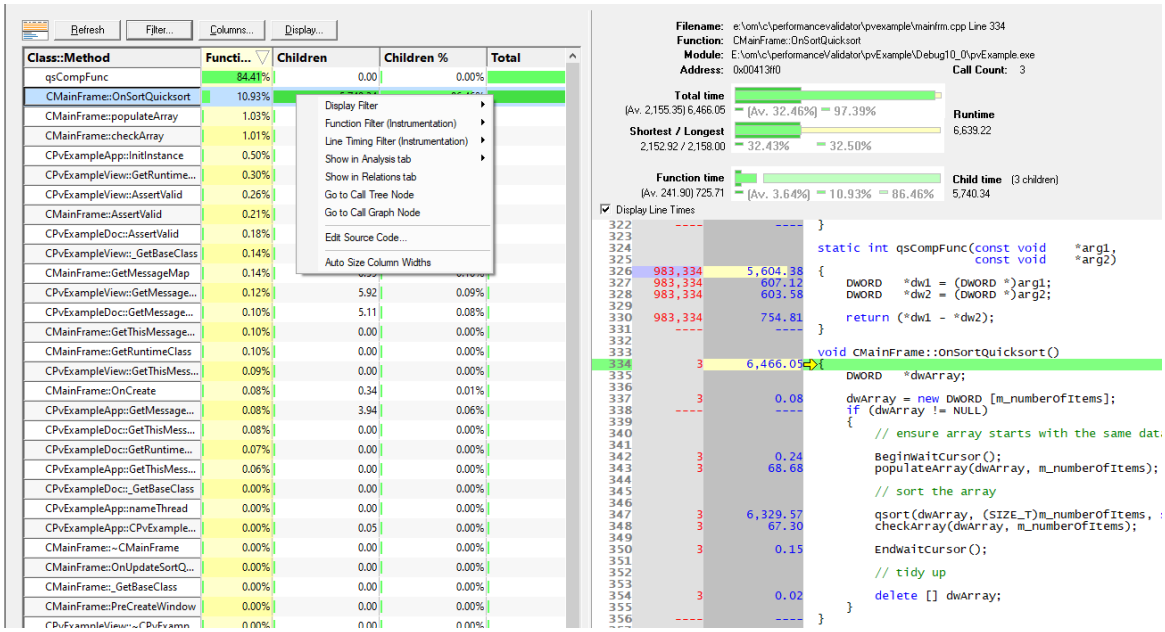
For threads not explicitly named by the above methods, Performance Validator provides automatically generated names based on the name of the function passed to `CreateThread()`, `_beginthread()`, or `_beginthreadex()`. If you want to give a thread a name here by double clicking on the name column and entering a name for the thread. Click outside the box or press return to complete the entry.

➡ How can I give a name to a thread from my code?

3.7.2 Statistics

The **Statistics** tab displays performance data about each function called by your program.

Read on, or click a part of the image below to jump straight to the help for that area.



As with many of the tab views, the display is split into two resizable panes.

- The table of statistics on the left has extensive performance data

  The table's popup menu provides plenty of options to filter data or to examine more detail

- The right side shows the source code view for any function selected on the left

The statistics view

Performance data is shown for every function that has been hooked.

The default ordering of functions is by directory first, and then by the files in those directories.

The data can be otherwise sorted by any column and you can change the frequency with which the data is updated.

The amount of information displayed can be controlled by adding or removing columns or by filtering for specific areas of interest.

Double clicking any item will display the function on the Relations tab.

What data is available?

The Statistics view can show a large amount of performance related data, although not all of it is displayed by default.

The following table list all the available columns of data.

Attribute	Description	Shown by default
• **Class**	class name	No
• **Method**	method name (or function name if no class)	No
• **Class::Method**	class::method name (or function name if no class)	Yes
• **Address**	function address	Yes if sampling
• **Num Children**	number of child functions of a function	No
• **Av Func** • **Av Func %**	average time a function takes to execute (excludes child functions)	No
• **Av Total** • **Av Total %**	average total time a function takes to execute, including its children	No
• **Call Count** • **Call Count %**	number of times the function is called	Yes
• **Function** • **Function %**	the time a function takes to execute (excludes child functions)	Yes
• **Children** • **Children %**	the time a function's child functions take to execute	Yes
• **Total** • **Total %**	the time a function and its child functions take to execute	Yes
• **Longest** • **Longest %**	the longest time a function and its child functions take to execute	
• **Shortest** • **Shortest %**	the shortest time a function and its child functions take to execute	
• **Sample Count** • **Sample Count %**	the number of times a function is found in the sampled data	Yes
• **Module**	name of the module containing the function	Yes
• **Filename**	name of the file containing the function	Yes

Items in green are not available in Sampling data collection mode as the yellow **Sample Count** columns are substituted instead.

Percentage values are relative to the total run time or total number of calls made to all functions.

➡ You may not need all this information - see the section on changing which columns are displayed.

Percentage bars

All the cells in the table that show numerical data have a percentage bar indicating one of the following:

- the function's value relative to the maximum value in the column

  e.g. Call Count in the example below

- the function's percentage contribution to the total

  e.g. Call Count %, or Function time, below

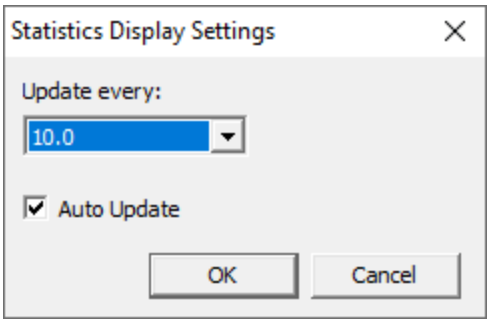
Class::Method	Call C...	Call Cou...	Function	Function...
CPvExampleView::GetRuntime...	6,751	14.74%	10.72	4.88%
CAtlTraceProcess::CategoryCo...	4,868	10.63%	3.02	1.37%
CPvExampleView::_GetBaseClass	3,526	7.70%	6.48	2.95%
CPvExampleView::GetThisMes...	2,149	4.69%	2.80	1.28%
CPvExampleDoc::GetThisMess...	1,912	4.17%	2.52	1.15%
CPvExampleDoc::GetRuntime...	1,704	3.72%	3.31	1.50%
CAtlTraceProcess::MaxSize	1,624	3.54%	1.01	0.46%
CAtlAllocator::GetCategory	1,622	3.54%	3.62	1.65%
CAtlTraceSettings::TryAllocate	1,597	3.49%	1.34	0.61%
CPvExampleApp::GetThisMess...	1,592	3.47%	2.08	0.95%
CPvExampleDoc::_GetBaseClass	107	0.23%	0.28	0.13%

Window orientation

To adapt to your screen layout, the horizontal or vertical orientation of the statistics and source code panes can be toggled with the orientation button.


Updating the display

- **Display...** › display the Statistics display dialog, which controls the auto-updating of the display.



- **Auto update...** › switch the automatic updating on or off - see the next option
- **...every *N* seconds** › automatically updates the display at your choice of interval, from 1.0 to 60 seconds

  Adjust this depending on the complexity of your application.

  An update interval that is too short may mean Performance Validator spends too much time updating the display.

- **Refresh** › updates the display - as does the button on the Tools menu and toolbar

  With auto update off, you'll need to use this Refresh button to update the display when you wish.

- **Do not scroll first column** › optionally keep the first column fixed when scrolling the table horizontally

  Unless you changed the visible columns, or reordered them, the first column will typically be Class::Method.

Sorting the data

You can sort the data in the table by clicking in the table header.

Note that while your application is executing, the sorted data is live. Sorting may not complete correctly as the data may change during the sort. Only when your program has finished executing is the sorted data guaranteed accurate.

Managing the data being displayed

There are two ways to change what's displayed in the view.

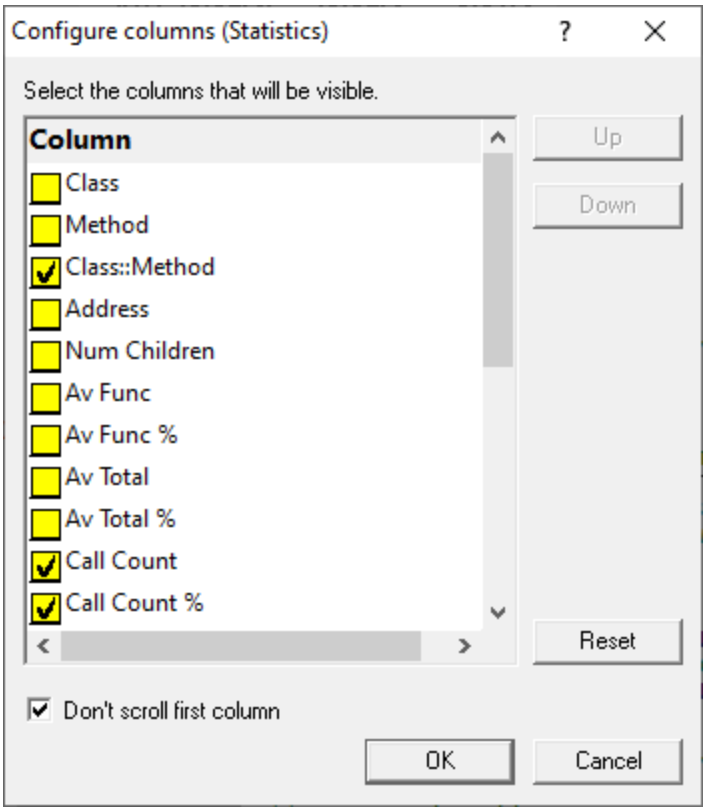
- hide or show whole columns of data in the table
- filter out unwanted functions, or only show specific functions of interest

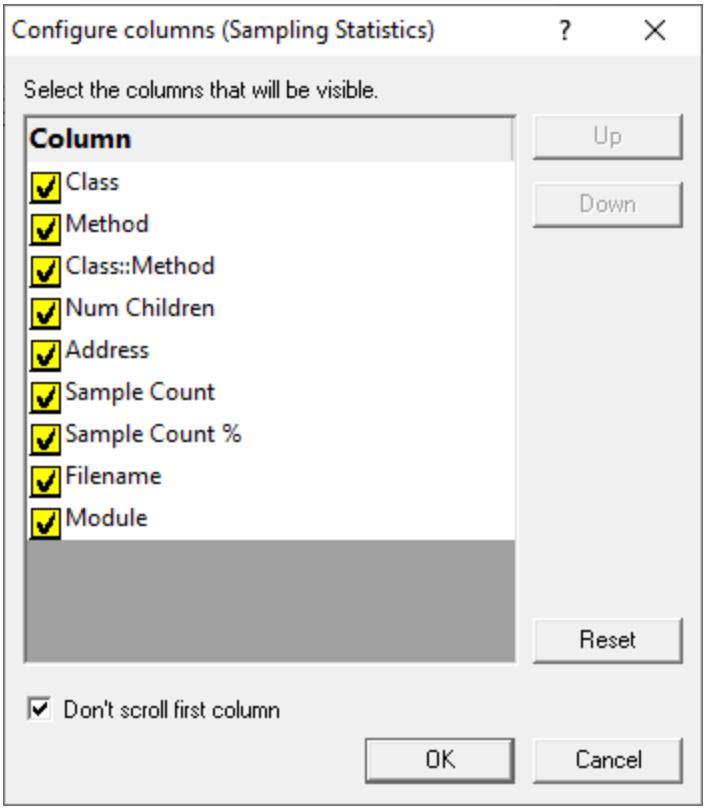
Changing which columns are displayed

The choice of which columns to display is the same on the Statistics and Relations tabs. In fact, you can choose to control columns in both areas from the same configuration dialog.

- **Columns** › shows the Configure Columns dialog for the Statistics view

  If you're using a sampling method to collect statistics, you'll see the dialog on the right.





Check or uncheck which columns you want to show and hide.

- **Up / Down** › nudge a selected column name up or down in the list

  Columns at the top are displayed left-most in the table

- **Reset** › set the visibility and the order of columns back to their defaults

- **Don't scroll first column** › optionally keep the first column fixed when scrolling the table horizontally

  Unless you changed the visible columns, or reordered them, the first column will typically be Class::Method.

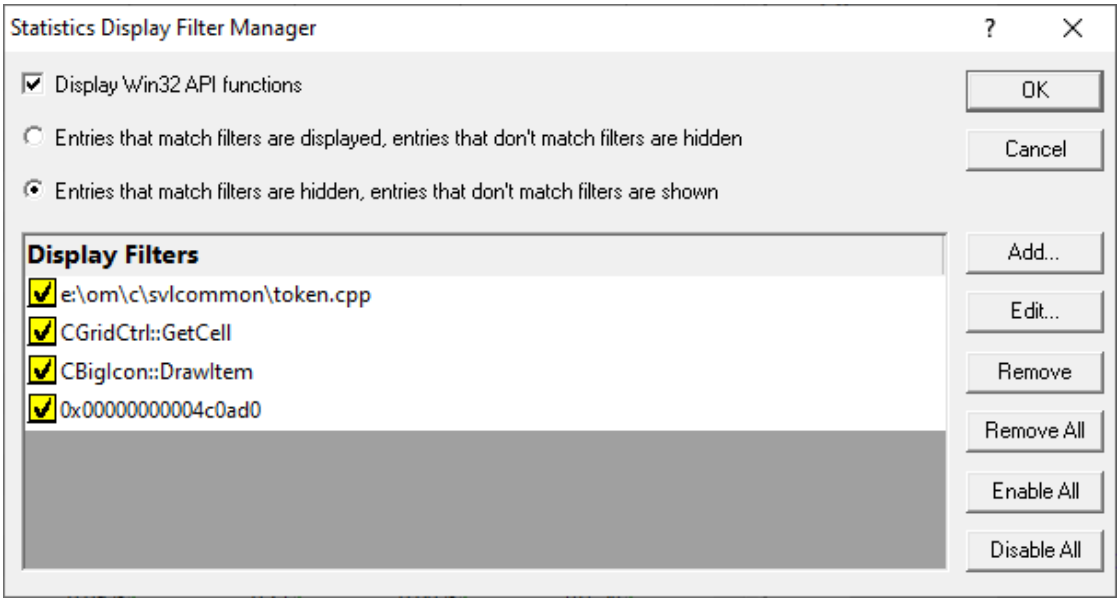
- **Apply to all display tabs** › if checked (default), the changes you make will affect both Statistics and Relations tabs

Once configured, click **OK** to apply the changes.

Filtering statistics in the table

The 'display filters' affect which functions are hidden and shown in the data. They do not affect which functions are hooked in the first place.

- **Filter** › shows the Statistics Display Filter Manager:



The dialog initially has no items in the list. Add some items manually or use the convenience filter options on the popup menu.

- **Add...** › displays the display filter dialog described below

- **Edit...** › opens the display filter dialog populated with the selected item's criteria, ready for editing

  Alternatively, just double click an entry in the list to show the filter dialog.

- **Remove** › remove selected filter(s) in the list
- **Remove All** › remove all filters

- **Enable All** › enables all filters in the list
- **Disable All** › disables all filters

  You can also enable or disable individual items in the list via the yellow check box at the left of each row.

- **Display Win32 API functions** › if selected this displays Win32 API functions otherwise Win32 API functions are hidden

- **Entries that match filters are displayed** › select this to *display only* matched items

- **Entries that match filters are hidden** › select this to *remove* matched items from the display

Take care when selecting **Entries that match filters are displayed** as clearing the list and leaving this checked will leave *no functions being displayed at all*!

The Display Filter dialog

The dialog below allows you to create a filter based on matching one or more criteria.

If you don't enter some of the details, they simply won't form part of the match criteria.

- **Enabled** › set this particular filter active or inactive

  This is exactly equivalent to checking the listed item in the display filter manager.

- **Class** › enter the class name that the filter must match

  If you enter a class but no method name then all functions in the class are filtered.

- **Method** › enter the method name

  If you enter a method but no class then the filter will match the named function in any class.

- **Filename** › filter all functions in the specified file

  The full path to the file is required.

- **Directory** › filter all functions in the specified directory

  The full directory path is required.

- **Module** › filter all functions in the specified module

  The full path to the module is required.

- **Address** › filter an exact address in memory

Finding text

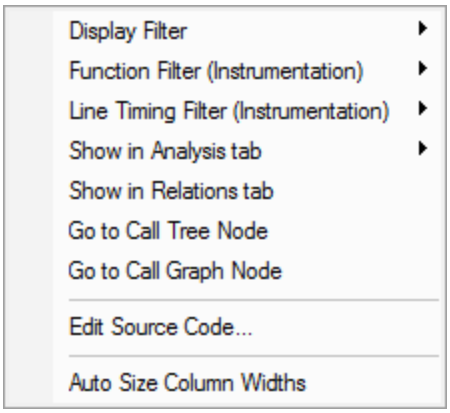
To find text in the table of statistics, use the Find Dialog where you can search in any or all of the different columns.

➡ The source code view has its own Find and Goto dialogs.

Statistics menu options

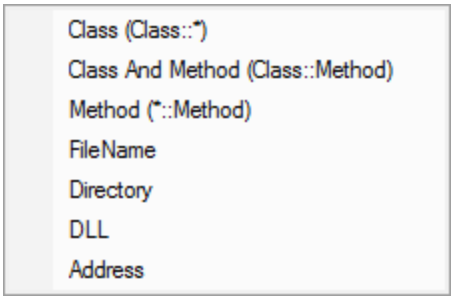
The following popup menu is available over the data area to add filters, examine relations or edit code.

Menu actions apply to the function for the row at the menu-click location.



Menu options: Display Filter

The display filter sub-menu below provides a quick and convenient way to hide or show data based on attributes of the selected item.



Choosing any of these options will add the filter to the Display Filter dialog.

For example:

- **Class** › hides all functions belonging to the same class
- **FileName** › hides all functions that were in the same file

These options work well for filtering out something you see in the display that you'd like to remove. You may not get the results you expect if the Display Filter dialog is set to have the filters inverted.

Menu options: Function filter (Instrumentation)

While the display filter controls visibility of hooked data, instrumentation filters control which functions are hooked in the first place.

The function instrumentation filter sub-menu lets you add hook filters at different levels of granularity.

The affect of adding function filters here depends on the current filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *excluding* newly selected hooks
- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The first three options add filters to the Class and Function Filter Settings:

- **By Class** › adds a new filter, excluding the entire class from the results of subsequent sessions
- **By Class and Method** › excludes only the selected function from new sessions
- **By Function** › excludes all matching function names irrespective of their containing class or even if not in a class at all

The next two, Filename and Directory, are part of the Source Files Filter settings.

- **By FileName** › adds a new filter, excluding all functions in the same file (as the selected item) from the results of subsequent sessions
- **By Directory** › excludes functions in all files in the same directory as the selected function

Finally, the DLL level is controlled by the Hooked DLLs settings.

- **By DLL** › excludes functions in all files belonging to the same executable or DLL as the selected function

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu options: Line timing filter (Instrumentation)

Line timing instrumentation filters control which lines are hooked for line timing and are independent of the function filters above.

The affect of adding line timing filters here depends on the current line timing filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *only including* newly selected hooks

  Note that this is the opposite of function filters.

- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The line timing instrumentation filter sub-menu lets you add hook filters at three different levels of granularity.

Each option add filters to the Line Timing Filter Settings:

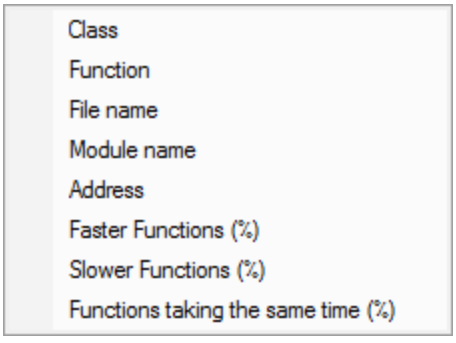
- **By Class** › adds a new filter, appending the entire class in the line timing results of subsequent sessions
- **By Class and Method** › include only the selected function in the line timing of new sessions
- **By Function** › includes all matching function names irrespective of their containing class or even if not in a class at all

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu option: Show in Analysis tab

The Analysis tab shows results of a query on the call tree based on the selected function and the criteria chosen from the menu:

- **Show in Analysis tab** › choose any item in the following sub-menu, to be switched to the Analysis tab



For example:

- **Class** › the Analysis tab will show all points in the call tree that match the class of the selected function
- **File name** › shows all points in the call tree that match the file name of the selected function

- **Slower Functions (%)** › shows all functions that are slower than the selected function

Menu options: Show in other tabs

- **Show in Relations tab** › switch to the Relations tab where you can examine functions that either call, or are called by, the selected function

  Double clicking any item will also display it in the Relations tab.

- **Go to Call Tree Node** › switch to the Call Tree view where the display will be expanded to show the first match found for the selected function
- **Go to Call Graph Node** › switch to the Call Graph view where the display will be expanded to show the first match found for the selected function

Menu option: editing source code

- **Edit Source Code...** › opens the default or preferred editor to edit the source code

Menu option: column widths

- **Auto size column widths** › sets the width of each column in the table appropriate to the content within

The file source code view

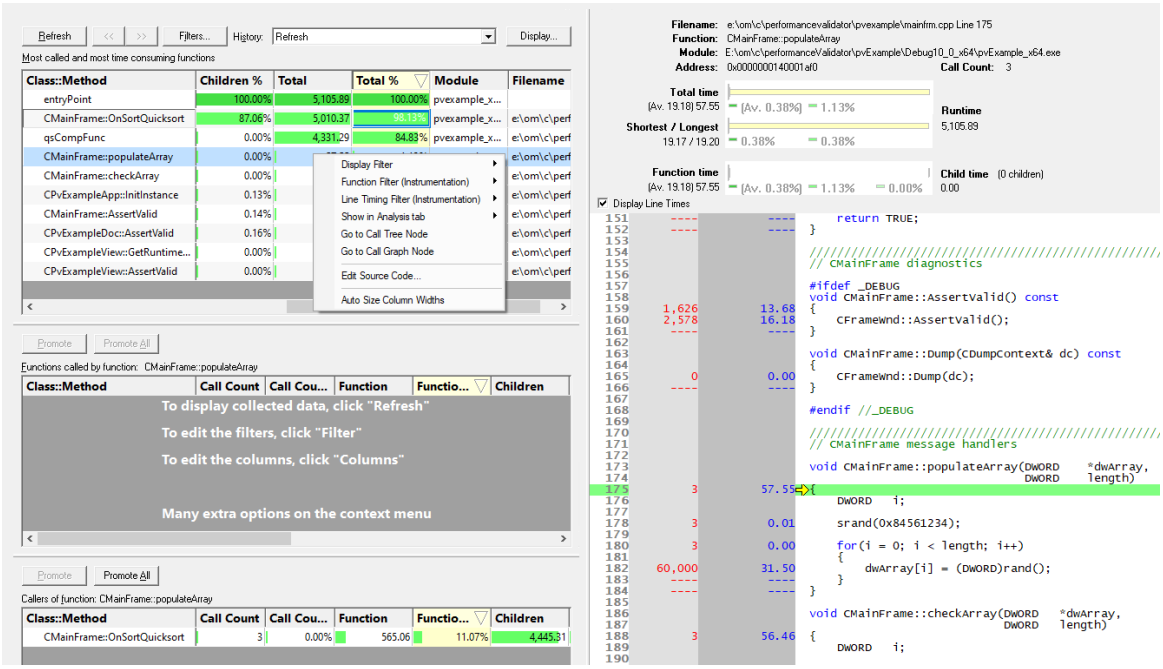
Clicking on a function in the statistics table shows that function's source code file in the right hand pane.

The source code view is described in detail separately as its behaviour is the same for all views.

3.7.3 Relations

The **Relations** tab displays information about the slowest or most called functions in your program, as well as their calling functions or functions that are called by them.

Read on, or click a part of the image below to jump straight to the help for that area.



As with many of the tab views, the display is split into two resizable panes.

- the left side shows three tables of related functions:
  - most called and most time consuming functions
  - functions *called by* one of those functions
  - functions *that call* one of those function

  Each table's popup menu provides options to filter data or to examine it in more detail
- The right side shows the source code view for any function selected from any table on the left

Most common and most time consuming functions

The table shows a list of functions, with the statistics displayed being identical to that shown in the Statistics view.

This top table can be populated with functions in several ways:

- use Refresh to update the list with the top items, using display options

  There is no automatic refresh - the display is only updated on a manual refresh.
- select a function from another tab view to make it appear here

  For example, double clicking any function in the Statistics view will display the selected function here.
- promote one or more functions from one of the two lower tables

The statistics can be sorted by any column and filtered by class, function, file or module.

The amount of information displayed can be controlled by adding or removing columns or by filtering for specific areas of interest.

When a function is selected in this table, the lower two tables update to show information about called and caller functions.

Percentage bars

Like the Statistics tab, all cells in the tables that show numerical data have a percentage bar indicating one of the following:

- the function's value relative to the maximum value in the column
- the function's percentage contribution to the total

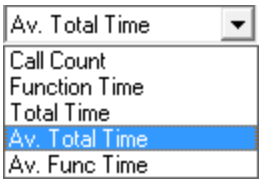
Updating the display

- **Refresh** › updates the display with the top functions - as does the button on the Tools menu and toolbar

  As there's no auto update, you'll need to use this Refresh button to update the display when you wish.

When manually refreshing the top functions, you may be interested in a certain performance measurement:

- **Display** › choose one of the available criteria by which to display the top functions



  The default is Average Total Time - i.e. the average time taken by a function and all its children.

  Changing the metric will refresh the list functions in the table.

  When in sampling mode, **Sample Count** will be the only available option here - i.e. the number of times a function appears in the sampled collection data.

- **Quantity** › set the number of items to show when refreshing the top functions

Managing the data being displayed

There are two ways to change what's displayed in the view.

- hide or show whole columns of data in the table
- filter out unwanted functions, or only show specific functions of interest

Changing which columns are displayed

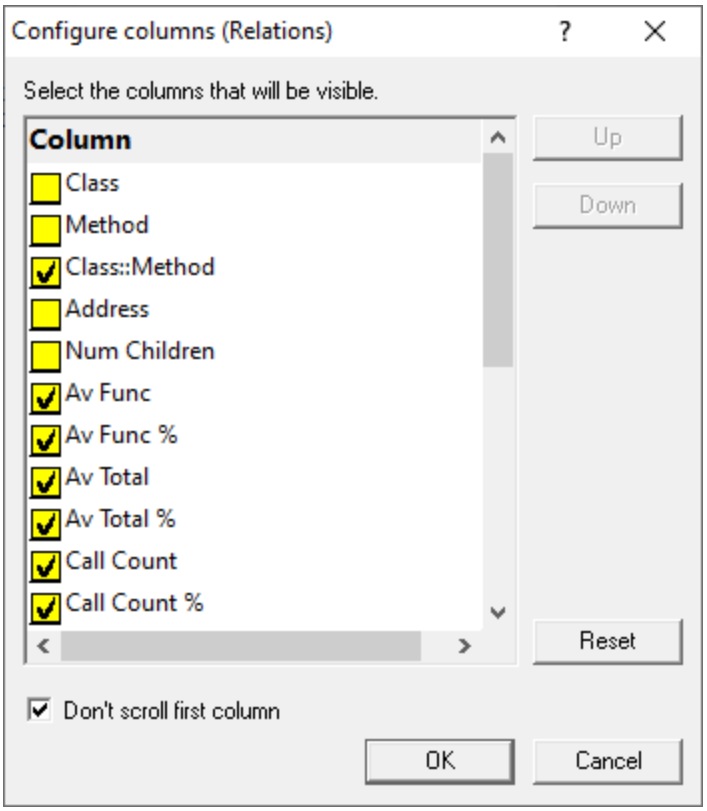
You can sort the data in the tables by clicking in the table headers.

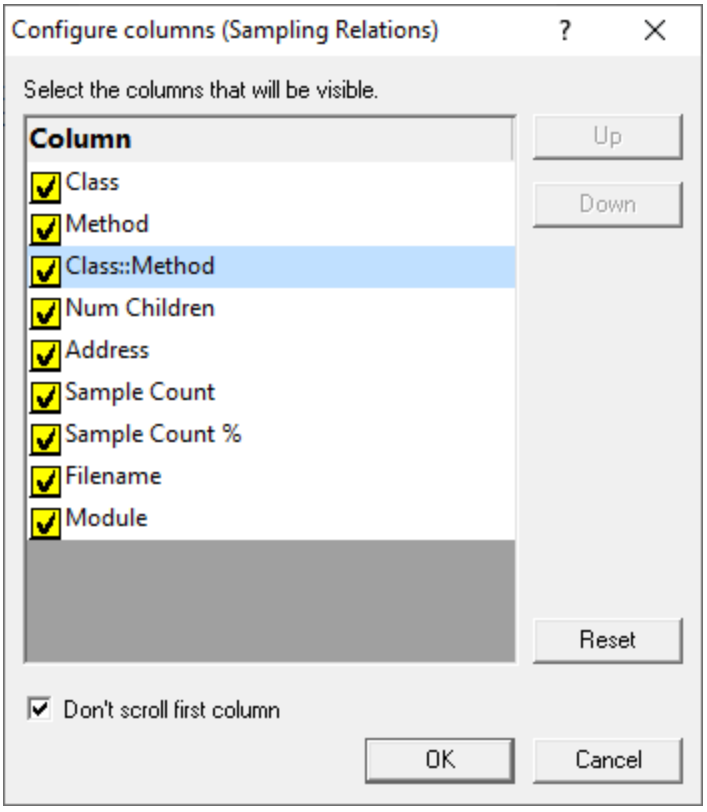
The choice of which columns to display is the same on the Statistics and Relations tabs. In fact, you can control columns in both areas from the same configuration dialog.

Each table on the Relations tab has control of its own columns, but by default, the displayed columns are synched across all three tables.

- **Columns** › shows the Configure Columns dialog for the Relations view

  If you're using a sampling method to collect statistics, you'll see the dialog on the right.





Check or uncheck which columns you want to show and hide.

- **Up / Down** › nudge a selected column name up or down in the list

  Columns at the top are displayed left-most in the table

- **Reset** › set the visibility and the order of columns back to their defaults

- **Don't scroll first column** › optionally keep the first column fixed when scrolling the table horizontally

  Unless you changed the visible columns, or reordered them, the first column will typically be Class::Method.

  All three tables are affected.

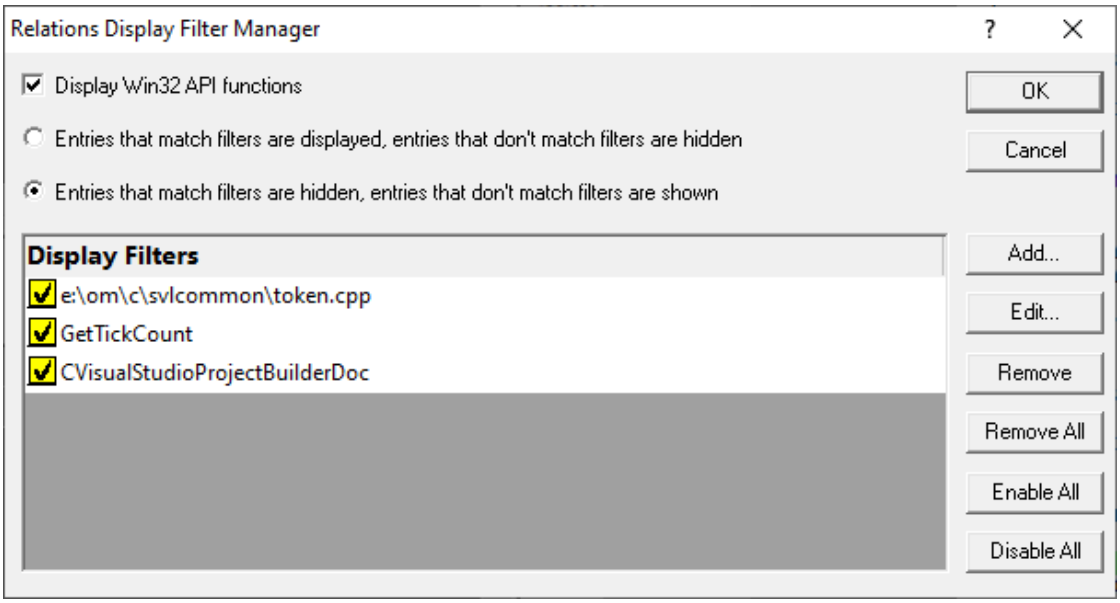
- **Apply to all display tabs** › if checked (default), the changes you make will affect all three tables *and* the data on the Statistics tab

Once configured, click **OK** to apply the changes.

Filtering data in the tables

The display filters affect which functions are hidden and shown in the data. They do not affect which functions are hooked in the first place.

- **Filters** › shows the Relations Display Filter Manager:



The dialog initially has no items in the list. Add some items manually or use the convenience filter options on the popup menus.

- **Add...** › displays the display filter dialog described below

- **Edit...** › opens the display filter dialog populated with the selected item's criteria, ready for editing

  Alternatively, just double click an entry in the list to show the filter dialog.

- **Remove** › remove selected filter(s) in the list
- **Remove All** › remove all filters

- **Enable All** › enables all filters in the list
- **Disable All** › disables all filters

  You can also enable or disable individual items in the list via the yellow check box at the left of each row.

- **Display Win32 API functions** › if selected this displays Win32 API functions otherwise Win32 API functions are hidden

- **Entries that match filters are displayed** › select this to *display only* matched items

- **Entries that match filters are hidden** › select this to *remove* matched items from the display

Take care when selecting **Entries that match filters are displayed** as clearing the list and leaving this checked will leave *no functions being displayed at all*!

The display filter affects all three tables.

The Display Filter dialog

The dialog below allows you to create a filter based on matching one or more criteria.

If you don't enter some of the details, they simply won't form part of the match criteria

- **Enabled** › set this particular filter active or inactive

  This is exactly equivalent to checking the listed item in the display filter manager.

- **Class** › enter the class name that the filter must match

  If you enter a class but no method name then all functions in the class are filtered.

- **Method** › enter the method name

  If you enter a method but no class then the filter will match the named function in any class.

- **Filename** › filter all functions in the specified file

  The full path to the file is required.

- **Directory** › filter all functions in the specified directory

  The full directory path is required.

- **Module** › filter all functions in the specified module

  The full path to the module is required.

- **Address** › filter an exact address in memory

Browsing history

The History option provides a simple way to revisit previously refreshed or promoted functions:

- **<< / >>** › navigate backwards or forwards through the groups of functions

  These buttons will be disabled if there are no prior or later views available.

- **History** › select a result directly from the drop-down menu

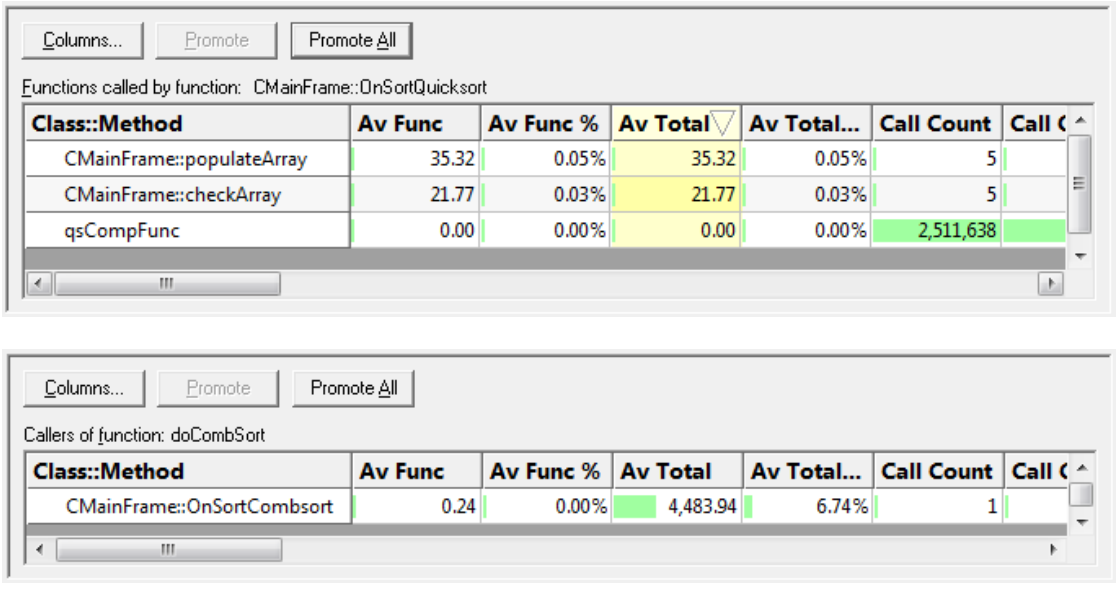
  Where a set of functions resulted from a manual refresh, the item in the drop down list is labeled **Filter Refresh**.

Navigating the browsing history affects only the set of functions displayed. It does not revert display filters or other options.

If your session is still running, navigating back and forth in the results doesn't update the numbers. Only a manual **Refresh** does this.

Called and caller functions

When a function is selected in the top table, the lower two tables update to show information about called and caller functions.



Column visibility is controlled as for the top table.

Both tables give you the option to promote one or all functions into the top table.

Repeating this process effectively navigates up or down the call tree hierarchy.

- **Promote** › push the selected function into the top table

  Double clicking an item has the same effect.

- **Promote All** › push all the functions into the top table

Finding text

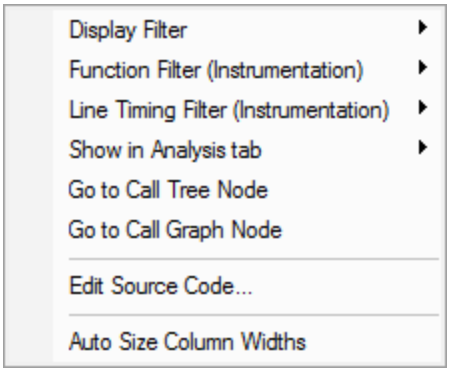
To find text in the top table, use the Find Dialog where you can search in any or all of the different columns.

➜ The source code view has its own Find and Goto dialogs.

Relations menu options

The following popup menu is available over the tables to add filters, examine relations or edit code.

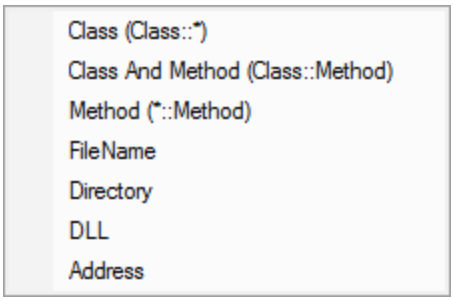
Menu actions apply to the function for the row at the menu-click location.



The menu options are identical in behaviour to the Statistics tab menu options so if you've already read that you can skip to the next topic - the Call Tree.

Menu options: Display Filter

The display filter sub-menu below provides a quick and convenient way to hide or show data based on attributes of the selected item.



Choosing any of these options will add the filter to the Display Filter dialog.

For example:

- **Class** › hides all functions belonging to the same class
- **FileName** › hides all functions that were in the same file

Filtering out functions will reduce the number of functions displayed, even if there are more 'top' functions than specified by the Quantity setting

These options work well for filtering out something you see in the display that you'd like to remove. You may not get the results you expect if the Display Filter dialog is set to have the filters inverted.

Menu options: Function filter (Instrumentation)

While the display filter controls visibility of hooked data, instrumentation filters control which functions are hooked in the first place.

The function instrumentation filter sub-menu lets you add hook filters at different levels of granularity.

The affect of adding function filters here depends on the current filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *excluding* newly selected hooks
- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The first three options add filters to the Class and Function Filter Settings:

- **By Class** › adds a new filter, excluding the entire class from the results of subsequent sessions
- **By Class and Method** › excludes only the selected function from new sessions
- **By Function** › excludes all matching function names irrespective of their containing class or even if not in a class at all

The next two, Filename and Directory, are part of the Source Files Filter settings.

- **By FileName** › adds a new filter, excluding all functions in the same file (as the selected item) from the results of subsequent sessions
- **By Directory** › excludes functions in all files in the same directory as the selected function

Finally, the DLL level is controlled by the Hooked DLLs settings.

- **By DLL** › excludes functions in all files belonging to the same executable or DLL as the selected function

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu options: Line timing filter (Instrumentation)

Line timing instrumentation filters control which lines are hooked for line timing and are independent of the function filters above.

The affect of adding line timing filters here depends on the current line timing filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *only including* newly selected hooks

  Note that this is the opposite of function filters.

- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The line timing instrumentation filter sub-menu lets you add hook filters at three different levels of granularity.

Each option add filters to the Line Timing Filter Settings:

- **By Class** › adds a new filter, appending the entire class in the line timing results of subsequent sessions
- **By Class and Method** › include only the selected function in the line timing of new sessions

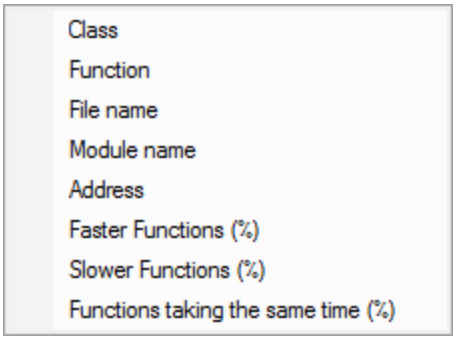
- **By Function** › includes all matching function names irrespective of their containing class or even if not in a class at all

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu option: Show in Analysis tab

The Analysis tab shows results of a query on the call tree based on the selected function and the criteria chosen from the menu:

- **Show in Analysis tab** › choose any item in the following sub-menu, to be switched to the Analysis tab



For example:

- **Class** › the Analysis tab will show all points in the call tree that match the class of the selected function
- **File name** › shows all points in the call tree that match the file name of the selected function
- **Slower Functions (%)** › shows all functions that are slower than the selected function

Menu options: Show in other tabs

- **Go to Call Tree Node** › switch to the Call Tree view where the display will be expanded to show the first match found for the selected function
- **Go to Call Graph Node** › switch to the Call Graph view where the display will be expanded to show the first match found for the selected function

Menu option: editing source code

- **Edit Source Code...** › opens the default or preferred editor to edit the source code

Menu option: column widths

- **Auto size column widths** › sets the width of each column in the table appropriate to the content within

The file source code view

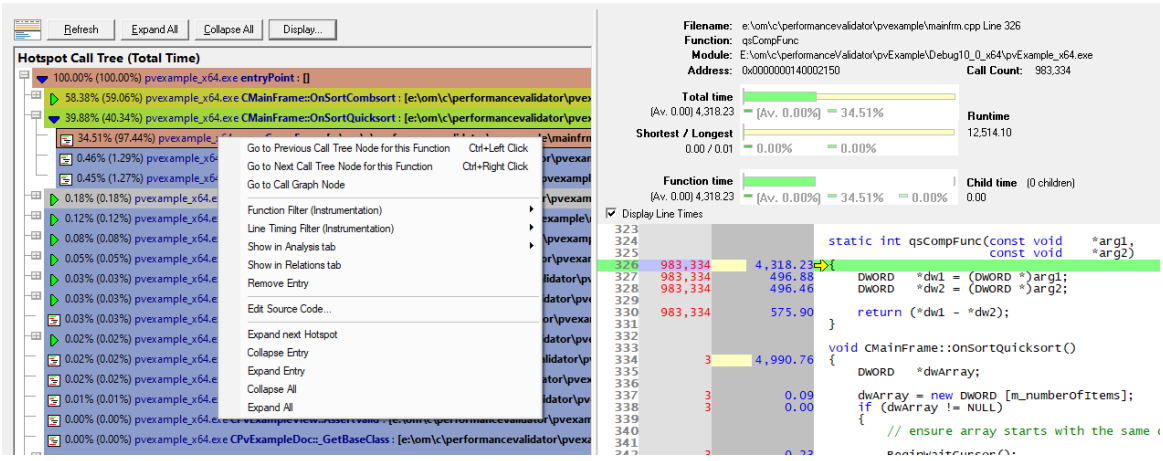
Clicking on a function in any of the tables shows that function's source code file in the right hand pane.

The source code view is described in detail separately as its behaviour is the same for all views.

3.7.4 Call Tree

The **Call Tree** view displays the performance data as a hierarchical tree.

Read on, or click a part of the image below to jump straight to the help for that area.



As with many of the tab views, the display is split into two resizable panes.

- the left side shows an ordered hierarchical view of the functions called in the program's execution

  The tree's popup menu provides options to filter data or to examine it in more detail.

- The right side shows the source code view for any function selected on the left

The call tree view

Performance data is shown in an ordered tree for every function that has been hooked and called.

Functions are initially ordered by Total Time - the time a function and its child functions contribute to the total run time.

Child functions that get called will appear as child nodes in the tree; just expand a node to dig deeper.

Selecting a function shows its source code in the right hand pane.

Double clicking any item will display the function on the Relations tab.

As this is a call tree, functions can appear in multiple locations if called by different parent functions.

Unlike the Call Graph, function timings shown here are for the time spent in the *relevant part of the call tree*, not a combined total for *everywhere* that a function may be used.

Window orientation

To adapt to your screen layout, the horizontal or vertical orientation of the call tree and source code panes can be toggled with the orientation button.

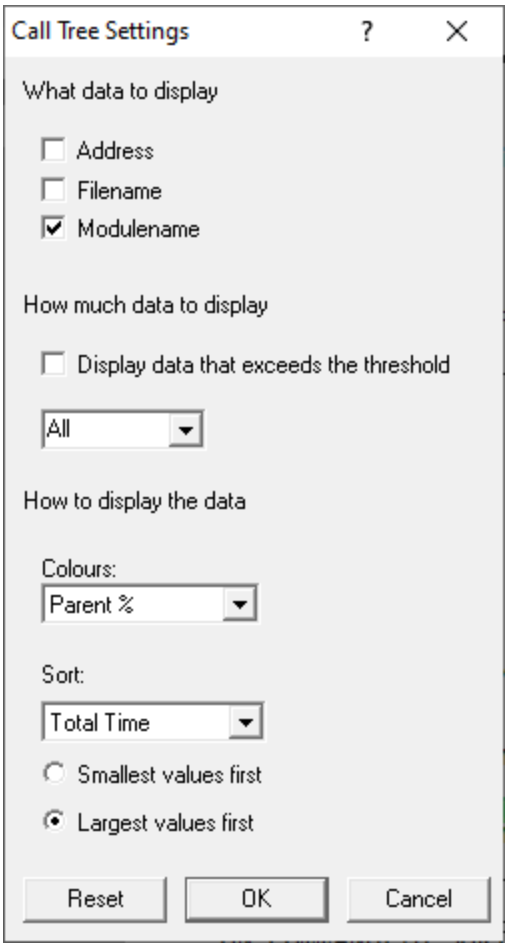
Updating the display

- **Refresh** › updates the display with the called functions and performance data - as does the button on the Tools menu and toolbar

  A refresh automatically expands the first nodes in the tree and highlights the most time consuming low-level function.

  As there's no auto update here, you'll need to use this Refresh button to update the display when you wish.

- **Collapse / Expand All** › hide or show every node in the tree
- **Display...** › shows the Call Tree Display Settings dialog



Call tree colours

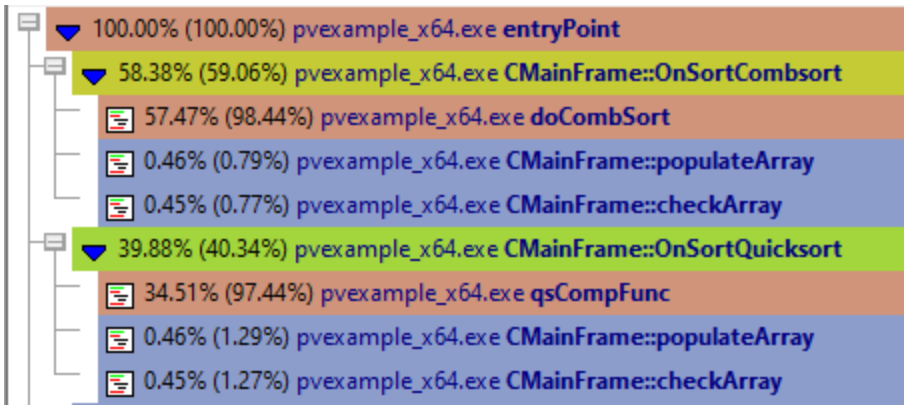
The tree is coloured using the customisable Hotspot Colours settings that range from 100% down to 0%.

- **Colours** › choose the way the colour scheme is applied in the tree
  - **Parent %** › colouring is based on function time relative to that of its parent's function time

    In the example below:

    `qsCompFunc` is in the 90-100% colour band as it contributed 97.44% of its parent's function time

    `doCombSort` is in the 90-100% colour band as it contributed 98.44% of its parent's function time

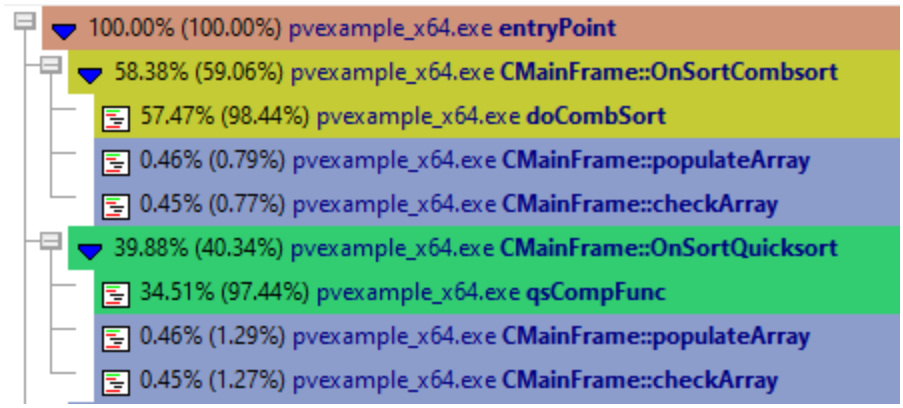


- **Total %** › colouring is based on function time relative to the total execution time

  Now in the example:

  `qsCompFunc` is in the 50-60% colour band as it contributed 34.51% to the total run time

  `doCombSort` is in the 30-40% colour band as it contributed 57.47% to the total run time



- **No Colour** › black and white display only

Sorting the data

The tree is initially ordered by most time consuming function first (Total Time)

- **Sort** › choose one of the criteria from the list › **Refresh** the display

  The options are:

  - **Total Time** › the time all calls to a function and it's child functions contribute to the total run time
  - **Average Time** › the time an average call to a function and it's child functions contribute to the total run time
  - **Call Count** › the number of times a function appears in the sampled collection data

When in sampling mode, **Call Count** will be the *only* available option here

- **Ascending / Descending** › change the ordering direction of the data

Note that while your application is executing, the sorted data is live. Sorting may not complete correctly as the data may change during the sort. Only when your program has finished executing is the sorted data guaranteed accurate.

Managing the data being displayed

You can't filter out functions by name but there are two ways to change what's displayed in the view:

Change the amount of detail shown for each function:

- **Address** › check to show the address in memory for the function
- **Filename** › check to show the file location in which the function was found
- **Modulename** › shows the function's module

Reduce the scope of the tree by hiding less significant functions:

- **Threshold** › set a percentage threshold below which contributing functions are hidden

  Higher numbers exclude more nodes.

  You'll need to do a manual **Refresh** to update the display.

  By default the threshold applies to the top level functions only.

  The threshold percentage is based on each callstack's contribution to the total runtime or total number of function calls.

  The default **All** option includes all nodes.

- **Apply Threshold to Children** › check to hide *any* function (as opposed to just top level nodes) in the tree that lies below the threshold contribution

Finding text

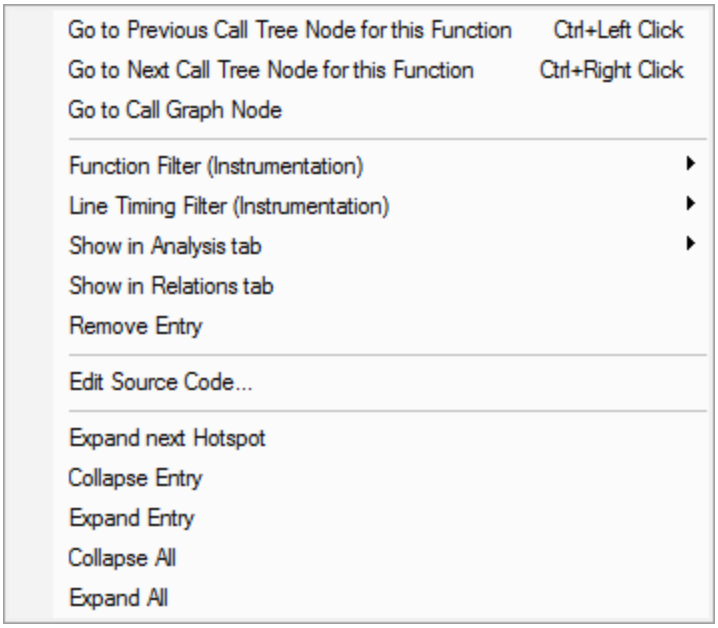
To find text in the tree, use the Find Dialog where you can search for functions, files and modules.

➡ The source code view has its own Find and Goto dialogs.

Call tree menu options

The following popup menu is available over the tree to add filters, examine relations or edit code.

Menu actions apply to the function in the tree at the menu-click location.



Menu options: Previous and next call tree nodes

Functions may appear in the tree more than once if called by different parent functions.

- **Go to Previous Call Tree Node for this Function** › jump to the *previous* instance of this function in the tree

  Ctrl + has the same action

- **Go to Next Call Tree Node for this Function** › jump to the *next* instance of this function in the tree

  Ctrl + has the same action

If there are no previous or next instances, nothing will happen.

Menu options: Call graph

The Call Graph view is similar to the Call Tree, but where a function would appear multiple times, it instead appears once as the main instance, and is then linked to from other locations.

The times shown in a call graph are accumulated total times rather than the time spent strictly under their parent functions.

- **Go to Call Graph Node** › open the Call Graph view at the main entry for the selected function

Menu options: Function filter (Instrumentation)

While the display filter controls visibility of hooked data, instrumentation filters control which functions are hooked in the first place.

The function instrumentation filter sub-menu lets you add hook filters at different levels of granularity.

The affect of adding function filters here depends on the current filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *excluding* newly selected hooks
- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The first three options add filters to the Class and Function Filter Settings:

- **By Class** › adds a new filter, excluding the entire class from the results of subsequent sessions
- **By Class and Method** › excludes only the selected function from new sessions
- **By Function** › excludes all matching function names irrespective of their containing class or even if not in a class at all

The next two, Filename and Directory, are part of the Source Files Filter settings.

- **By FileName** › adds a new filter, excluding all functions in the same file (as the selected item) from the results of subsequent sessions
- **By Directory** › excludes functions in all files in the same directory as the selected function

Finally, the DLL level is controlled by the Hooked DLLs settings.

- **By DLL** › excludes functions in all files belonging to the same executable or DLL as the selected function

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu options: Line timing filter (Instrumentation)

Line timing instrumentation filters control which lines are hooked for line timing and are independent of the function filters above.

The affect of adding line timing filters here depends on the current line timing filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *only including* newly selected hooks

  Note that this is the opposite of function filters.

- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The line timing instrumentation filter sub-menu lets you add hook filters at three different levels of granularity.

Each option add filters to the Line Timing Filter Settings:

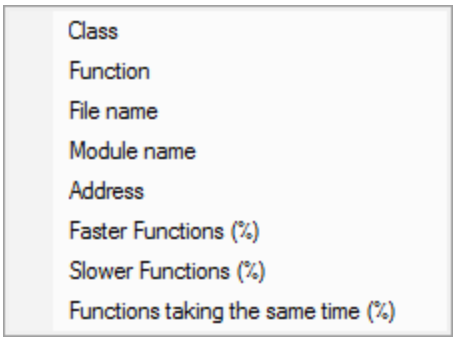
- **By Class** › adds a new filter, appending the entire class in the line timing results of subsequent sessions
- **By Class and Method** › include only the selected function in the line timing of new sessions
- **By Function** › includes all matching function names irrespective of their containing class or even if not in a class at all

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu option: Show in Analysis tab

The Analysis tab shows results of a query on the call tree based on the selected function and the criteria chosen from the menu:

- **Show in Analysis tab** › choosing any item in the following sub-menu, to be switched to the Analysis tab



For example:

- **Class** › the Analysis tab will show all points in the call tree that match the class of the selected function
- **File name** › shows all points in the call tree that match the file name of the selected function
- **Slower Functions (%)** › shows all functions that are slower than the selected function

Menu options: Show in Relations tabs

- **Show in Relations tab** › switch to the Relations tab where you can examine functions that either call, or are called by, the selected function

  Double clicking any item will also display it in the Relations tab.

Menu options: Remove entry

You can hide some entries from the Call Tree display.

Hiding entries is a very temporary action since a function and its children will only be hidden from view until the next **Refresh**.

- **Remove entry** › hides the selected function in the tree

  Only the selected node is hidden. Other calls to the same function in a different part of the call tree will remain.

Menu option: editing source code

- **Edit Source Code...** › opens the default or preferred editor to edit the source code

Menu options: Expand and collapse

The last few menu options expand and collapse parts of the tree.

- **Expand Next Hotspot** › finds the next most significant performance hotspot in the call tree and expands all the callstack nodes to make it visible
- **Collapse / Expand Entry** › close or recursively open the selected function to its full extent
- **Collapse / Expand All** › completely collapse or expand the entire tree

The file source code view

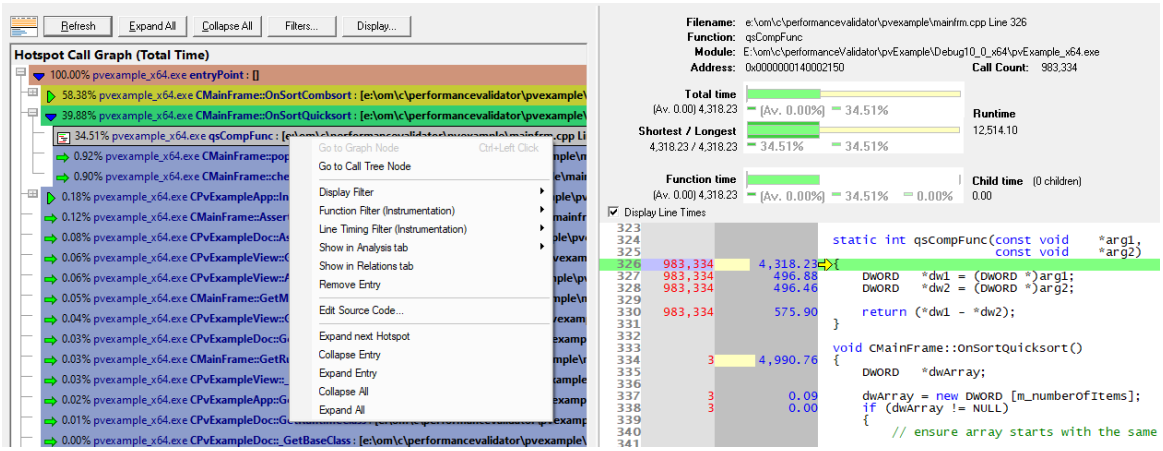
Clicking on a function in the call tree shows that function's source code file in the right hand pane.

The source code view is described in detail separately as its behaviour is the same for all views.

3.7.5 Call Graph

The **Call Graph** view displays the performance data as a hierarchical tree, similar to the Call Tree.

Read on, or click a part of the image below to jump straight to the help for that area.



As with many of the tab views, the display is split into two resizable panes.

- the left side shows an ordered hierarchical view of the functions called in the program's execution

  The graph's popup menu provides options to filter data or to examine it in more detail

- The right side shows the source code view for any function selected on the left

The call graph view

Performance data is shown in an ordered graph for every function that has been hooked and called.

Functions are initially ordered by Total Time - the time a function and its child functions contribute to the total run time.

Child functions that get called will appear as child nodes in the graph; just expand a node to dig deeper.

Selecting a function shows its source code on the right hand pane.

Double clicking any item will display the function on the Relations tab.

Functions in the graph may display one of the following icons:

- Function is not the *main* instance but links to its main node in the graph via the menu options
- Function call is recursive

Note that while your application is executing, the data is live and may not show correctly, for example some percentages may be large. Only when your program has finished executing is the data guaranteed accurate.

The call graph vs the call tree

In a call tree the same hierarchy of functions and their children can appear in multiple locations if called by different parent functions.

In a call *graph* that hierarchy can only appear once. There will be one *main* instance and multiple links to it from other locations in the graph.

The main instance will detail timings as a combined total for *everywhere* that a function is used.

This is as opposed to a call tree where function timings are for the time spent only in the callstack that leads to the node.

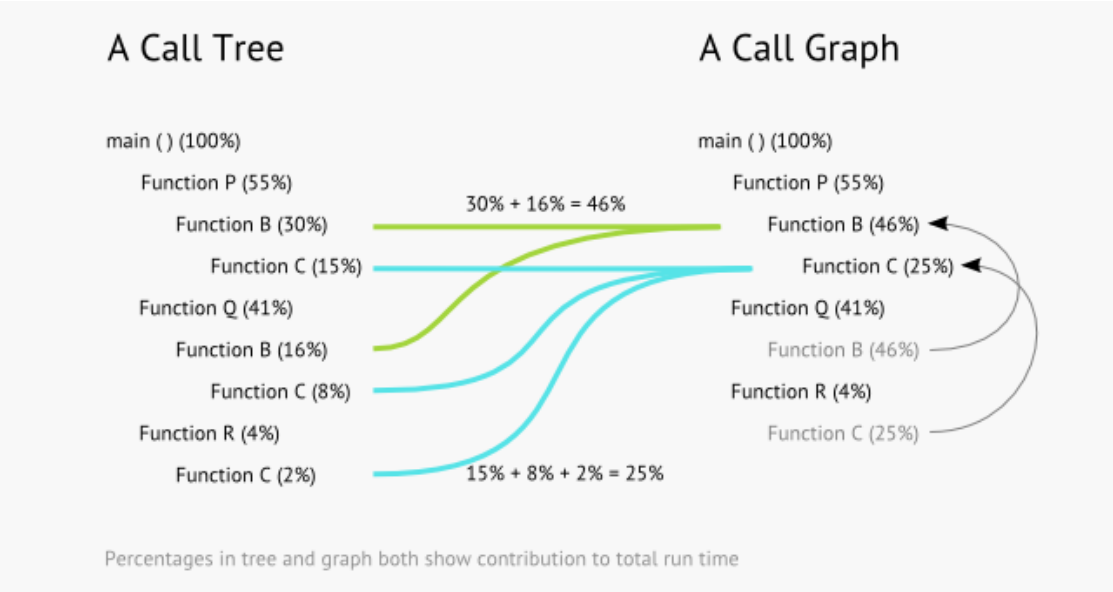
This is demonstrated in the following example where...

- Functions P and Q both call B which in turn calls C
- Function R calls C directly

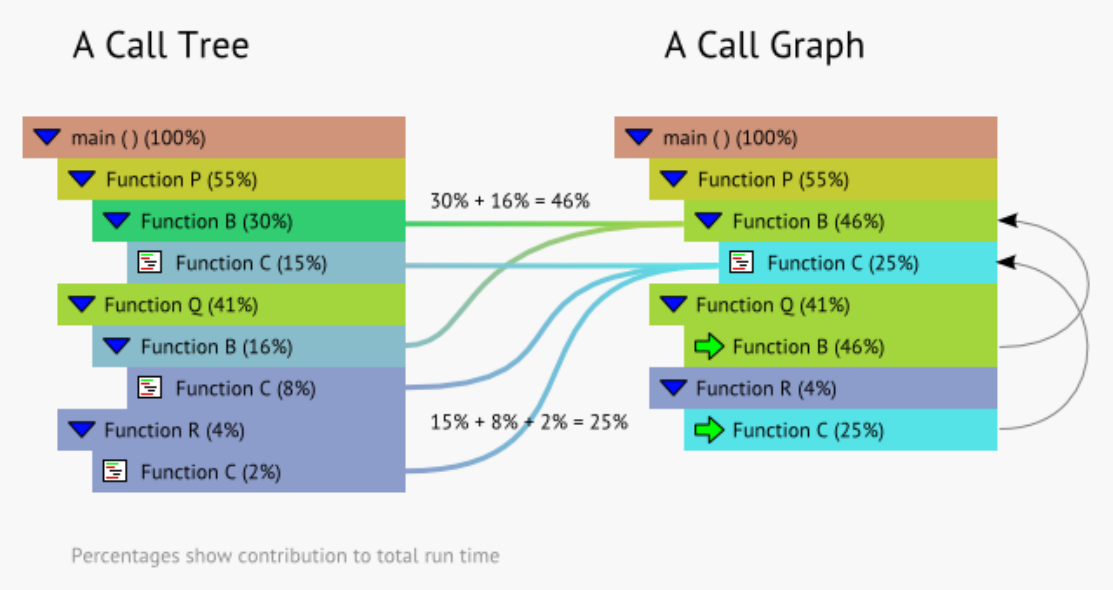
The call tree on the left below shows different timings for each of the 2 calls to B, and the 3 calls to C. These are the contributions from the different callstacks.

In the call graph all the times are summed together.

The call graph shows one main instance for B and C, and although there are other entries for functions B and C, all those do is link to the main instance.



In Performance Validator these examples might appear as below, with the tree and graph both coloured according to Total %.



Window orientation

To adapt to your screen layout, the horizontal or vertical orientation of the call graph and source code panes can be toggled with the orientation button.


Updating the display

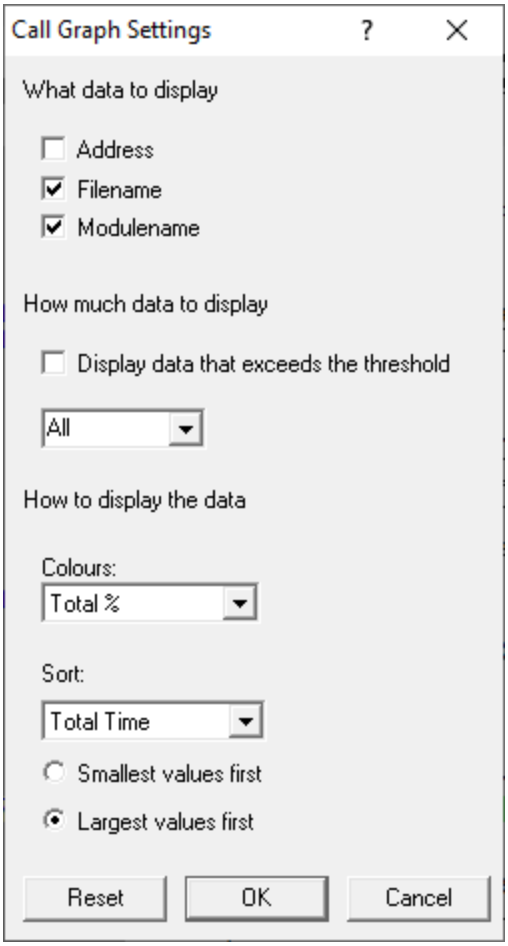
- **Refresh** › updates the display with the called functions and performance data - as does the button on the Tools menu and toolbar

  A refresh automatically expands the first nodes in the graph and highlights the most time consuming low-level function.

  As there's no auto update here, you'll need to use this Refresh button to update the display when you wish.

- **Collapse / Expand All** › hide or show every node in the graph

- **Display...** › shows the Call Graph Display Settings dialog



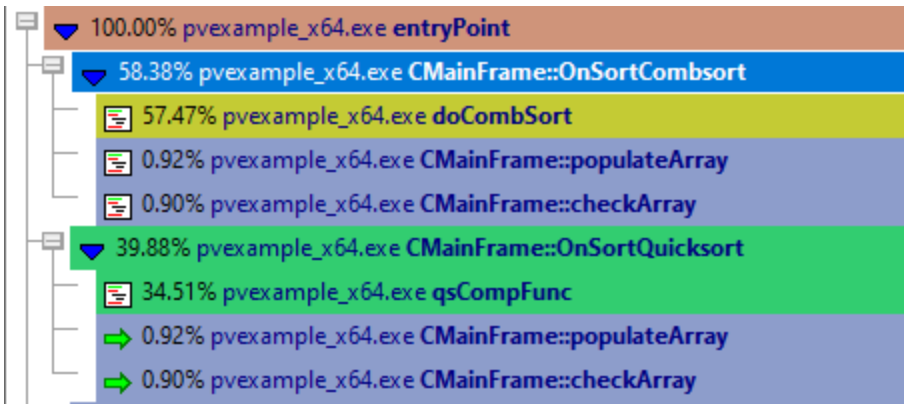
Call graph colours

The graph is coloured using the customisable Hotspot Colours settings that range from 100% down to 0%.

- **Colours** › choose the way the colour scheme is applied in the graph
  - **Total %** › colouring is based on function time relative to the total execution time

    `qsCompFunc` is in the 30-40% colour band as it contributed 34.51% to the total run time

    `doCombSort` is in the 50-60% colour band as it contributed 57.47% to the total run time



  - **Total % Scaled** › similar to **Total %** but relative to the total time attributed to the function's *top level node* in the graph

    This colour scheme 'stretches' its range to use the full range of colours under each top level node.

    Multi-threaded programs may have multiple roots, and the sampling data collection mode may also result in multiple roots, since sample callstacks won't always join up.

    Colours cannot be compared between different top level nodes as they may each be responsible for very different contributions to the program's total run time.

    If there is only one top level node, the two colour schemes will be identical.

  - **No Colour** › black and white display only

Sorting the data

The graph is initially ordered by most time consuming function first (Total Time)

- **Sort** › choose one of the criteria from the list › **Refresh** the display

  The options are:

  - **Total Time** › the time all calls to a function and its child functions contribute to the total run time

- **Average Time** › the time an average call to a function and its child functions contribute to the total run time
- **Call Count** › the number of times a function appears in the sampled collection data

When in sampling mode, **Call Count** will be the *only* available option here

- **Ascending / Descending** › change the ordering direction of the data

Note that while your application is executing, the sorted data is live. Sorting may not complete correctly as the data may change during the sort. Only when your program has finished executing is the sorted data guaranteed accurate.

Managing the data being displayed

There are three ways to change what's displayed in the view.

Change the amount of detail shown for each function:

- **Address** › check to show the address in memory for the function
- **Filename** › check to show the file location in which the function was found
- **Modulename** › shows the function's module

Reduce the scope of the graph by hiding less significant functions:

- **Threshold** › set a percentage threshold below which contributing functions are hidden

  Higher numbers exclude more nodes.

  You'll need to do a manual **Refresh** to update the display

  By default the threshold applies to the top level functions only.

  The threshold percentage is based on a functions accumulated contribution to the total runtime or total number of function calls.

  The default **All** option includes all nodes.

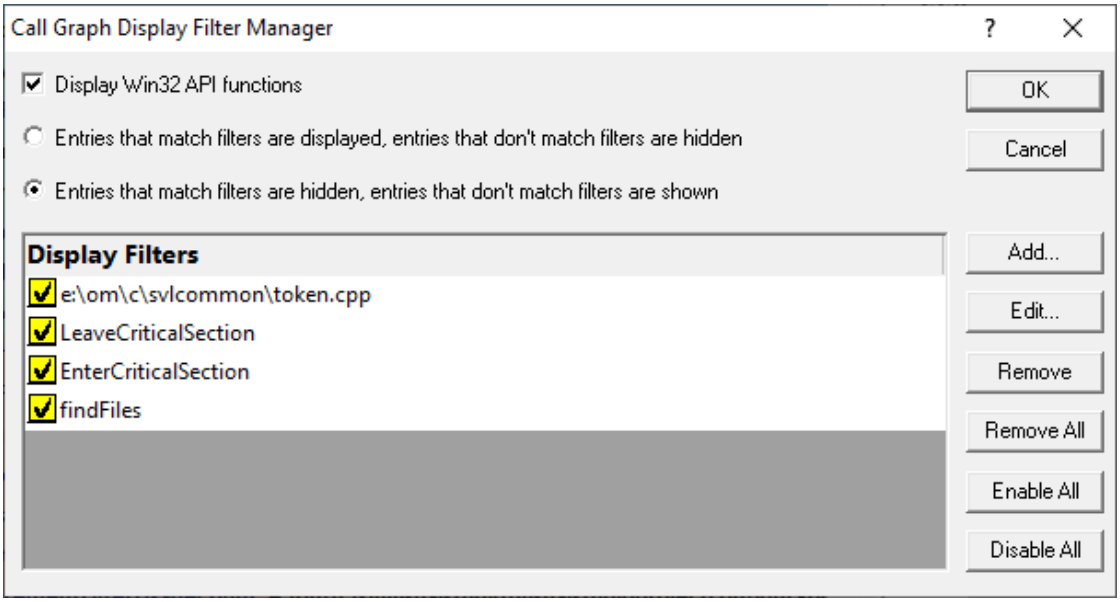
- **Apply Threshold to Children** › check to hide *any* function (as opposed to just top level nodes) in the graph that lie below the threshold contribution

Alternatively, filter out unwanted functions, or only show specific functions of interest.

Filtering data in the tables

The display filters affect what functions are hidden and shown in the call graph. They do not affect which functions are hooked in the first place.

- **Filters** › shows the Call Graph Display Filter Manager:



The dialog initially has no items in the list. Add some items manually or use the convenience filter options on the popup menus.

- **Add...** › displays the display filter dialog described below
- **Edit...** › opens the display filter dialog populated with the selected item's criteria, ready for editing

  Or double click an entry in the list to show the filter dialog.

- **Remove** › remove selected filter(s) in the list
- **Remove All** › remove all filters

- **Enable All** › enables all filters in the list
- **Disable All** › disables all filters

  You can also enable or disable individual items in the list via the yellow check box at the left of each row.

- **Display Win32 API functions** › if selected this displays Win32 API functions otherwise Win32 API functions are hidden

- **Entries that match filters are displayed** › select this to *display only* matched items

- **Entries that match filters are hidden** › select this to *remove* matched items from the display

Take care when selecting **Entries that match filters are displayed** as clearing the list and leaving this checked will leave *no functions being displayed at all*!

The Display Filter dialog

The dialog below allows you to create a filter based on matching one or more criteria.

If you don't enter some of the details, they simply won't form part of the match criteria

- **Enabled** › set this particular filter active or inactive

  This is exactly equivalent to checking the listed item in the display filter manager

- **Class** › enter the class name that the filter must match

  If you enter a class but no method name then all functions in the class are filtered

- **Method** › enter the method name

  If you enter a method but no class then the filter will match for the named function in any class

- **Filename** › filter all functions in the specified file

  The full path to the file is required.

- **Directory** › filter all functions in the specified directory

The full directory path is required.

- **Module** › filter all functions in the specified module

  The full path to the module is required.

- **Address** › filter an exact address in memory

Finding text

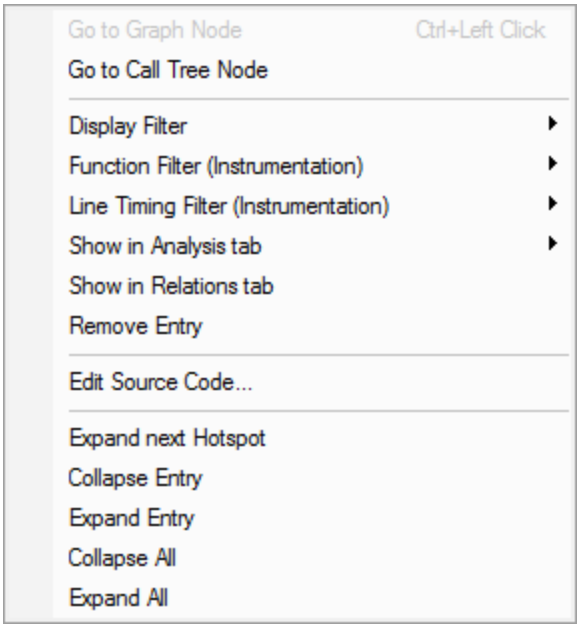
To find text in the graph, use the Find Dialog where you can search for functions, files and modules.

➡ The source code view has its own Find and Goto dialogs.

Call graph menu options

The following popup menu is available over the graph to add filters, examine relations or edit code.

Menu actions apply to the function in the graph at the menu-click location.



Menu options: Graph node

Functions may be linked to their main instance from multiple locations if called by different parent functions.

- **Go to Graph Node** › jump to the main instance of this function in the graph

Ctrl + has the same action

If the selected function is already the main instance, this option will be disabled.

Menu options: Call tree

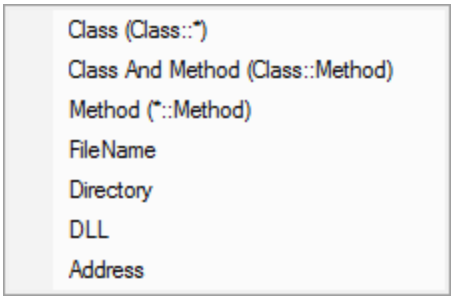
The Call Tree view is similar to the Call Graph, but a function and its children can appear multiple times.

The times shown in a call tree are related to the relevant callstack rather than being an accumulated total time.

- **Go to Call Tree Node** › open the Call Tree view at the first entry for the selected function

Menu options: Display Filter

The display filter sub-menu below provides a quick and convenient way to hide or show data based on attributes of the selected item.



Choosing any of these options will add the filter to the Display Filter dialog.

For example:

- **Class** › hides all functions belonging to the same class
- **FileName** › hides all functions that were in the same file

Menu options: Function filter (Instrumentation)

While the display filter controls visibility of hooked data, instrumentation filters control which functions are hooked in the first place.

The function instrumentation filter sub-menu lets you add hook filters at different levels of granularity.

The affect of adding function filters here depends on the current filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *excluding* newly selected hooks
- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The first three options add filters to the Class and Function Filter Settings:

- **By Class** › adds a new filter, excluding the entire class from the results of subsequent sessions
- **By Class and Method** › excludes only the selected function from new sessions
- **By Function** › excludes all matching function names irrespective of their containing class or even if not in a class at all

The next two, Filename and Directory, are part of the Source Files Filter settings.

- **By FileName** › adds a new filter, excluding all functions in the same file (as the selected item) from the results of subsequent sessions
- **By Directory** › excludes functions in all files in the same directory as the selected function

Finally, the DLL level is controlled by the Hooked DLLs settings.

- **By DLL** › excludes functions in all files belonging to the same executable or DLL as the selected function

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu options: Line timing filter (Instrumentation)

Line timing instrumentation filters control which lines are hooked for line timing and are independent of the function filters above.

The affect of adding line timing filters here depends on the current line timing filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *only including* newly selected hooks

  Note that this is the opposite of function filters.

- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The line timing instrumentation filter sub-menu lets you add hook filters at three different levels of granularity.

Each option add filters to the Line Timing Filter Settings:

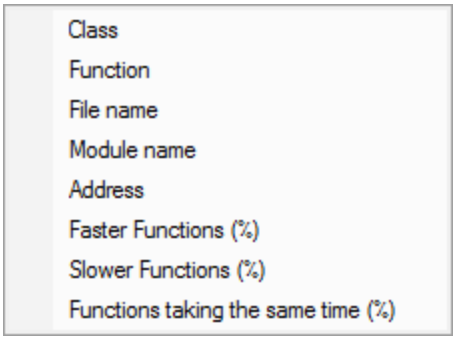
- **By Class** › adds a new filter, appending the entire class in the line timing results of subsequent sessions
- **By Class and Method** › include only the selected function in the line timing of new sessions
- **By Function** › includes all matching function names irrespective of their containing class or even if not in a class at all

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu option: Show in Analysis tab

The Analysis tab shows results of a query on the call tree based on the selected function and the criteria chosen from the menu:

- **Show in Analysis tab** › choosing any item in the following sub-menu, to be switched to the Analysis tab



For example:

- **Class** › the Analysis tab will show all points in the call tree that match the class of the selected function
- **File name** › shows all points in the call tree that match the file name of the selected function

- **Slower Functions (%)** › shows all functions that are slower than the selected function

Menu options: Show in Relations tabs

- **Show in Relations tab** › switch to the Relations tab where you can examine functions that either call, or are called by, the selected function

  Double clicking any item will also display it in the Relations tab.

Menu options: Remove entry

You can hide some entries from the Call Graph display.

Hiding entries is a very temporary action since a function and its children will only be hidden from view until the next **Refresh**.

- **Remove entry** › hides the selected function in the graph

  Only the selected node is hidden. Other calls to the same function in a different part of the call graph will remain.

Menu option: editing source code

- **Edit Source Code...** › opens the default or preferred editor to edit the source code

Menu options: Expand and collapse

The last few menu options expand and collapse parts of the graph.

- **Expand Next Hotspot** › finds the next most significant performance hotspot in the call graph and expands all the callstack nodes to make it visible
- **Collapse / Expand Entry** › close or recursively open the selected function to its full extent
- **Collapse / Expand All** › completely collapse or expand the entire graph

The file source code view

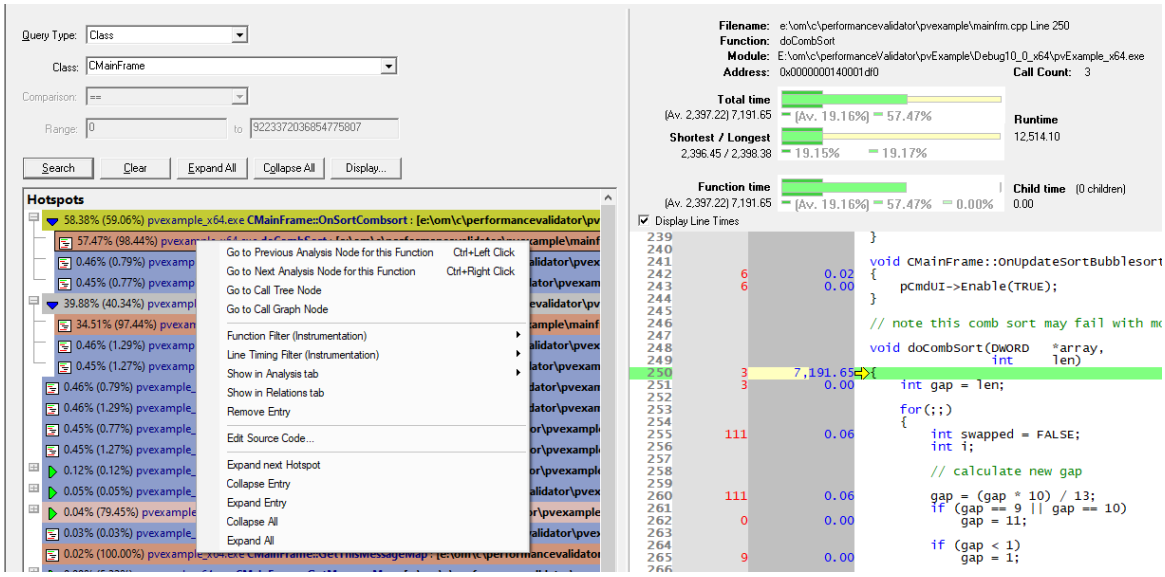
Clicking on a function in the call graph shows that function's source code file in the right hand pane.

The source code view is described in detail separately as its behaviour is the same for all views.

3.7.6 Analysis

The **Analysis** tab performs queries on the collected performance data and displays the results.

Read on, or click a part of the image below to jump straight to the help for that area.



As with many of the tab views, the display is split into two resizable panes.

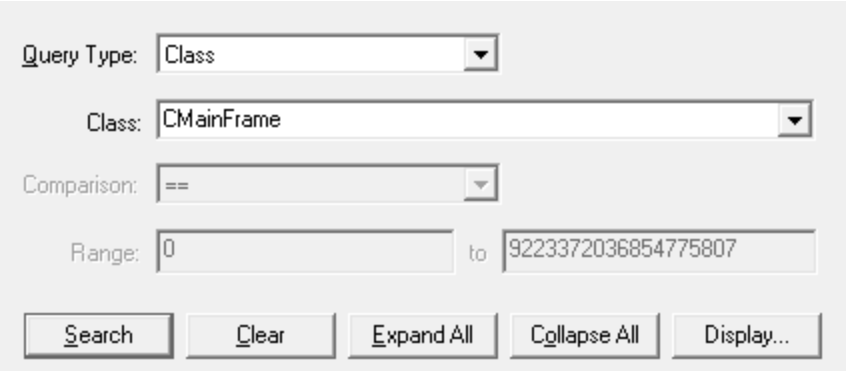
- the left side shows a query form and an ordered hierarchical view of the matching functions called in the program's execution

  The result tree's popup menu provides options to filter data or to examine it in more detail

- The right side shows the source code view for any function selected on the left

The Query form

The analysis query form lets you search the collected data and the performance statistics for a wide set of criteria.



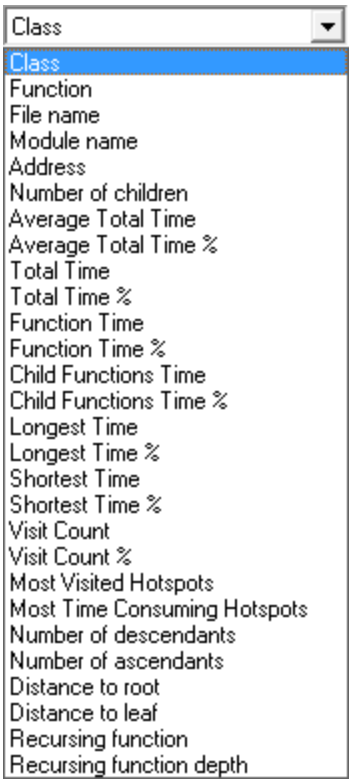
Setting up the Query Type

- **Query Type** › choose the main feature on which you want to search

  There are a wide range of options and they fall into four categories:

  - Function information like class, function or file name
  - Performance data like total time, average time or visit count
  - Hotspot queries like most visited or most time consuming
  - Callstack investigation like callstack length, or recursion

  The full list:



Most of these types are self explanatory or described briefly in the Statistics data but there's a few new ones:

Distance to root / **leaf** › find function calls at a certain nesting level from the top or the lowest point of the callstack

Recursing function › find any functions that have been called recursively

Recursing function depth › find functions called recursively to a specific depth

The options underneath the Query Type may change to one of the following to match the corresponding type of query:

- **Class**, **Function**, **File** or **Module** › choose from the drop down list the name you want to search for

  The drop down is populated with known options from the hook data.

  This option is disabled if the query type doesn't require a subsequent choice of name.

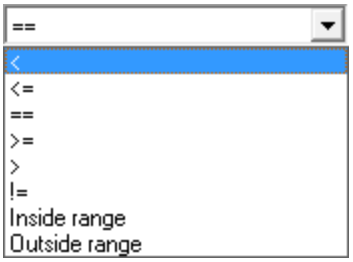
Constraining the results

The results may be constrained by type of comparison with optional range checking.

For function information like class, name, file, these constraints do not apply.

For number based queries, including **Address**, you can limit, invert or box the results

- **Comparison** › choose from the comparison type from the drop down list



- **Range** › enter one or both values to specify a limit or a range, depending on the comparison type

  For example:

  < (less than) or **==** (equals) would need just the one limit.

  Inside range would need lower and upper bounds specified.

The analysis results view

Query results are shown as an ordered list of trees for every matched function that has been hooked and called.

For example, if there are 10 matching results, there will be 10 top level nodes in the tree. Some of these may show child functions, some may not.

The query result structure can be likened to taking the Call Tree data, removing all functions *above* a matching functions, while keeping all functions *below*.

Each result is shown independently of any other, so it's quite likely that some later results may also appear as children of earlier results in the list.

Functions are initially ordered by Total Time - the time a function and it's child functions contribute to the total run time.

Selecting a function shows its source code on the right hand pane.

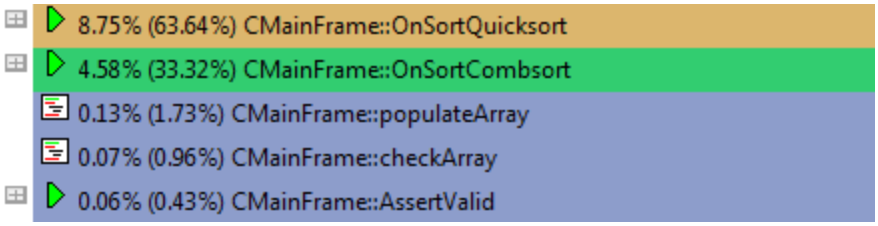
Double clicking any item will display the function on the Relations tab.

Like the Call Tree view, function timings shown here are for the time spent in the *relevant part of the call tree*, not a combined total for *everywhere* that a function may be used.

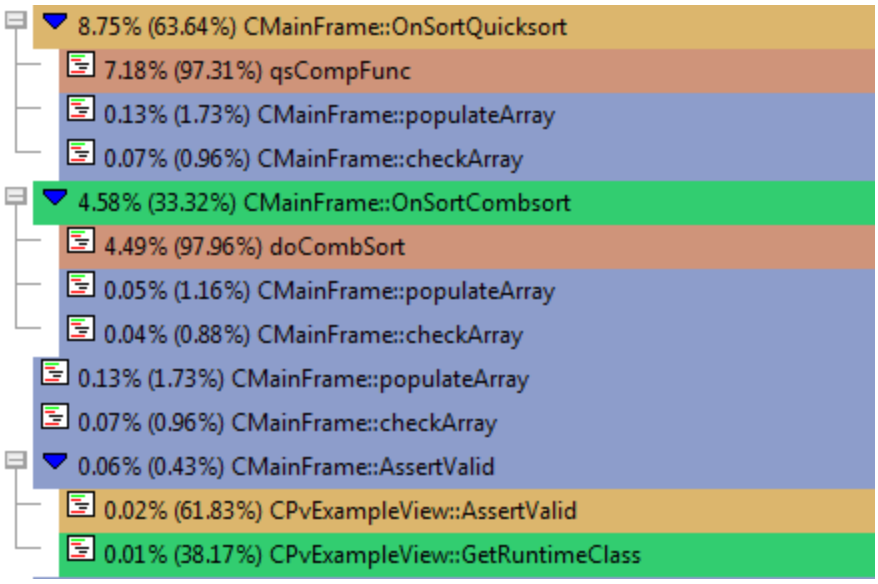
This example shows part of the results when searching for all functions in the class `CMainFrame` using the example application.

Example:

The results below show the first 5 most time consuming results when searching for functions in the class `CMainFrame` using the example application.



Expanding the nodes shows that results 3 and 4 above can be found within the children of the first result



Analysis result colours

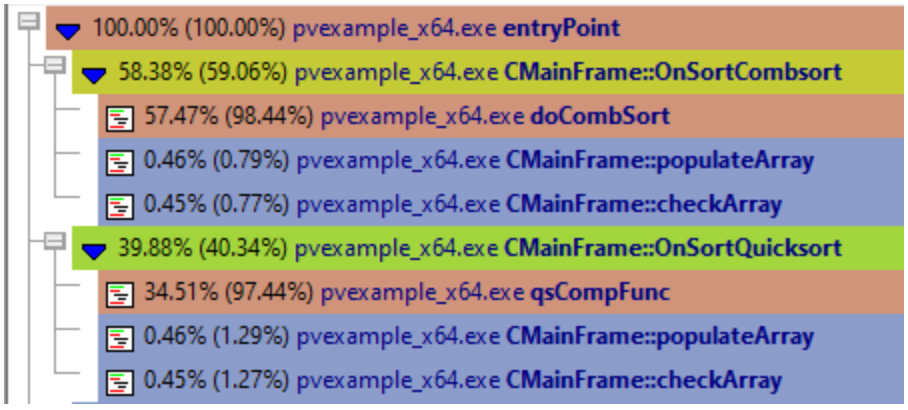
The query result tree is coloured using the customisable Hotspot Colours settings that range from 100% down to 0%.

- **Colours** › choose the way the colour scheme is applied in the tree
  - **Parent %** › colouring is based on function time relative to that of its *parent's* function time

    In the example below:

    `qsCompFunc` is in the 90-100% colour band as it contributed 97.31% of its parent's function time

    `doCombSort` is in the 90-100% colour band as it contributed 97.96% of its parent's function time

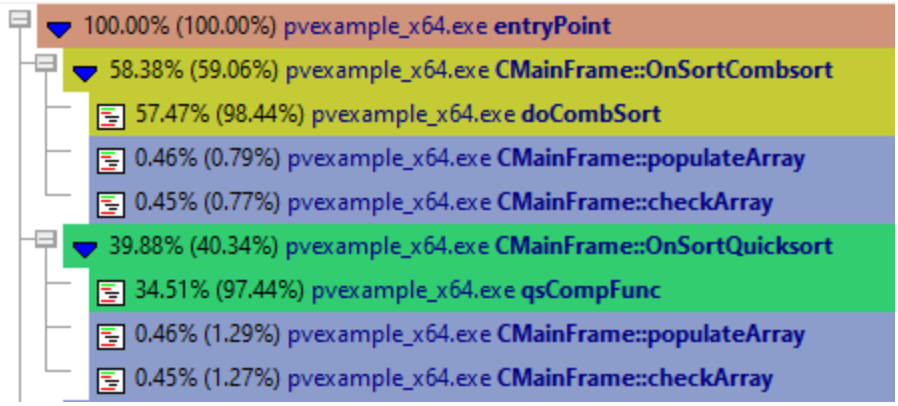


  - **Total %** › colouring is based on function time relative to the *total* execution time

Now in the example:

`qsCompFunc` is in the 50-60% colour band as it contributed 51.29% to the total run time

`doCombSort` is in the 30-40% colour band as it contributed 32.06% to the total run time



- **No Colour** › black and white display only

Updating the display

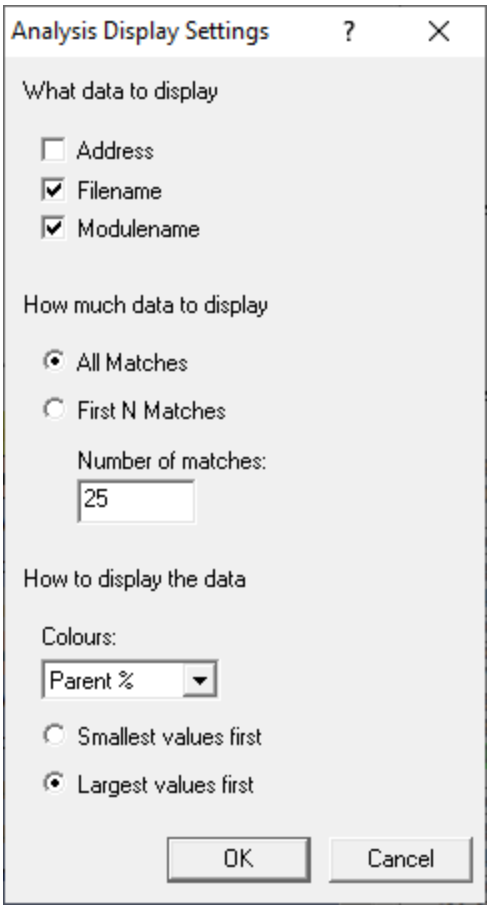
On other tabs, it's the Refresh button that updates the display. Here, although the Search button triggers the query again, it essentially does the same thing.

- **Search** › updates the display with the search results - as does the button on the Tools menu and toolbar

  A search automatically expands the first nodes in the tree and highlights the most time consuming low-level function (hotspot).

  As there's no auto update here, you'll need to use this Search button to update the display whenever you wish.

- **Collapse / Expand All** › hide or show every node in all the result trees
- **Clear** › removes the results
- **Display...** › displays the Analysis Display Settings dialog



Sorting the data

The result tree is initially ordered by most time consuming function first (Total Time)

- **Smallest values first** › change the ordering direction of the data
- **Largest values first** › change the ordering direction of the data

Note that while your application is executing, the sorted data is live. Sorting may not complete correctly as the data may change during the sort. Only when your program has finished executing is the sorted data guaranteed accurate.

Managing the data being displayed

You can't filter out functions by name but there are two ways to change what's displayed in the view.

Change the amount of detail shown for each function:

- **Address** › check to show the address in memory for the function
- **Filename** › check to show the file location in which the function was found

- **Modulename** › shows the function's module

Reduce the scope of the tree by only showing a partial list of results:

- **First N Matches** › restricts the results to a specified number of matches
- **All Matches** › shows all results

You'll need to **Search** again in order to update the display

Finding text

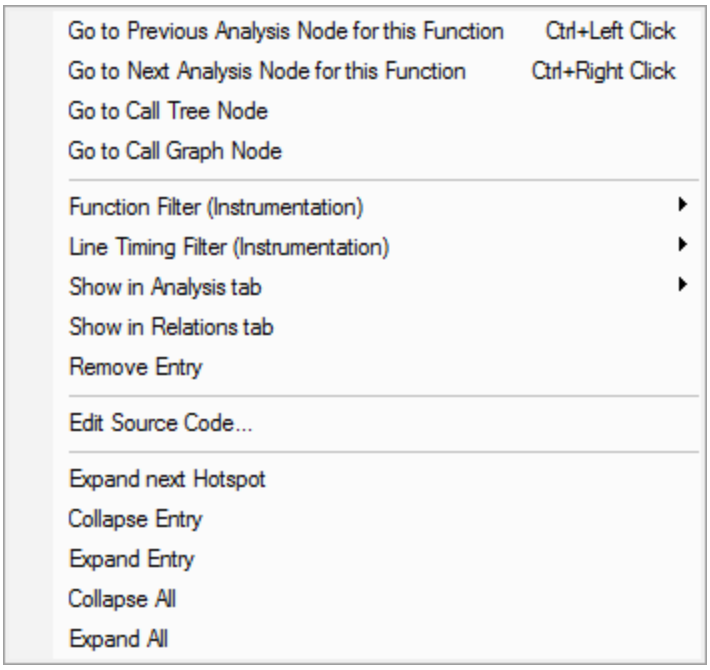
To find text in the tree, use the Find Dialog where you can search for functions, files and modules.

➜ The source code view has its own Find and Goto dialogs.

Analysis results menu options

The following popup menu is available over the result tree to add filters, examine relations or edit code.

Menu actions apply to the function in the tree at the menu-click location.



Menu options: Previous and next result nodes

Functions may appear in the tree more than once if called by different parent functions.

- **Go to Previous Analysis Node for this Function** › jump to the previous instance of this function in any of the result trees

  Ctrl + has the same action

- **Go to Next Analysis Node for this Function** › jump to the next instance of this function in the results

  Ctrl + has the same action

If there are no previous or next instances, nothing will happen.

Menu options: Show in other tabs

- **Go to Call Graph Node** › switch to the Call Graph view where the display will be expanded to show the first match found for the selected function

Menu options: Go to Call Tree or Graph

- **Go to Call Tree Node** › switch to the Call Tree view where the display will be expanded to show the first match found for the selected function
- **Go to Call Graph Node** › open the Call Graph view at the main entry for the selected function

  The Call Graph view is similar to the Call Tree, but where a function would appear multiple times, it instead appears once as the main instance and is then linked to from other locations.

Menu options: Function filter (Instrumentation)

While the display filter controls visibility of hooked data, instrumentation filters control which functions are hooked in the first place.

The function instrumentation filter sub-menu lets you add hook filters at different levels of granularity.

The affect of adding function filters here depends on the current filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *excluding* newly selected hooks
- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The first three options add filters to the Class and Function Filter Settings:

- **By Class** › adds a new filter, excluding the entire class from the results of subsequent sessions
- **By Class and Method** › excludes only the selected function from new sessions
- **By Function** › excludes all matching function names irrespective of their containing class or even if not in a class at all

The next two, Filename and Directory, are part of the Source Files Filter settings.

- **By FileName** › adds a new filter, excluding all functions in the same file (as the selected item) from the results of subsequent sessions
- **By Directory** › excludes functions in all files in the same directory as the selected function

Finally, the DLL level is controlled by the Hooked DLLs settings.

- **By DLL** › excludes functions in all files belonging to the same executable or DLL as the selected function

 Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

 Menu options: Line timing filter (Instrumentation)

Line timing instrumentation filters control which lines are hooked for line timing and are independent of the function filters above.

 The affect of adding line timing filters here depends on the current line timing filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *only including* newly selected hooks

  Note that this is the opposite of function filters.

- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The line timing instrumentation filter sub-menu lets you add hook filters at three different levels of granularity.

Each option add filters to the Line Timing Filter Settings:

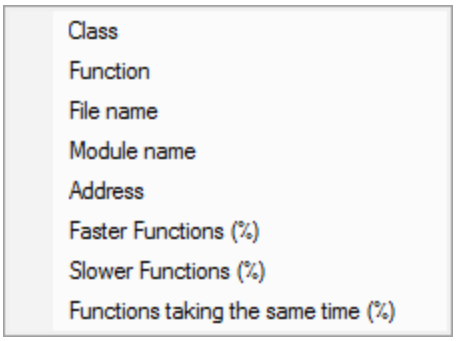
- **By Class** › adds a new filter, appending the entire class in the line timing results of subsequent sessions
- **By Class and Method** › include only the selected function in the line timing of new sessions
- **By Function** › includes all matching function names irrespective of their containing class or even if not in a class at all

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu option: Show in Analysis tab

While this may already be the Analysis tab, sometimes it can be useful to choose a function from the results and pivot the search to show a new result set:

- **Show in Analysis tab** › choosing any item in the following sub-menu, to perform a new search in the Analysis tab



For example:

- **Class** › the results show all points in the call tree that match the class of the selected function
- **File name** › shows all points in the call tree that match the file name of the selected function
- **Slower Functions (%)** › shows all functions that are slower than the selected function

Menu options: Show in Relations tabs

- **Show in Relations tab** › switch to the Relations tab where you can examine functions that either call, or are called by, the selected function

  Double clicking any item will also display it in the Relations tab.

Menu options: Remove entry

You can hide some entries from the displayed results.

However, this is a very temporary action, as a function and its children will only be hidden from view until the next **Search**.

- **Remove entry** › hides the selected function in the tree

  Only the selected node is hidden. Other calls to the same function in a different part of the results will remain.

Menu option: editing source code

- **Edit Source Code...** › opens the default or preferred editor to edit the source code

Menu options: Expand and collapse

The last few menu options expand and collapse parts of the tree.

- **Expand Next Hotspot** › finds the next most significant in the call tree and expands all the callstack nodes to make it visible
- **Collapse / Expand Entry** › close or recursively open the selected function to its full extent
- **Collapse / Expand All** › completely collapse or expand the entire tree

The file source code view

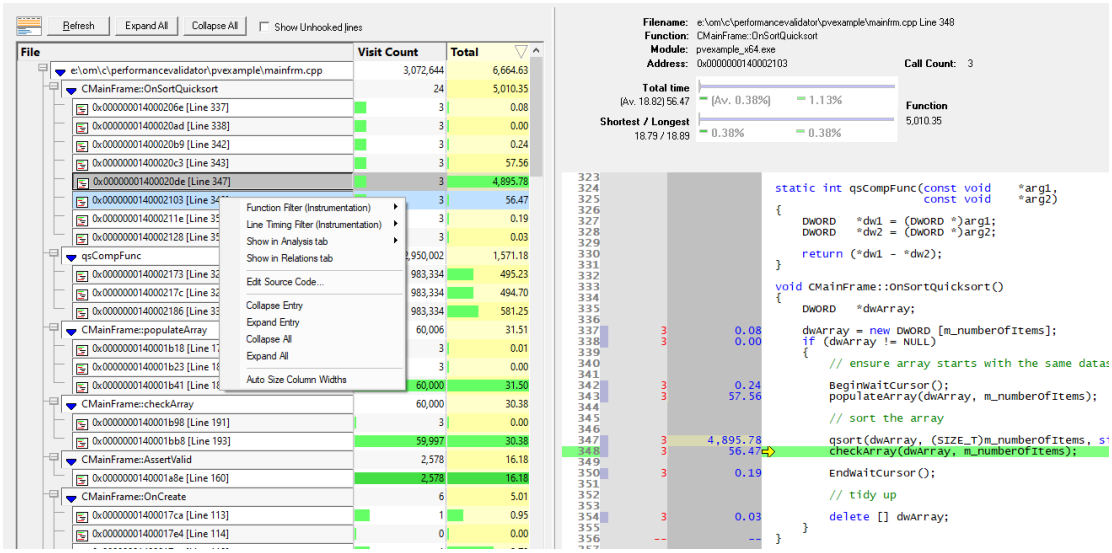
Clicking on a function in the results tree shows that function's source code file in the right hand pane.

The source code view is described in detail separately as its behaviour is the same for all views.

3.7.7 Line Times

The **Line Times** tab displays statistics about each line of code visited in the application under test.

Read on, or click a part of the image below to jump straight to the help for that area.



As with many of the tab views, the display is split into two resizable panes.

- The table of files and lines on the left has performance data for each line

  The table's popup menu provides plenty of options to filter data or to examine more detail

- The right side shows the source code view for any file, function or line selected on the left

Line timing in sampling mode

Line timing is not possible when using the sampling method of data collection.

The option to collect line time information will be disabled in the Launch dialog, and at the top of the Lime Times view, you'll see the following message:

The line times view

Performance data is shown for every visited line in the functions and files that have been hooked.

The lines are ordered hierarchically in a tree organised by file, function and line.

The data can be sorted via the headers of any column, although there are fewer columns than for the Statistics or Relations tab:

- **Visit Count** › the number of visits to a line

  A function shows accumulated visits for all lines in the function.

A file shows accumulated visits for all lines in all functions in the file.

- **Total** › the time a line and any associated child functions take to execute

  Functions show total function time.

  Files show accumulated time for all functions in the file.

- **Average** › average time a line takes to execute, including associated child functions

  Functions and files show no useful information and are left blank or zeroed.

- **Shortest** › the shortest time a function and its child functions take to execute

- **Longest** › the longest time a function and its child functions take to execute

Double clicking any item will display the *function* on the Relations tab.

Lines which could not be hooked will be coloured brown in the table and marked by hyphens in the source code.

Note that while your application is executing, the sorted data is live. Sorting may not complete correctly as the data may change during the sort. Only when your program has finished executing is the sorted data guaranteed accurate.

Line timing calculation method

Timing calculations for each line are made using the processor's time stamp counter unless the OS supports the provision of per-thread CPU cycle counts (Windows Vista onwards).

➡ See Performance settings for Line Timing.

Window orientation

To adapt to your screen layout, the horizontal or vertical orientation of the line times and source code panes can be toggled with the orientation button.

Updating the display

- **Refresh** › updates the display - as does the button on the Tools menu and toolbar

  As there's no auto update here, you'll need to use this Refresh button to update the display when you wish.

  A refresh automatically collapses the nodes in the tree.

- **Collapse / Expand All** › hide or show every node in the tree
- **Show Unhooked lines** › choose whether to include the unhooked lines in the data
- **Do not scroll first column** › optionally keep the first column fixed when scrolling the table horizontally

Managing the data being displayed

There are two ways to change what's displayed in the view.

- hide or show whole columns of data in the table
- filter out unwanted functions, or only show specific functions of interest

Finding text

To find text in the tree, use the Find Dialog where you can search the function and file names, as well as the data in the other columns.

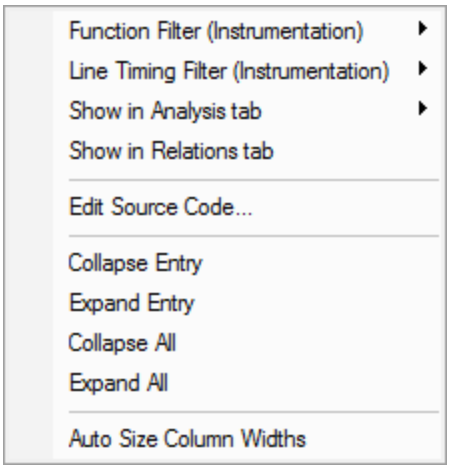
Since the text for lines in the file column includes line numbers and addresses, it happens that you can search for that information too.

➡ The source code view has its own Find and Goto dialogs.

Call tree menu options

The following popup menu is available over the data to add filters, examine relations or edit code.

Menu actions apply to the function in the tree at the menu-click location.



Menu options: Function filter (Instrumentation)

While the display filter controls visibility of hooked data, instrumentation filters control which functions are hooked in the first place.

The function instrumentation filter sub-menu lets you add hook filters at different levels of granularity.

The affect of adding function filters here depends on the current filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *excluding* newly selected hooks
- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The first three options add filters to the Class and Function Filter Settings:

- **By Class** › adds a new filter, excluding the entire class from the results of subsequent sessions
- **By Class and Method** › excludes only the selected function from new sessions
- **By Function** › excludes all matching function names irrespective of their containing class or even if not in a class at all

The next two, Filename and Directory, are part of the Source Files Filter settings.

- **By FileName** › adds a new filter, excluding all functions in the same file (as the selected item) from the results of subsequent sessions
- **By Directory** › excludes functions in all files in the same directory as the selected function

Finally, the DLL level is controlled by the Hooked DLLs settings.

- **By DLL** › excludes functions in all files belonging to the same executable or DLL as the selected function

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu options: Line timing filter (Instrumentation)

Line timing instrumentation filters control which lines are hooked for line timing and are independent of the function filters above.

The affect of adding line timing filters here depends on the current line timing filter settings:

- If the current filters are set to hook *everything*, adding new filters will switch to *only including* newly selected hooks

  Note that this is the opposite of function filters.

- Otherwise, the current filter will be retained, i.e. hook or don't hook newly selected items

The line timing instrumentation filter sub-menu lets you add hook filters at three different levels of granularity.

Each option add filters to the Line Timing Filter Settings:

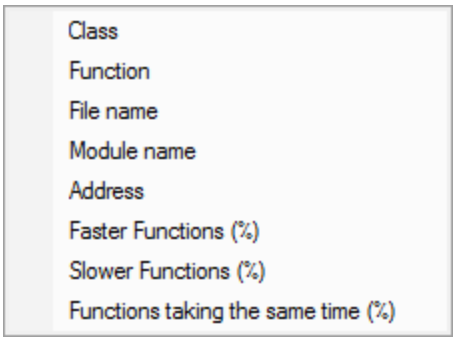
- **By Class** › adds a new filter, appending the entire class in the line timing results of subsequent sessions
- **By Class and Method** › include only the selected function in the line timing of new sessions
- **By Function** › includes all matching function names irrespective of their containing class or even if not in a class at all

Instrumentation filters become effective at the start of the *next* session. Adding a filter during a session will show the relevant rows in grey so that you can see which files would be filtered, but the performance data will continue to be included for the rest of the current session.

Menu option: Show in Analysis tab

The Analysis tab shows results of a query on the call tree based on the selected function and the criteria chosen from the menu:

- **Show in Analysis tab** › choosing any item in the following sub-menu, to be switched to the Analysis tab



For example:

- **Class** › the Analysis tab will show all points in the call tree that match the class of the selected function
- **File name** › shows all points in the call tree that match the file name of the selected function
- **Slower Functions (%)** › shows all functions that are slower than the selected function

Menu options: Show in Relations tabs

- **Show in Relations tab** › switch to the Relations tab where you can examine functions that either call, or are called by, the selected function

  Double clicking any item will also display it in the Relations tab.

Menu option: editing source code

- **Edit Source Code...** › opens the default or preferred editor to edit the source code

Menu options: Expand and collapse

The last few menu options expand and collapse parts of the tree.

- **Collapse / Expand Entry** › close or recursively open the selected function to its full extent
- **Collapse / Expand All** › completely collapse or expand the entire tree

Menu option: column widths

- **Auto size column widths** › sets the width of each column in the table appropriate to the content within

The file source code view

Clicking on any function or line in the tree shows that function's source code file in the right hand pane.

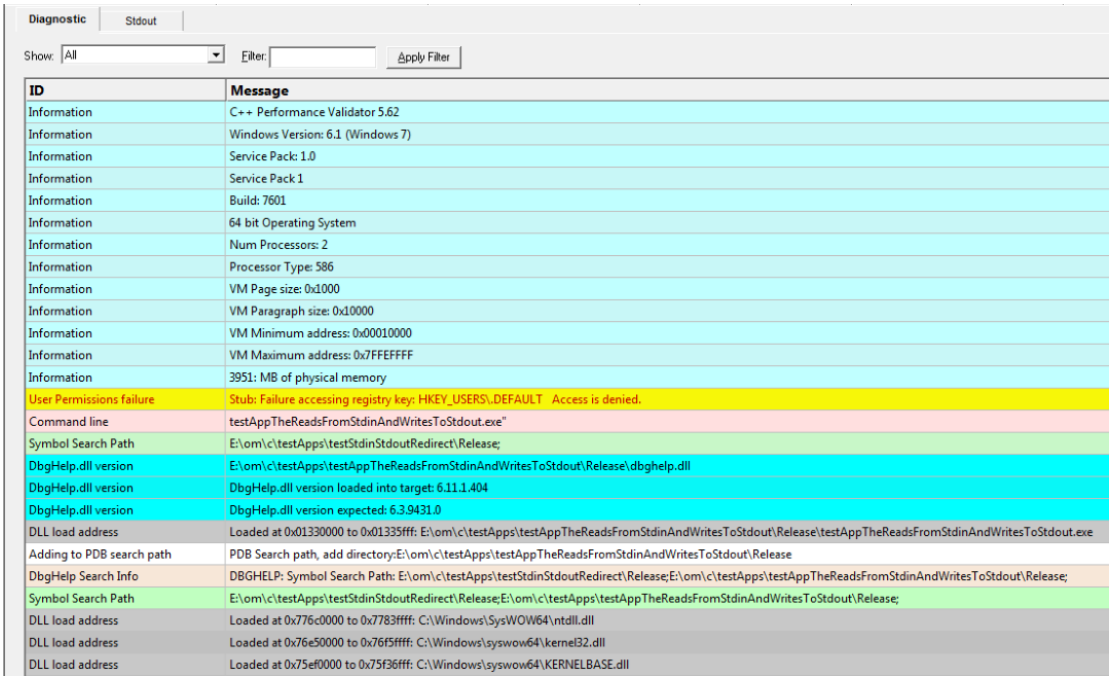
The source code view is described in detail separately as its behaviour is the same for all views, although the function information bars differ slightly to other displays.

3.7.8 Diagnostic

The **Diagnostic** tab displays information collected by Performance Validator about the target program.

There are two subtabs. One for Diagnostic information and one for displaying any data captured from stdout and stderr.

Diagnostic



ID	Message
Information	C++ Performance Validator 5.62
Information	Windows Version: 6.1 (Windows 7)
Information	Service Pack: 1.0
Information	Service Pack 1
Information	Build: 7601
Information	64 bit Operating System
Information	Num Processors: 2
Information	Processor Type: 586
Information	VM Page size: 0x1000
Information	VM Paragraph size: 0x10000
Information	VM Minimum address: 0x00010000
Information	VM Maximum address: 0x7FFEFFFF
Information	3951: MB of physical memory
User Permissions failure	Stub: Failure accessing registry key: HKEY_USERS\.DEFAULT Access is denied.
Command line	testAppTheReadsFromStdinAndWritesToStdout.exe"
Symbol Search Path	E:\om\c\testApps\testStdinStdoutRedirect\Release;
DbgHelp.dll version	E:\om\c\testApps\testAppTheReadsFromStdinAndWritesToStdout\Release\dbghelp.dll
DbgHelp.dll version	DbgHelp.dll version loaded into target: 6.11.1.404
DbgHelp.dll version	DbgHelp.dll version expected: 6.3.9431.0
DLL load address	Loaded at 0x01330000 to 0x01335fff: E:\om\c\testApps\testAppTheReadsFromStdinAndWritesToStdout\Release\testAppTheReadsFromStdinAndWritesToStdout.exe
Adding to PDB search path	PDB Search path, add directory:E:\om\c\testApps\testAppTheReadsFromStdinAndWritesToStdout\Release
DbgHelp Search Info	DBGHELP: Symbol Search Path: E:\om\c\testApps\testStdinStdoutRedirect\Release;E:\om\c\testApps\testAppTheReadsFromStdinAndWritesToStdout\Release;
Symbol Search Path	E:\om\c\testApps\testStdinStdoutRedirect\Release;E:\om\c\testApps\testAppTheReadsFromStdinAndWritesToStdout\Release;
DLL load address	Loaded at 0x776c0000 to 0x7783ffff: C:\Windows\SysWOW64\ntdll.dll
DLL load address	Loaded at 0x76e50000 to 0x76f5ffff: C:\Windows\syswow64\kernel32.dll
DLL load address	Loaded at 0x75ef0000 to 0x75f36fff: C:\Windows\syswow64\KERNELBASE.dll

Diagnostic information

When Performance Validator's stub is injected into the target program, it logs diagnostic information to the main window for inspection.

Examples of diagnostic data collected are below, and may be displayed with a message, although you may not see some of these if all is well:

Hooking information

- Ordinal hook found
- Function hook success or failure
- Delay loaded function hooked
- Possible hook found
- Function already hooked
- Hook at address

Other information

- DLL load address
- DbgHelp searching
- Image source line
- Unknown instruction found
- Disassembly of troublesome code
- Other text message

The locations of loaded DLLs are also displayed in the window for each `LoadLibrary()`, `LoadLibraryEx()` and `FreeLibrary()` in the target program.

If for whatever reason, you don't want to collect diagnostic information, you can switch it off in the Data Collection > Miscellaneous settings.

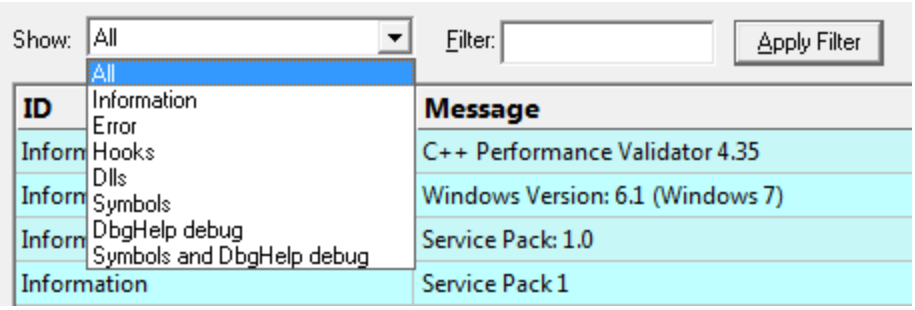
Unhooked lines

Messages indicating that particular source lines could not be hooked are common and are because there was not enough space to safely insert a hook for the particular line.

This is normal and is to be expected. The number of lines that cannot be hooked because of this will vary from program to program, and from debug mode to release mode based on what the program is doing and how the program is optimized.

Filtering diagnostic information

By default, all information is displayed, but you can filter the messages to show only one type:



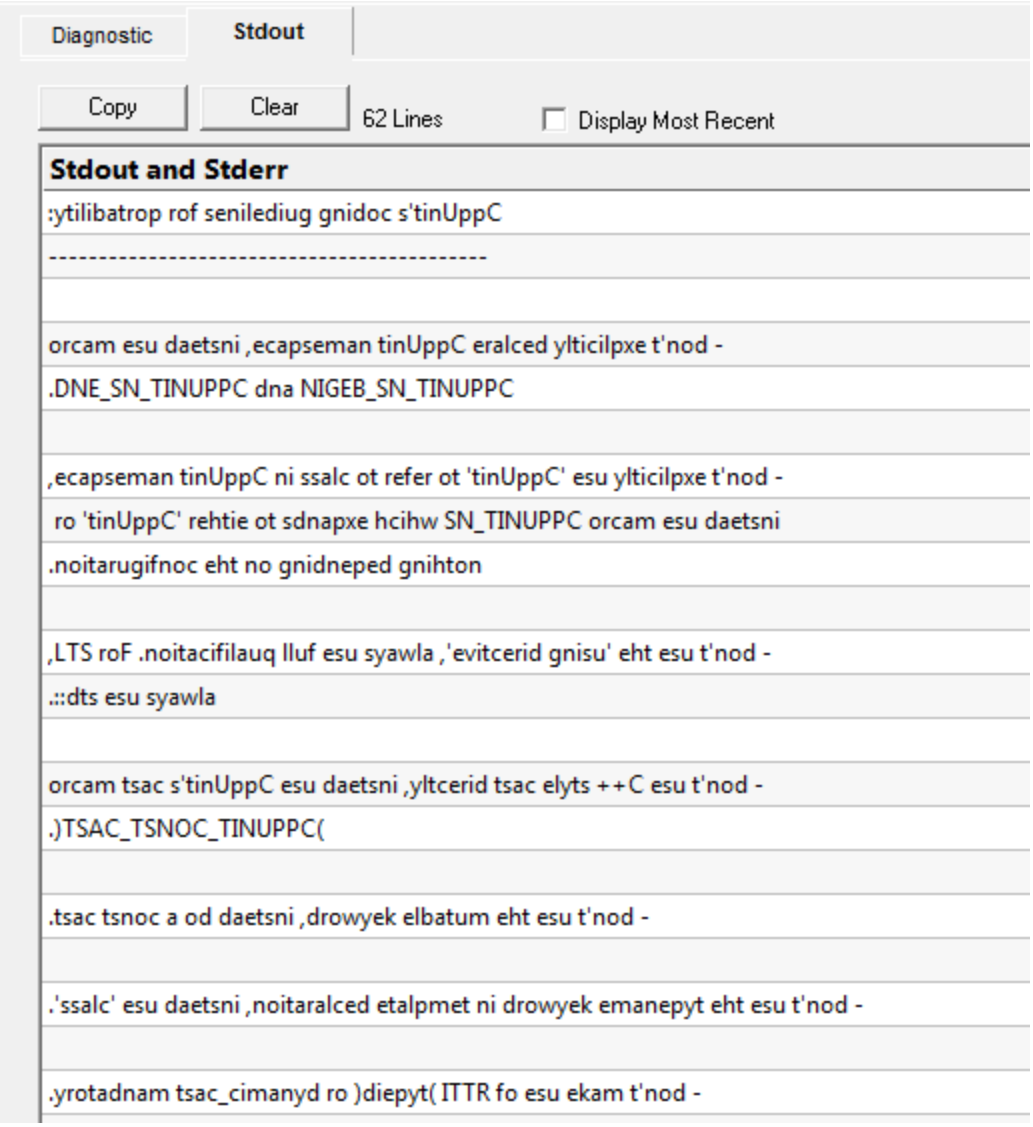
- **All** › the default option is to show everything
- **Information** › operating system and environment information, etc
- **Error** › notification of denied access and other error messages
- **Hooks** › hooking success and failure messages
- **DLLs** › DLL related information
- **Symbols** › symbol loading status messages
- **DbgHelp debug** › messages from DbgHelp.dll about the DLL symbol search processes
- **Symbols and DbgHelp debug** › both the previous two

As well as filtering different *types* of lines, you can also search for specific terms:

- **Filter** › enter some text and **Apply Filter** to show lines with the term in the Message column

When identifying why symbols aren't loading, you'll find it's much easier when showing only the **DbgHelp debug** information.

Stdout and Stderr



The **Stdout** tab displays any data collected from stdout and stderr. ➜ The option to enable this data collection is specified on the launch dialog/wizard.

The above image shows some data collected from a program that reverses the characters in each line passed to it.

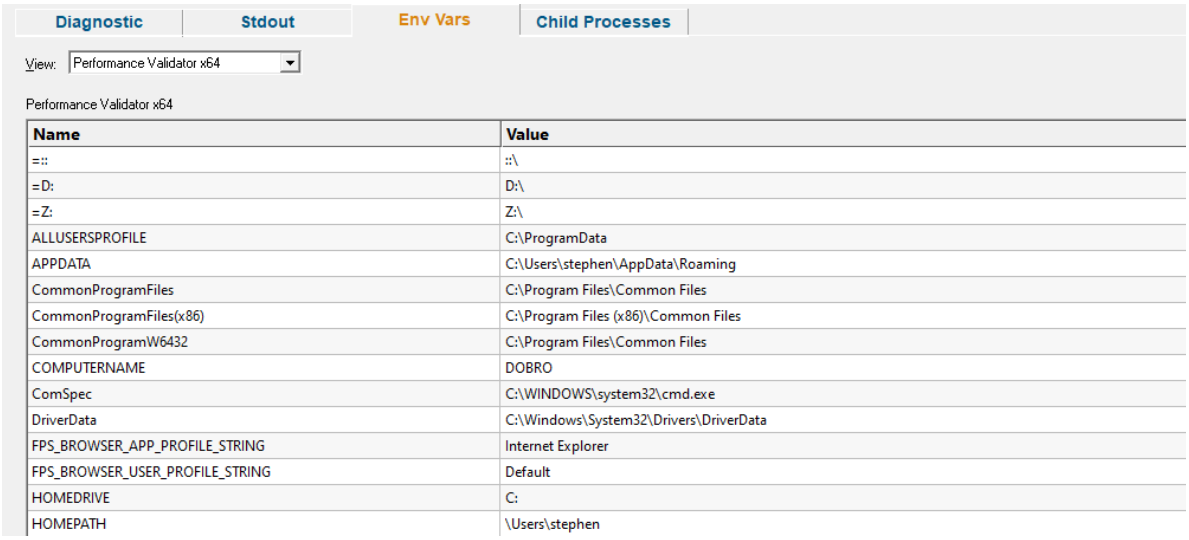
- **Copy** › copy all data from the display on to the clipboard. For large amounts of data this can be time consuming.
- **Clear** › clear the display of any captured data.
- **Display Most Recent** › the display will be scrolled to ensure the most recently captured data is displayed.

Environment Variables

Environment variables tab displays environment variables from Performance Validator, environment variables from the program under test and environment variable substitution errors.

Choose which data you wish to view using the combo box at the top left of the tab.

Performance Validator environment variables

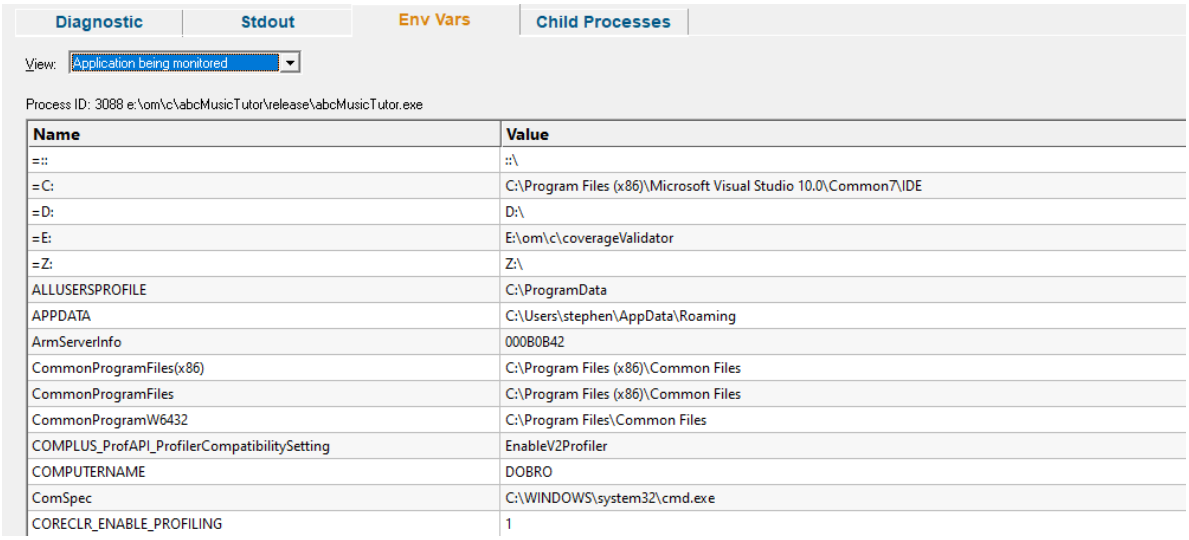


Name	Value
=::	::\
=D:	D:\
=Z:	Z:\
ALLUSERSPROFILE	C:\ProgramData
APPDATA	C:\Users\stephen\AppData\Roaming
CommonProgramFiles	C:\Program Files\Common Files
CommonProgramFiles(x86)	C:\Program Files (x86)\Common Files
CommonProgramW6432	C:\Program Files\Common Files
COMPUTERNAME	DOBRO
ComSpec	C:\WINDOWS\system32\cmd.exe
DriverData	C:\Windows\System32\Drivers\DriverData
FPS_BROWSER_APP_PROFILE_STRING	Internet Explorer
FPS_BROWSER_USER_PROFILE_STRING	Default
HOMEDRIVE	C:
HOMEPATH	\Users\stephen

Target application environment variables

If you launched the target application from Performance Validator the target application's environment variables will be similar to those in Performance Validator, but with some additional env vars to control .Net profilers and and some other SVL_ prefixed env vars to communicate various data to Software Verify components that are loaded.

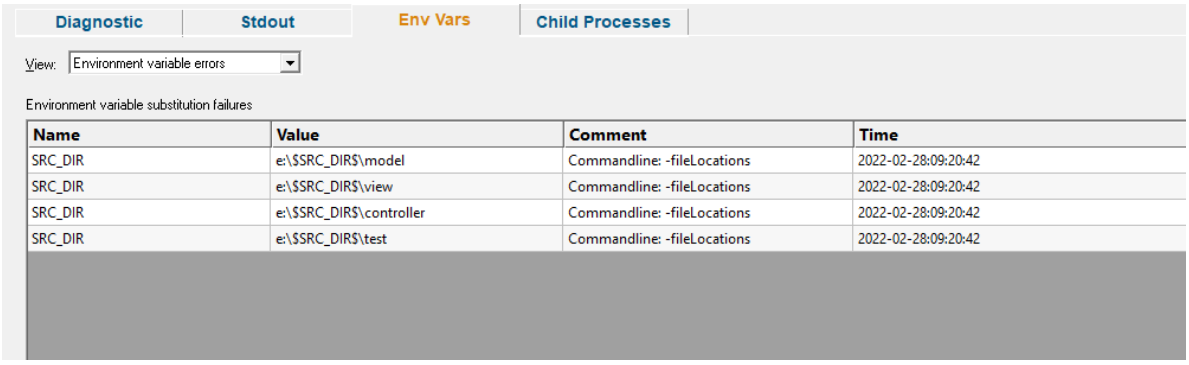
If you launched the target application as a standalone application, or service and used one of our APIs to connect to Performance Validator, the environment variables shown will reflect those in force at the time the application/service was started, and the account that application/service is running on.



Name	Value
=::	::\
=C:	C:\Program Files (x86)\Microsoft Visual Studio 10.0\Common7\IDE
=D:	D:\
=E:	E:\om\c\coverageValidator
=Z:	Z:\
ALLUSERSPROFILE	C:\ProgramData
APPDATA	C:\Users\stephen\AppData\Roaming
ArmServerInfo	000B0B42
CommonProgramFiles(x86)	C:\Program Files (x86)\Common Files
CommonProgramFiles	C:\Program Files (x86)\Common Files
CommonProgramW6432	C:\Program Files\Common Files
COMPLUS_ProfAPI_ProfilerCompatibilitySetting	EnableV2Profiler
COMPUTERNAME	DOBRO
ComSpec	C:\WINDOWS\system32\cmd.exe
CORECLR_ENABLE_PROFILING	1

Environment variable errors

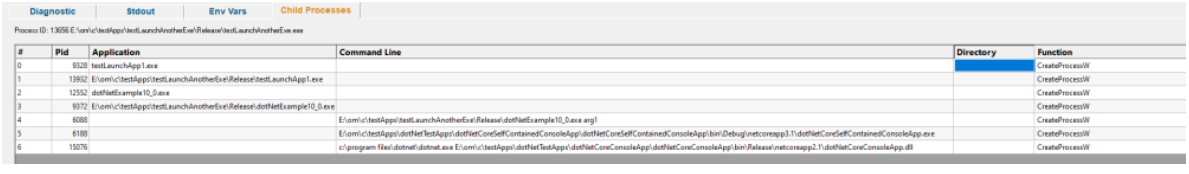
The environment variable errors display shows the name of the environment variable that could not be found, the string containing the environment variable, a comment indicating where the string came from (in this example, the command line), and a timestamp.



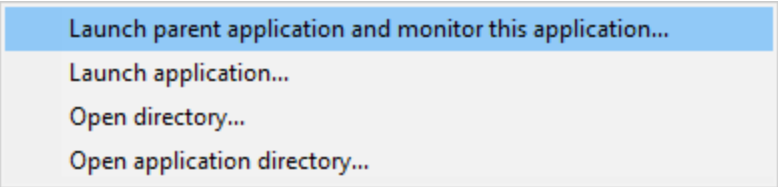
Name	Value	Comment	Time
SRC_DIR	e:\SRC_DIR\model	Commandline: -fileLocations	2022-02-28:09:20:42
SRC_DIR	e:\SRC_DIR\view	Commandline: -fileLocations	2022-02-28:09:20:42
SRC_DIR	e:\SRC_DIR\controller	Commandline: -fileLocations	2022-02-28:09:20:42
SRC_DIR	e:\SRC_DIR\test	Commandline: -fileLocations	2022-02-28:09:20:42

Child Processes

Information about child processes, and the appropriate launch parameters passed to CreateProcess (and related functions) are displayed on this tab.



A context menu is provided to allow you to perform some actions with the launched application data.

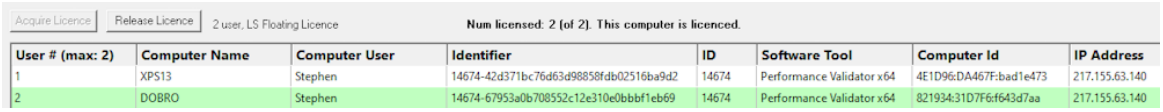


- **Launch parent application and monitor this application...** › the launch application dialog is displayed configured to launch the parent application and monitor this application
- **Launch application...** › the launch application dialog is displayed configured to launch and monitor this application
- **Open directory...** › Windows Explorer is launched to view the contents of the launch directory (the directory field is empty nothing will be shown)
- **Open application directory...** › Windows Explorer is launched to view the directory that contains the application (if the application specification has no path nothing will be shown)

3.7.9 Floating Licence

The **Floating Licence** view displays information about the computers using the floating licence.

This view is only displayed if a floating licence has been purchased. Evaluation users will not see this view.


Acquire Licence | Release Licence | 2 user, LS Floating Licence | Num licensed: 2 (of 2). This computer is licenced.

User # (max: 2)	Computer Name	Computer User	Identifier	ID	Software Tool	Computer Id	IP Address
1	XPS13	Stephen	14674-42d371bc76d63d98858fdb02516ba9d2	14674	Performance Validator x64	4E1D96:DA467F:bad1e473	217.155.63.140
2	DOBRO	Stephen	14674-67953a0b708552c12e310e0bbbf1eb69	14674	Performance Validator x64	821934:31D7F6:f643d7aa	217.155.63.140

The screenshot above show two computers using the same 2 user floating licence, that has maintenance id 14674. Both computer users are licenced and can use the software.

On startup the software automatically checks to see if a floating licence is available, and acquires the licence if possible. This takes a few seconds to process, after startup of the software.

Global Floating Licences

An internet connection is required for floating licences to work. The licence server is managed and run by Software Verify.

Local Network Floating Licences

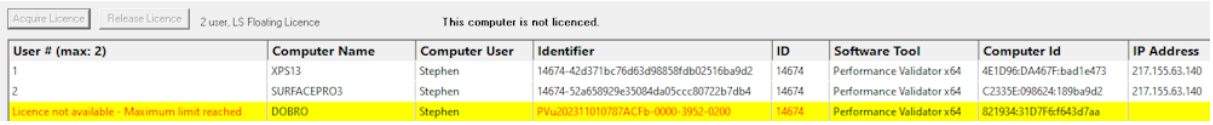
An internet connection is not required for local network floating licences to work. No licence server is required. The licences are automatically managed by the computers on the local network.

Licence information

The information show in this display allows you to identify which of your colleagues are using the software and which versions of the software are in use.

- User
  The user id (1 to number of licensed users).
- Computer Name
  The name of the computer
- Computer User
  The login name of the user of the computer.
- Identifier
  The unique identifier for this licence, used on the licence server.
- ID
  The maintenance id for the software.
- Software Tool
  The software tool and version of the software that is running on that computer.
- Computer ID
  The unique id for this computer.
- IP Address
  This computer's IP address.

Unlicenced users



If any additional users are trying to get a licence for the software, but there are not enough licences, they will also be shown in the display, but with red text on a yellow background.

Please note that on the machine of an unlicensed user the status information will be different.

The software checks to see if a licence has been released on a periodic basis, so that if a licence is released by another user, it can be acquired by the next waiting user.

Releasing a licence

If you have finished using a licence and wish to let a team mate use the software, you have two choices.

You can close Performance Validator, releasing the licence as it closes.

Or you can keep Performance Validator running by manually releasing the licence. Do this by clicking the **Release Licence** button.

Acquiring a licence

If you have released a licence you will need to actively reclaim a licence when you wish to use Performance Validator again. You can start this procedure by clicking the **Acquire Licence** button.

3.7.10 Source Code View

All the performance data tabs have a source code view on the right hand side, each with identical behaviour, although the Line Times tab has slightly different data on the bars.

The file source code view

Clicking on a function in a table or tree shows that function's source code file in the right hand pane.

The source code uses syntax highlighting, with the background colour of the line marking the line of interest.

Call counts and timings are shown in-line with the code.

Source code line times

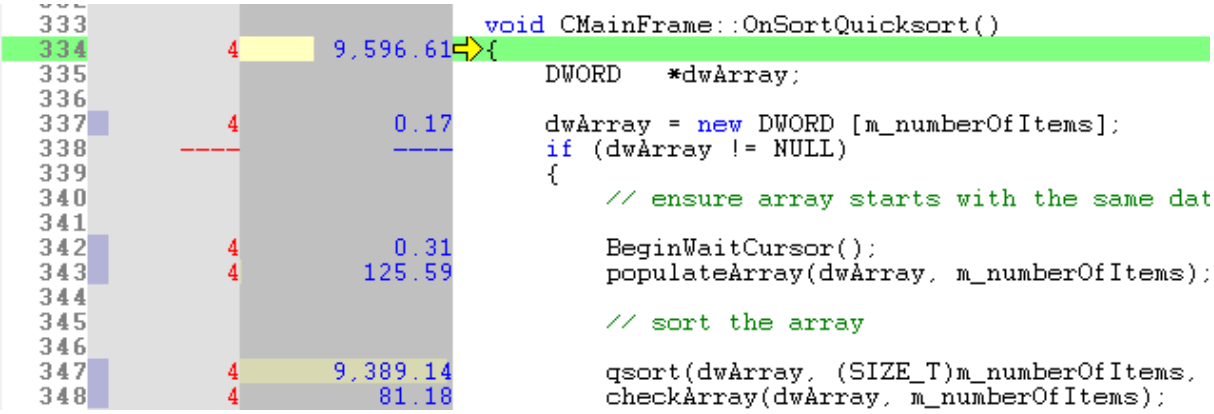
If the collection of line times has been enabled, an extra checkbox is shown above the source code.

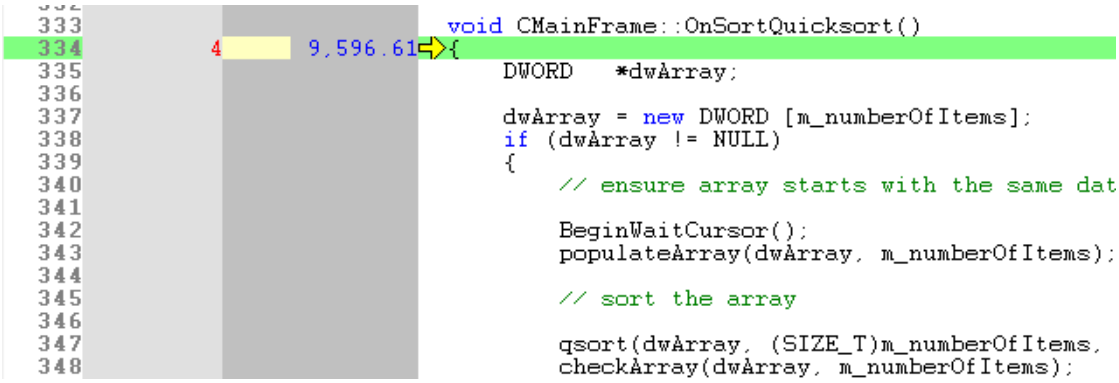
- **Display Line Times** › if checked, shows the embedded visit count and line time information for each line of code

  The very first line of a function will always show function visit counts and function times.

  Lines which could not be hooked will be identified with ----.

  Examples with and without individual line times:





Source code function information

On the right hand panel, above the source code, you'll find some information about the source file.

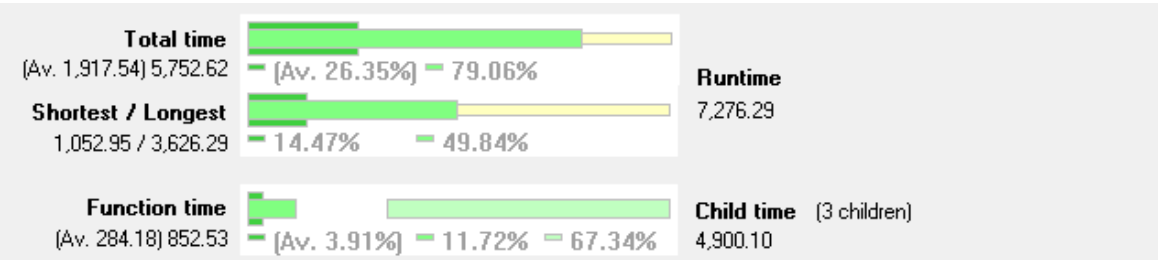
At the top is a text summary of the function, including:

- the function and its address
- the filename and executable or DLL
- the number of times the function was called

Function information bars

Below the textual summary, you'll also see three horizontal bars which provide a visual *signature* for the function's impact on performance.

These bars show many of the same performance timing and percentage statistics as seen in the left hand panel.



From top to bottom, each bar shows a deeper view of the function's behaviour:

The top bar shows **total function times** (including children):

- Average total function time relative to runtime

- Total function time relative to runtime

The second bar shows the **range of times for individual function calls**, including children:

- Shortest function time relative to runtime
- Longest function time relative to runtime

The last bar shows the segmentation of **time in function and in child functions**:

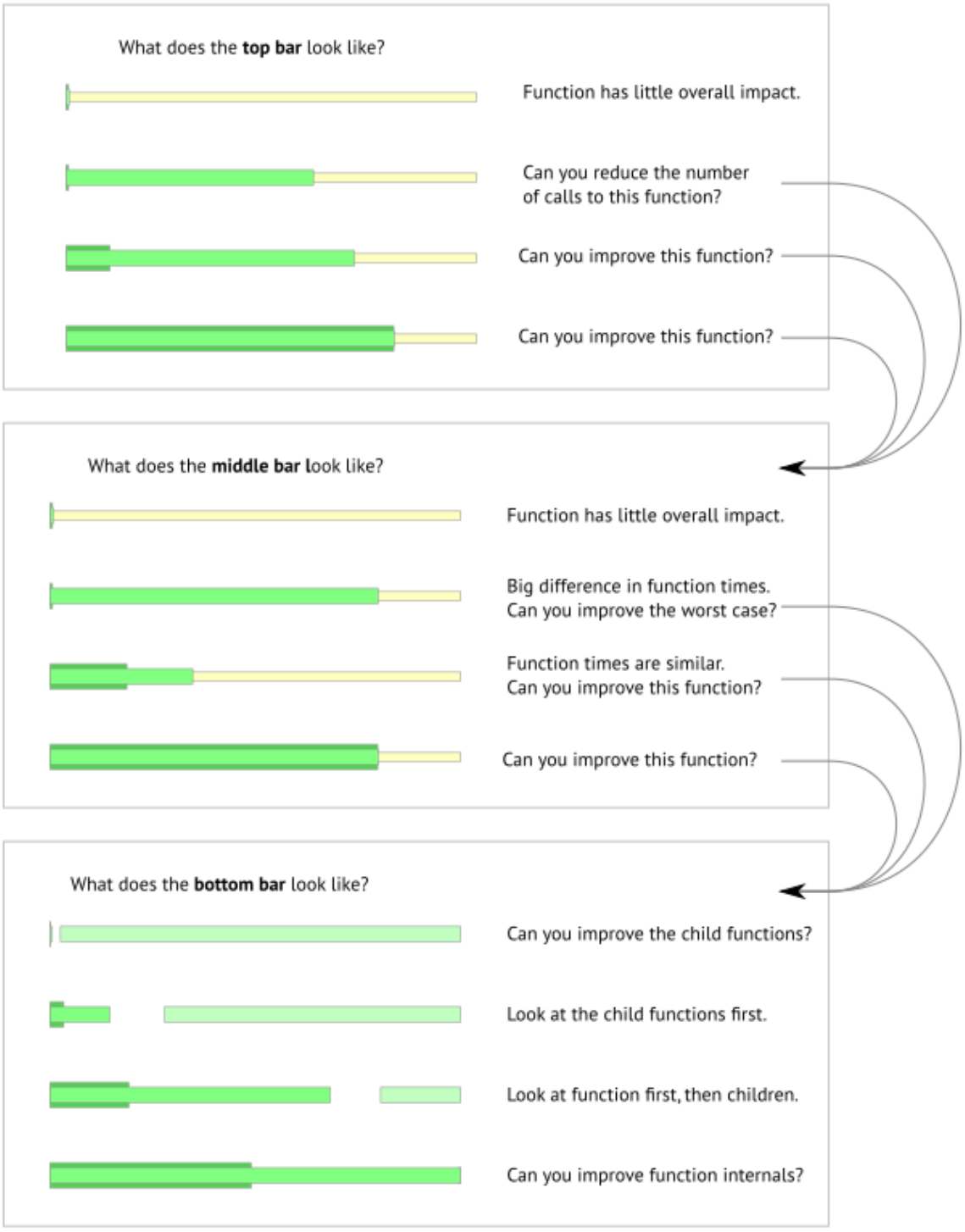
- Average time in function relative to runtime
- Total time in function relative to runtime
- Total time in child functions relative to runtime

 Time in function and time in children sum to the total function time. The gap between these in the third bar therefore indicates time in all other functions.

Reading the bars

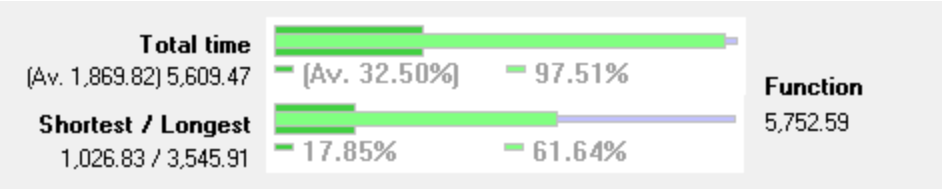
The extent of the colours in the bars helps to provide a hint as to the impact the function has on performance and where it might be improved.

The following guide can be used to interpret the bars to see where improvements might be made:



Line time information bars

On the Line Times tab, the information in the bars is different. They show selected line time *relative to function time*, rather than to runtime.



The top bar shows **total line times**:

- Average total line time relative to total function time
- Total line time relative to total function time

The bottom bar shows the **range of times for individual line calls**:

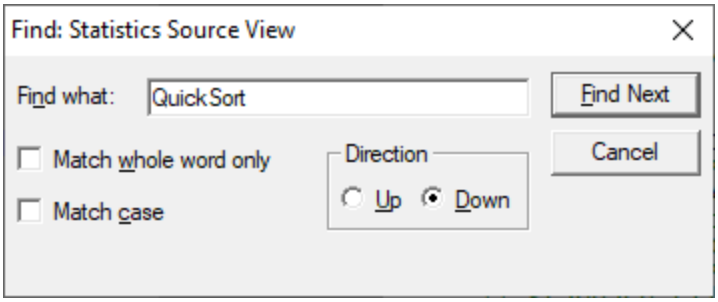
- Shortest individual line time relative to total function time
- Longest individual line time relative to total function time

The longer the green bar, the more this line of code contributes to the function time, and therefore identifies a line within the function that most needs improvement.

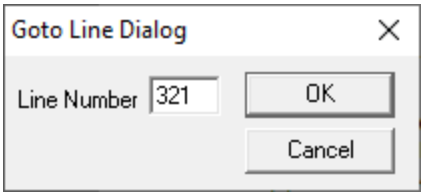
Find and Goto

When the source code view has focus, some keyboard access is available to search for text, or to navigate to numbered lines.

In the source code view, Ctrl + F lets you search by full or partial match anywhere in the file.



Also in the source code view, Ctrl + G displays a goto-line dialog.



➡ To find text in the data tables, call tree or call graph, use the Find Dialog where you can search many different criteria.

3.8 User Interface Mode

Setting the user interface mode - Wizards or Dialogs?

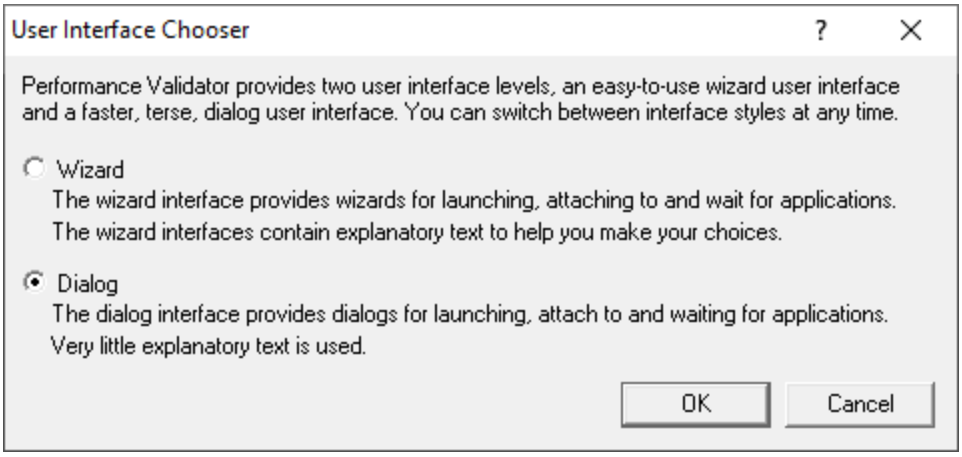
For some key tasks, there are two user interface modes controlling the way in which options are presented to you:

- **Wizard mode** › guides you through the tasks in a linear fashion
- **Dialog mode** › all options are contained in a single dialog

  Experienced users will find this mode quicker to use.

To set the user interface mode:

Settings menu › **User Interface Mode...** › select the desired mode in the **User Interface Chooser** dialog:



The user interface mode affects the following tasks:

- Attaching to an application (Injection)
- Launching an application
- Wait for application to start

3.9 UX Theme

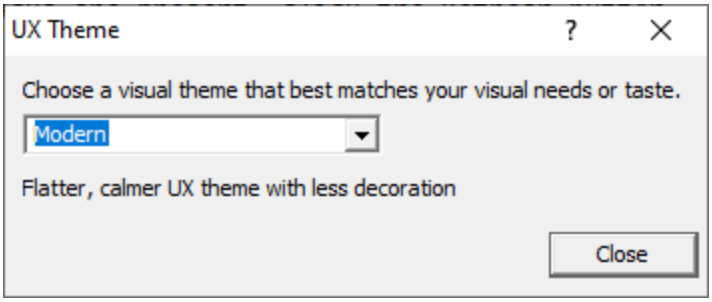
The user interface provides three UX themes.

- Modern. The look and feel of current Software Verify tools.
- Classic. The look and feel of previous Software Verify tools.
- High Contrast. A higher contrast version of the Modern theme.

Setting the UX theme

To set the UX theme

Settings menu › **UX Theme...** › shows the UX Theme chooser dialog



Changing the UX theme will update some of the colours that you can modify with the colour settings dialog.

3.10 Settings

Performance Validator allows extensive control over which data is collected and how that data is displayed. Additional options control the way the application behaves.

These settings can generally be considered as being either Global settings or Local settings.

Global and local settings

Global settings affect all data collected and its display throughout Performance Validator.

Global settings are changed via the Data Collection Settings Dialog and the following 20 or so pages describe each available group of settings.

Local settings apply to controls and data displayed in each of the main display windows.

Local settings are found at the top of each relevant tab.

Other settings

There are a few more settings not included in the global settings dialog such as:

- User interface mode
- Session settings
- User permissions warnings

3.10.1 Data Collection Settings

The Data Collection Settings dialog allows you to control all the global settings in Performance Validator that affect the way data is collected and displayed. There are also local display options on most of the main tabs.

This page has a warning about use of the Reset button.

Opening the settings dialog

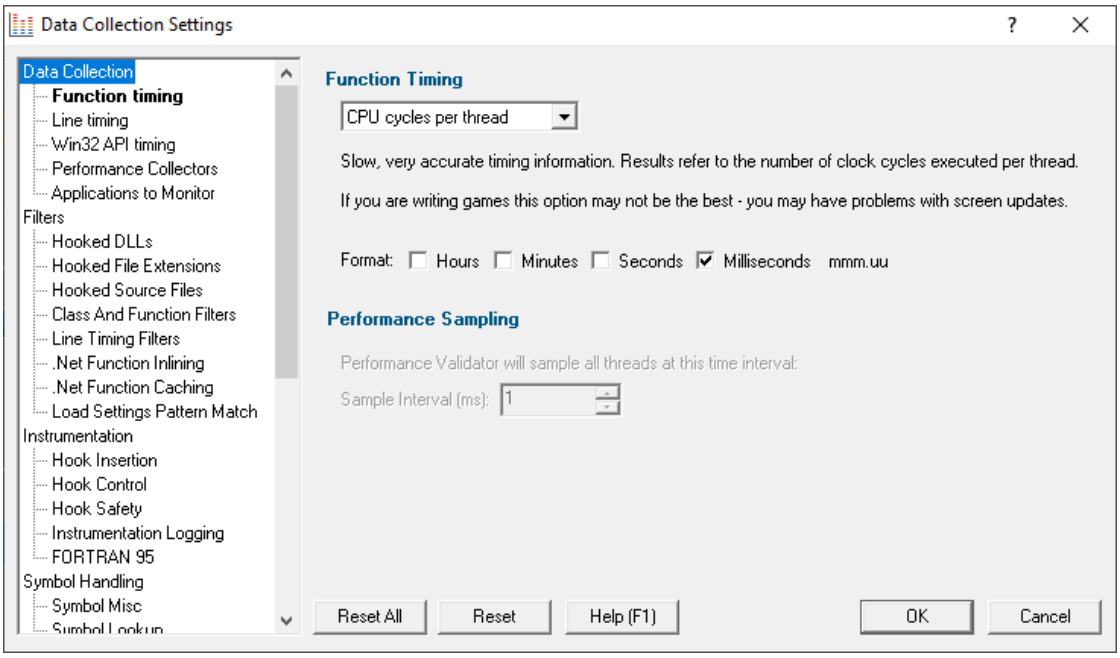
To view the settings dialog, choose **Settings** menu > **Edit Settings...**

Or use the option on the Session Toolbar:

Using the settings dialog

The dialog has a scrolled list on the left hand side, grouping the topics. When a topic is clicked, its related controls are displayed on the right hand side.

The default display of the dialog is shown below with the first topic selected.

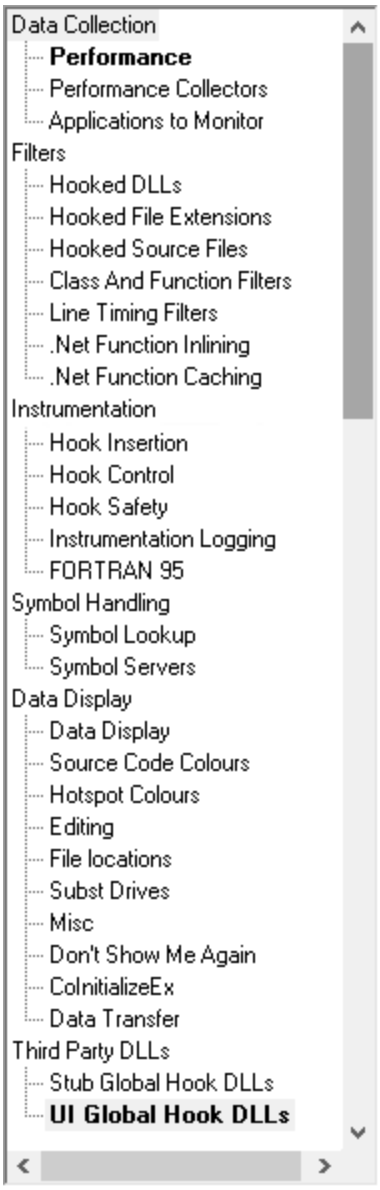


After selecting a topic, you can also use the cursor up and down arrow keys to change the selected item.

Entering a character on the keyboard cycles though topics starting with that letter.

Too many settings? It may seem that there is an overwhelming number of settings to worry about. **Don't panic!** The good news is that for new users, very few (if any) settings actually need to be changed to use the application in most cases, and even for experienced users, many groups of settings will not be needed. However, Performance Validator remains flexible for all our users in many different scenarios.

Click on any item in the picture below to find out more about the settings for that group.



Restoring the default settings

The settings dialog has **Reset All** and **Reset** buttons near the bottom left of the dialog which you can use to reset all global settings back to their default values.

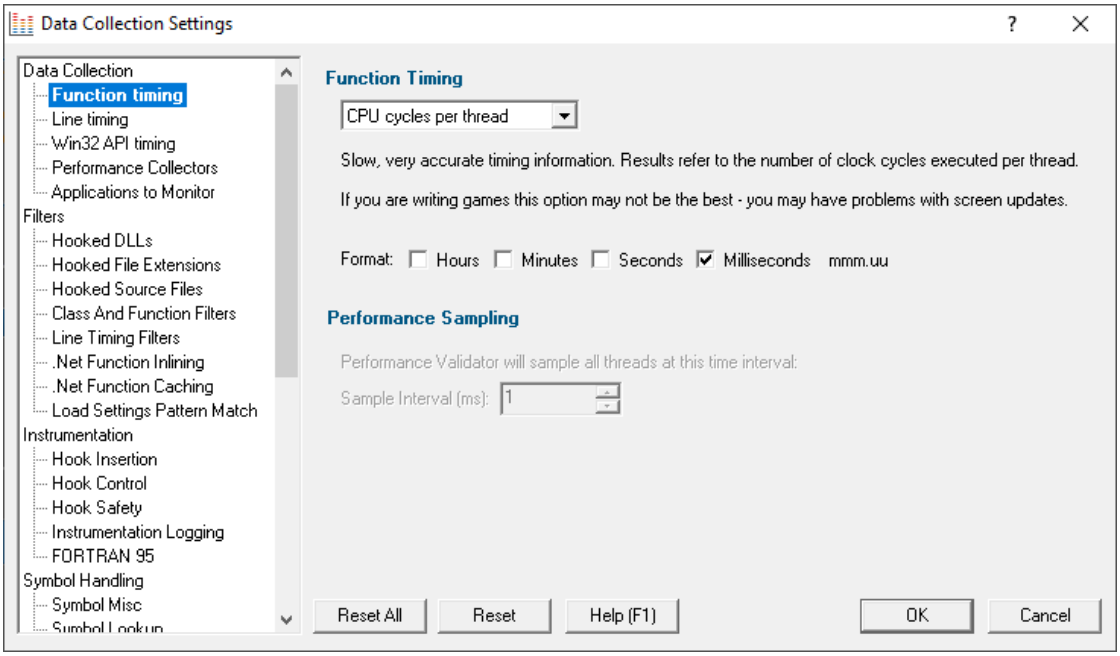
This **Reset All** button resets nearly **all global settings** in Performance Validator, not just the settings visible on the current tab of the dialog.

The **Reset** button resets just the settings visible on the current tab of the dialog.

3.10.1.1 Data Collection

3.10.1.1.1 Function Timing

The **Function Timing** page allows you control how function timing data is collected.



Function Timing

There are a number of methods available for collecting performance data, with some of them being system dependent.

When Performance Validator was installed, the most appropriate timing method was selected automatically.

Most of the options count every function visit, but the timing method is different:

- **CPU cycles per thread** › counts function visits and times them using the processor's instruction cycle counter on per-thread basis

  Only CPU cycles used by the owning thread will be counted.

  This method is slower but more accurate.

  Recommended choice for: Windows Vista and onwards, although we have found that some games cannot be profiled with this setting as it interferes with the screen update.

- **Performance Counters** › counts function visits and times the functions using a very accurate counter that is provided by modern computer chipsets

  Your application will run slower than with the other options as the function calls to provide the accurate counter value are quite slow.

  Recommended choice for: Windows XP and earlier with two or more processor cores.

- **Time Stamp Counter** › counts function visits and times them using the processor's instruction cycle counter

  If your processor does not support this option, you will not be able to select it.

  Most modern processors (Pentium II, III, IV, Athlon etc) support this option.

  Recommended choice for: Windows XP and earlier with just one processor core, running non-hyperthreaded applications.

- **1 ms Accuracy** › counts function visits and times them using a fast function call that is only accurate to approximately 1ms

- **Call Count** › counts function visits only - no timing information

- **Sampling** › stops all application threads at specified intervals and records the callstack for each thread

  Performance data is calculated based on each callstack.

  The Statistics and Relations tabs will show Sample Count rather than Call Count data.

  The **Sample Count** and **Sample Count %** statistics show how often a given function/file/line combination is identified in the sampling statistics.

  The Call Tree tab and Analysis tab are the most useful way of analysing statistics gathered in **Sampling** mode.

  Recommended choice for: quickly determining which areas of the application are running slowly before switching to a more accurate method, e.g. **Performance Counters** or **Time Stamp Counter**.

Time Format

The format of timing information in Performance Validator is controlled by the **Format** checkboxes.

Typically, you'd choose all the options up to one level, rather than mixing just hours and milliseconds for example!

Some examples are below, where `HH` means hours, `MM` minutes, `SS` seconds and `mmm.uu` means milliseconds.

- **Hours + Minutes + Seconds + Milliseconds** › `HH:MM:SS:mmm.uu` e.g. 1:35:28:133.42
- **Minutes + Seconds + Milliseconds** › `MM:SS:mmm.uu` e.g. 95:28:133.42
- **Seconds + Milliseconds** › `SS:mmm.uu` e.g. 5,728:133.42
- **Milliseconds** › `mmm.uu` e.g. 5,728,133.42

Performance Sampling

- **Sample Interval (ms)** › sets a sampling interval in milliseconds

  50ms is a good starting point. 10ms or less will provide good sampling rates.

  Depending on your application, you *may* be able to set intervals as low as 1ms.

  If your application runs incredibly slowly, with sampling dominating your application's processing then try increasing the interval.

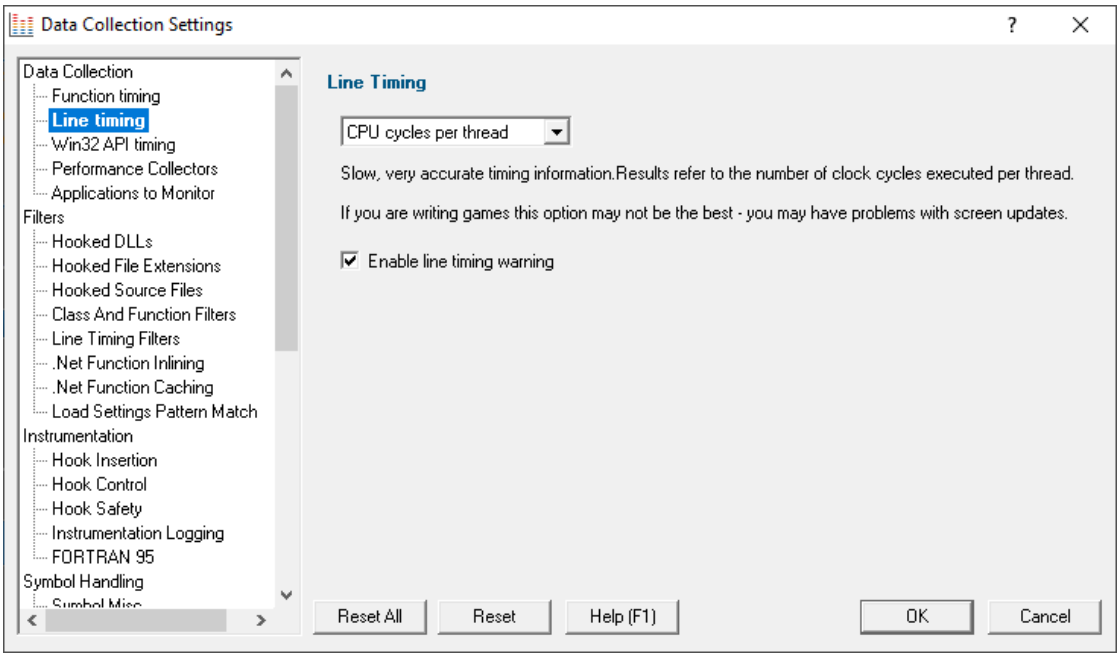
 In Sampling mode, Symbol Servers are not used.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.1.2 Line Timing

The **Line Timing** page allows you control how line timing data is collected.



Line Timing

In a similar way to Performance Timing above, the Line Timing options control how the line times are determined.

However, here there are just two relevant options:

- **CPU cycles per thread** › Counts line visits and times them using the processor's instruction cycle counter on per-thread basis

  Only CPU cycles used by the owning thread will be counted.

  This method is slower but more accurate.

  Recommended choice for: Windows Vista and onwards, although we have found that some games cannot be profiled with this setting as it interferes with the screen update.

- **Time Stamp Counter** › Counts line visits and times them using the processor's instruction cycle counter

  If your processor does not support this option, you will not be able to select it.

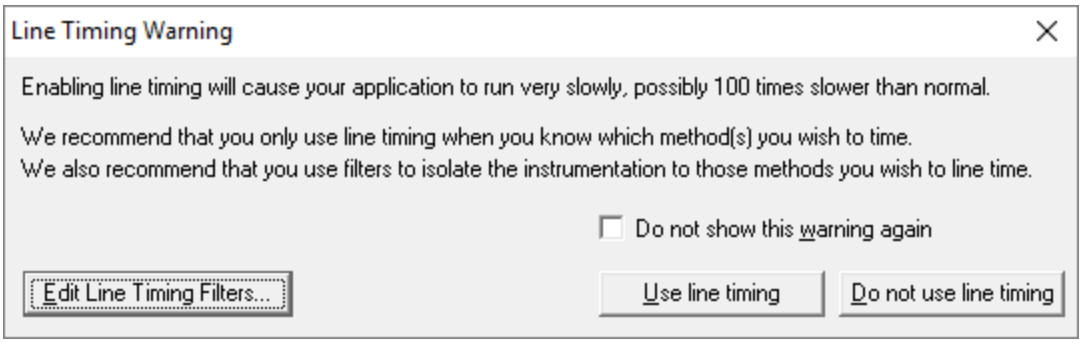
  Most modern processors (Pentium II, III, IV, Athlon etc) support this option.

  Recommended choice for: Windows XP and earlier with one processor core, running non-hyperthreaded applications.

Line Timing Warning

- **Enable line timing warning** › controls an optional warning displayed when you enable line timing on the launch wizard/dialog

  If enabled, a warning dialog is displayed to remind you of the possible performance slowdown when using line timing



- **Edit Line Timing Filters** › shows the Line Timing Filters settings dialog

  Set specific classes, methods and functions to be included in, or excluded from, the hooking process.

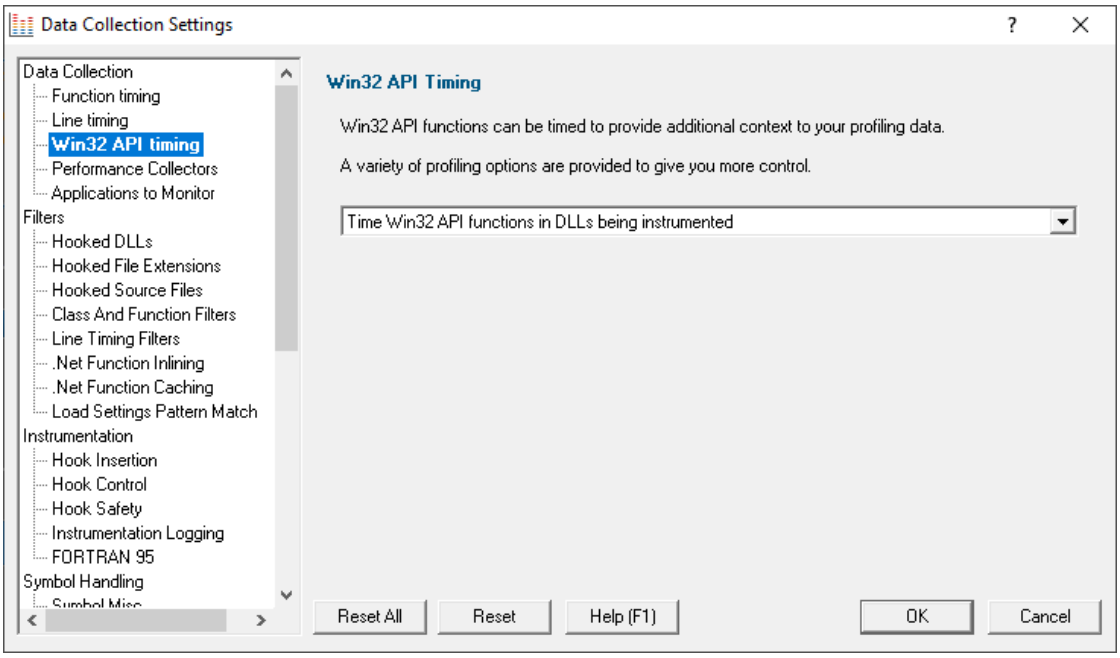
  This dialog is identical to the Line Timing Filters page of the global settings dialog.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.1.3 Win32 API Timing

The **Win32 API Timing** page allows you control how Win32 API data is collected.



Win32 API Hooking

As well as timing the execution of functions in code you've written, Performance Validator can time Win32 API functions, allowing you to see which API calls are causing poor performance.

Choose an option from the combo box.

- **Don't time Win32 API functions** › No Win32 API timing
- **Time Win32 API functions in all DLLs** › Win32 API timing for all Win32 API calls, from your code and from code you call in any DLL
- **Time Win32 API functions in non operating system DLLs** › Win32 API timing for all Win32 API calls, from your code and from code you call in any non operating system DLL
- **Time Win32 API functions in non Microsoft DLLs** › Win32 API timing for all Win32 API calls, from your code and from code you call in any non Microsoft DLL
- **Time Win32 API functions in DLLs being instrumented** › Win32 API timing for all Win32 API calls from DLLs being instrumented. **This is the default option**
- **Time Win32 API functions in non Microsoft DLLs being instrumented** › Win32 API timing for all Win32 API calls from non Microsoft DLLs being instrumented

These different options allow you to choose how much Win32 API timing data you want to collect.

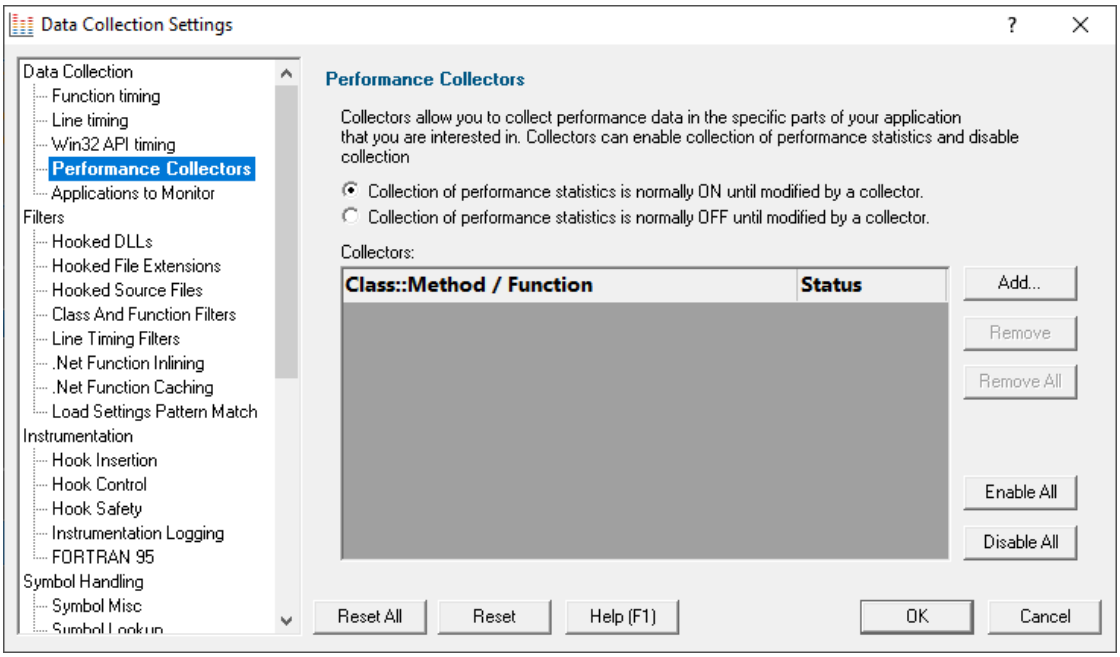
The default option is **Time Win32 API functions in DLLs being instrumented** which means you'll only get timing data for Win32 API functions that your code directly calls. Any indirect calls to Win32 API functions (for example from user32.dll to kernel32.dll) will not be timed.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.1.4 Performance Collectors

The **Performance Collectors** page allows you control how performance data can be conditional collected.



Collectors

When collecting performance data you may want to concentrate on very specific parts of your application.

Collectors allow you to switch data collection on or off as the program enters a named function. The collection state before entry is resumed on function exit.

The initial collection state, i.e. before entering any collectors, can be set on or off.

Changes to the collectors will apply to the *next* session, not the current session.

Data collection is subject to the other global data collection flags.

➡ See the question on using Performance Collectors or Class & Function Filters?

Example use of collectors

Example 1

Consider an imaginary application where only the **myApp::sortThisData()** function and all functions called from it are of interest.

You would configure Performance Validator to initially not collect performance data, by selecting **Collection of performance statistics is normally OFF until modified by a collector**.

You'd also add **myApp::sortThisData** to the list of collectors and set the status to **Collect**.

Now when the application reaches **myApp::sortThisData** the collection of performance data is turned on because of that **Collect** status.

The application runs as normal, and performance data is collected until the function **myApp::sortThisData** finishes executing.

At that point the previous collection status (OFF) is restored.

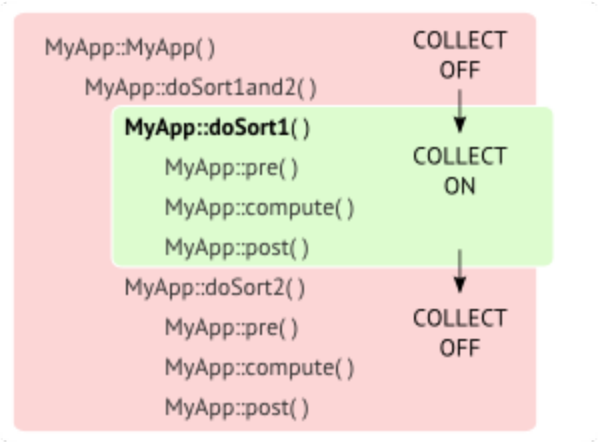
Example 2

Consider a simple application that calls two different sorting algorithms `doSort1` and `doSort2` as in the call sequence below:

```
MyApp::MyApp( )
    MyApp::doSort1and2( )
        MyApp::doSort1( )
            MyApp::pre( )
            MyApp::compute( )
            MyApp::post( )
        MyApp::doSort2( )
            MyApp::pre( )
            MyApp::compute( )
            MyApp::post( )
```

Imagine you're only interested in the performance of the algorithm `doSort1`, but none of the other application code.

You'd set **MyApp::doSort1** as a collector, triggering data collection to turn on only whilst in that function and any of it's children.



Another way to look at this is to say that you're interested in the `pre()`, `compute()` and `post()` functions, but *only* if called from `doSort1()`.

You can add multiple triggers to switch collection on for methods of interest or to switch collection off to eliminate unwanted data.

Initial collection state

The initial collection of data can be on or off until a collector is visited

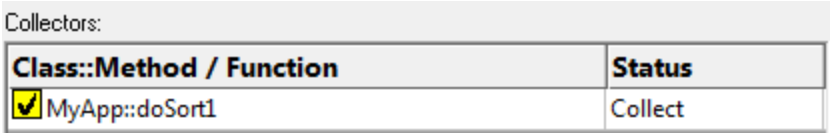
- **Collection of performance statistics is normally ON...** › collect performance data until switched off by a collector
- **Collection of performance statistics is normally OFF...** › prevent data collection until switched on by a collector

Managing the list of collectors

- **Add** › adds a row to the **Collectors** table › enter the class::method name and the desired collection status

  The two status options are **Collect** and **Don't Collect**.

  Collectors are enabled by default. Use the yellow checkbox at the start of the line to disable it without having to remove it from the list.



- **Remove** › removes any selected collectors in the list
- **Remove All** › clears the list

- **Enable All** › enables all collectors in the list
- **Disable All** › disables all collectors

  Don't confuse the collection status (second column) and the enabled status (checkboxes)

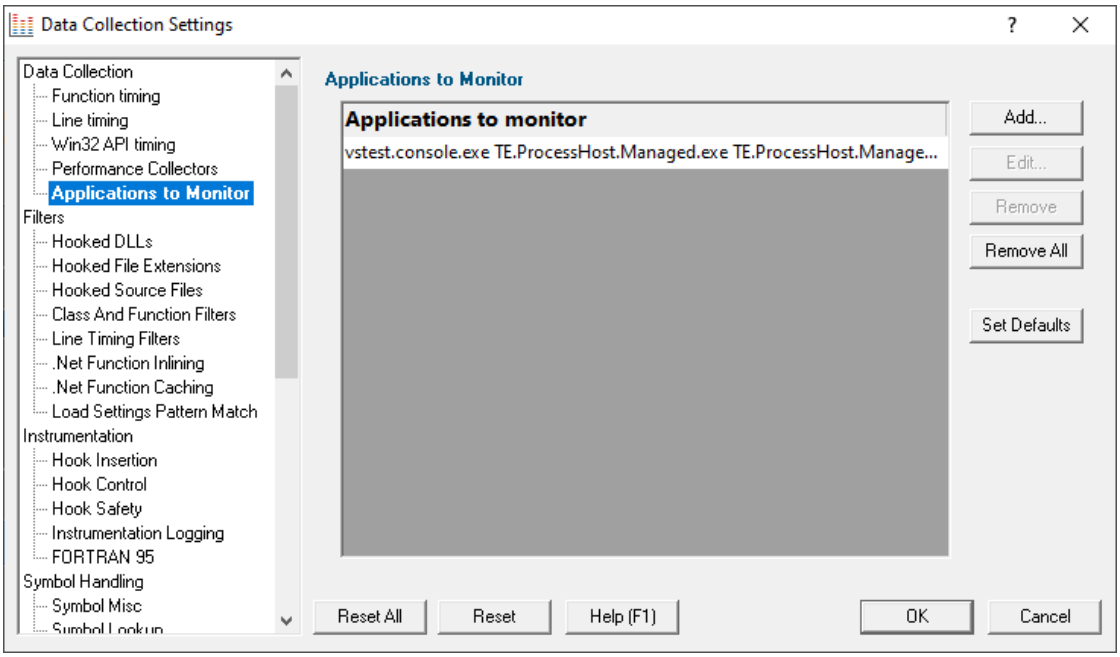
  Disabled collectors don't affect the performance data collection status.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.1.5 Applications to Monitor

If your target program launches other child applications then the **Applications to Monitor** page lets you choose which ones to monitor.



Monitoring child applications

You may have a case where the program you need to start is not the one you are interested in.

Your program may launch child applications and it may be one of *those* that you want to monitor with Performance Validator.

An example might be for unit testing where a test program spawns one or more child applications, or it might launch the same application multiple times.

The applications to monitor

The main list of **Applications to monitor** shows programs you may want to launch and the child applications they subsequently start - i.e. the you may be interested in monitoring.

Once a definition has been added, you can then use the Application to Monitor setting on the Launch Dialog or wizard to choose which of these child applications you actually want to monitor in a given session.

Managing the applications to monitor

The list contains a set of definitions - each one being for a different launch program.

For each launch program you can set the child applications you might want to monitor later.

An application is defined by its type (native and .Net, or .Net Core), the application executable name, and for .Net Core applications an additional application DLL that is used to identify the application.

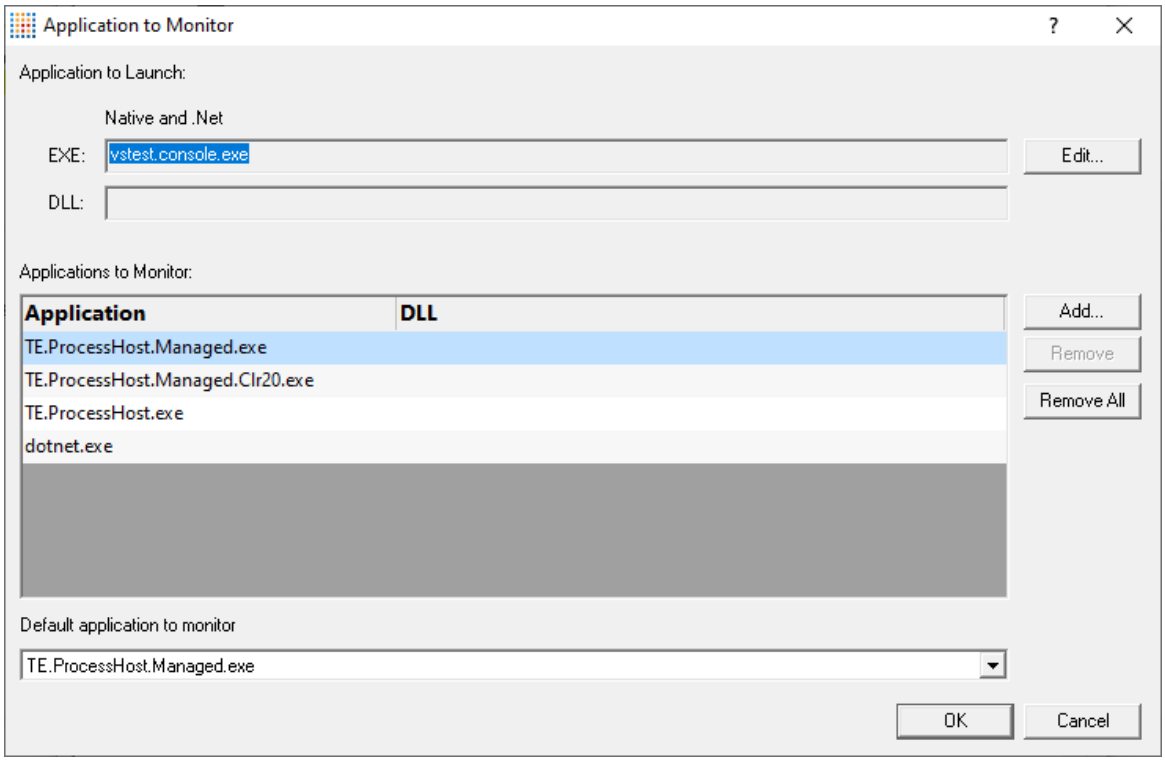
- **Add** › add a new module definition using the **Application to Monitor** dialog below
- **Edit** › modify a selected definition in the list, using the **Application to Monitor** dialog again
- **Remove** › removes any selected definitions in the list
- **Remove All** › clears the list
- **Set Defaults** › reset the list of known applications to those as configured with a new install of Performance Validator

  The defaults are currently setup for Microsoft's Visual Test software `vstest.console.exe`.

The Application to Monitor dialog

The **Application to Monitor** dialog lets you define or edit a launch program and it's child applications.

The values you specify here are the ones used on the launch dialog and launch wizard to customize which application actually gets monitored.



- **Application to Launch** › **Edit...** to select the initial starting application that will be *launching* the applications you want to monitor

  Any executable names found in the selected program will automatically be displayed in the list of **Applications to Monitor**.

  If you don't wish to use these automatic names you can **Remove** them.

- **Add** › add an additional application that you know will be started by the launch program

  Child applications that you add are used *without* the path.

  Excluding the path gives more scope for matching launched application names if they are launched with a different path.

- **Remove** › removes any selected applications in the list

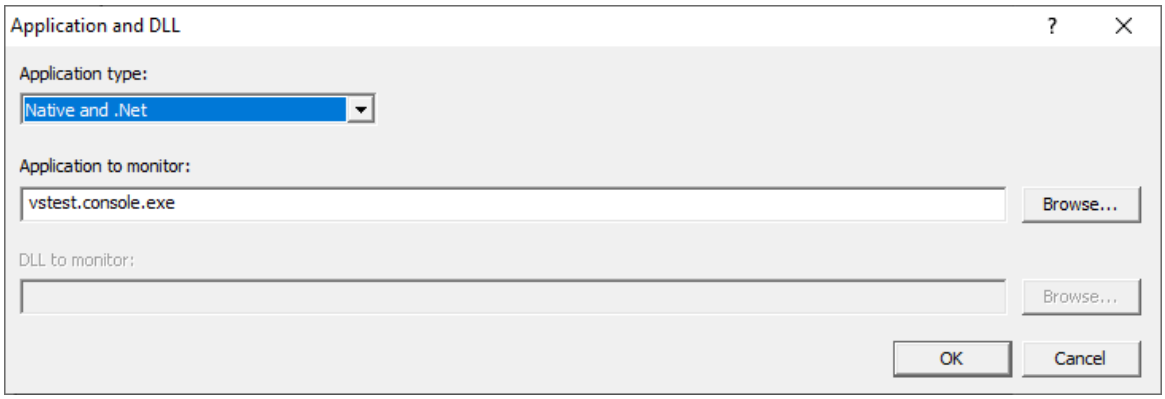
- **Remove All** › clears the list

- **Default application to monitor** › choose the appropriate item to be the default item

  The default application will be selected on the launch dialog (or wizard) whenever the *start* program is specified as the one at the top of this dialog.

The Application and DLL dialog

The **Application and DLL** dialog lets you define or edit a launch program and a launch DLL.



- **Application type** › choose the type of application
  - Native and .Net
  - .Net Core (Framework Dependent)
  - .Net Core (Self Contained)
- **Application to monitor** › edit or **Browse...** the application EXE to monitor.

  This can be an executable name or the full path to the executable. For example **test.exe** or **c:\unitTests\test.exe**.

  For native applications this is the application executable.

  For .Net Framework applications this is the application executable.

  For .Net Core Framework-dependent applications this is most likely going to be **c:\program files\dotnet\dotnet.exe**.

  For .Net Core Self-contained applications this is the application executable.
- **DLL to monitor** › edit or **Browse...** the application DLL to monitor. This field is only needed for .Net Core applications.

  This can be an executable name or the full path to the executable. For example **test.dll** or **c:\unitTests\test.dll**.

  For native applications this is not used.

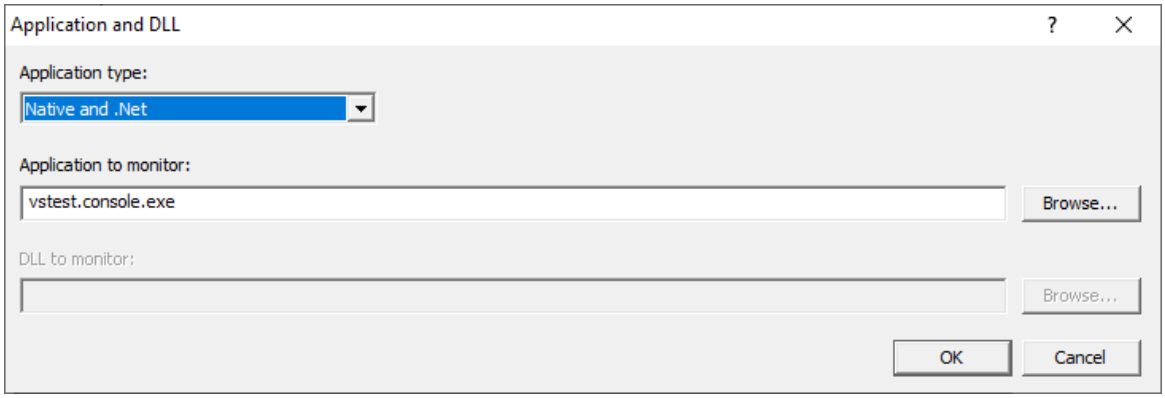
  For .Net Framework applications this is not used.

  For .Net Core Framework-dependent applications this is the application dll. (the name of the dll that you would pass to dotnet.exe on the command line).

  For .Net Core Self-contained applications this is the dll that has the same name as the application executable. (for theApp.exe, the dll name is theApp.dll).

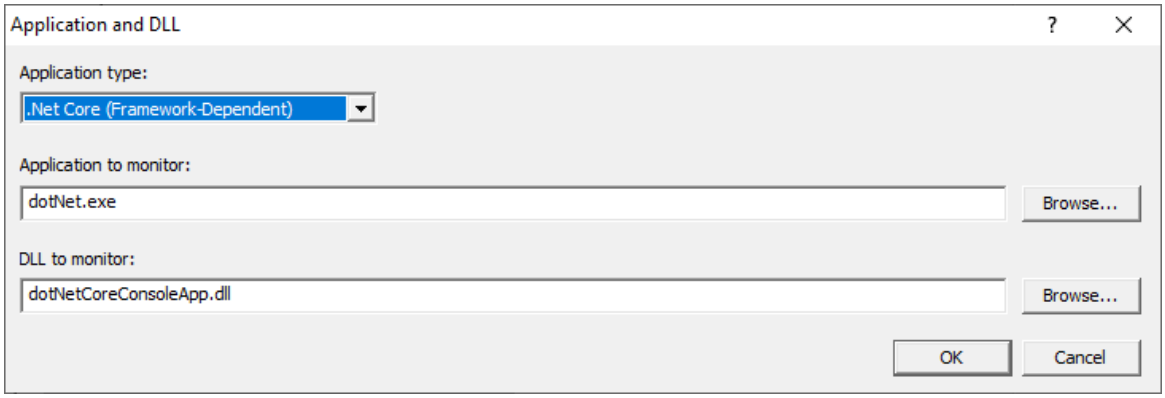
Example Dialogs

Native

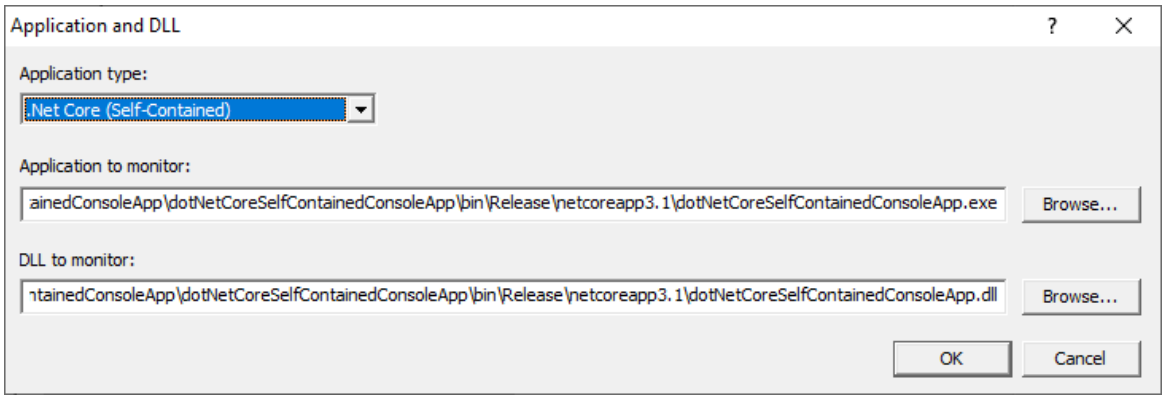


.Net

.Net Core (Framework-dependent)



.Net Core (Self-contained)



Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

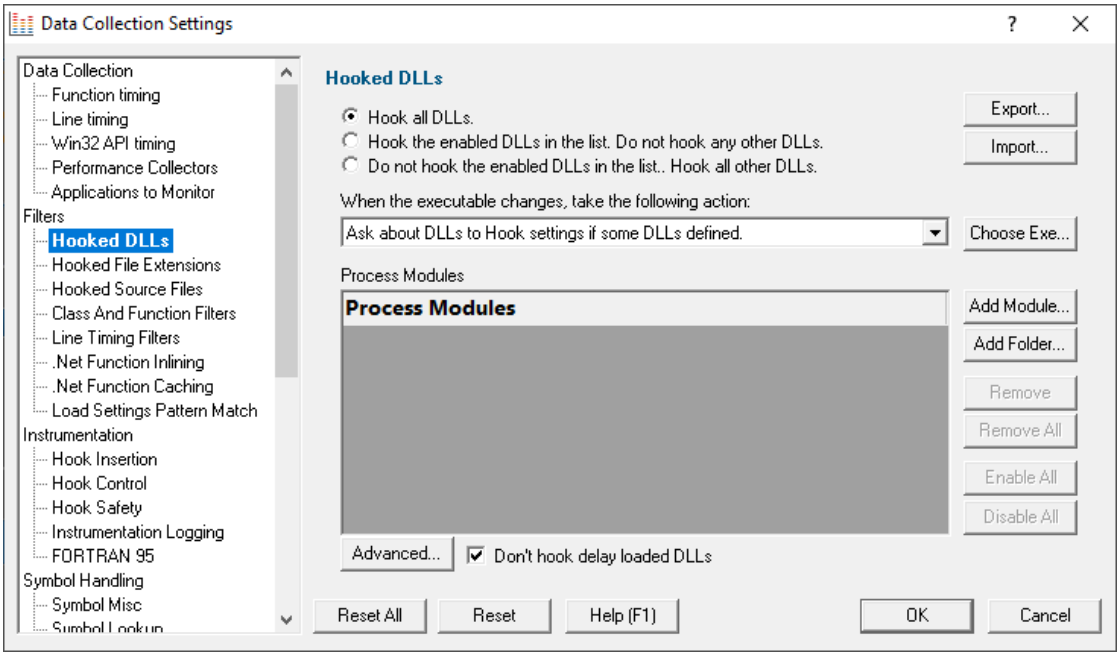
3.10.1.2 Filters

3.10.1.2.1 Hooked DLLs

The **Hooked DLLs** tab allows you to specify which DLLs should be hooked or not.

The default is simply to hook everything.

Read on, or click on a setting in the picture below to find out more.



Which DLLs to hook - the hooking rule

By default, Performance Validator will try to hook all DLLs and .EXEs used by your application, but you can choose to list only those which should be included or excluded:

- **Hook all DLLs** › hook everything - ignoring the settings in the list
- **Hook the enabled DLLs in the list** › hook only the ticked modules listed
- **Do not hook the enabled DLLs in the list** › *ignore* all the ticked modules in the list, and hook everything else

Populating the process modules list

The process modules list should specify the following items to be included or excluded from hooking in the target application

- DLLs
- .EXEs
- folders *containing* DLLs and .EXEs

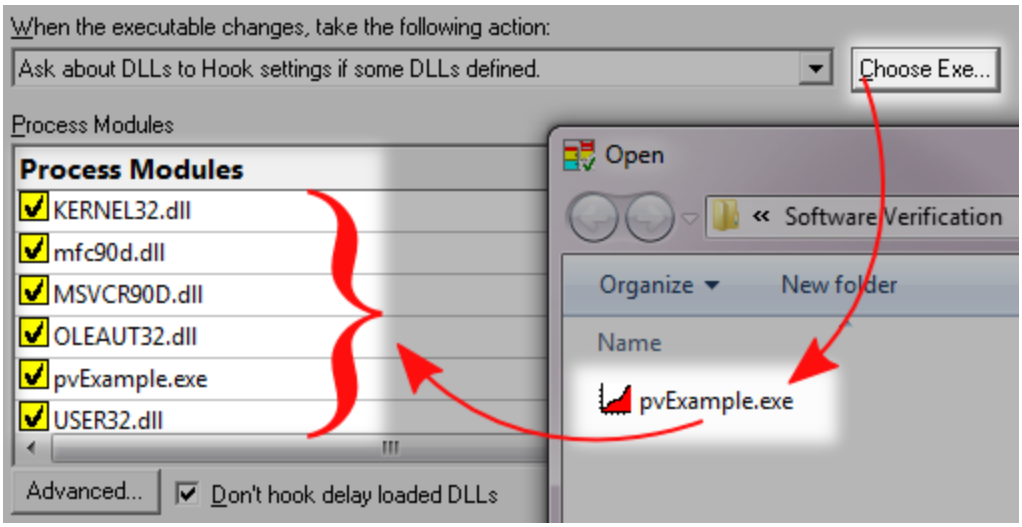
Initially the list is empty as the default option is to hook all DLLs and ignore the list. You can add modules to the list by:

- automatically adding modules on which your application is dependent
- manually adding modules or folders
- editing modules or folders already in the list

Automatic module addition

You can automatically populate the list with all the dependent modules for your application:

- **Choose Exe...** › navigate to your application and click **Open** › all the process modules appear in the list



Manual module addition

You can also manually add one or more modules or a folder to the list.

- **Add Module** › navigate to the DLL or EXE and click **Open** › all the selected items are added
- **Add Folder** › navigate to the folder and click **OK** › the folder is added to the list

Manual addition might be useful for example if you use `LoadLibrary()` to load a DLL rather than linking it, as this would not be picked up automatically by the *Choose Exe...* method.

By default, all the modules are ticked in the yellow checkboxes.

Any DLLs in the list override the DLL Hook Insertion settings on the Hook Insertion tab.

Note that ticked modules or folders are either **in**cluded or **ex**cluded depending on the hooking rule above

Altering existing module names

Although you can't add blank entries to the list and edit them, you *can* edit existing items in the list by double clicking on an entry:

- enter only the module name, not the path
- you can use wild-cards like MFC*.dll, but only for DLLs, not folders

Managing the process modules list

The usual controls apply for removing or changing the enabled state of items in the list:

- **Remove** › removes selected items in the list

- **Remove All** › removes all items, clearing the list
- **Enable All** › ticks all items in the list for applying to the hooking rule
- **Disable All** › unticks all items in the list, meaning they won't apply to the hooking rule

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

Exporting and importing

Since the list of hooked DLLs (and the rule being applied) can be quite complicated to set up and optimise, you can export the settings to a file and import them again later. This is useful when switching between different target applications.

- **Export...** › **choose or enter** a filename › **Save** › outputs the hooking rule and the list of modules to the file
- **Import...** › **navigate** to an existing *.pvx file › **Open** › loads the hooking rule and the list of modules

The exported file can also be used with the -dllHookFile command line option.

Optionally hooking delay loaded DLLs

- **Don't hook delay loaded DLLs** › prevents hooking of delay loaded DLLs. The default is to hook these.

  What is 'delay loading'?

  Delay loading a DLL is when it is implicitly linked, but not actually loaded until your code references a symbol contained in the DLL.

  Delay loading can speed up startup time, but unhandled exceptions may cause your program to terminate if the DLL can't be found when needed during the run time.

Launching new Applications

When specifying DLLs to hook, and launching different applications, it can be quite easy to forget to change the hooked DLLs for the new program. This might be the case when performing unit tests, for example.

Using the wrong list of hooked DLLs for a program will likely cause incorrect performance data results, so you can opt to be warned about the DLLs being hooked whenever the target application changes between sessions (using the dialog below).

The choices in the drop down list are only applicable when the application changes:

- **Ask about DLLs to Hook settings if some DLLs defined**

You'll only be asked about the settings if you defined some DLLs in the list *and* if the hooking rule is not set to *hook all DLLs*

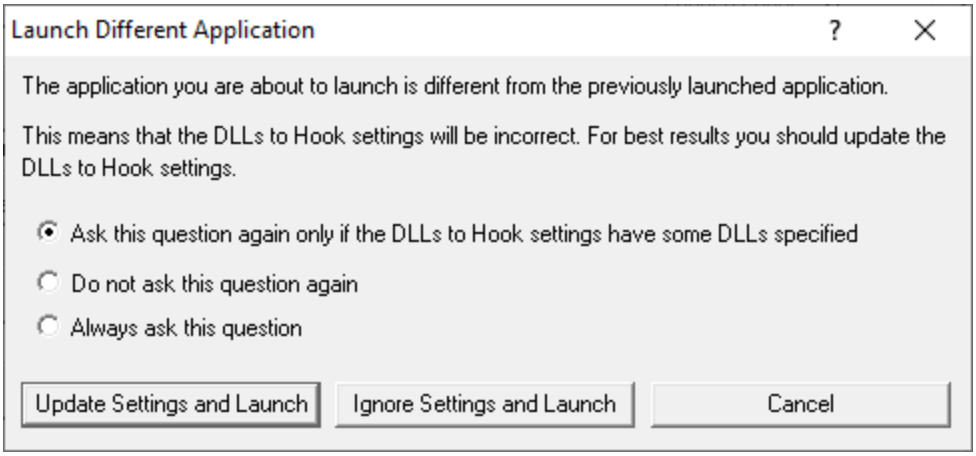
- **Always ask about DLLs to Hook settings**

  You'll always be asked about the settings - *whatever* the other settings are.

- **Never ask about DLLs to Hook settings**

The 'Launch Different Application' dialog

When being asked about the hooked DLL settings, you'll see the following dialog:



You can update the settings; ignore them and launch anyway, or just cancel the launch:

- **Update Settings and Launch** › **edit** the settings › click **OK** › the application will be launched
- **Ignore Settings and Launch** › the application will be launched without updating the settings
- **Cancel** › won't launch the application

To change when you are asked this question, just choose the appropriate option in the dialog.

Advanced options

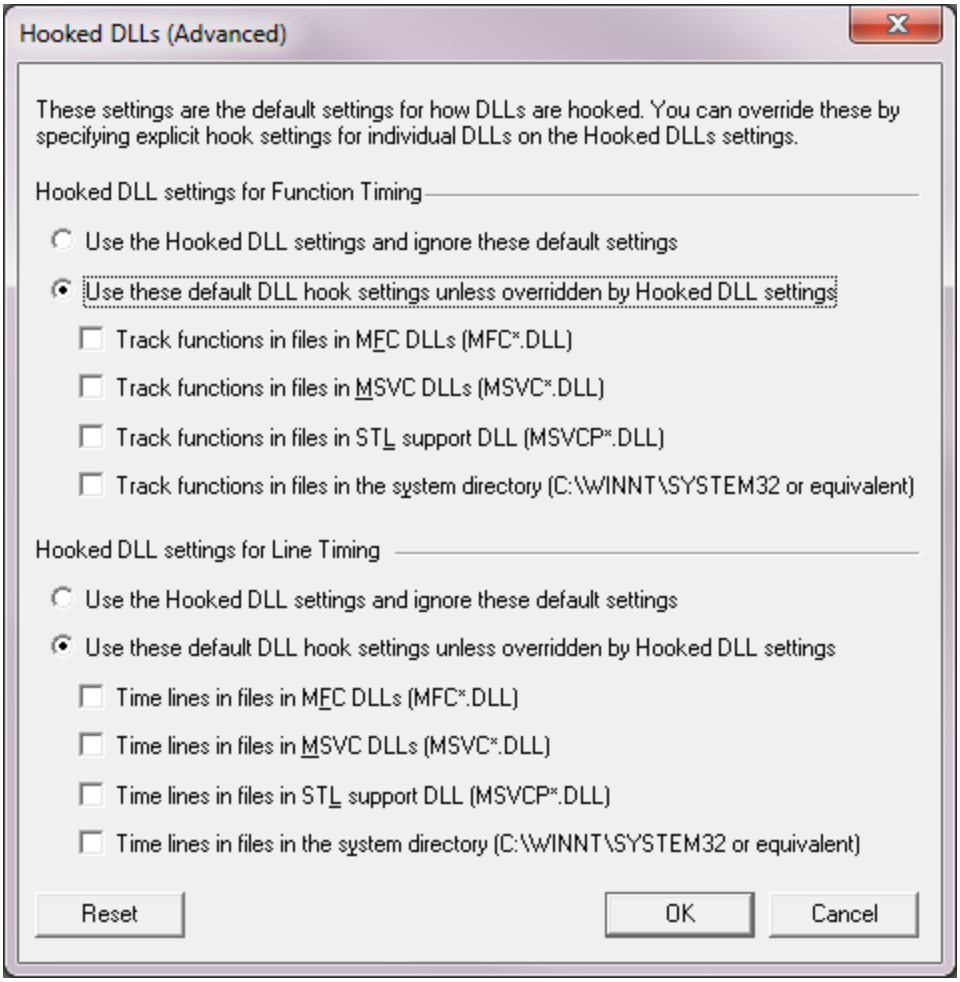
There are a few system DLLs which are generally not much use when hooked for function or line timing.

The source code for these DLLs is unlikely to be available, and even if it is, your application is unlikely to be able to influence their performance.

Consequently, by default these system files are not hooked - unless you override that by specifically including them in the process modules list above.

With the advanced options below, you can change this behaviour if you need to, letting you specify which DLLs will be processed according to the rules for Source Code Line Hook Insertion.

- **Advanced** › shows the Hooked DLLs (Advanced) dialog for function and line timing



In the Hooked DLLs (Advanced) dialog there are two identical groups of settings - one for function timing and one for line timing:

- **Use the Hooked DLL settings...** › if selected then *only* the general settings apply (i.e. those on the Hooked DLLs tab)
- **Use these default DLL settings...** › if selected then the checkboxes control the default behaviour for the relevant DLLs

  The default is *not* to track functions in files in the following:

  - **MFC DLLs...** › check to cover `MFC*.DLL` or leave unchecked to ignore
  - **MSVC DLLs...** › check to cover `MSVC*.DLL` or leave unchecked to ignore
  - **STL support DLL...** › check to cover `MSVCP*.DLL` or leave unchecked to ignore

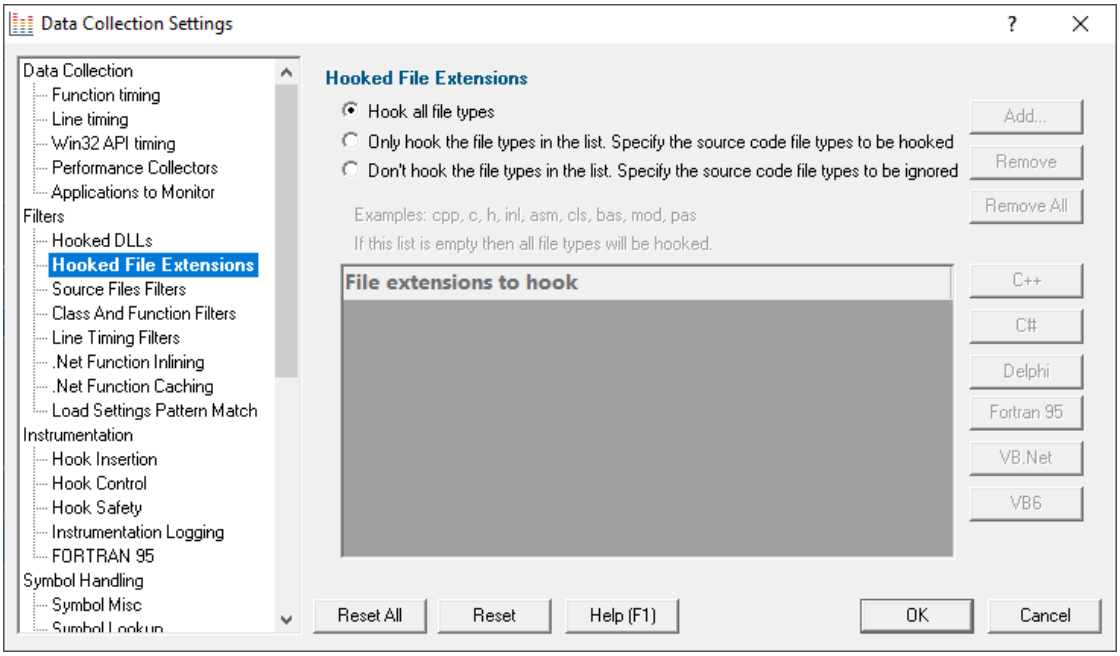
- **the system directory...** › check to cover anything in `C:\WINDOWS\SYSTEM32` or leave unchecked to ignore them

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.2.2 Hooked File Extensions

The **Hooked File Extensions** page lets you specify which source code file types should be hooked or not.



Which file types to hook - the hooking rule

By default, Performance Validator will try to hook all file types used by your application, but you can choose to list only those which should be included or excluded:

- **Hook all file types** › hook everything - ignoring the settings in the list
- **Only hook the file types in the list** › hook only the listed file types
- **Don't hook the file types in the list** › *ignore* all the listed file types, and hook everything else

File extensions to hook

By default, all source code files are hooked, but you can change this by specifying only those file extensions which *should* be hooked.

For example, you may want to include C++ source and header files but exclude C source files with the .c extension:

```
cpp
h
```

or

```
cpp
cxx
hpp
hxx
h
```

The usual controls apply for adding, removing or changing items in a list:

- **Add...** › adds a new row to the list › enter the extension you want to allow
- **Remove** › removes selected items in the list
- **Remove All** › removes all items, clearing the list
- **C++** › adds the file extensions for C++
- **C#** › adds the file extensions for C#
- **Delphi** › adds the file extensions for Delphi
- **Fortran 95** › adds the file extensions for Fortran 95
- **VB.Net** › adds the file extensions for the VB.Net
- **VB6** › adds the file extensions for the Visual Basic 6

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

Clear the list to hook all source file types again.

Do not include the dot in the extension.

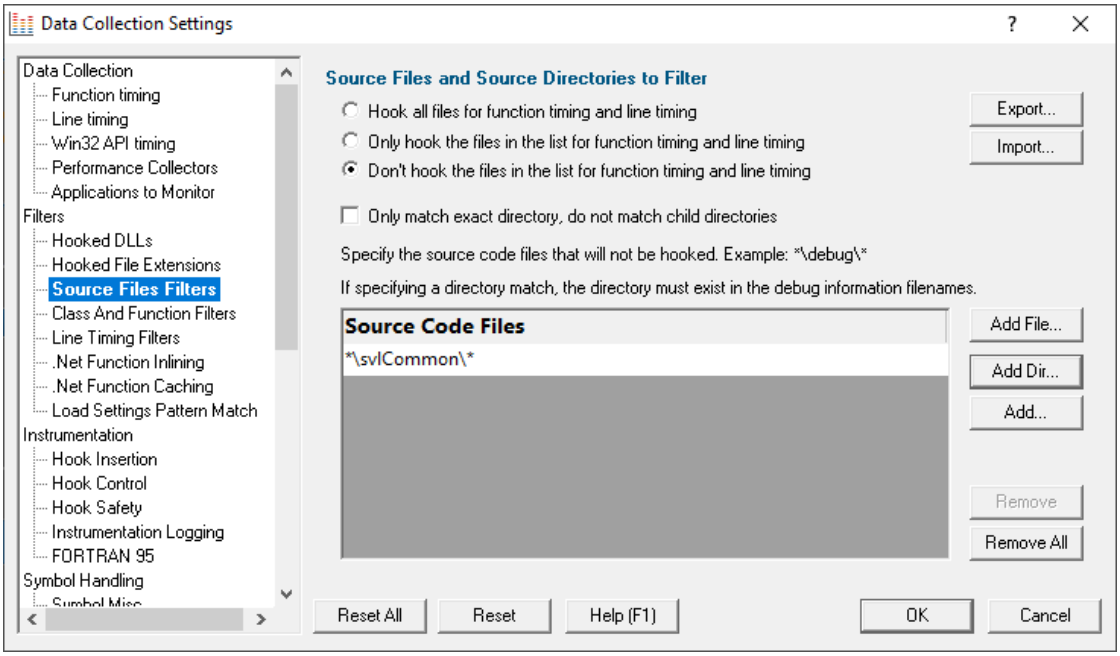
The filters take effect on the next session. If you're in the middle of a session and existing views show data that will be excluded in the next session, then that data will be highlighted according to the colours settings

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.2.3 Source Files Filters

The **Source Files Filter** page allows you to specify which source files should not be hooked for function and line timing.



Listing files to exclude or include

By default, Performance Validator will try to hook all source files used by your application, but you can choose to list only those which should be included or excluded

- **Hook all files...** › hook all files
- **Don't hook the files in the list...** › hook everything *except* the files in the list
- **Only hook the files in the list...** › hook *only* the source files listed

In the list you can include files or directories. If using directories you may want only that specific directory, or everything underneath it (the default):

- **Only match exact directory...** › check this so as *not* to recurse into child directories

Managing the list of files

Add files or directories on disk:

- **Add File...** › navigate to the source files › select one or more files › click **Open** › all the selected items are added

- **Add Dir...** › navigate to the folder › select it and click **OK** › the folder is added to the list

Or manually enter a file:

- **Add...** › a new row is added to the list › Type the file path › press **Return** › the file is added to the list

Remove items as normal:

- **Remove** › removes selected items in the list
- **Remove All** › removes all items, clearing the list

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

Exporting and importing

Since the list of source files can be quite complicated to set up, you can export the settings to a file and import them again later. This is useful when switching between different target applications.

- **Export...** › **choose or enter** a filename › **Save** › outputs the filtered source files to the file
- **Import...** › **navigate** to an existing *.pvxft file › **Open** › loads the filtered source files

The exported file can be used with the -sourceFileFilterHookFile command line option.

Wildcards

All file and directory specifications can contain the * wildcard.

Some examples will help:

Consider a project with three source directories:

```
e:\dev\srcMain\
e:\dev\srcCommon\
e:\dev\srcCustom\
```

Possible filters could be:

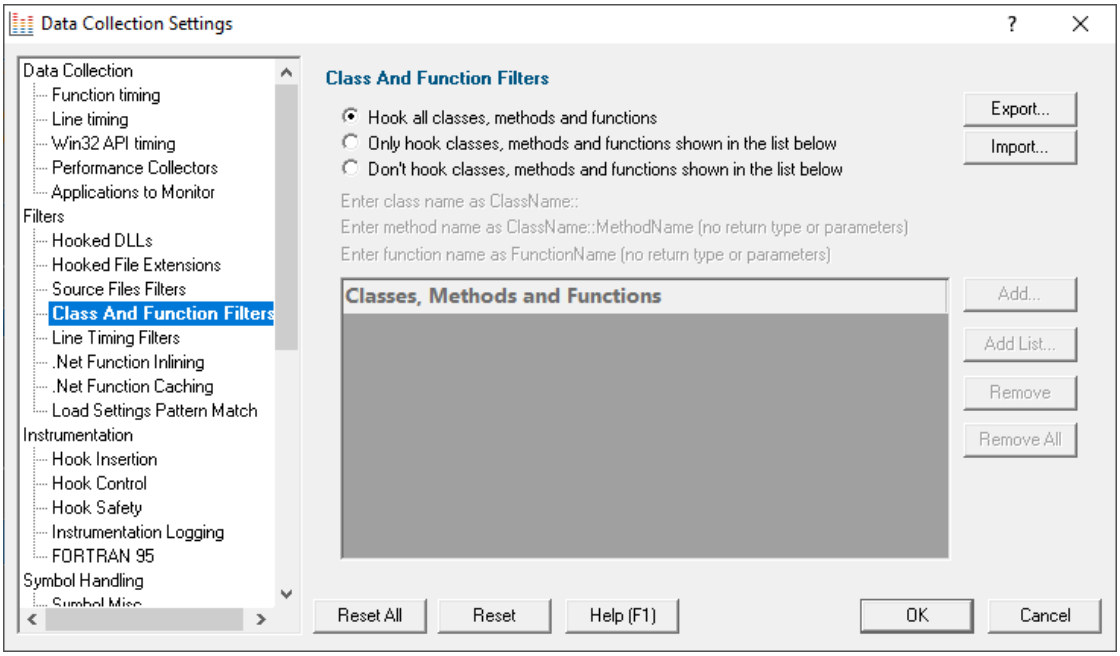
```
e:\dev\src*\
*\src*\
*\srcC*\*
```

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.2.4 Class and Function Filters

The **Class And Function Filters** page allows you to set specific classes, methods and functions to be included in, or excluded from, the hooking process.



These filters apply only to the DLLs and files that you have not already excluded via other filters.

Listing what to exclude or include

By default, Performance Validator will try to hook all classes, methods and functions in the hooked files, but you can choose to list only those which should be included or excluded.

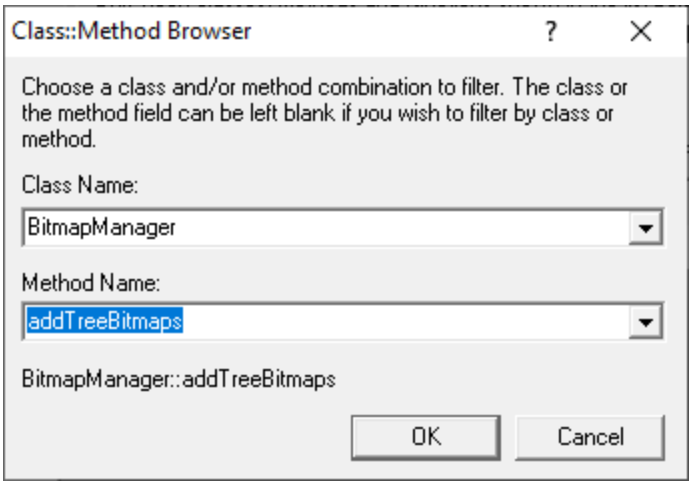
- **Hook all...** › hook everything (the default)
- **Only hook ...** › hook *only* the classes, methods and functions listed
- **Don't hook ...** › hook everything *except* the classes, methods and functions listed

Managing the list

Choose from known methods:

- **Add...** › shows the **Class::Method Browser** dialog below

Type or choose a class and/or method from the pre-populated drop-down list of all functions:

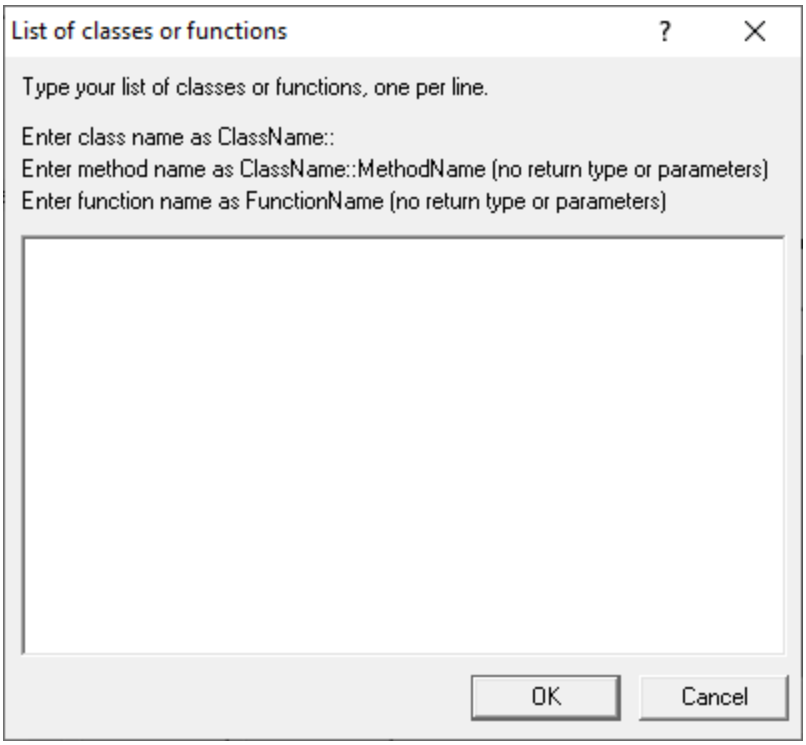


When typing an entry, you'll see a message at the bottom of the dialog if the symbol doesn't exist:

Choose from known methods:

- **Add List...** > shows the **List of classes or functions** dialog below

  Enter any number of plain class::method or function names or just paste them in.



The list will not be validated against known functions. Do not include return types, brackets, parameters or other details.

Remove items as normal:

- **Remove** › removes selected items in the list
- **Remove All** › removes all items, clearing the list

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

Exporting and importing

Since the list can be quite complicated to set up, you can export the settings to a file and import them again later. This is useful when switching between different target applications.

- **Export...** › **choose or enter** a filename › **Save** › outputs the filtered list to the file
- **Import...** › **navigate** to an existing *.pvxc file › **Open** › loads the filtered list

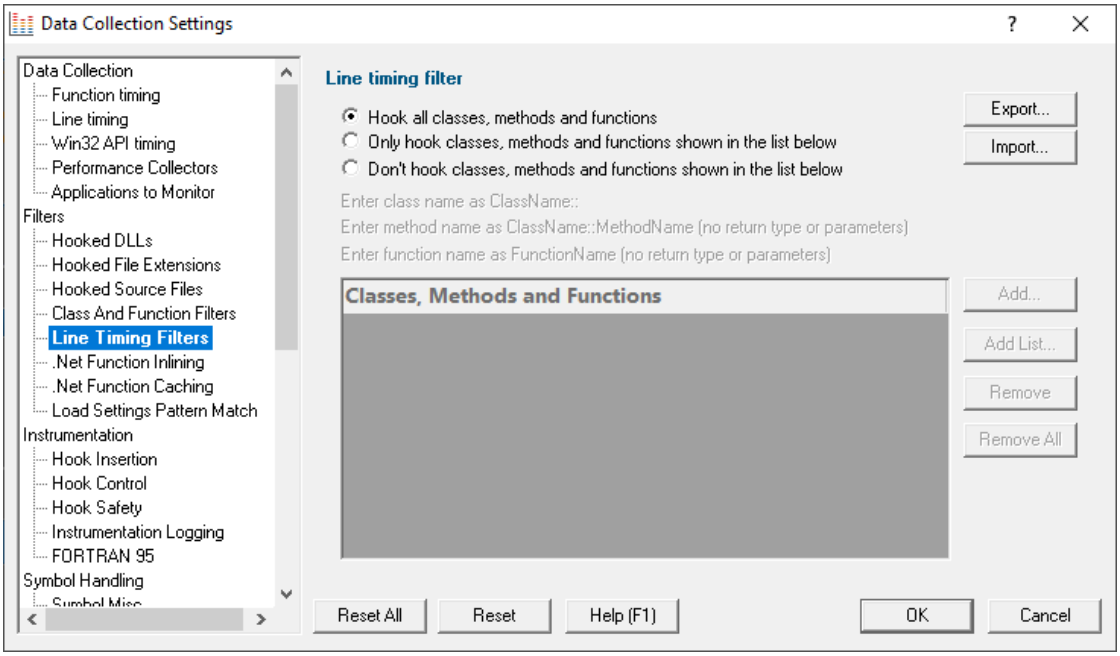
The exported file can be used with the -classAndFunctionFile command line option.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.2.5 Line Timing Filters

The **Line Timing Filters** page allows you to set specific classes, methods and functions to be included in, or excluded from, the line hooking process.



These settings are identical to the Class And Function filters in the previous section, except they only affect the line timing hooks.

Since line-timed functions are controlled independently from other functions being monitored in a session, you can time just the lines within a single function or a single method in a class without the overhead of line-timing everything else.

These filters apply only to the DLLs and files that you have not already excluded via other filters.

Listing what to exclude or include

By default, Performance Validator will try to hook lines in all classes, methods and functions in the hooked files, but you can choose to list only those which should be included or excluded.

- **Hook all...** › hook everything (the default)
- **Only hook ...** › hook *only* the classes, methods and functions listed

  If not line timing everything (which has a performance overhead), this would be the typical case, i.e. to selectively line-time only your areas of interest

- **Don't hook ...** › hook everything *except* the classes, methods and functions listed

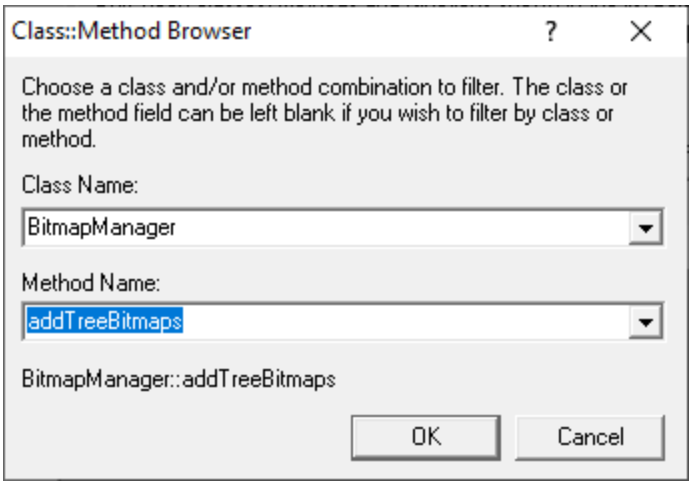
➜ Line timing filters can also be added via the instrumentation filter options on the context menus of each main tab. See more on the Statistics menu for example.

Managing the list

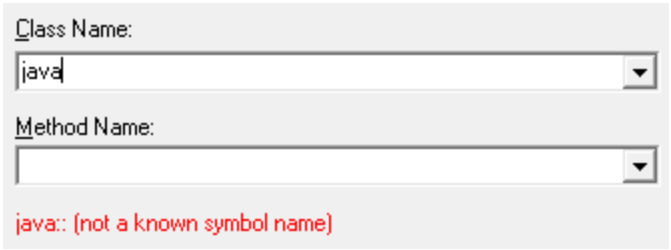
Choose from known methods:

- **Add...** › shows the **Class::Method Browser** dialog below

  Type or choose a class and/or method from the pre-populated drop-down list of all functions:



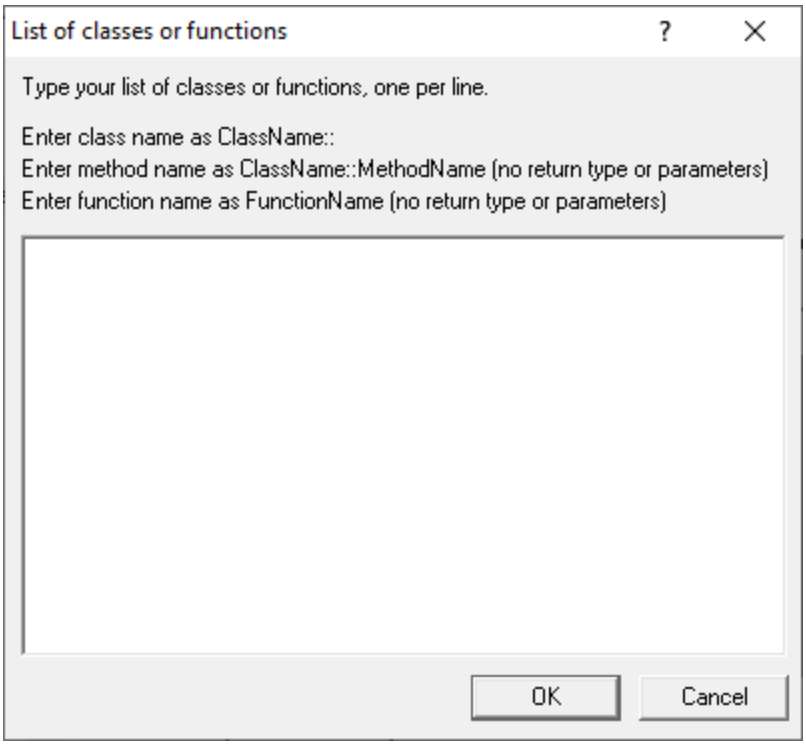
  When typing an entry, you'll see a message at the bottom of the dialog if the symbol doesn't exist:



Choose from known methods:

- **Add List...** › shows the **List of classes or functions** dialog below

  Enter any number of plain class::method or function names or just paste them in.



The list will not be validated against known functions. Do not include return types, brackets, parameters or other details.

Remove items as normal:

- **Remove** › removes selected items in the list
- **Remove All** › removes all items, clearing the list

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

Exporting and importing

Since the list can be quite complicated to set up, you can export the settings to a file and import them again later. This is useful when switching between different target applications.

- **Export...** › **choose or enter** a filename › **Save** › outputs the filtered list to the file
- **Import...** › **navigate** to an existing *.pvxc file › **Open** › loads the filtered list

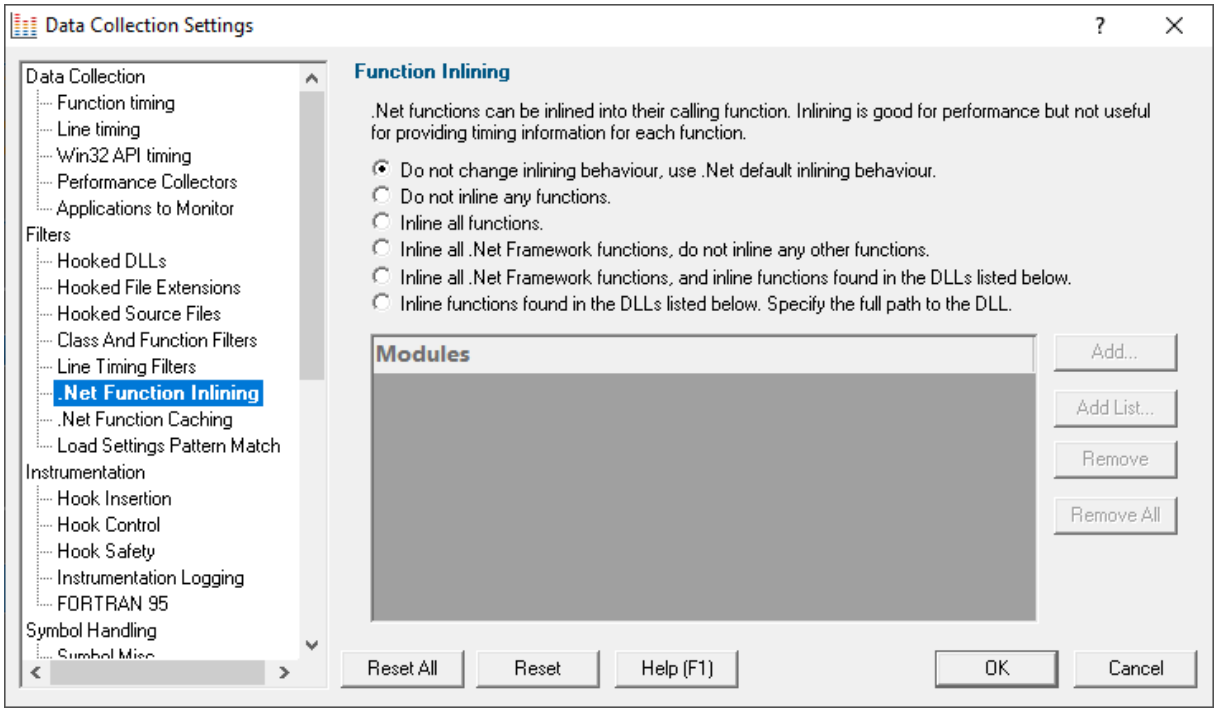
The exported file can be used with the -classAndFunctionFile command line option.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.2.6 .Net Function Inlining

The **.Net Function Inlining** tab allows you to configure how .Net inlines functions.



Inlining of .Net functions can affect your code coverage results.

- Do not inline any functions.
- Inline all functions.
- Inline only .Net Framework functions.
- Inline only .Net Framework functions, and functions in specific DLLs.
- Inline only functions in specific DLLs.

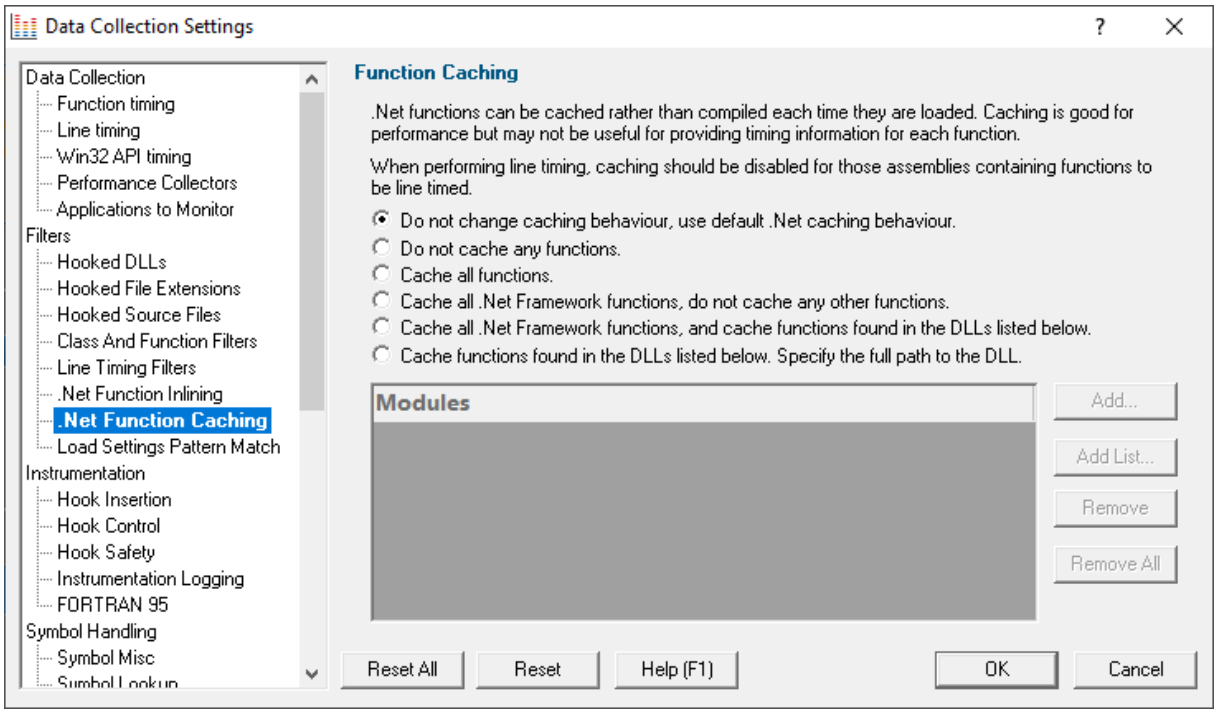
We recommend that you don't inline any functions. This is the default option.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.2.7 .Net Function Caching

The **.Net Function Caching** tab allows you to configure how .Net caches functions.



Caching of .Net functions can affect your code coverage results.

- Do not cache any functions.
- Cache all functions.
- Cache only .Net Framework functions.
- Cache only .Net Framework functions, and functions in specific DLLs.
- Cache only functions in specific DLLs.

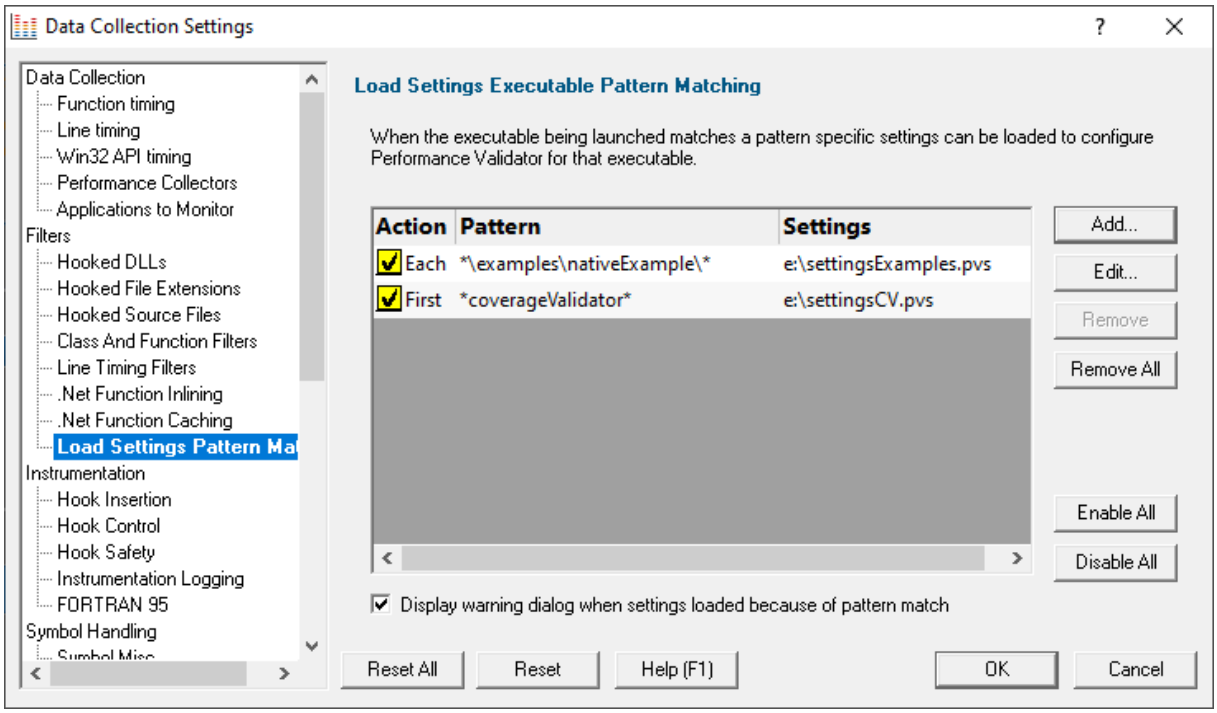
We recommend that you don't cache any functions. This is the default option.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.2.8 Load Settings Pattern Match

The **Load Settings Pattern Match** tab allows you to configure loading of different settings depending on the executable being launched (or relaunched).



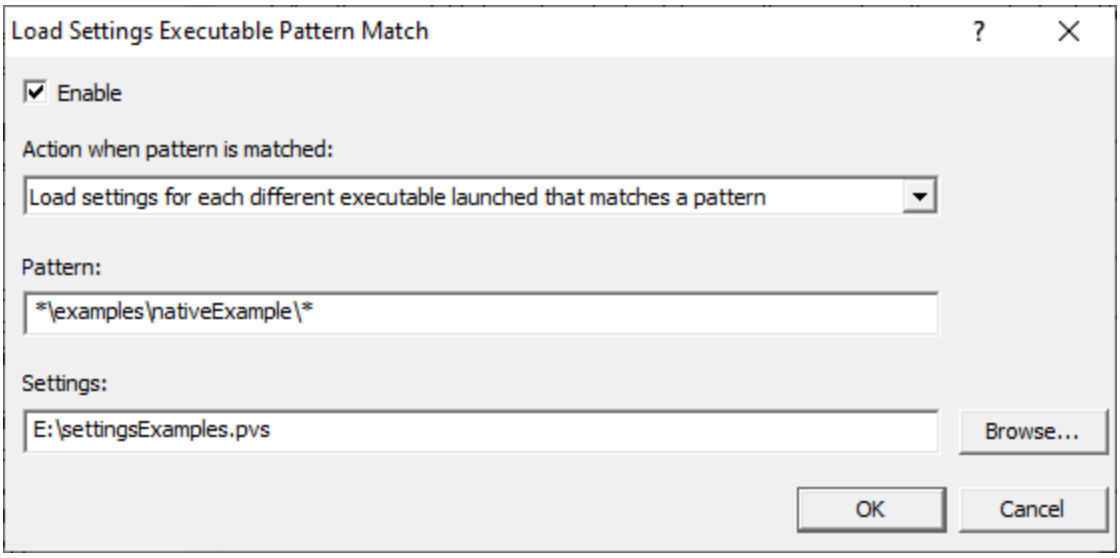
The grid shows one pattern match per line.

The buttons alongside allow you to Add, Edit and Remove patterns that you have created. You can also enable and disable them all.

- **Add...** › display the pattern match dialog to create a pattern to match.
- **Edit...** › display the pattern match dialog to edit the selected pattern.
- **Remove...** › delete the selected pattern.
- **Remove All...** › delete all selected patterns.
- **Enable All...** › enable all patterns.
- **Disable All...** › disable all patterns.

Pattern Match Dialog

The pattern match dialog allows you to create and edit pattern matches.



- **Enable** › enable or disable this pattern.
- **Action** › how to evaluate if this pattern is matched.
  - **Load settings for first executable...** › the first executable that matches a pattern causes the settings to be loaded.
  - **Load settings for each executable...** › each executable that matches a pattern causes the settings to be loaded provided it is not the same executable that previously loaded the settings.
  - **Load settings for every executable...** › every executable that matches a pattern causes the settings to be loaded.

  When a different pattern matches the first/each status is reset.
- **Pattern** › a text pattern, including the * wildcard, to match an executable path.

  Examples:
  ```
  *\examples\nativeExample\*
  c:\tests\*
  e:\dev\myProject\release\*.exe
  ```
- **Settings** › the full path to the settings you want to load if the action and pattern match an executable.

How does the pattern matching work?

It is probably easiest to demonstrate how pattern matching works with some examples.

Let's assume we have two patterns:

`*\examples\nativeExample\*` that will load `e:\settingsExamples.pvs`
`*coverageValidator*` that will load `e:\settingsCV.pvs`.

We'll cover each of the possible action criteria for a sequence of application launches, showing which settings are loaded and why.

- **Load settings for first executable...** › the first executable that matches a pattern causes the settings to be loaded.

Launched application	Settings loaded	Reason
e:\examples\nativeExample\release\nativeExample.exe	e:\settingsExamples.pvs	1st application, new pattern
e:\examples\nativeExample\release\nativeExample.exe		repeat application, same pattern
e:\examples\nativeExample\debug\nativeExample.exe		2nd application, same pattern
c:\program files (x86)\software verify\coverage validator x86\coverageValidator.exe	e:\settingsCV.pvs	1st application, new pattern
e:\examples\nativeExample\release\nativeExample.exe	e:\settingsExamples.pvs	1st application, new pattern

- **Load settings for each executable...** › each executable that matches a pattern causes the settings to be loaded provided it is not the same executable that previously loaded the settings.

Launched application	Settings loaded	Reason
e:\examples\nativeExample\release\nativeExample.exe	e:\settingsExamples.pvs	new application, new pattern
e:\examples\nativeExample\release\nativeExample.exe		repeat application, same pattern
e:\examples\nativeExample\debug\nativeExample.exe	e:\settingsExamples.pvs	new application, same pattern
c:\program files (x86)\software verify\coverage validator x86\coverageValidator.exe	e:\settingsCV.pvs	new application, new pattern
e:\examples\nativeExample\release\nativeExample.exe	e:\settingsExamples.pvs	new application, new pattern

- **Load settings for every executable...** › every executable that matches a pattern causes the settings to be loaded.

Launched application	Settings loaded	Reason
e:\examples\nativeExample\release\nativeExample.exe	e:\settingsExamples.pvs	Every application
e:\examples\nativeExample\release\nativeExample.exe	e:\settingsExamples.pvs	Every application
e:\examples\nativeExample\debug\nativeExample.exe	e:\settingsExamples.pvs	Every application
c:\program files (x86)\software verify\coverage validator x86\coverageValidator.exe	e:\settingsCV.pvs	Every application
e:\examples\nativeExample\release\nativeExample.exe	e:\settingsExamples.p	Every application

vs

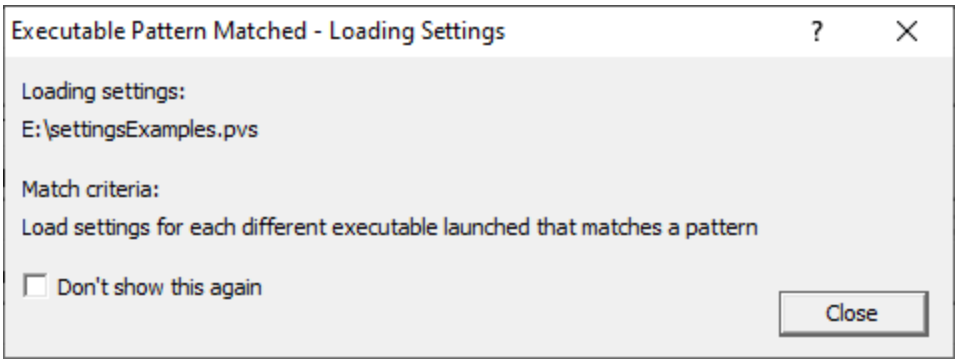
Warning

When a pattern is matched and the action criteria are satisfied the specified settings will be loaded.

A warning can be displayed at this point to remind you that the settings are being changed.

- **Display warning dialog...** > the warning dialog will be displayed when the pattern match criteria are met.

The warning dialog looks like this:



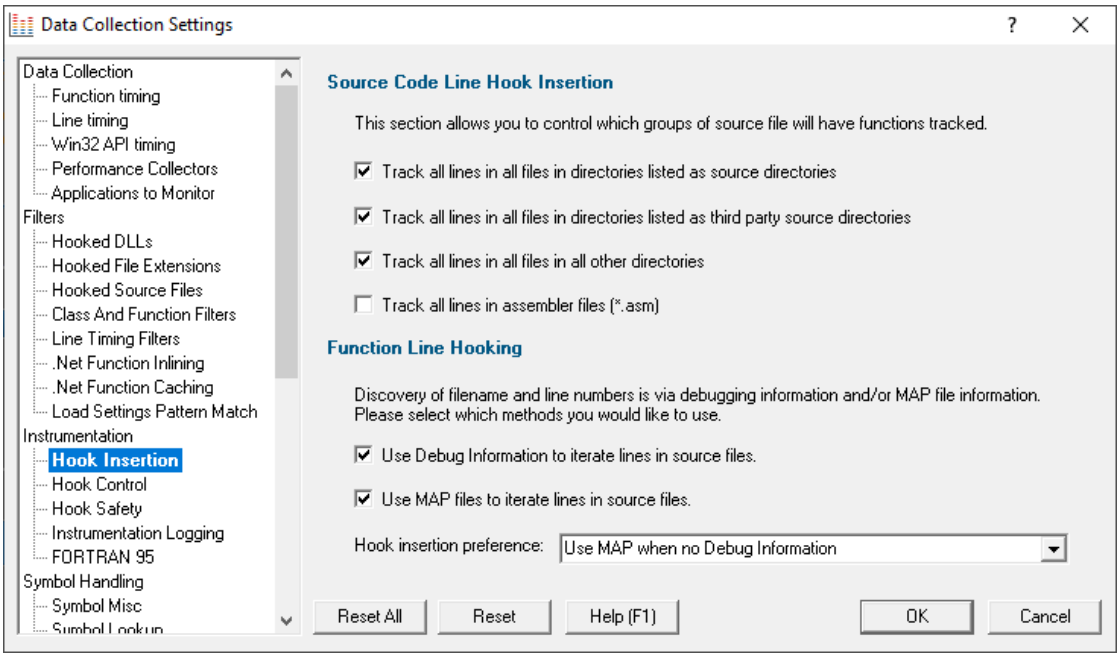
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.3 Instrumentation

3.10.1.3.1 Hook Insertion

The **Hook Insertion** page allows you to specify which groups of source files are hooked in the target program.



These hook settings will not take effect during a session that is already running.

Source Code Line Hook Insertion

The File Locations settings let you set several lists of files including

- your own source files
- third party source files

and then of course there's implicitly:

- 'everything else' that you *didn't* specify.

The default behaviour is to hook everything referenced in a PDB or MAP file that is in one of these three categories.

You can change whether to include or exclude any of these sets.

Untick the boxes to stop tracking all lines in all files in...

- **directories listed as *source* directories**
- **directories listed as *third party source* directories**
- ***all other* directories** (i.e. not any directory matching the two options above)
- **assembler files in any directory**

Function Line Hooking

To hook each source code line Performance Validator has to find the start address of each line and then ensure hooking the line will not result in corruption of the code relating to other parts of the program.

The data to determine the location of each source code line is found in PDB files and MAP files that contain line number information.

You can choose whether to use *only* PDB files, *only* MAP files, or to set a preference for one source over the other.

- **Use PDB files...** > Allow use of PDB files for iterating files
- **Use MAP files...** > Allow use of MAP files for iterating files

If setting PDB *and* MAP files to be used, you can set the preferred use in the drop-down list:

Hook insertion preference

- **PDB files only** > Ignores MAP files (same as unchecking MAP file usage)
- **MAP files only** > Ignores PDB files (same as unchecking PDB file usage)
- **Use MAP when no PDB** > PDB files are used in preference to MAP files.

  MAP files are only used when the required PDB file cannot be found
- **Use PDB when no MAP** > MAP files are used in preference to PDB files.

  PDB files are only used when the required MAP file cannot be found, or the MAP file does not contain line number information

Warning: You should be aware that MAP files may not include all line information, meaning some displayed lines may not be coloured. Consider using the **Use MAP when no PDB** option instead.

Map file not recognised?

Due to daylight saving times it is possible for a MAP file to have an embedded timestamp that is different than the DLL timestamp by an hour.

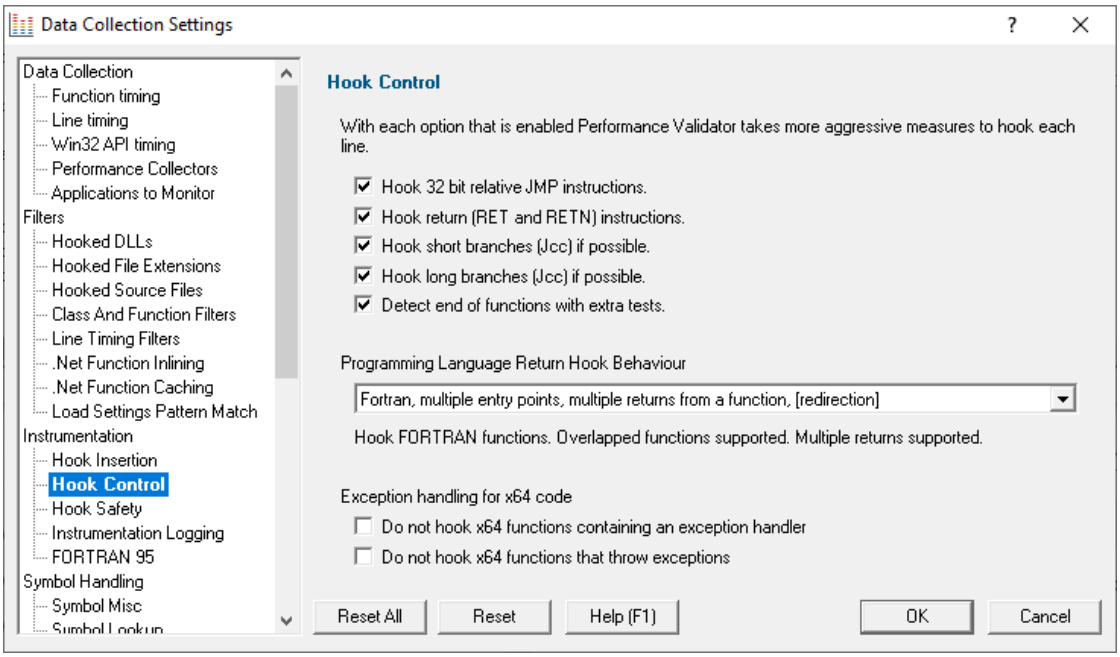
Performance Validator will not recognise such a MAP as valid, but rebuilding the application will resolve this.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.3.2 Hook Control

The **Hook Control** page allows you to specify how some of the more 'awkward' lines of code are hooked.



Most of these options are fairly advanced. They are also enabled by default, but as usual, we provide the ability to control the settings if needed.

Hook Control

Some lines of code are trickier to hook than others. By default Performance Validator is quite zealous in performing the safety checks and enabling hooking of these lines.

If necessary, you can choose *not* to enable these hooks.

The options are:

- **Hook 32 bit relative JMP instructions** › hooks lines with `JMP` instructions in them
- **Hook return (RET and RETN) instructions** › hooks lines with `RET` or `RETN` instructions in them
- **Hook short branches (Jcc) if possible** › hooks lines with short branches in them

  (`Jcc` is a conditional jump)
- **Hook long branches (Jcc) if possible** › hooks lines with long branches in them
- **Detect end of functions with extra tests** › perform extra tests when identifying the end of function, to avoid overwriting the code for any function that follows.

Programming Language Return Hook Behaviour

Different computer languages allow different constructs. For example most languages only permit one entry point per function, but FORTRAN allows many entry points per function.

When there are multiple entry points per function in the debugging information, it looks like there are functions that overlap each other. This can also happen in the C runtime internals (implemented in assembler). For the C runtime internals overlapped functions must not be instrumented as they often include jump tables but there is no indication in the debugging information that the jump table is present - instrumenting overlapped C runtime functions typically results in damaged code. For Fortran this isn't the case as the compiler generates the entry points without jump tables in the middle of the code - instrumenting overlapped Fortran functions is safe.

To correctly handle the each language we've provided an option to treat the instrumentation safety rules in a specific way.

The options are:

- **Automatic** › Performance Validator will choose the appropriate settings based on the detected computer language (using file extensions to identify the language)
- **C, C++, Delphi, one return** › Performance Validator will instrument assuming all lines are C, C++ or Delphi, allowing only one return from a function. Overlapped functions are not allowed.
- **C, C++, Delphi, multiple returns** › Performance Validator will instrument assuming all lines are C, C++ or Delphi, allowing multiple returns from a function. Overlapped functions are not allowed.
- **Fortran** › Performance Validator will instrument assuming all files are Fortran. This allows for multiple entry points and multiple exit points from a function. Overlapped functions are allowed.

The default behaviour is **Automatic**.

x64 Exception Handling

x64 Exception handling is table based, which can cause problem with instrumentation. We provide options to turn instrumentation off in certain circumstances.

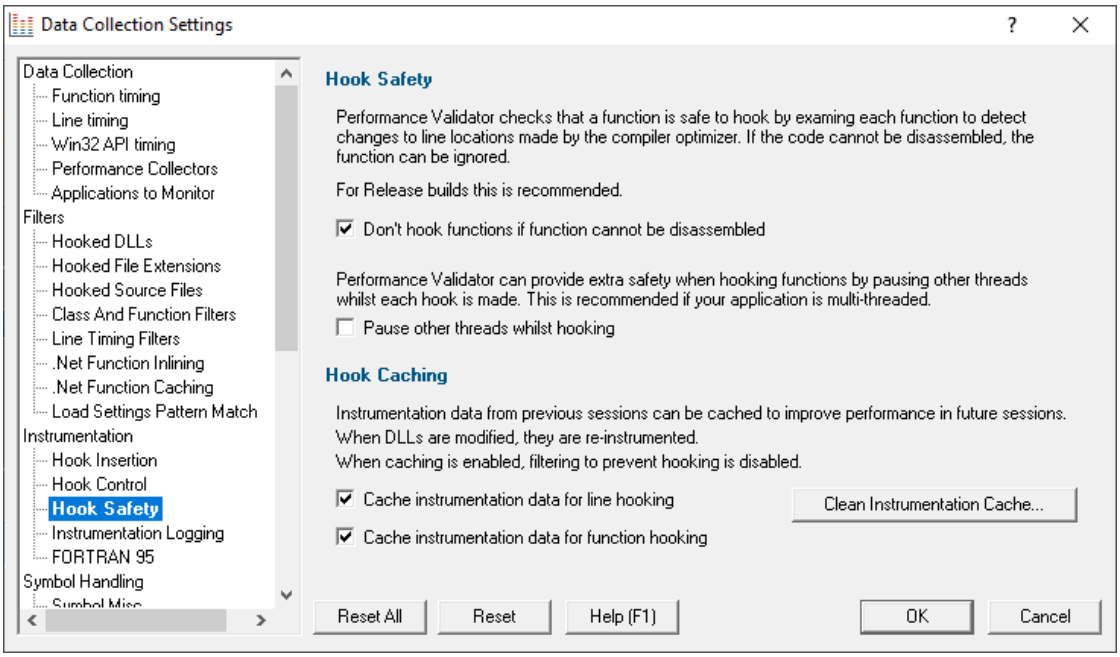
- **x64 exception handlers** › do not hook x64 functions that contain an exception handler.
- **x64 functions throwing exceptions** › do not hook x64 functions that throw exceptions.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.3.3 Hook Safety

The **Hook Safety** page allows you to specify which safety features are enabled during hooking.



Hook safety with Release Mode software

When hooking functions, it is important that the information being used is verified against the actual object code being modified to insert the hooks.

This is especially important in Release builds where the code optimizer may have rearranged the object code so that it does not match the information in the PDB and MAP files.

To ensure this, the default behaviour is to disassemble each function and check it prior to hooking it. If the function can't be disassembled, it won't get hooked.

You can switch off disassembling of functions and hook them anyway:

- **Don't hook functions if function cannot be disassembled** › uncheck to hook the functions anyway

  It's recommended to keep this option enabled for Release builds

Hook safety with multi-threaded applications

When working with multi-threaded applications, it is possible for the thread hooking the application to be modifying code that is executing in a different thread.

If you think this might be affecting you, you can pause the other threads while hooking..

- **Pause other threads whilst hooking** › check to pause other threads

Hook caching

When hook caching is enabled, the first time a module (DLL or EXE) is instrumented, various information about the module is stored in a cache file.

Every subsequent time the module is instrumented, the cached data is used to instrument the module, rather than inspecting the module again.

This can provide quite significant performance improvements.

- **Cache instrumentation data** › check to use the instrumentation cache

   If the module is recompiled/relinked, the cache data will be discarded and recalculated.

Cache invalidation

The data in the instrumentation cache for each DLL is invalidated and discarded when:

- The module is recompiled or relinked
- Hook Control settings are changed
- Hook Safety settings are changed

About cache files

Cached instrumentation files are stored in the same directory as the module to which they refer.

They have the same name as the module, with the **.svlPV_performance** extension.

For example, instrumentation data for:

```
c:\winnt\system32\msvcrtd.dll
```

is stored as:

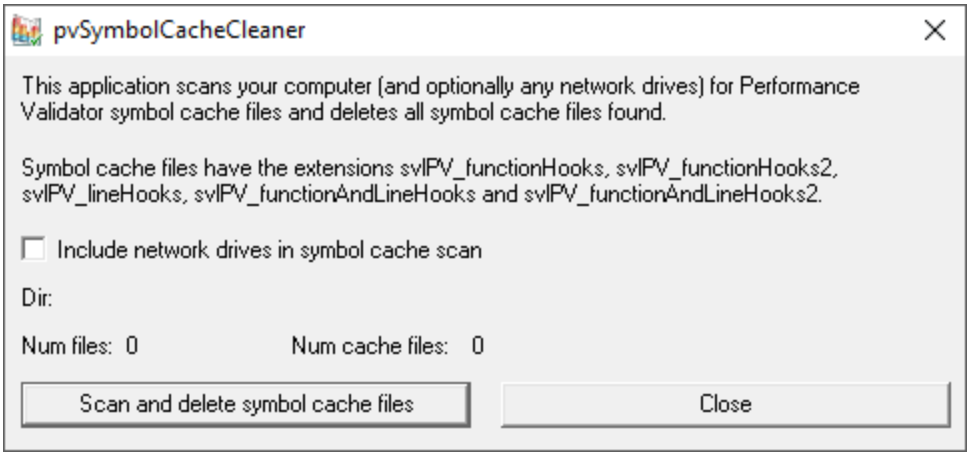
```
c:\winnt\system32\msvcrtd.dll.svlPV_performance
```

Cleaning up the cache files

You may not want to keep cache files lying around on your system amongst your code, so Performance Validator provides a utility to automatically clean up those files.

Files with the `.svlPV_performance` extension are searched for on your drive, and deleted if found.

- **Clean instrumentation cache** › shows the Symbol Cache Cleaner utility dialog



- **Include network drives** › tick this to clean up networked drives
- **Scan and delete symbol cache files** › starts the scan

The dialog shows a count of the number of files scanned and the total number of cache files found

- **Close** › cancels the process and closes the dialog

You can continue to use Performance Validator as normal while the scan takes place. If starting a new session that caches instrumentation, be aware that cache files may be recreated after the scan has passed!

Cached files and the Class and Function Filters

If the Class and Function Filter has been set up to only include or exclude specified classes or functions, then the Cached Instrumentation data will be ignored.

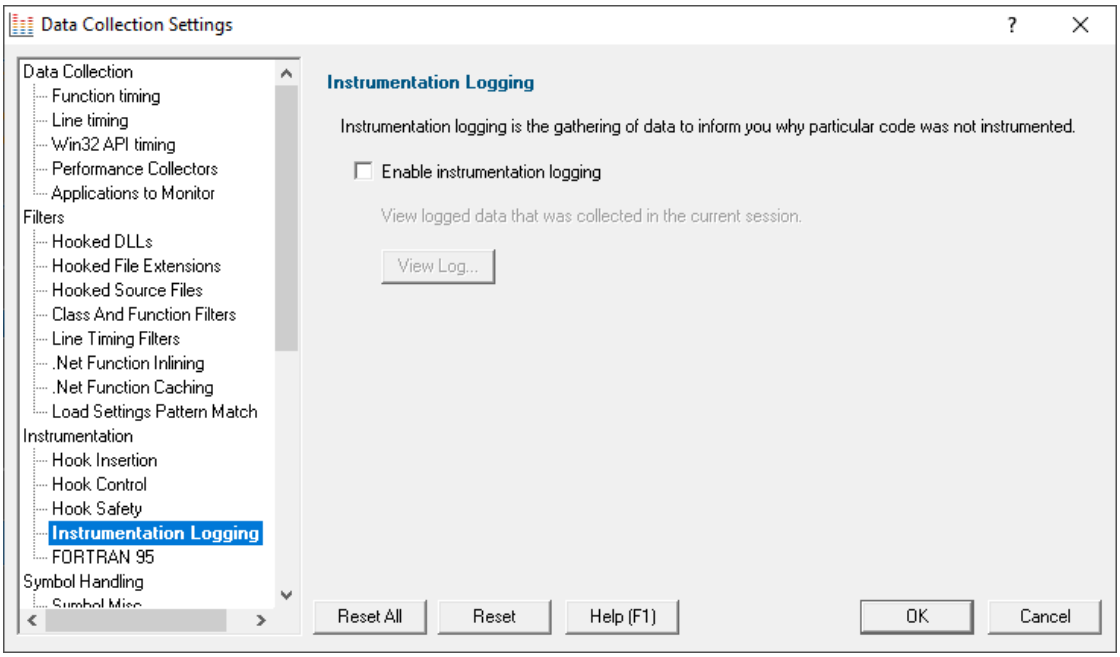
Instead, functions will be hooked according to the Class and Function Filter.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.3.4 Instrumentation Logging

The **Instrumentation Logging** tab enables you to understand the reason why part of your code isn't getting the profiling information you expect.



Instrumentation logging

The logging of DLLs, source files, classes, methods and functions that are not instrumented can help you understand the reason why part of your code isn't getting the coverage information you expect.

Once enabled, and a session has started, you can view a list of items that have not been instrumented via the Tools menu.

- **Enable instrumentation logging** › check to enable logging once the next session starts

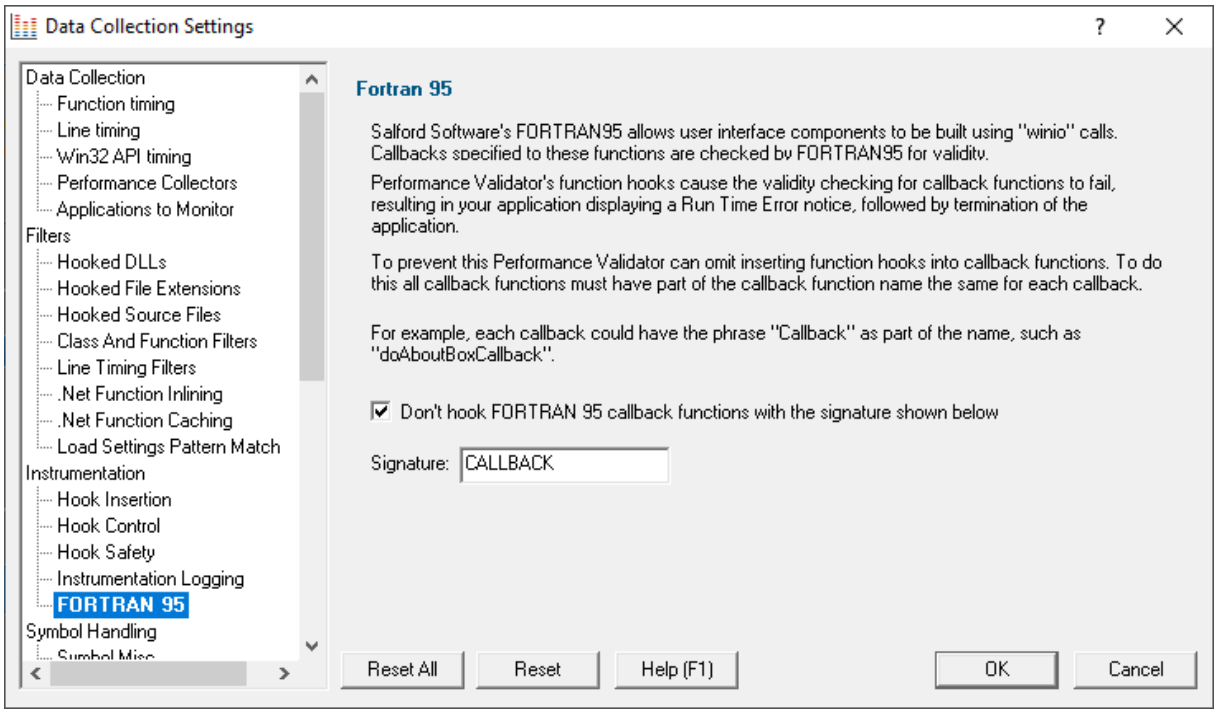
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.3.5 FORTRAN95

The **FORTRAN95** tab is a special tab for interacting with the Salford Software FORTRAN95 compiler.

If you aren't using this compiler you can ignore this setting.



Fortran 95

Hooking some callback functions in FORTRAN 95 code can cause internal 'code validation' errors and early exit of your program.

A workaround lets you use a signature name in callback function names to prevent them being hooked.

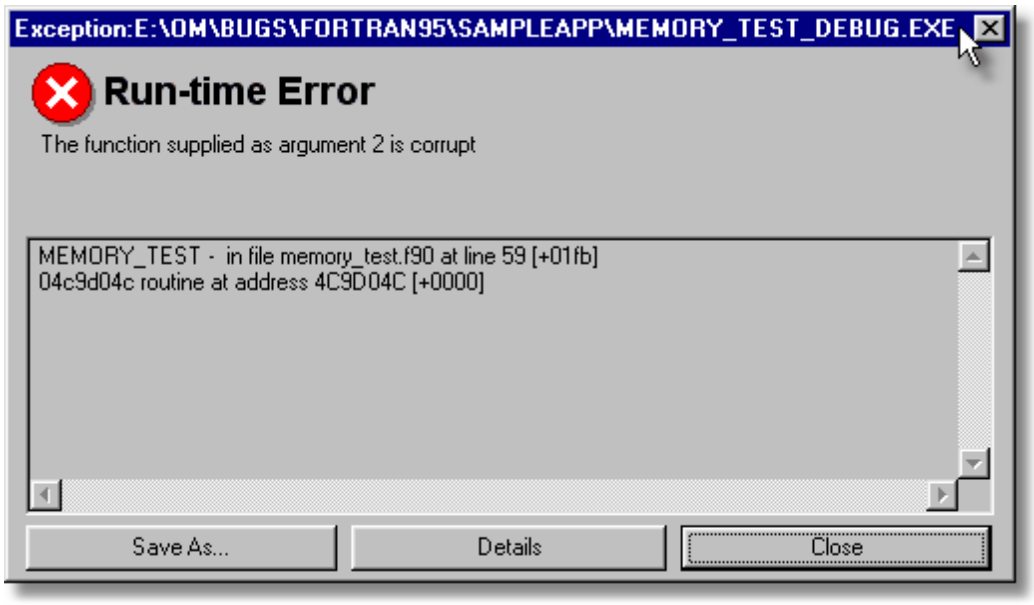
In more detail...

FORTRAN 95 allows user interface components to be built using `winio` function calls.

These calls specify callback functions to be called when the user interface component is activated, for example when a button is pressed.

FORTRAN 95 checks the machine code at the start of the callback to ensure the callback is valid.

However, since Performance Validator modifies the machine code of your application during instrumentation, this causes FORTRAN 95 to assume the callback function has been corrupted, and FORTRAN 95 terminates with a warning dialog:



To prevent FORTRAN 95 from displaying this error, the only solution is to ensure that `winio` callbacks are not instrumented.

Unfortunately `winio` callbacks can't be identified in the application simply by inspecting the executable.

To overcome this, we ask that you use a detectable naming convention by including a specific word (e.g. `CALLBACK`) in the callback function name.

- **Don't hook FORTRAN 95 callback functions...** › check the box and enter the **Signature** word used to identify the `winio` callbacks

  All FORTRAN 95 functions containing the specified word will not be hooked.

  Performance Validator defaults to using the signature `CALLBACK`

Reset All - Resets **all** global settings, not just those on the current page.

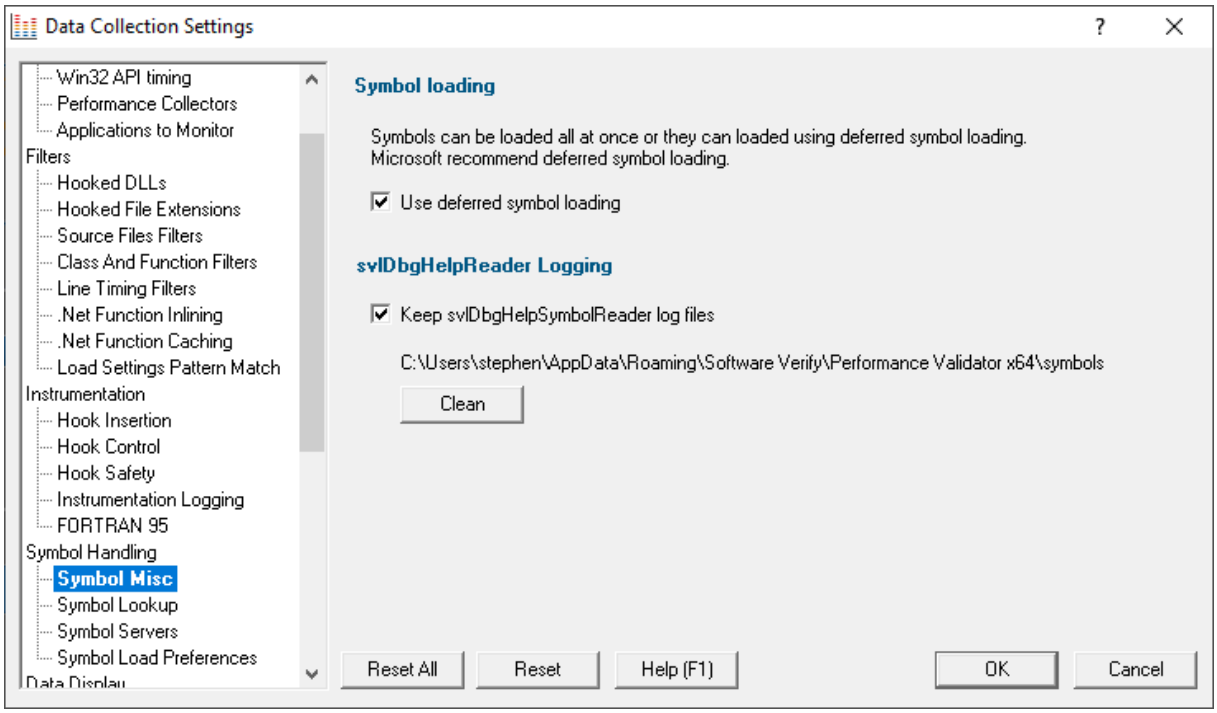
Reset - Resets the settings on the current page.

3.10.1.4 Symbol Handling

Enter topic text here.

3.10.1.4.1 Symbol Misc

The **Symbol Misc** tab allows you to set miscellaneous symbol settings.



Immediate or deferred symbol loading

When converting program addresses to symbol names, you can choose immediate symbol loading, or defer loading until each symbol is needed.

- **Use deferred symbol loading** › uses deferred symbol loading rather than 'all at once' (on by default)

  Microsoft® recommend deferred symbol loading, claiming it is the fastest option. We give you the choice.

Symbol Reader Logging

Symbols are fetched from symbol servers using a helper process svlDbgHelpSymbolReader.exe. We log the command line and behaviour of this helper tool. This is displayed on the diagnostic tab.

If you wish the log files can be kept for later analysis. By default this option is turned off.

- **Keep svlDbgHelpSymbolReader log files** › keep the log files after Performance Validator has finished processing them

The path to the directory containing the log files is shown.

- **Clean** › delete all svlDbgHelpSymbolReader log files

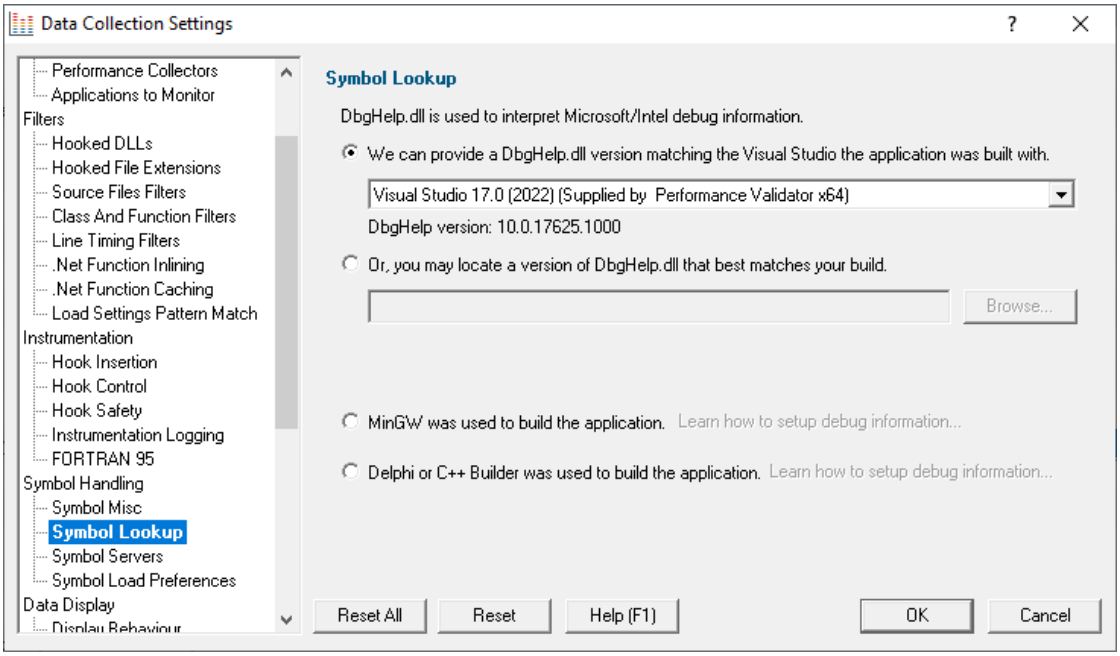
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.4.2 Symbol Lookup

The **Symbol Lookup** tab allows you to specify how and where symbolic information is retrieved for your application or service.

The default settings are shown below, although the Visual Studio version may vary.



Compiler / IDE Choice

Use the first combo box to choose which compiler / IDE you used to build your software.

Performance Validator will use the appropriate methods to read your symbols.

The choices are:

- Visual Studio
- Visual Basic 6
- Delphi or C++ Builder
- MingW
- Rust
- Dev C++
- Metrowerks CodeWarrior

- Salford Fortran 95
- Other

Symbol lookup for Microsoft / Intel compilers

- **We can provide a Dbghelp.dll** › choose one of Performance Validator's known good DbgHelp.dll's based on the version of Visual Studio you are using

  Performance Validator fetches symbols for your application using an appropriate symbol handler for the type of debugging information you have.

  For Microsoft Visual Studio users each version of Visual Studio provides different debugging formats which are readable by the appropriate DbgHelp.dll supplied by Visual Studio. A given version of DbgHelp.dll is usually able to read earlier formats of Microsoft debugging information but is not able to read a future format. For example Visual Studio 2005 (version 8) can read Visual Studio 6 debug information but cannot read Visual Studio 2008 debug information.

  Visual Studio 6.0 doesn't supply a DbgHelp.dll so we have provided one for use with Visual Studio 6.0.

  Visual Studio 10 is unusual in that the DbgHelp.dll (6.12) supplied by Visual Studio cannot read the debug information created by Visual Studio. To solve this problem we have supplied DbgHelp.dll (6.11) as an alternative.

  Performance Validator will choose the appropriate (most recent) version of Visual Studio automatically. You can override Performance Validator's choice by choosing the Visual Studio version from the **Visual Studio** combo box.

Specify your own DbgHelp.dll

- **Or, you may locate a version of DbgHelp.dll** › specify your own DbgHelp.dll to use with Performance Validator

  If you wish to explicitly specify which DbgHelp.dll to use choose the **Or, you may locate a version of DbgHelp.dll** option enter the path in the **DbgHelp.dll** edit field or use the **Browse...** button to select the dbgHelp.dll.

  Note that the directory that contains DbgHelp.dll ***should also contain symsrv.dll*** if you wish to use symbol servers with Performance Validator.

Don't update DbgHelp.dll

- **You're providing your own DbgHelp.dll** › use the DbgHelp.dll that ships with your application

  If your application needs to use a specific version of DbgHelp.dll that you're already providing with your application you should choose the **You're providing your own DbgHelp.dll** option to prevent Performance Validator from overwriting your DbgHelp.dll.

Note that the directory that contains DbgHelp.dll ***should also contain symsrv.dll*** if you wish to use symbol servers with Performance Validator.

Visual Studio DbgHelp.dll version compatibility

For Microsoft Visual Studio users, each VS version provides different debugging formats which are readable by the appropriate DbgHelp.dll supplied with Visual Studio.

These handlers are usually backwards compatible, but not forwards compatible. For example Visual Studio 2005 (version 8) can read Visual Studio 6 debug information but cannot read Visual Studio 2008 debug information.

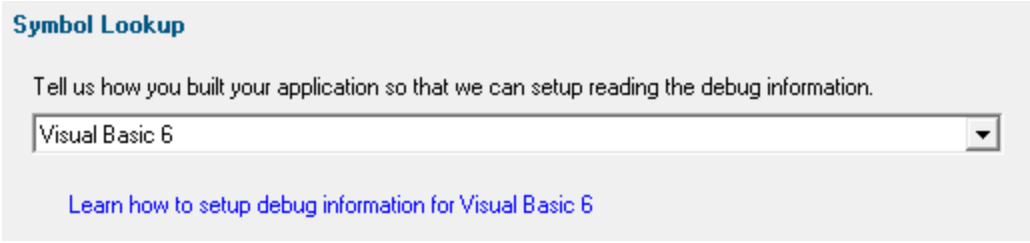
Visual Studio 6.0 doesn't supply a DbgHelp.dll so we have provided one for use with Visual Studio 6.0.

Visual Studio 10 is unusual in that the DbgHelp.dll (6.12) supplied by Visual Studio cannot read the debug information created by Visual Studio! To solve this problem we supply version 6.11 as an alternative.

To see the order in which the *DbgHelp.dll* process checks directories to find symbols, see the diagnostic tab with the filter set to *DbgHelp debug*.

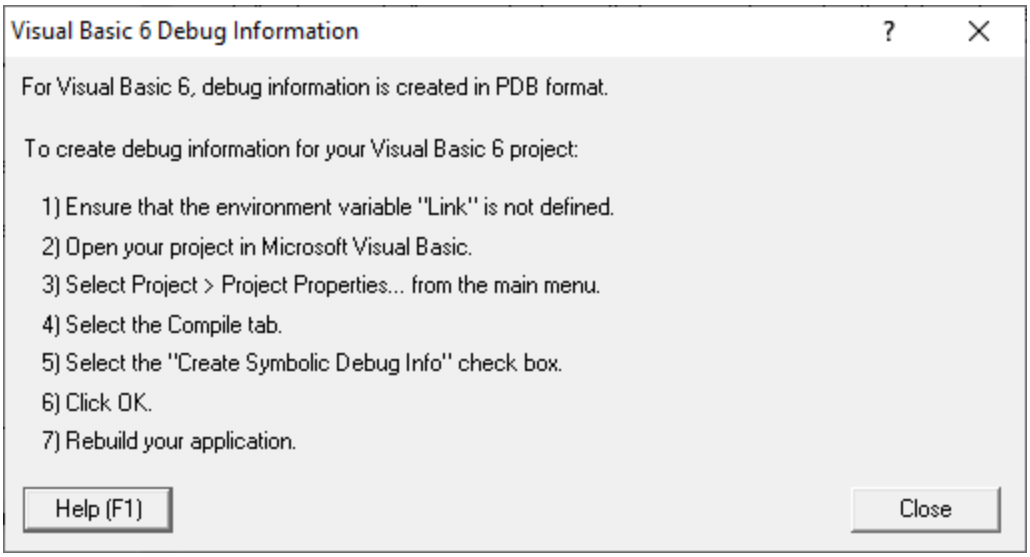
Symbol lookup for other compilers

If you are using another compiler click the link to see information about configuring debug information for that compiler.



After selecting the compiler, clicking the link will show a dialog box containing information relevant to the selected compiler.

For example:



Reset All - Resets **all** global settings, not just those on the current page.

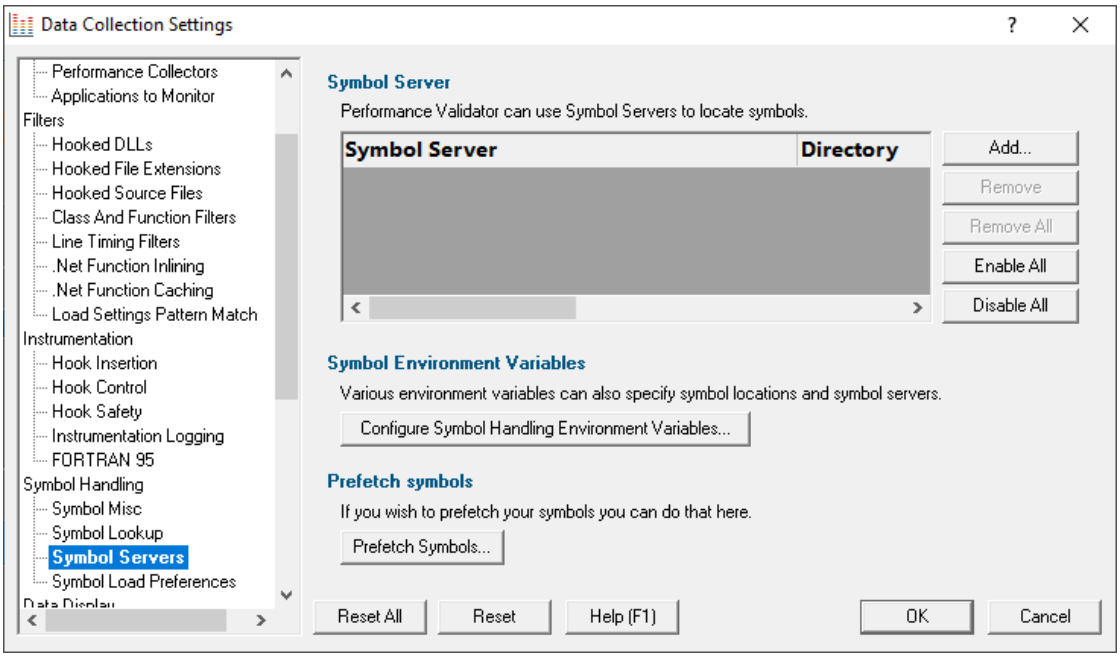
Reset - Resets the settings on the current page.

3.10.1.4.3 Symbol Servers

The **Symbol Servers** tab allows you to specify Symbol Servers to retrieve symbols used in your application.

You do not *need* to specify symbol servers if you do not wish to, and Performance Validator will work correctly without them.

Read on, or click a setting in the picture below to find out more.



Symbol servers

Symbol servers are entirely optional, but are useful for obtaining symbols from a centralized company resource or for obtaining operating symbols from Microsoft.

The default symbol server is the Microsoft symbol server used for acquiring symbols about Microsoft's operating system DLLs. You may also wish to add some symbol servers for any software builds in your organisation.

A symbol server is defined by at least the following:

- the symbol server dll to be used to handle the symbol server interaction
- a directory location where symbol definitions are saved
- the server location - a url

Each symbol server can be enabled or disabled allowing you to keep multiple symbol server configurations available without constantly editing their definitions.

You can define up to four symbol servers and more than one can be enabled at a time.

Symbol Server Errors

Any symbol server entry shown in red indicates there is a problem with parts of the definition of that symbol server.

In the image shown above the symbol server at http://127.0.0.42:8000 cannot be reached. It is either offline or does not exist.

Managing symbol servers

- **Add...** › displays the symbol server dialog described below

- **Remove** › remove selected symbol server(s) in the list
- **Remove All** › remove all symbol servers

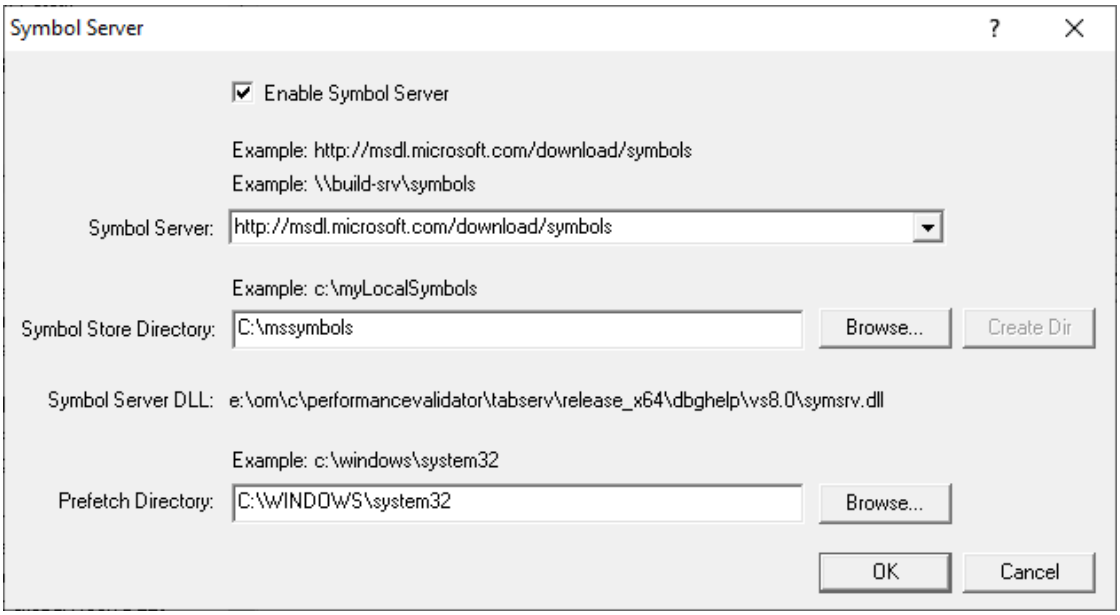
- **Enable All** › enables all symbol servers in the list
- **Disable All** › disables all symbol servers

> You can also enable or disable an item in the list via the yellow check box at the left of each row.

To edit the details for a symbol server, just double click the entry in the list to show the symbol server dialog again.

Symbol server dialog

The dialog initially appears pre-populated with some default values and allows you to set up or edit the definition of a symbol server. Some of the default values can be changed.



- **Enable Symbol Server** › enable or disable this server

The following three entries must be set to enable the **OK** button and define the symbol server.

> OK button not enabled?The OK button will only be enabled when the following entries have a valid value: - Symbol Server DLL names a dll present in the Memory Validator install directory. - Symbol Store Directory has been specified and exists. - Symbol Server URL has been specified (this value will not be checked for correctness).

- **Symbol Server** › select a predefined public symbol server or enter the URL of the symbol server you wish to use - the Microsoft server is initially set as the default
- **Symbol Store Directory** › enter or **Browse** to set the directory that will contain local copies of the downloaded symbols
    - **Create Dir** › creates a directory if you entered a directory name that does not exist yet

The **Symbol Server DLL** is set based on the Symbol Lookup settings you have chosen.

You can optionally associate a directory to scan when you are prefetching symbols (below)

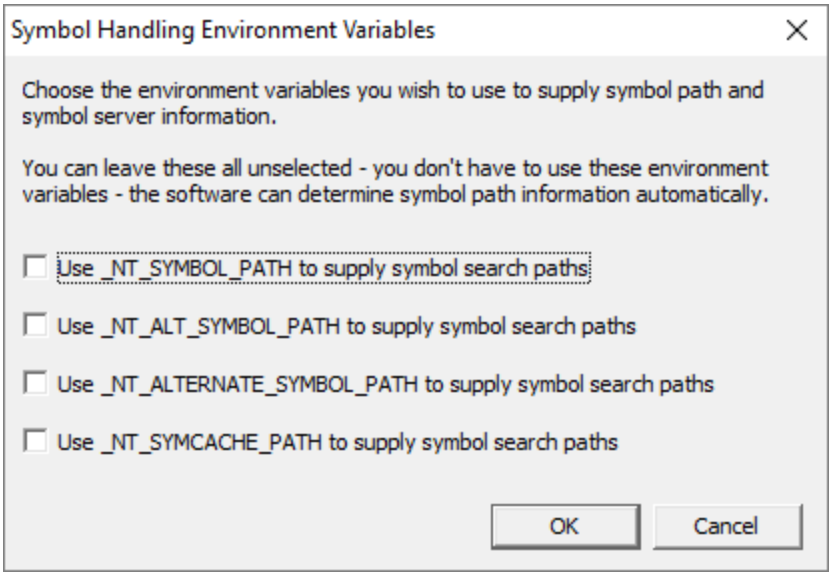
- **Prefetch Directory** › specify the directory to scan for symbols

Environment variables related to symbols

If you wish, you can set some environment variables to supply symbol paths.

- **Configure Symbol Handling Environment Variables** › opens the dialog below

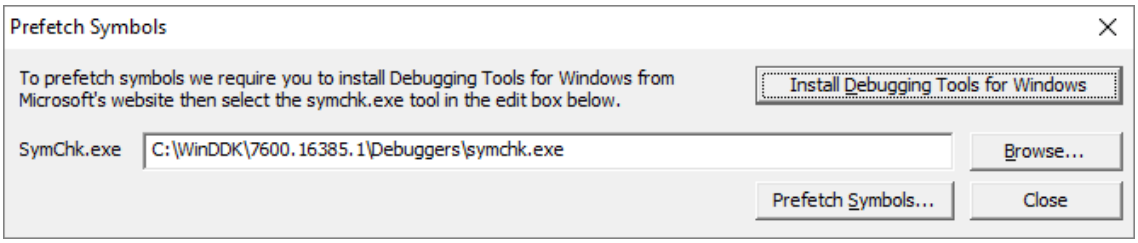
    Check the desired options - if any.



Pre-fetching symbols

To avoid delays when using symbol servers, you can trigger the retrieval of symbols (by running SymChk.exe) to collect symbols for all executable files specified in the exe/dll which you associated with each symbol server.

- **Prefetch Symbols...** › open the Prefetch Symbols dialog below to continue



Prerequisites for pre-fetching symbols

The pre-fetching of symbols requires the installation of Microsoft's Debugging Tools.

You may already have Debugging Tools if you've previously installed the Windows Driver Kit (DDK or WDK) or the Windows SDK.

- **Install Debugging Tools for Windows** › opens a web page (as above) to download and install the x86 or x64 Debugging Tools for Windows

After installing the Debugging Tools, you must specify the location of SymChk.exe from the installed area.

- **SymChk.exe** › enter or **Browse** to SymChk.exe location

  A typical path might be `C:\WinDDK\7600.16385.1\Debuggers\symchk.exe`

Getting the symbols

Note that prefetching symbols may consume a large amount of disk space and download bandwidth.

You should ensure that you have at least 2 or 3Gb of disk free space, because of the total size of the download packages.

- **Prefetch Symbols...** › runs SymChk.exe to get all the symbols

  The symbols for each symbol server are stored in the associated symbol store directory.

If no symbol servers are specified in the symbol server settings above, you'll see a warning dialog and no symbols will be fetched.

Command line pre-fetching of symbols with the SymChk utility

The section on Pre-fetching symbols above is a convenient alternative to manually using the SymChk,exe utility.

To avoid delays when using symbol servers, you can pre-fetch symbols using the SymChk.exe command line tool that is part of Microsoft's Debugging Tools.

You may want to add the folder of the Debugging Tools for Windows package to the PATH environment variable on your system so that you can access this tool easily from any command prompt.

Example:

To use SymChk.exe to download symbol files for all of the components in the `c:\windows\System32` folder, you might use the command:

```
symchk.exe /r c:\windows\system32 /s SRV*c:\symbols\*http://msdl.microsoft.com/download/sym
```

where

`/r c:\windows\system32` finds all symbols for files in that folder *and any sub-folders*

`/s SRV*c:\symbols*http://msdl.microsoft.com/download/symbols` specifies the symbol path to use for symbol resolution.

In this case, `c:\symbols` is the local folder where the symbols will be copied from the symbol server.

➡ To obtain more information about the command-line options for SymChk.exe, type `symchk /?` at a command prompt.

Other options include the ability to specify the name or the process ID (PID) of an executable file that is running.

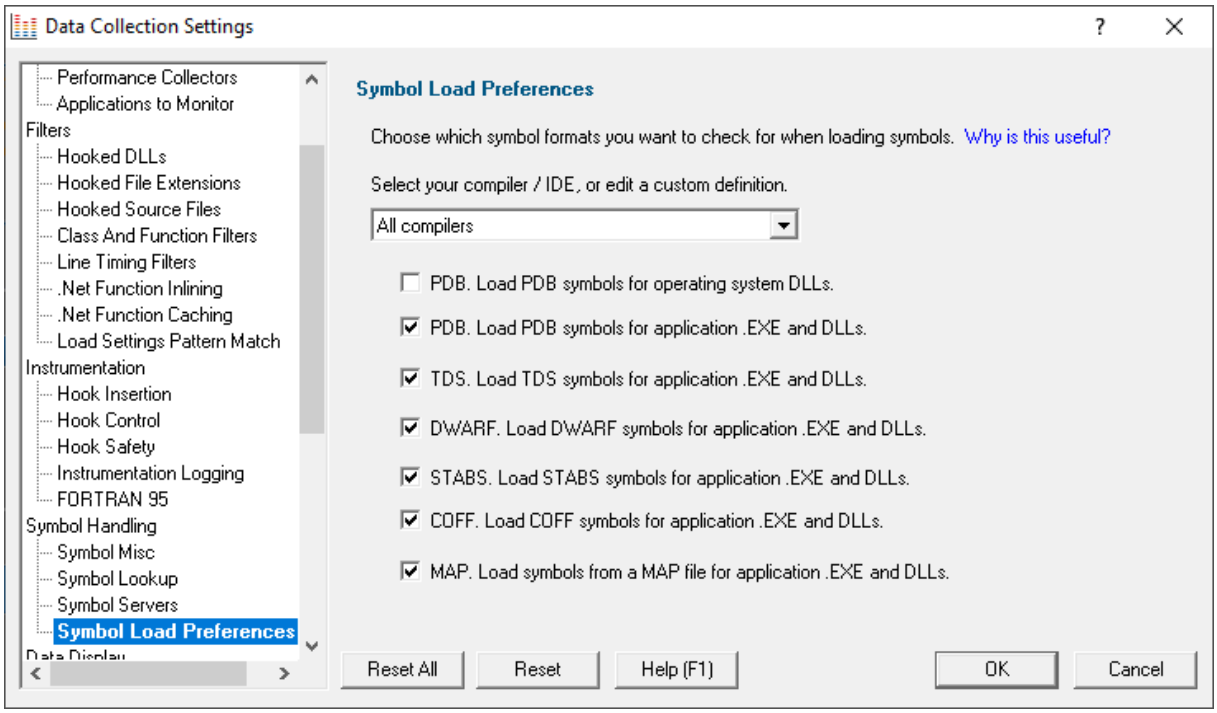
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.4.4 Symbol Load Preferences

The **Symbol Load Preferences** tab allows you to configure which debug information types are looked for and which are ignored.

This can save some time fetching symbols each time a DLL is loaded.



- **Select your compiler / IDE...** › choose a preset definition for a compiler / IDE, or edit one of four custom symbol load preferences

The present definitions are:
  - **I don't know which compilers** › choose this if you don't know which compilers were used to build the software
  - **All compilers** › choose this to let Performance Validator fetch the symbols
  - **Visual Studio** › choose this if you're only using Visual Studio
  - **Visual Basic 6** › choose this if you're only using Visual Basic 6
  - **Delphi** › choose this if you're only using Delphi
  - **C++ Builder** › choose this if you're using C++ Builder on 32 bit Windows
  - **C++ Builder 32 bit** › choose this if you're using C++ Builder to build 32 bit applications
  - **C++ Builder 64 bit** › choose this if you're using C++ Builder to build 64 bit applications
  - **MingW / gcc / g++ / QtCreator / Dev C++** › choose this if you're using MingW / gcc / g++
  - **QtCreator / Dev C++** › choose this if you're using QtCreator
  - **Dev C++** › choose this if you're using Dev C++
  - **Rust** › choose this if you're using Rust
  - **Salford Fortran 95** › choose this if you're using Salford Fortran 95
  - **Custom 1** › choose this to edit a definition you can reuse
  - **Custom 2** › choose this to edit a definition you can reuse
  - **Custom 3** › choose this to edit a definition you can reuse
  - **Custom 4** › choose this to edit a definition you can reuse

Editing a definition

Once a definition has been selected the appropriate check boxes next to each debug information type are populated.

You can edit these selections, for example to include or exclude PDB debug information for operating system DLLs, or allow Performance Validator to search for COFF debug information, whatever is optimal for the way you are working.

Custom definitions

Only the custom definitions will be remembered if they are edited.

The four custom definitions will be remembered, so the next time you choose them you'll get the definition you edited. If you choose one of the preset definitions and edit it, you'll use the edited definition, but if you then change to a different preset (or a custom definition) and then back to the original preset you'll get the preset definition, not your edited version of the preset definition.

Reset All - Resets **all** global settings, not just those on the current page.

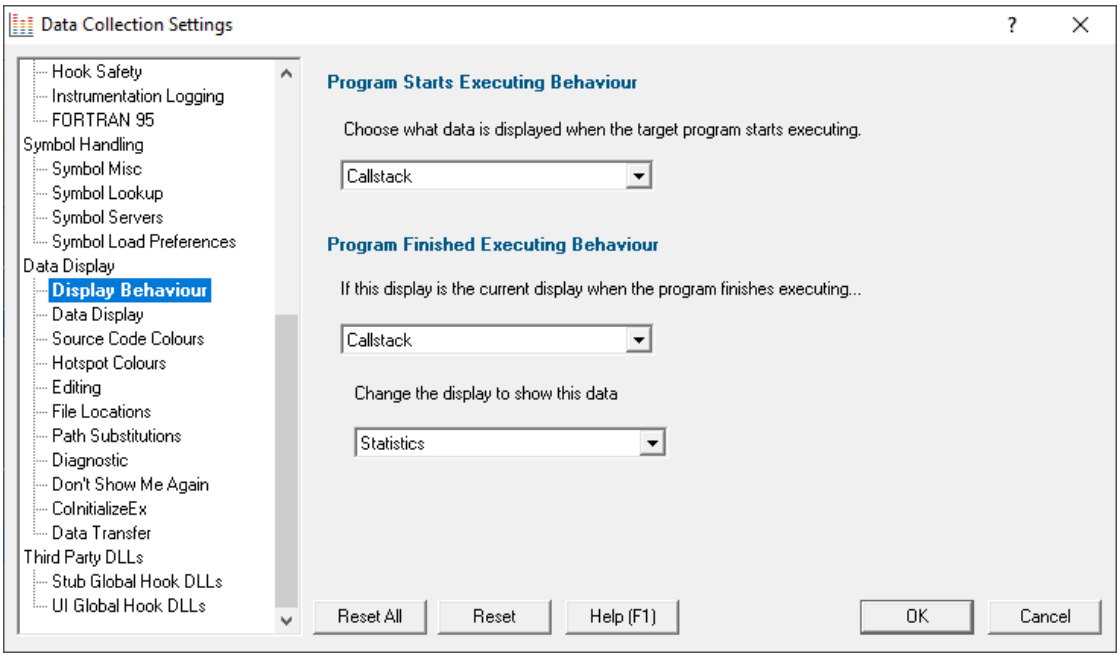
Reset - Resets the settings on the current page.

3.10.1.5 Data Display

3.10.1.5.1 Display Behaviour

The **Display Behaviour** tab allows you control how which displays are shown when a program starts executing and when a program finishes executing.

The default options are shown below:



Performance Validator can change the current display to any of the following displays.

- **Callstack** › real time callstack of selected thread
- **Statistics** › function timing statistics
- **Relations** › function timing information for a function, it's callers and callees.
- **Call Tree** › function timing call tree
- **Call Graph** › function timing call graph (reduced form of the call tree)
- **Analysis** › query the function timing data
- **Line Times** › line timing data
- **Diagnostic : Diagnostic** › diagnostic information
- **Diagnostic : Stdout** › text collected from stdout
- **Diagnostic : Environment Variables** › environment variables from the program under test
- **Diagnostic : Child Processes** › processes launched by the program under test

Program Starts Executing Behaviour

When Performance Validator starts monitoring the behaviour of an application the current display can automatically be switched to any of the displays listed above.

There is also the option not to change the display.

Program Finished Executing Behaviour

When Performance Validator has finished processing all the information from the target application the current display can automatically be switched to any of the displays listed above if the current display matches a specified condition. This allows you to not change the display, always change the display or change the display if the current display is a specific display (for example *if at the end of program execution the current display is callstacks, change it to statistics*).

There is also the option not to change the display.

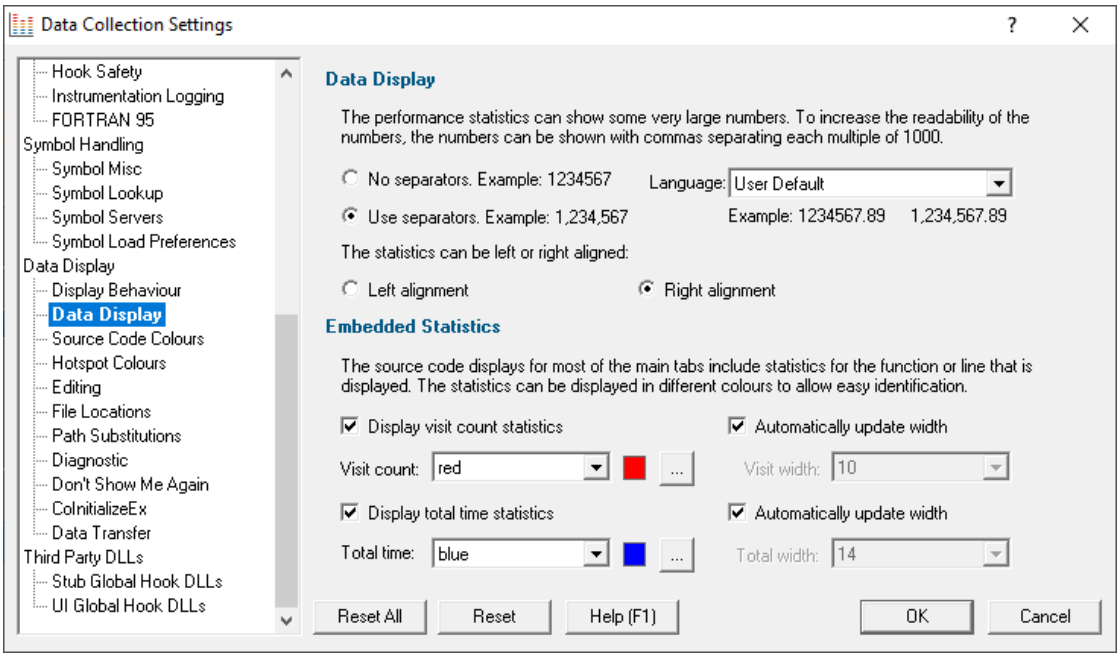
The type of display that may interesting for collected data depends on the type of program that was executed. Native, .Net or Mixed mode. To accommodate this we provide one setting for each of the three program types.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.2 Data Display

The **Data Display** page allows you to specify how data is shown on all the data displays.



Numerical data format

Numeric data on the displays can contain some pretty big values, up to 2^64-1 if needed!

Long values are hard to read without grouping digits. To improve readability Performance Validator can delimit each group of three digits, so 1234567 becomes 1,234,567 for example.

- **No separators / Use separators** › Choose whether to group digits

The format used to delimit digit groups is set to **User Default**, which uses your computer's current locale, but you can change the format to suit another language if you wish.

- **Language** › Format numbers according to the default locale, or choose another language

Numerical data alignment

Numeric data on the displays can be aligned left or right, with right aligned numbers being more easily compared.

- **Left alignment / Right alignment** › Choose preferred alignment

Embedding visit counts in the source code

The source code displayed on several of the main tabs can show a colour-coded visit count or total time in-lined to the left of the source code.

You can choose a colour to display these statistics to distinguish them from the code and line numbers.

Without embedding statistics:

```
324  static int qsCompFunc(const void    *arg1,
325                        const void    *arg2)
326 {
327      DWORD   *dw1 = (DWORD *)arg1;
328      DWORD   *dw2 = (DWORD *)arg2;
329
330      return (*dw1 - *dw2);
331  }
332
```

With embedded statistics:

```
324                                  static int qsCompFunc(const void    *arg1,
325                                                        const void    *arg2)
326    327,778          201.91 {
327                                      DWORD   *dw1 = (DWORD *)arg1;
328                                      DWORD   *dw2 = (DWORD *)arg2;
329
330                                      return (*dw1 - *dw2);
331                                  }
332
```

In the above example, the function `qsCompFunc` has been visited 327,778 times and for a total of 201.91ms, the time unit being defined by the time format.

- **Display visit count statistics** › Choose whether to include the visit count

  If displayed (the default), you can choose a preferred text colour, and a width for the column:

  - **Visit count** › Set your preferred colour

- **Automatically update width** (for visit count) › Choose whether to auto adjust the column width as numbers increase

  If the width is set *not* to be automatically updated, choose a preferred width for the column:

  - **Visit width** › Change the column width

Similar settings are repeated for the total time statistics:

- **Display total time statistics** › Choose whether to include the total time

  If displayed (the default), you can choose a preferred text colour, and a width for the column:

  - **Total time** › Set your preferred colour

- **Automatically update width** (for total time) › Choose whether to auto adjust the column width as numbers increase

  If the width is set *not* to be automatically updated, choose a preferred width for the column:

  - **Total width** › Change the column width

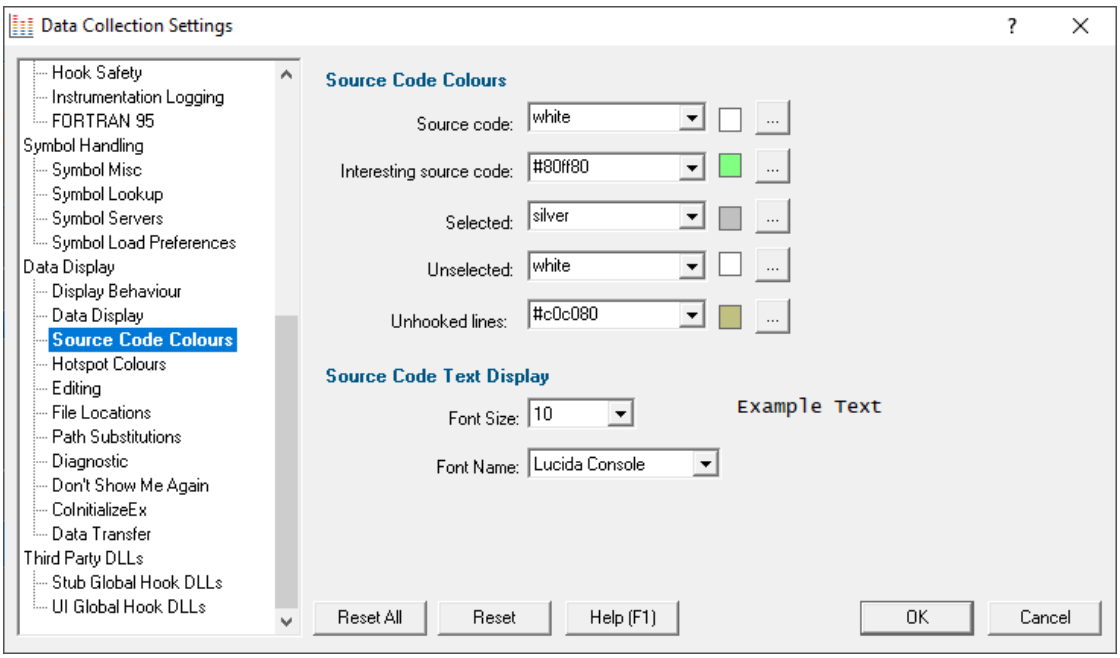
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.3 Source Code Colours

The **Source Code Colours** tab lets you choose the colours (and the font) used to display source code.

The default colours are shown below:



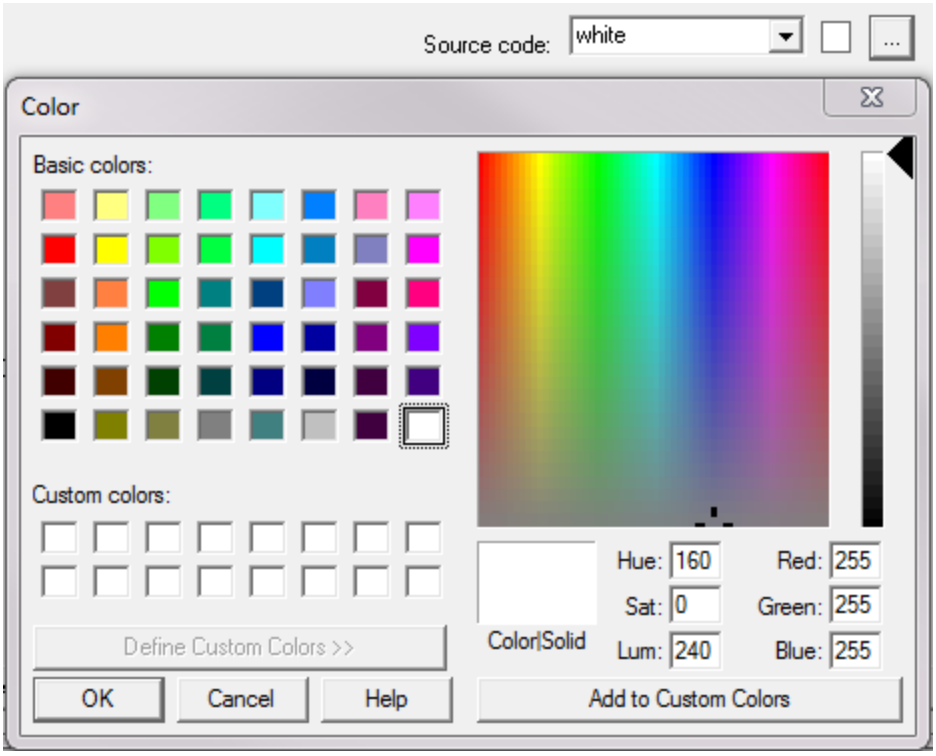
The colours are used for highlighting the source code on most of the main tabs, as well as in some of the statistics.

Changing display colours

For each colour you can choose a predefined colour or make your own:

- Use the drop-down list white › pick one of 16 predefined colours below

- Click the ... button › edit the colour using the standard colour dialog:



➡ See the Data Display Settings for changing the colour of the 'visit count' or the 'total time' statistics shown in the source code..

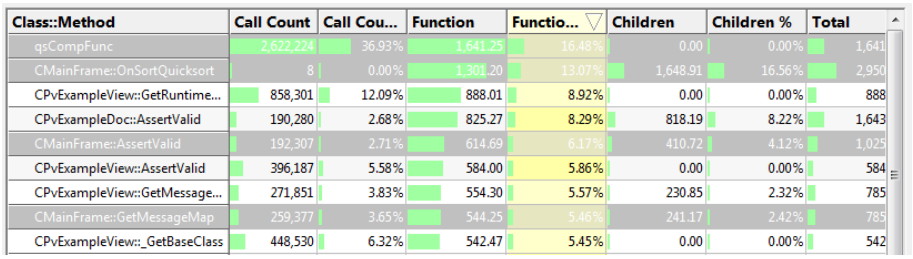
Highlighting data that won't be shown on the next run

You can use settings, such as the Hooked Source Files, to exclude files or directories of source code from being analyzed.

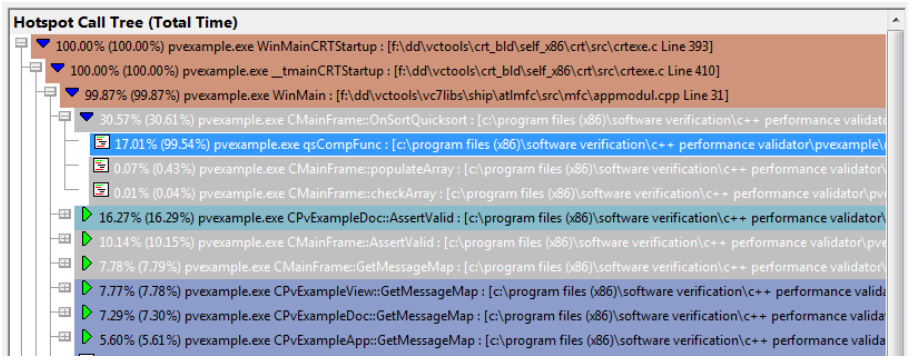
If you've already got performance data being displayed, and you filter out some of that data, it is not removed from statistics in the current session.

However, the data that would be excluded is highlighted using the *Selected* colour (light grey in the above example).

In the example below, the `mainfrm.cpp` file has just been added to the Hooked Source Files as an unhooked file, causing rows to be highlighted in the Statistics and Call Tree tabs:



Class::Method	Call Count	Call Cou...	Function	Functio...	Children	Children %	Total
qsCompFunc	2,622,224	36.93%	1,641.25	16.48%	0.00	0.00%	1,641
CMainFrame::OnSortQuicksort	8	0.00%	1,301.20	13.07%	1,648.91	16.56%	2,950
CPvExampleView::GetRuntime...	858,301	12.09%	888.01	8.92%	0.00	0.00%	888
CPvExampleDoc::AssertValid	190,280	2.68%	825.27	8.29%	818.19	8.22%	1,643
CMainFrame::AssertValid	192,307	2.71%	614.69	6.17%	410.72	4.12%	1,025
CPvExampleView::AssertValid	396,187	5.58%	584.00	5.86%	0.00	0.00%	584
CPvExampleView::GetMessage...	271,851	3.83%	554.30	5.57%	230.85	2.32%	785
CMainFrame::GetMessageMap	259,377	3.65%	544.25	5.46%	241.17	2.42%	785
CPvExampleView::_GetBaseClass	448,530	6.32%	542.47	5.45%	0.00	0.00%	542



Source Code Text Display

The font used to display the source code can be changed:

- **Font Size** › pick a font size that suits you
- **Font Name** › choose your favourite monospaced font

While all fonts listed should be monospaced (non proportional), webdings and wingdings might not be great choices for code readability.

A small sample of the text in the chosen font name and point size is shown below your selections.

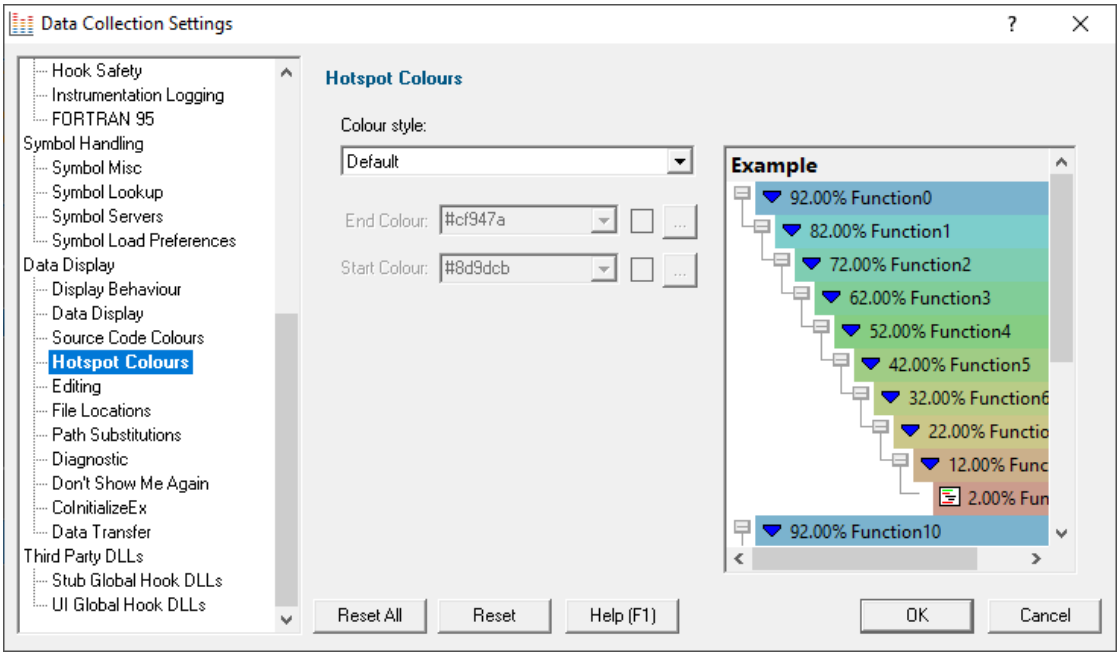
The font selected here doesn't affect the Performance Validator source code editor.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.4 Hotspot Colours

The **Hotspot Colours** page controls the colours used for different levels of performance on performance trees and graphs.



Colour Style

There are 7 predefined colour styles and one custom colour style that you can edit.

The 7 predefined colour styles are:

- Default › the multicoloured colour range
- Red › a red colour range
- Green › a green colour range
- Blue › a blue colour range
- Yellow › a yellow colour range
- Cyan › a cyan colour range
- Magenta › a magent colour range

When the custom style is selected the start colour and end colour become editable, allowing you to configure a custom colour range.

Changing hotspot colours

For each colour you can choose a predefined colour or make your own.

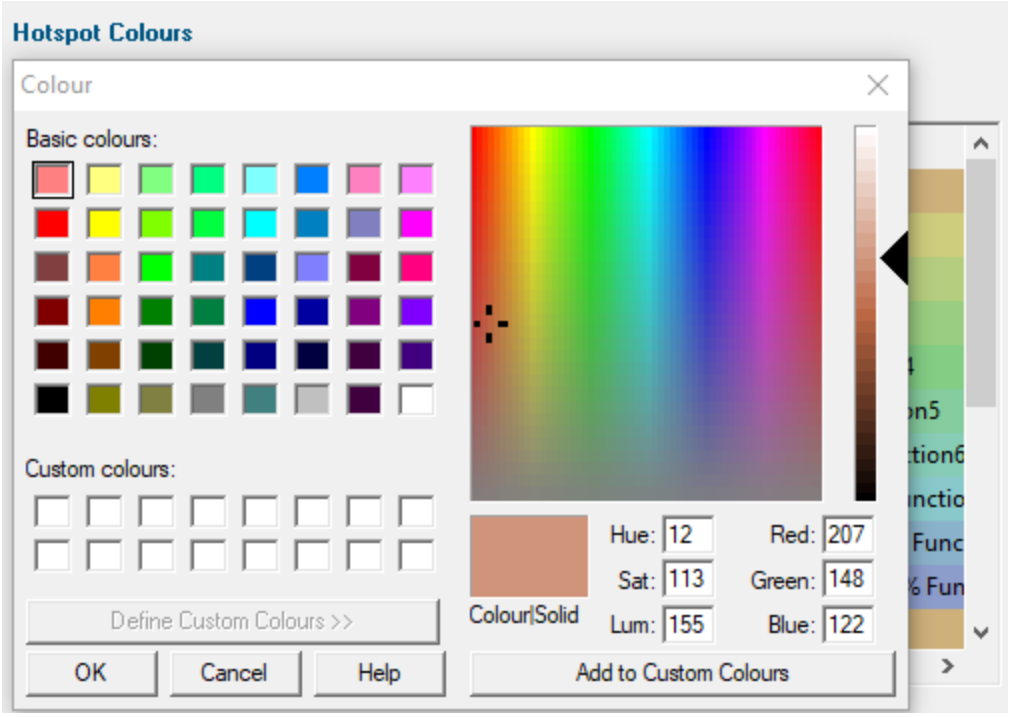
The default colours follow a rainbow-like progression. A meaningful sequence helps visually distinguish areas of higher or lower significance more easily.

- Use the drop-down list 

 › pick one of 16 predefined colours below

- Or click the 

 button › edit the colour using the standard colour dialog:



A preview of your chosen colours is displayed on the right of the page.

Since the text is very dark, we recommend use a lighter range of colours to keep things readable.

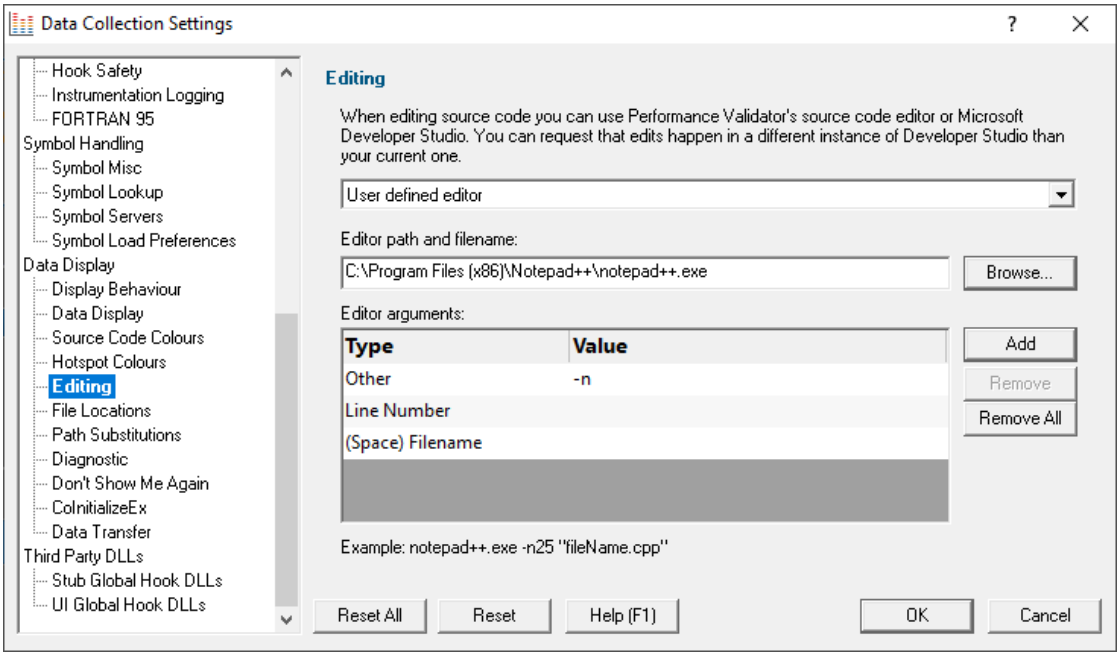
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.5 Editing

The **Editing** tab allows you to configure which editor Performance Validator will use for editing source code.

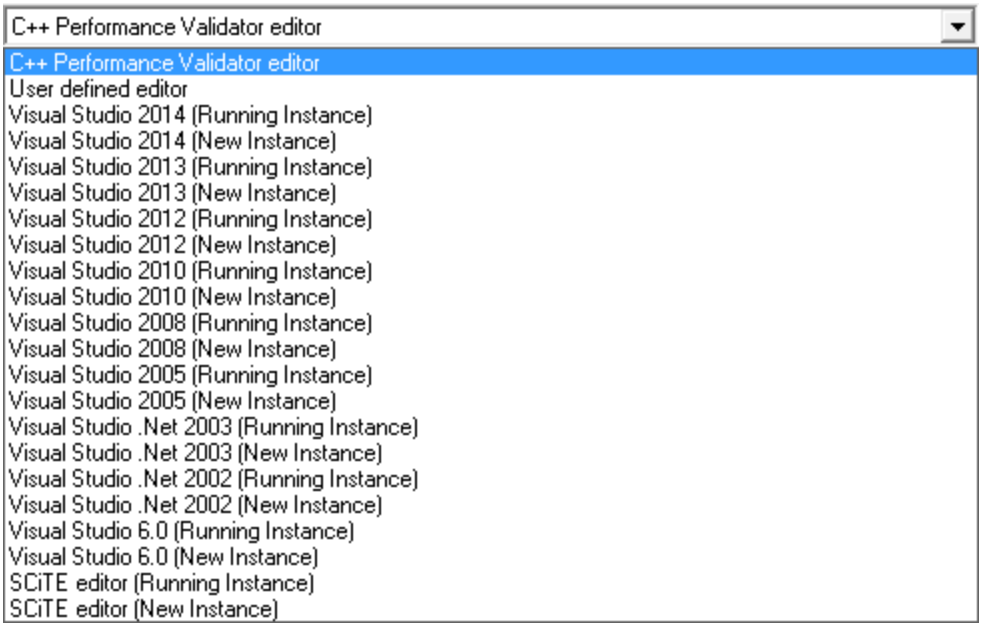
The default settings are shown below:



Editing source code

From the Tools menu, or any of the data views in the main tabs, you can right click to edit the source code.

By default, source code is opened in a provided source code editor using syntax colouring, but you can change where you edit code via the drop-down list:



When choosing one of the editors listed, you can request a currently open instance (e.g. the same one you are using to develop your application), or to open a new instance.

➜ SCiTE is included in the list of editors, but there are many text editors that can be used for source code on windows. Wikipedia has a comparison of editors including their programming feature support

Editing with your preferred editor

We've all got our favourite editors! To use yours:

- Select **User defined editor** from the list of options › enables the fields below
- Enter the **Editor path and filename** or just **Browse** › choose the executable for your preferred editor

Now when you want to edit source code, that editor will be opened, but typically you'll need to specify some command line arguments with which to start the editor.

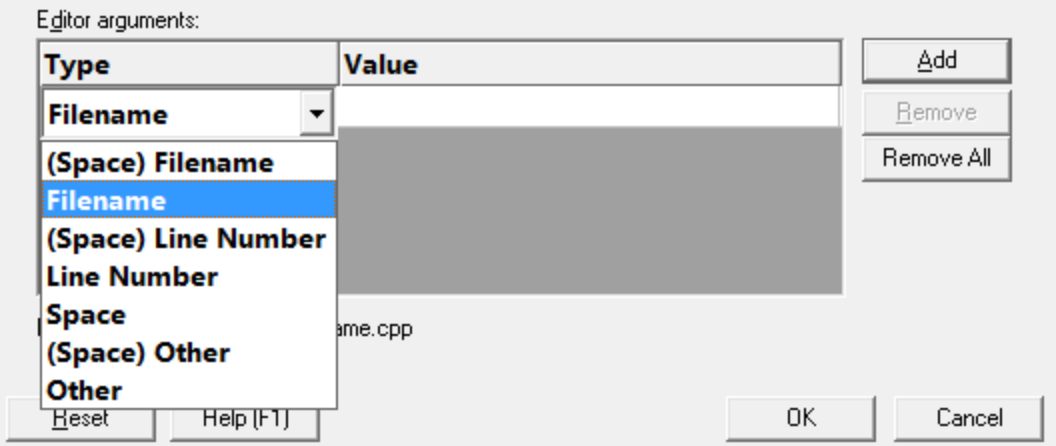
Starting your preferred editor with command line arguments

By default, just the file name is passed as a command line argument to the editor.

Depending on the editor, you may need to tailor the arguments, for example if you want the file scrolled to a particular line.

The arguments can be specified by adding them to the table provided, one at a time and in the order required

- **Add** › adds a row to the **Editor arguments** table › select an argument **Type** from the following options



The possible arguments include:

- **(Space) Filename** › appends a space followed by the filename
- **Filename** › appends just the filename

- **(Space) Line Number** › a space followed by the line number
- **Line Number** › just the line number

- **Space** › a space

- **(Space) Other** › a space followed by the text typed in the **Value** column of the list
- **Other** › just the text typed in the **Value** column of the list

Only the *Other* options need an entry in the Value column.
You will need to press **Return** after entering the value otherwise the entry won't get recognized.

The example below configures NotePad++ to edit a file at the required line using the -n switch

☑

As you modify the arguments an example command line is shown below the list.

Managing the command line arguments

Edit a **Type** or **Value** by double clicking the entry. The usual controls apply for removing list items:

- **Remove** › removes selected arguments in the list

- **Remove All** › removes all arguments, clearing the list

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

Reset All - Resets **all** global settings, not just those on the current page.

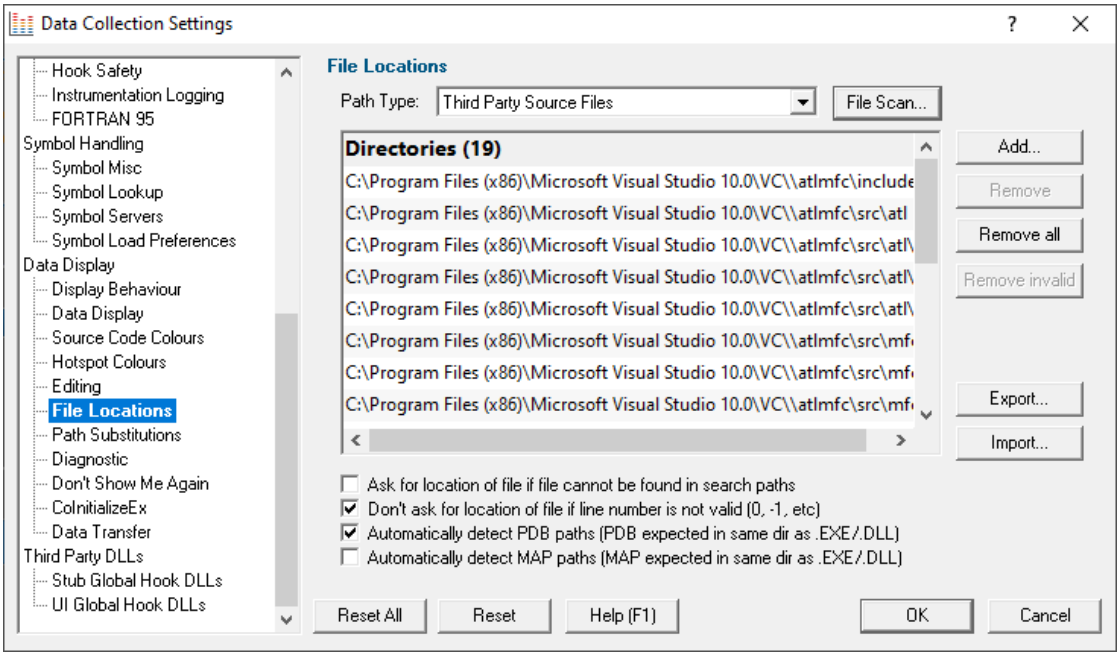
Reset - Resets the settings on the current page.

3.10.1.5.6 File Locations

The **File Locations** tab allows you to specify which directories Performance Validator should look in for source code files, whether that's your own or third party code.

The default settings are shown below:

Read on, or click on a setting in the picture below to find out more:



File locations

Sometimes the information Performance Validator has access to consists of the file name, but not the directory.

When this happens Performance Validator scans a set of directories that it knows about in order to find the file.

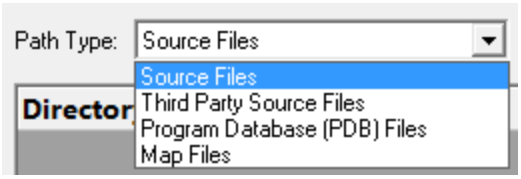
The options below allow you to specify those directories that should be searched for source files, PDB files and MAP files.

If a file can't be found, you'll get prompted for a location, but you can control this below as well.

Setting directories for a path type

There are four path types, and a separate list of directories to scan for each one.

- **Path Type** › select the type of file with which you want to modify the list directory



You don't *have* to specify any directories if you don't want to, or if you just don't have them. Nor do you have to give directories for *all* the path types.

Prompting for file locations

Whenever a file still cannot be found, then the default action is for a dialog to ask you where it is.

To avoid frequent user interruption, it is recommended that the directories for source code files (yours and third party) are specified, enabling Performance Validator to automatically load source code for browsing.

If however, you don't want to be prompted for locations, you can disable that too.

- **Ask for location of file...** › untick to stop prompting for file locations

Even when prompting is switched on, it can still happen that the line in question is invalid anyway, e.g. line number 0 or -1.

The default is not to prompt for invalid lines, but if you want to know when that happens, just switch that behaviour off.

- **Don't ask for location of file if line number is not valid...** › untick to be prompted for invalid lines anyway

PDB (program database) file paths

Normally PDB search paths are automatically generated, based on the same directories that .exe and .dll files are found in:

- **Automatically detect PDB paths** › automatically detect PDB locations (the default)

However, it is recommended that you specify paths for PDB (program database) files, especially if your build environment dictates that PDB files are kept in different directories to their binaries.

If you don't automatically generate PDB paths and you don't specify any paths for PDBs, the search path will be defined as the current directory plus any paths found in the following environment variables:

- _NT_SYMBOL_PATH
- _NT_ALTERNATE_SYMBOL_PATH
- SYSTEMROOT

MAP file paths

It's recommended that you specify paths for Map files if your build environment means they are kept in different directories to their binaries.

If you don't specify any paths for Map files, then search paths are automatically generated, based on the same directories that .exe and .dll files are found in.

Manually adding path type directories

Once you have chosen your path type you can modify the list of files for each path type in the following ways:

- **Add** › appends a row to the directory list › enter the directory path

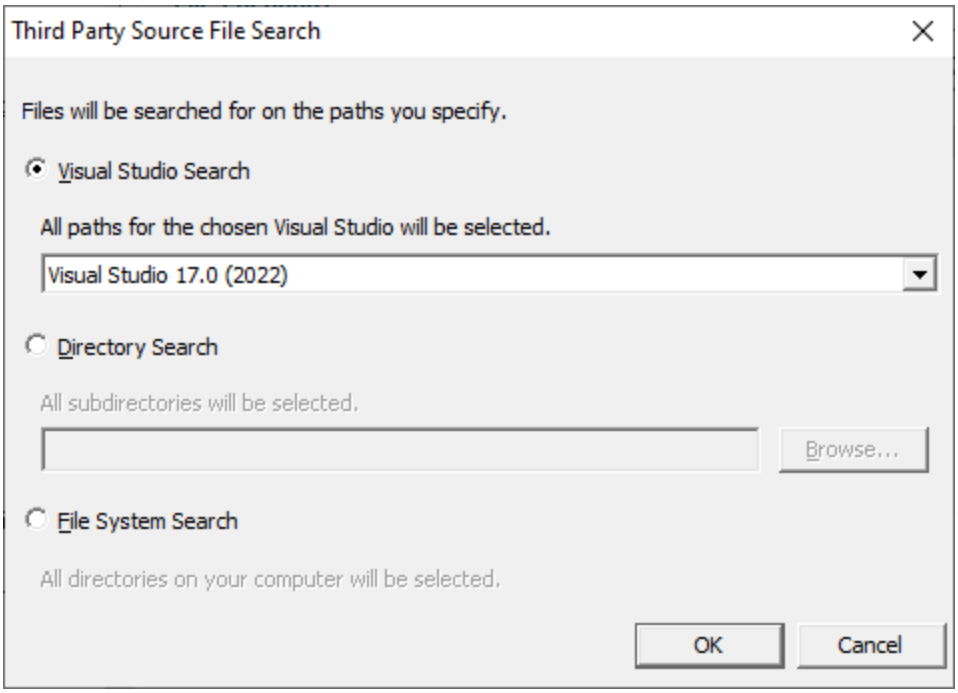
Edit a directory path by double clicking the entry. The usual controls apply for removing list items:

- **Remove** › removes selected items from the list
- **Remove all** › clears the list
- **Remove invalid** › removes all items that are not valid directories from the list

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

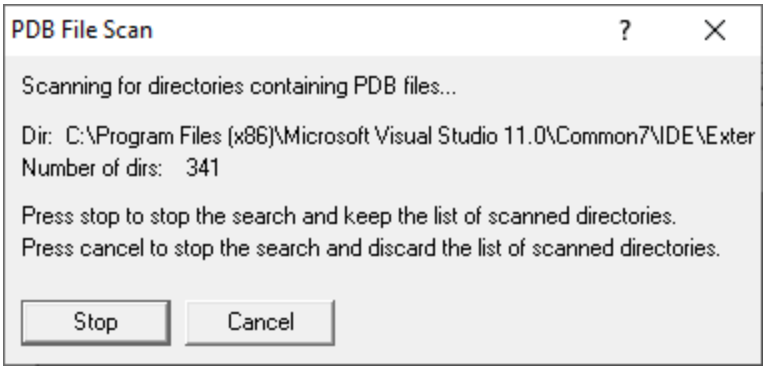
Scanning for directories to add

The **File Scan...** button displays the File Search dialog to provide three ways of specifying the files to scan.

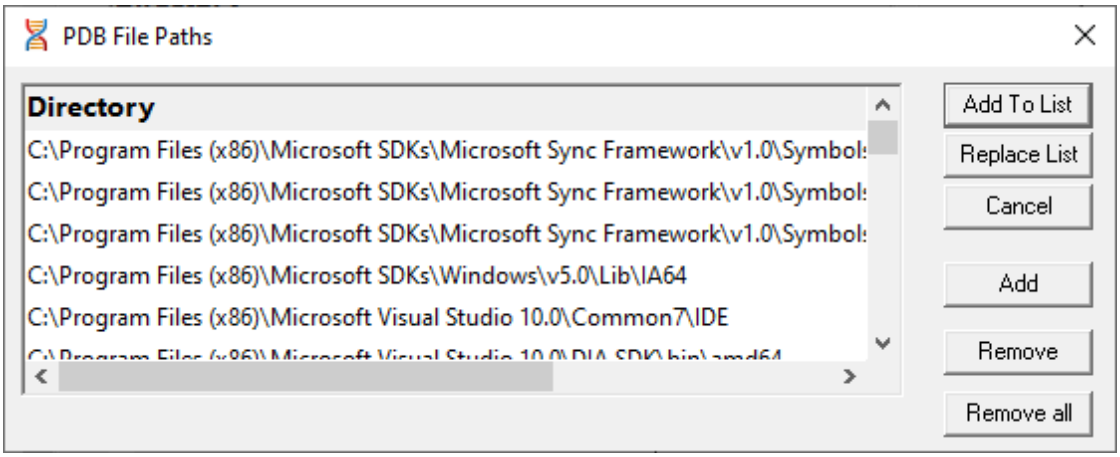


- **Visual Studio Search** › choose the version of Visual Studio › **OK** › starts a scan for directories related to that version of Visual Studio
- **Directory Search** › **Browse...** displays a directory browser › **navigate** to a location you want to scan within › **OK** › starts a scan for directories
- **File System Search** › **OK** › starts a scan of all drives for directories containing files

All options will bring up a **File Scan** dialog indicating number of relevant directories found, and giving you a chance to **Stop** or **Cancel** the scan at any time:



Once the scan is complete you'll see the **File Paths** dialog showing you the scan results:



You can modify the list of resulting directories by adding, removing or editing, exactly as for the path type list above.

Once you're happy with the scan results, either append or replace the path type directories with the scan results.

- **Add To List** › adds the scan results list to the path type directories and closes the File Paths dialog
- **Replace List** › replaces the path type directories with the scan results
- **Cancel** › discard the scan results and close the dialog

Exporting and Importing

Since the list of path types and their file locations can be quite complicated to set up and optimise, you can export the settings to a file and import them again later. This is useful when switching between different target applications.

- **Export...** › **choose or enter** a filename › **Save** › outputs all the path types and their file locations to the file
- **Import...** › **navigate** to an existing *.pvxfl file › **Open** › loads the hooking rule and the list of modules

The exported file can be used with the -fileLocations command line option.

Export file format

The file format is plain text with one folder listed per line. Sections are denoted by a line containing `[Files]` (for source code files), `[Third]` (for third party source code files), `[PDB]` etc.

Example:

```
[Files]
```

```
c:\work\project1\
[Third]
d:\VisualStudio\VC98\Include
[PDB]
c:\work\project3\debug
c:\work\project3\release
[MAP]
c:\work\project3\debug
c:\work\project3\release
```

Checking directory scanning order

To see the order in which the *DbgHelp.dll* process checks directories to find symbols, see the diagnostic tab, showing *DbgHelp debug* in the drop-down.

Reset All - Resets **all** global settings, not just those on the current page.

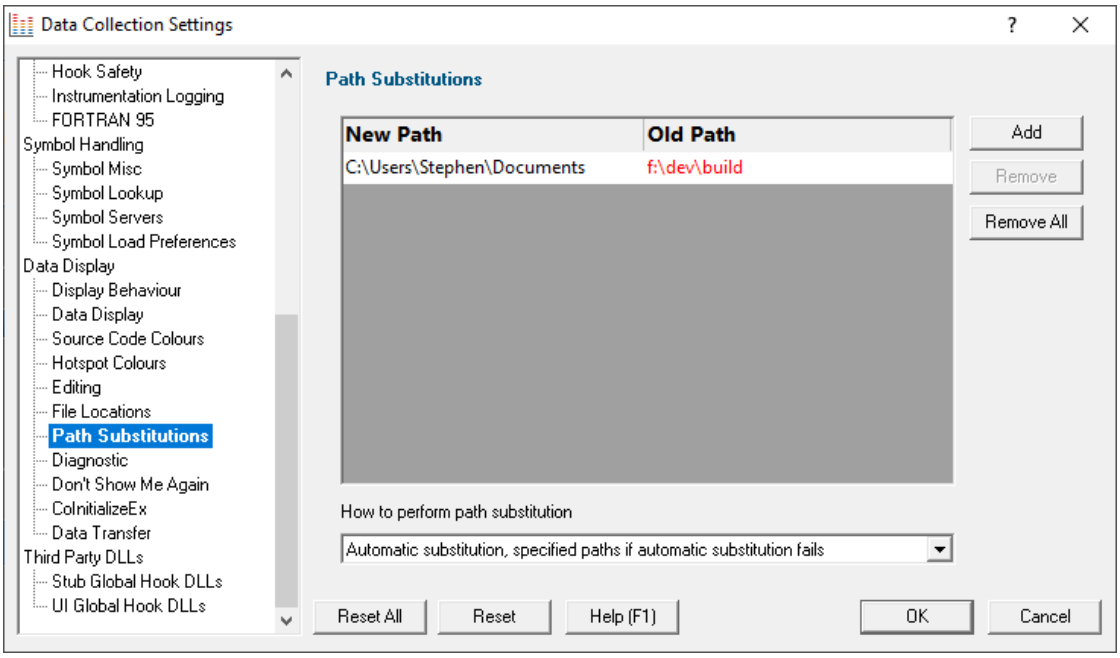
Reset - Resets the settings on the current page.

3.10.1.5.7 Path Substitutions

The **Path Substitutions** tab allows you to specify how file paths can be modified to account for copying a build from a build machine to a development machine or test machine.

File paths need to be modified otherwise the debug information will point to source code in locations that don't exist on the new machine.

There are no substitutions set up by default:



Path Substitutions

Some software development schemes have multiple rolling builds of their software, often enabled by using substituted disk drive naming schemes.

When you download the build to your development machine for development and testing, debugging information may reference disk drives that don't exist on your machine, for example, drive X: while your machine only has C:, D:, and E: drives.

Or you may just be copying a build from a drive on a development machine to a subdirectory on a drive on your test machine.

These options let you remap the substitution so that the Performance Validator looks in the correct place for the source code.

- **Add** › adds a row to the **File Paths Substitutions** table › enter the new path that will replace the old path in the **New Path** column › click in the Old **Path** column › enter the path that is being replaced

  For example, you might enter c:\users\stephen\documents for the new path and `f:\dev\build` for the old path.

You can double click to edit drives and paths in the table, or remove items:

- **Remove** › removes selected substitutions from the list
- **Remove All** › removes all substitutions from the list

Alternatively, press Del to delete selected items, and Ctrl + A to select all items in the list first.

Example: Changed disk drive

Project originally located at	m:\dev\build\testApp
Project copied to	e:\dev\build\testApp
New Path	e:\
Old Path	m:\

Example: Project copied to a new location

Project originally located at	f:\dev\build\testApp
Project copied to	C:\Users\Stephen\Documents\testApp
New Path	C:\Users\Stephen\Documents
Old Path	f:\dev\build

The slashes do not have to match, a forward slash will match a backslash when comparing path fragments. This is deliberate - to improve ease of use with libraries built by different compilers (LLVM and compilers that use it use forward slashes, whereas Visual Studio etc use backslashes).

Path Substitution Method

Path substitution can be turned off, use only manually specified paths, perform automatic path substitution based on best guesses based on information in the executable, or a combination.

Use the combo box to choose the appropriate path substitution method. The default is automatic path substitution and if that fails to try path substitution using the manually specified paths.

- **No path substitution** › path substitution does not happen
- **Only substitute specified paths** › path substitution uses the manually specified paths
- **Automatic substitution only** › path substitution is performed automatically using information in the executable
- **Automatic substitution, specified paths if substitution fails** › an attempt at automatic path substitution is made, if this fails path substitution is performed using the manually specified paths

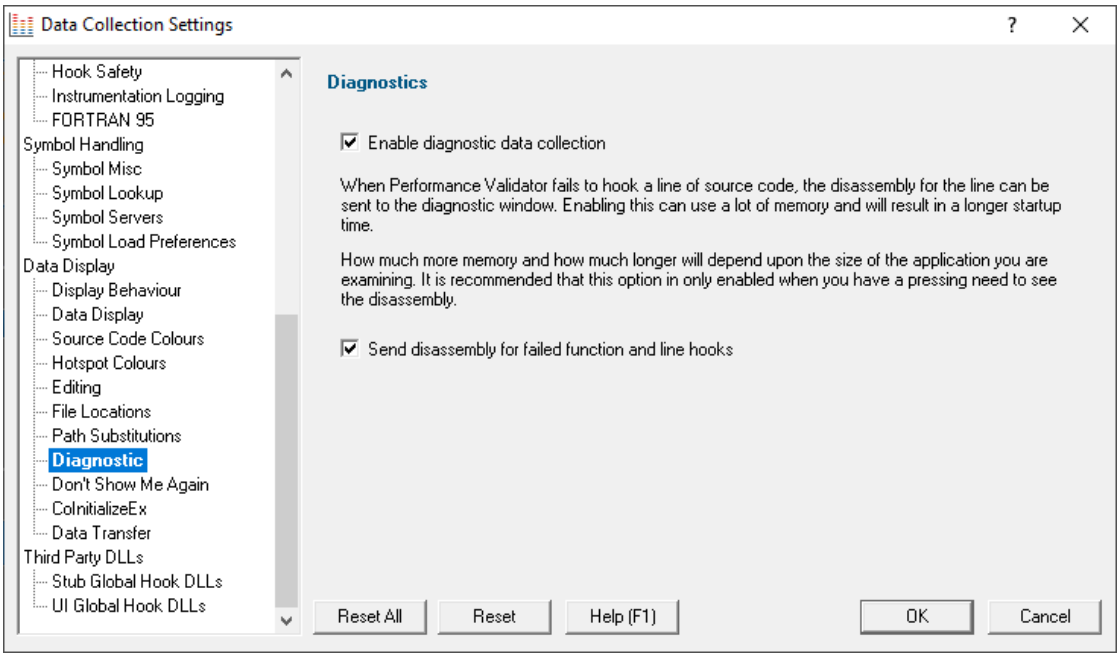
The default is **Automatic substitution, specified paths if substitution fails**.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.8 Diagnostic

The **Diagnostic** page controls the diagnostic display.



Diagnostics

Collection: A lot of diagnostic information is collected and displayed on the diagnostic tab when attaching to a target program.

Some of this information is *always* sent to Performance Validator, but you may not want to see it all.

- **Enable diagnostic data collection** › displays all diagnostic information in the diagnostic tab (on by default)

Disassembly: When hooking source code lines, some lines cannot be hooked due to the object code that corresponds to the source code location.

- **Send disassembly for failed function and line hooks** › shows the disassembly for lines that cannot be hooked (enabled by default)

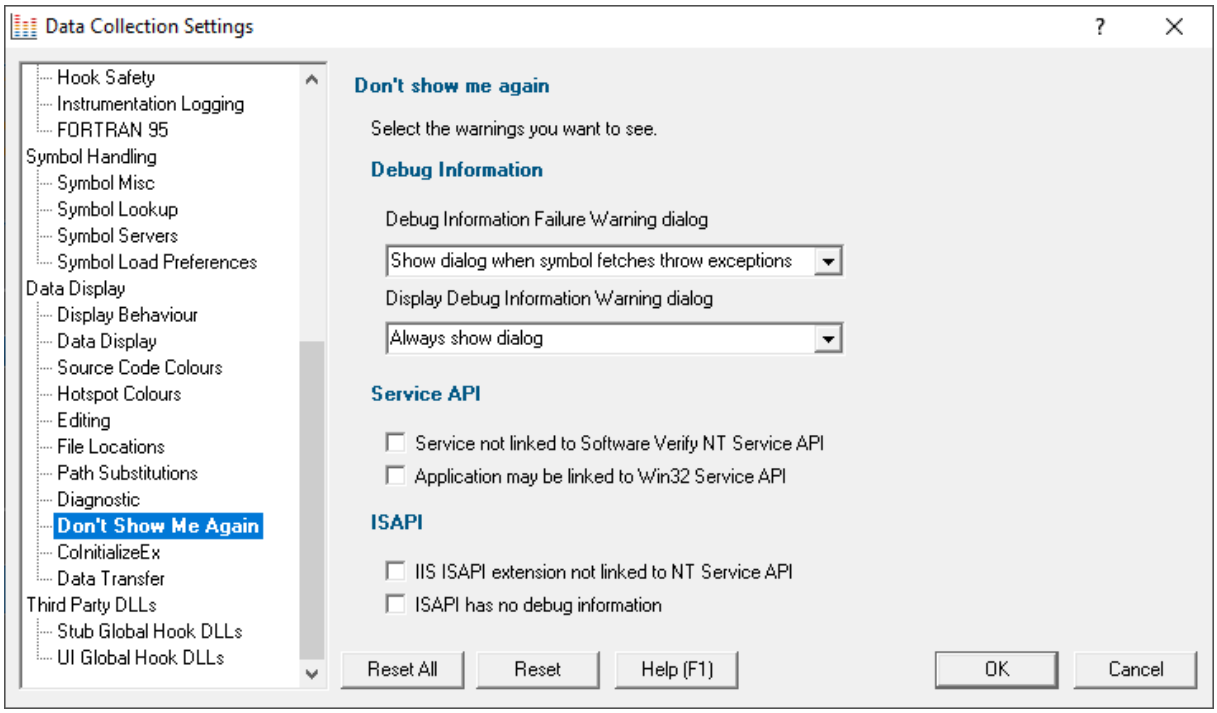
  This *can* increase startup time and memory usage if used very frequently.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.9 Don't Show Me Again

The **Don't Show Me Again** page allows you to control warnings that Performance Validator displays.



Debug Information

Debug Information Failure Warning

When there is a failure collecting debug symbols a warning can be displayed. The options are:
- Always show dialog
- Never show dialog
- Show dialog when symbol fetches throw exceptions

Display Debug Information Warning

When no debug information is available for at least one module a warning can be displayed. The options are:
- Always show dialog
- Never show dialog
- Show dialog when debug information is missing

Services API

- **Service not linked to Software Verify NT Service API** › warning will be shown if you try to monitor a service not linked to the Software Verify NT Service API. (on by default)

  When trying to monitor a service Performance Validator can detect if the service is not linked to the NT Service API and display a warning.

  It is possible to use the service API without linking to it (use GetProcAddress() to lookup the functions and call them) - in this case you would want to turn this warning off.

- **Application may be linked to Win32 Service API** › warning will be shown if you try to start an application that appears to be a service - it uses Win32 Service APIs. (on by default)

ISAPI

NT Service API
When trying to monitor ISAPI extensions Performance Validator can detect if the ISAPI is not linked to the NT Service API and display a warning.

It is possible to use the service API without linking to it (use GetProcAddress() to lookup the functions and call them) - in this case you would want to turn this warning off.

Debug Information
Performance Validator can warn if the ISAPI has no debug information. There may be cases where you don't want to see this warning.

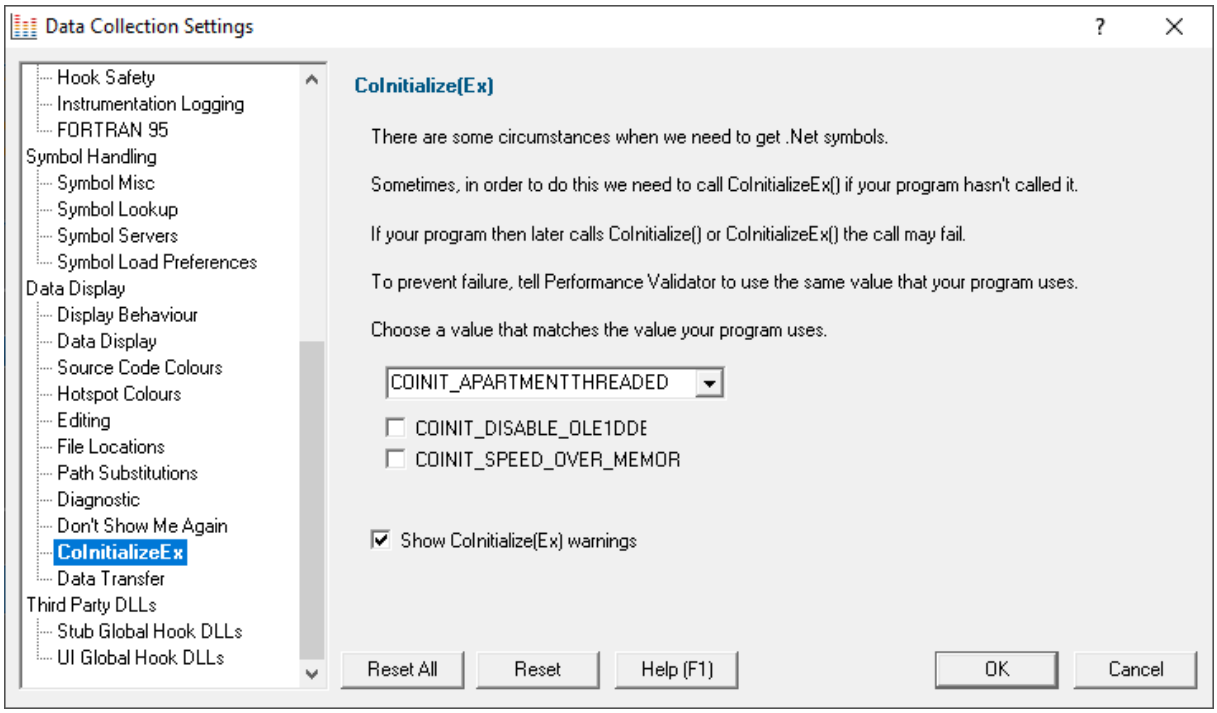
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.10 CoInitializeEx

The **CoInitializeEx** tab allows you to set the default behaviour used to initialize COM if Performance Validator needs to initialize COM to acquire symbols for .Net modules.

The default settings are shown below:



CoInitializeEx

In some situations the Validator needs to get .Net symbols and to do that COM needs to be initialized. This normally isn't a problem, but if your program also performs COM initialization and the sequence of events results in your COM initialization coming after the Validator's COM initialisation rather than getting the expected `ERROR_SUCCESS` return code you'll get either `ERROR_INVALID_FUNCTION` or `RPC_E_CHANGED_MODE`.

If you get `ERROR_INVALID_FUNCTION` this is OK, this just means you've called CoInitialize() or CoInitializeEx() multiple times with the same flags. Your code needs to handle `ERROR_INVALID_FUNCTION` as **not an error**.

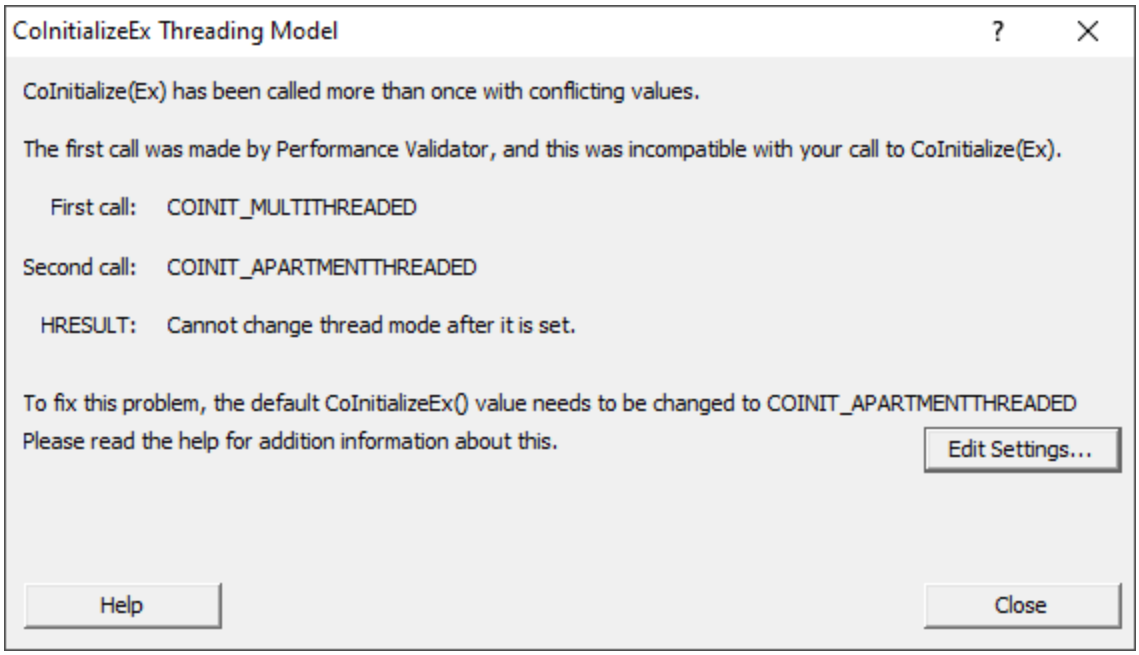
If you get `RPC_E_CHANGED_MODE` this means you need to change the Validator's default value to the same value your program is using. That's what this dialog allows you to do.

If you also wish to disable OLE DDE or favour speed rather than memory use we've provided appropriate options for you to select to add those flags to the threading mode.

See the Microsoft documentation for additional information on the behaviour of CoInitialize() and CoInitializeEx().

Runtime detection of CoInitializeEx conflict

When the above scenario happens, that the Validator has initialized COM before your code initializes COM and your call returns RPC_E_CHANGED_MODE, we display a dialog to warn you about this failure and provide you with the option of editing the default value for subsequent runs of your application.



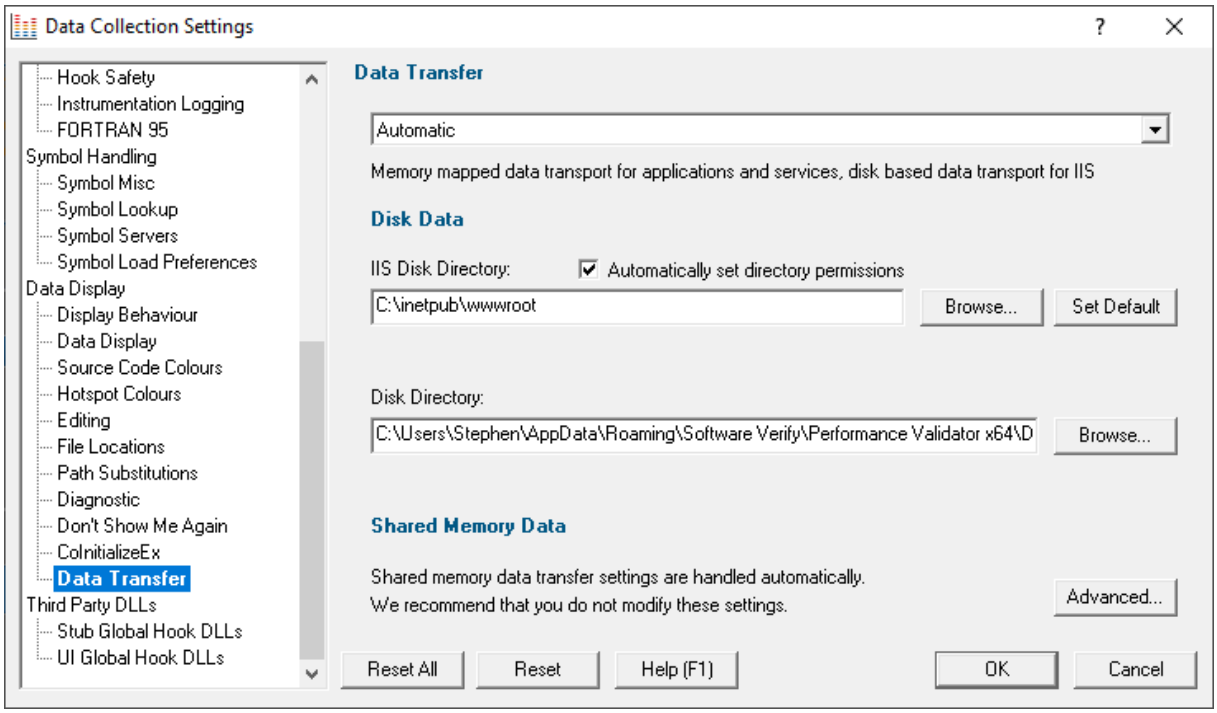
- **Edit Settings...** > opens the CoInitializeEx dialog shown above

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.5.11 Data Transfer

The **Data Transfer** tab allows you to specify the overall behaviour of data transfer between your application and Performance Validator.



Data Transport

Choose the type of data transport you wish to use.

- **Automatic**. Applications and services use shared memory to transfer data. IIS uses disk based data transfer.
- **Disk**. Applications, services and IIS use disk based data transfer.
- **High Volume**. Data transfer has no data throttling applied to it. This mode is for use with applications that generate very high volumes of data rapidly. They typically exceed the buffering capabilities of Performance Validator when working with shared memory. The High Volume setting uses a data transport that doesn't have a data-throttling requirement allowing the high volume application to continue without waiting.

Automatic

Under most circumstances data transfer between Performance Validator and the target program (desktop, service, etc) is via shared memory. This is handled automatically.

Disk Data

Some applications and services don't allow shared memory access. For these occasions we use a file based data transfer, where the files are stored in a directory of your choice.

We provide two options for this, one for most applications and services, and one for Internet Information Server, as this operates in a very restricted environment.

Both options are configured automatically, but you can override either by typing the path to a suitable directory or using the Microsoft directory browser.

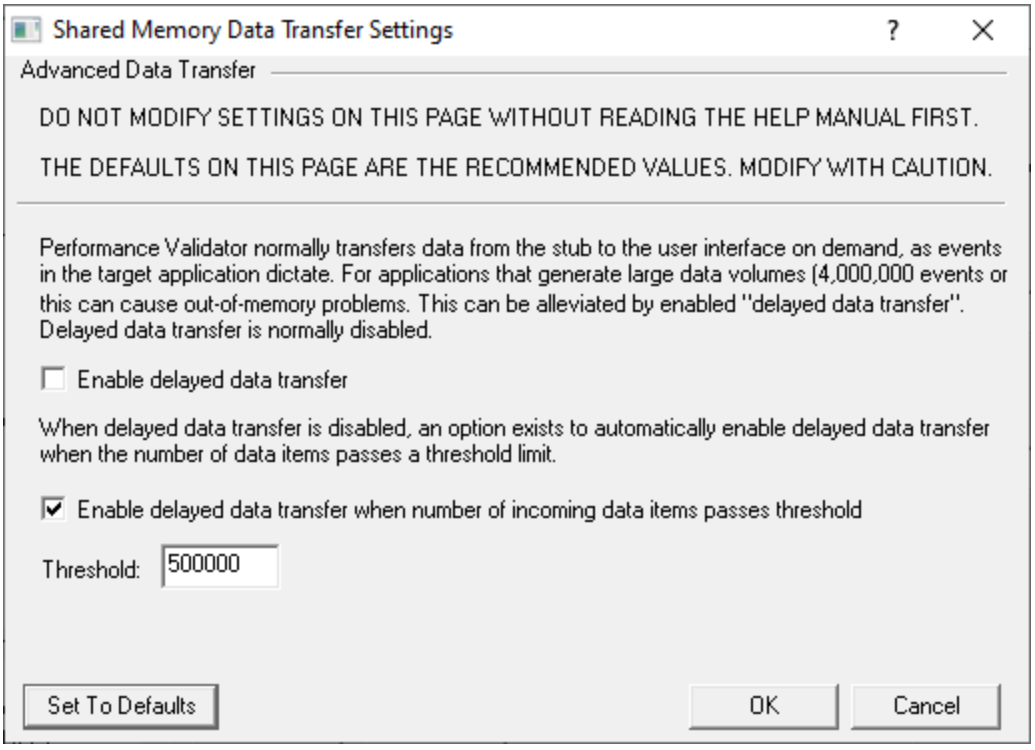
The ISS path you enter will be determined by the settings you have configured for IIS using the Internet Information Services Manager tool. We won't discuss that here because if you're using IIS we assume you already know how to configure IIS correctly.

Advanced

Shared memory data transfer can also be configured **but we strongly recommend that you leave these settings alone**.

The **Data Transfer Helper** is a separate application supplied in the installation directory.

- **Advanced...** › opens the data transfer settings dialog.



Here be dragons!

Caution: Modifying the settings on this page and using the data transfer helper application can prevent Performance Validator from working correctly.

- **Set To Defaults** › if you have modified the settings, this resets them

➡ See also the Reset to default buttons on the data transfer helper application below

If in doubt, don't modify these settings. If you promise to be careful, read on!

Delayed data transfer

Delayed data transfer is the process of throttling data rates in the stub so that the slower user interface can keep up with processing the data received.

In the stub, as an event occurs, data is queued and then sent to the user interface.

In the user interface, data from the stub is received and queued again for processing.

Any delay is usually in the slower user interface, but still not a problem for most applications.

However, some data intensive applications can generate so much data that the user interface gets swamped and can't process it all before running out of memory.

Temporarily limiting the data rate in the *stub* allows the user interface to stabilize the data processing.

Managing data rates

We recommend the default settings as shown above:

- disable delay data transfer for most applications
- enable *automatic* delay data transfer at a threshold of between 100,000 and 1,000,000 data items

If delayed data transfer is enabled all the time, the automatic options don't apply.

If you have more than 1GB RAM, you can raise these thresholds.

Data transfer helper application

A separate data transfer helper application is supplied in the installation directory.

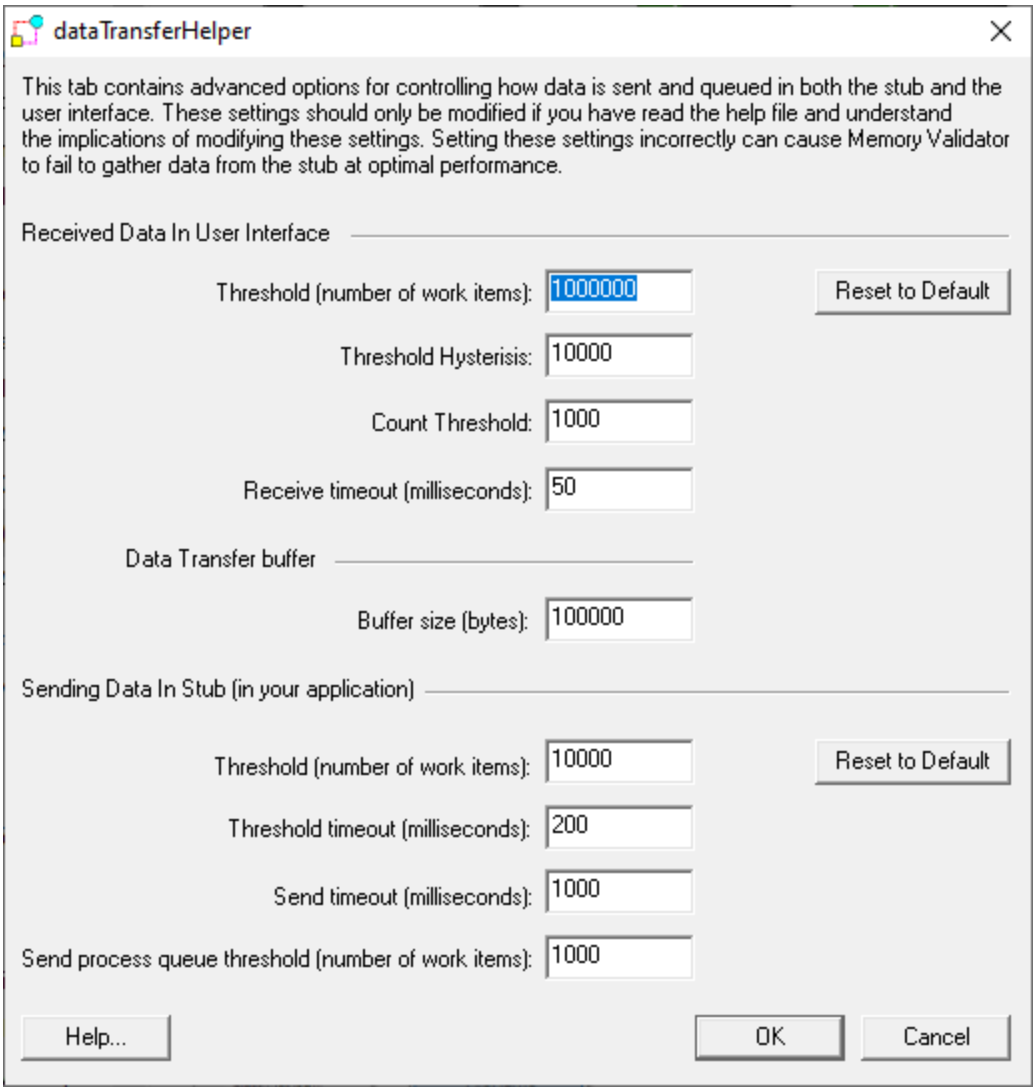
The helper application can be used to modify low level settings that apply when delay data transfer is activated as above.

 The helper should be used with care. We already warned of dragons above, but here we are, warning you again!

An HTML help page for this application is available by clicking the **Help** button on the helper application.

You can also find the help page directly as `dataTransferHelp.html`.

Please do take a moment to read the help before use.



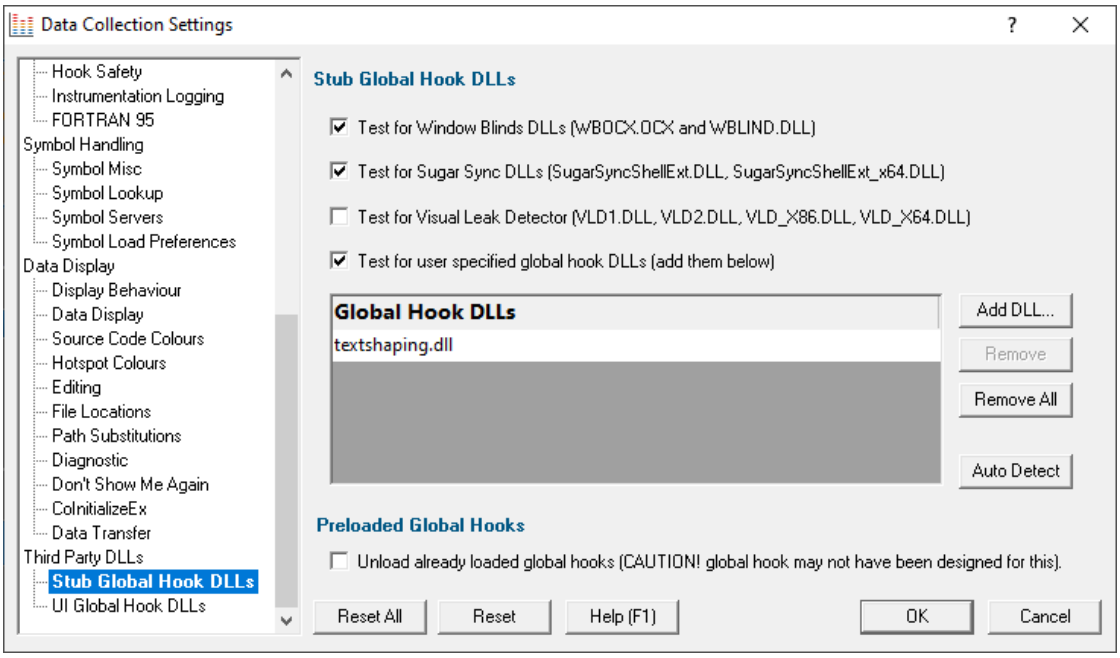
Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.6 Third Party DLLs

3.10.1.6.1 Stub Global Hook DLLs

The **Stub Global Hook DLLs** tab allows you to detect and specify global hook DLLs that may not be wanted in the stub process.



About global hook DLLS

Some third party products such as storage devices and video cards are supplied with software to help integrate the hardware device into the computer desktop environment.

An example is the Iomega® Zip® drive. This uses a global hook via the IMGHOOK.DLL which allows the *browse for files* and *browse for folders* interfaces to correctly display all the storage devices on the computer, including the zip drive and any special options for the drive.

Some global (or *system*) hook DLLs can interfere with the correct operation of Performance Validator when it inserts hooks into the target program, (although the IMGHOOK.DLL mentioned above doesn't).

The settings below allow you to specify and/or detect DLLs that should be treated as global hook DLLs.

Any DLL listed will fail to load into the target program when loaded via `LoadLibrary()` or `LoadLibraryEx()`.

For situations where the hook DLL is already present in the target program, it can optionally be forcibly unloaded. This may happen if it was loaded before Performance Validator attached to the process.

Managing global hook DLLs

- **Test for Window Blinds...** › test for Window Blinds DLLs loading into your application, and prevent them from loading

  Window Blinds DLLs WBOCX.OCX and WBLIND.DLL are not compatible with Performance Validator.

- **Test for Sugar Sync...** › test for Sugar Sync DLLs loading into your application, and prevent them from loading

  Sugar Sync DLLs SugarSyncShellExt.dll and SugarSyncShellExt_x64.dll are not compatible with Performance Validator.

- **Test for Visual Leak Detector...** › test for Visual Leak Detector DLLs loading into your application, and prevent them from loading

  Visual Leak Detector is not compatible with Performance Validator. If you are linked to Visual Leak Detector you'll need to create a build without Visual Leak Detector to use with Performance Validator.

- **Test for user specified...** › test for user specified DLLs loading into your application, and prevent them from loading

- **Add File...** › browse and select one or more DLLs › **Open** › adds the chosen DLLs to the **Global Hook DLLs** list

- **Remove** › removes any selected DLL from the list

- **Remove All** › removes all DLLs from the list

Auto detecting global hook DLLs

Performance Validator can detect any DLLs in its own process that are not ones it uses itself. Such DLLs are likely to be global hook DLLs:

- **Auto Detect** › automatically detect DLLs which may be global hook DLLs, *adding* them to the **Global Hook DLLs** list

Additionally, you can request unloading of any of the listed global hook DLLs that are detected as already loaded into the target process when Performance Validator attaches to it:

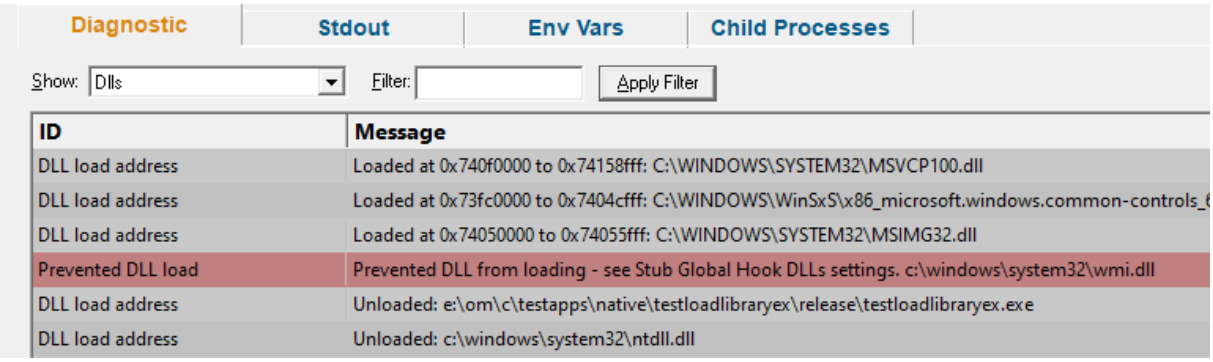
- **Unload already loaded global hooks** › when ticked, forces an unload of any listed global hook DLLs

   Use this with caution, as not all global hook DLLs may have been designed or intended for this!

Viewing the diagnostic information

If a DLL is prevented from loading because of these settings, or is allowed to load because of these settings, there will be an entry on the Diagnostic tab.

To view this data, go to the Diagnostic tab, select the Diagnostic sub tab, then set the Show combo box to "Dlls". All information about DLLs will be shown. Scroll through the list looking for "Prevented DLL load" in the left hand column. The right hand column will indicate if a DLL was prevented from loading, or allowed to load. The DLL name will also be shown.

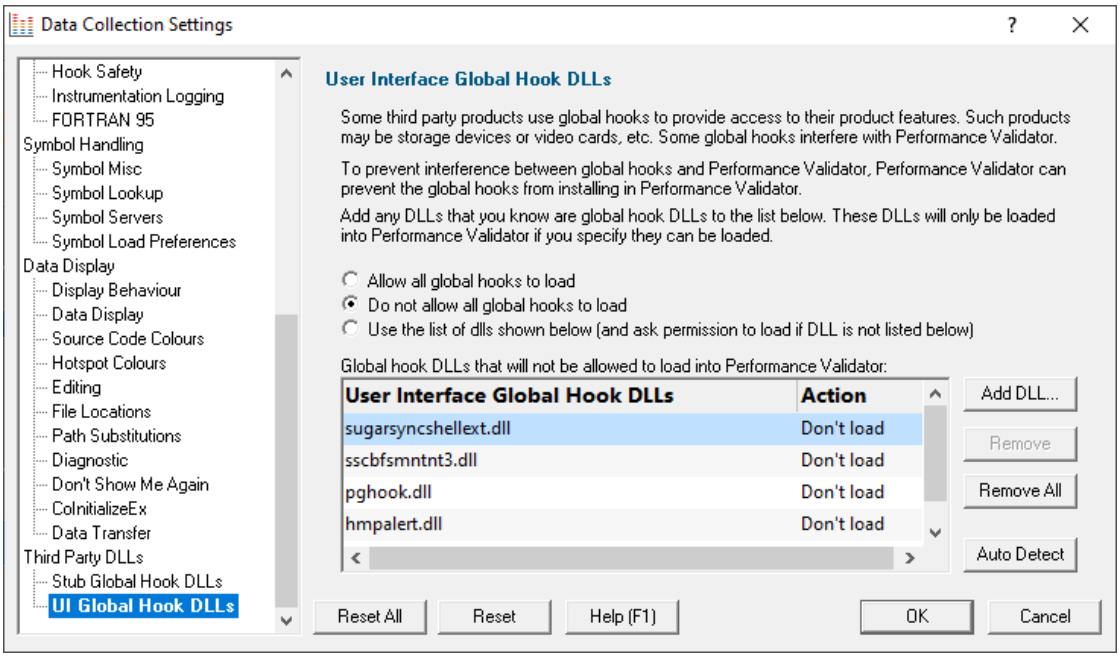


Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.1.6.2 User Interface Global Hook DLLs

The **User Interface Global Hook DLLs** tab allows you to detect and specify global hook DLLs that may not be wanted in the Performance Validator user interface process



About global hook DLLS

See the similar topic on stub global hooks to read about global hook DLLs

The user interface hook DLL loading rule

The default behaviour is not to allow the global hooks to load, but you can change this if necessary

- **Allow all global hooks to load** › allows all global hook DLLs to load into Performance Validator
- **Do not allow any global hooks to load** › prevent any global hook DLLs from loading (the default)
- **Use the list of dlls shown** › provide per-DLL control over which DLLs load or don't load via the **User Interface Global Hook DLLs** list

  Any global hook DLLs not listed will result in the user being asked for permission to load a DLL via the Global Hook Warning Dialog below

Managing user interface global hook DLLs

- **Add DLL...** › browse and select one or more DLLs › **Open** › adds the chosen DLLs to the **Global Hook DLLs** list

  Having added a DLL to the list, you can change whether the DLL is allowed to load or not, by double clicking in the second column and changing the value: **Load** or **Don't load**
- **Remove** › removes any selected DLL from the list
- **Remove All** › removes all DLLs from the list

Auto detecting global hook DLLs

Performance Validator can detect any DLLs in its own process that are not ones it uses itself. Such DLLs are likely to be global hook DLLs:

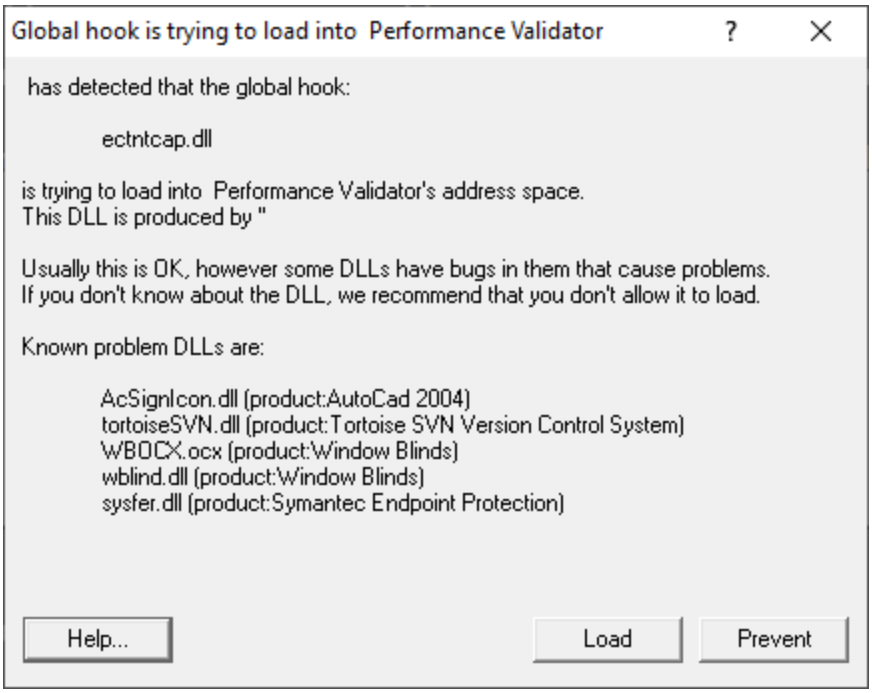
- **Auto Detect** › automatically detect DLLs which may be global hook DLLs, *adding* them to the **Global Hook DLLs** list

Global Hook Warning Dialog

When the global hook loading rule above is set to **Use the list of dlls shown**, the **Allow load** column controls whether the hook DLL is loaded.

When a global hook is loaded that is *not* on the list of known global hooks, the user is presented with a warning dialog like that shown below.

The user can then accept or block the global hook from loading. The dialog lists a couple of known problematic DLLs.



- **Help** › displays this help page
- **Yes** › lets the DLL load
- **No** › blocks the DLL

Your response is automatically recorded in the **Global Hook DLLs** list, so that you won't be asked again.

Reset All - Resets **all** global settings, not just those on the current page.

Reset - Resets the settings on the current page.

3.10.2 Loading and Saving Settings

Saving and loading settings files

Performance Validator settings can be saved to a file and restored at any time.

Settings menu › Save Settings... › save settings to a file

Settings menu › Load Settings... › load a previously saved settings file

Loading settings via command line option

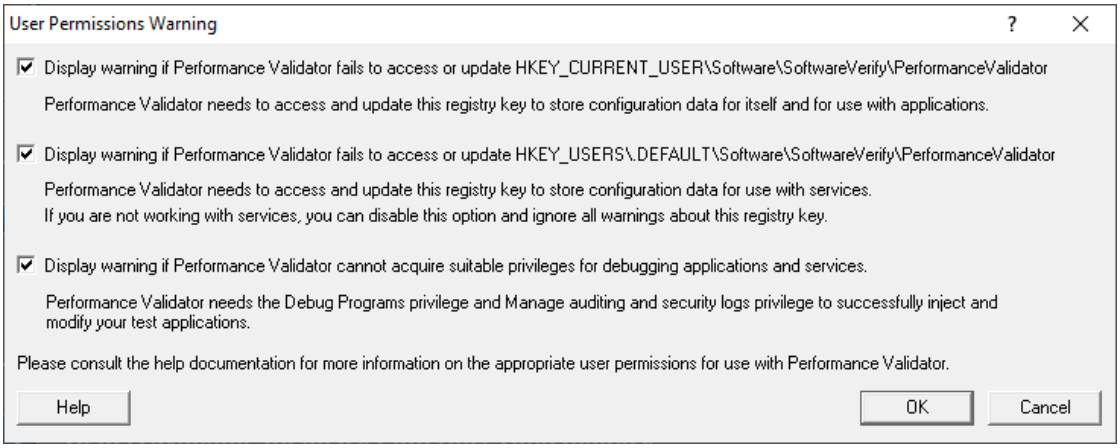
Different settings files can be used in the command line interface by using the -settings command line option and the required file path to load the settings when Performance Validator starts up.

3.10.3 User Permissions Warnings

You may see warning dialogs when Performance Validator receives an error accessing the registry or obtaining debugging privileges.

These warnings are enabled by default, but you can opt not to see them:

Settings menu › **User Permissions Warnings...** › shows the User Permissions Warnings dialog below



The Help button displays the User Permissions help topic.

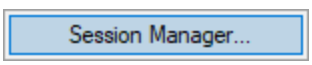
➜ See also, the question about creating Power User accounts on Windows XP.

3.11 Managers

Managers

The **Managers** menu provides just one lonely (but powerful) tool to manage sessions including comparing current and previous data.

Click on the menu item in the picture to find out more:



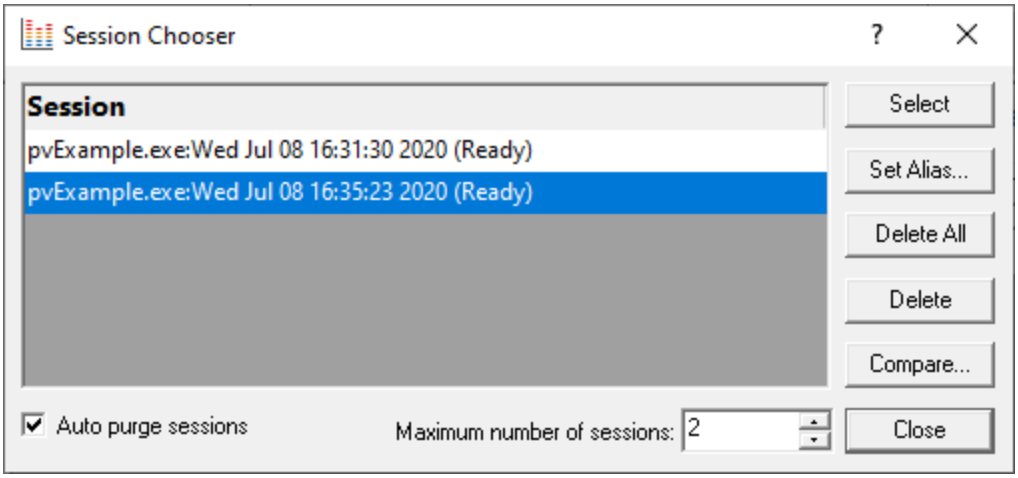
3.11.1 Session Manager

Managing multiple sessions

Performance Validator can manage multiple sessions at once.

As well as the actively running session, open sessions may include those run since Performance Validator started, or reloaded sessions that had been saved earlier.

Managers menu › **Session Manager...** › shows the **Session Chooser** dialog below, highlighting the current session



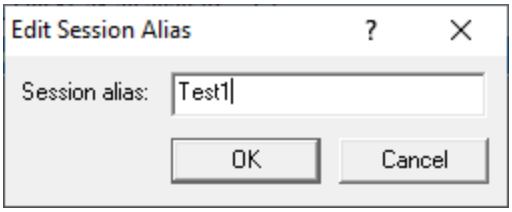
Each time a session is started or loaded it is added to this list, using the name of the executable program and the date and time the session started.

Managing the sessions

- **Select** › makes the selected entry the *current* session, i.e. the one for which data will be displayed

  Some tab views may update immediately, others may need a manual refresh

- **Set Alias...** › opens the **Edit Session Alias** dialog so you can give the session a more useful name



- **Delete** › removes the selected session

You can't delete a session that is actively collecting data.

- **Delete All** › removes all the loaded sessions

  If one of the session is actively collecting data, this will be disabled.

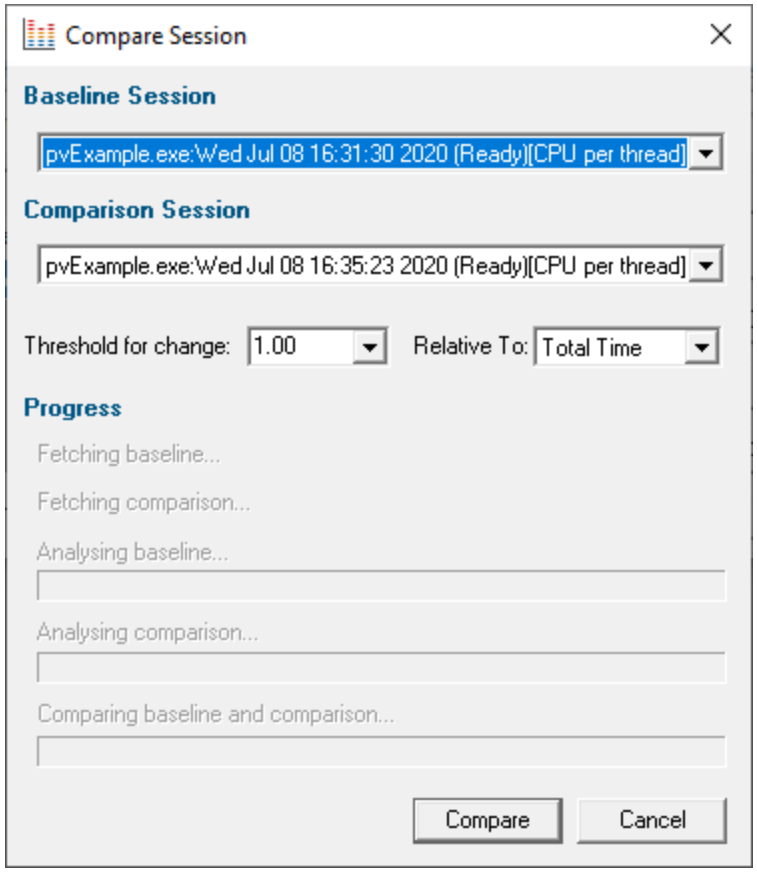
- **Close** › closes the dialog (as opposed to closing any selected sessions!)

Comparing loaded sessions

When two different sessions are loaded they can be compared as part of a manual regression test.

The comparison results are shown as a call tree, detailing the difference in timings at each node.

- **Compare...** › shows the Compare Session dialog for comparing hotspots.



Limiting the number of sessions

You can choose to limit the maximum number of sessions open at once.

Once this limit is reached, then each time a new session is added, the oldest session may automatically be removed:

- **Auto purge sessions** › ensures that the number of loaded sessions is limited to the maximum (below)
- **Maximum number of sessions** › sets the maximum number of sessions allowed if auto-purge is on

3.11.2 Comparing Sessions

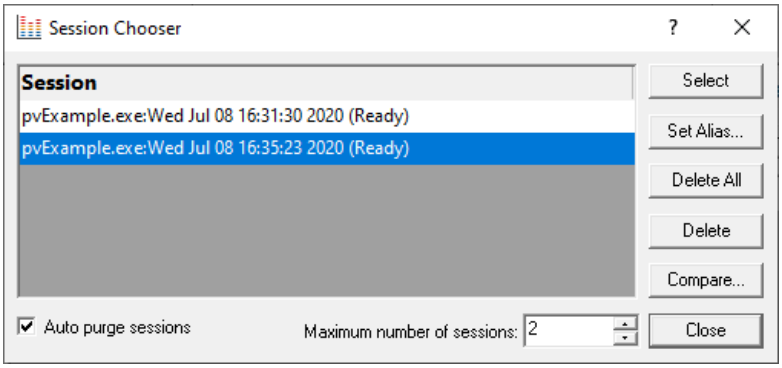
Comparing loaded sessions

When two different sessions are loaded they can be compared as part of a manual regression test.

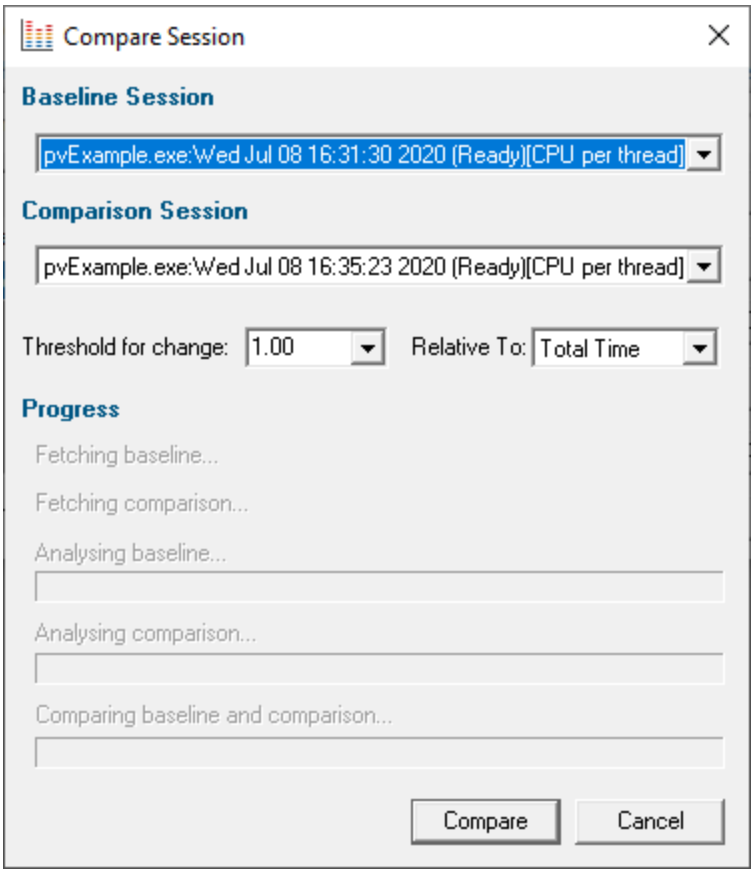
The comparison results are shown as a call tree, detailing the difference in timings at each node.

Session comparison is accessed from the Session Chooser dialog:

Managers menu › **Session Manager...** › shows the **Session Chooser** dialog below, highlighting the current session



- **Compare...** › shows the **Compare Session** dialog for comparing performance times.



Select the two sessions to compare:

- **Baseline session** › the session you want to compare *against*
- **Comparison session** › to compare against the baseline

Both sessions *must* have used the same performance timing method (shown in square brackets). The **Compare** button is only enabled when two different sessions of the same timing method are selected.

Set the criteria for making comparisons:

- **Threshold for change** › type or choose a percentage difference below which differences will be ignored

  Some variation in timings for different runs of the same code is normal. This threshold helps filter out such 'jitter' in timings.

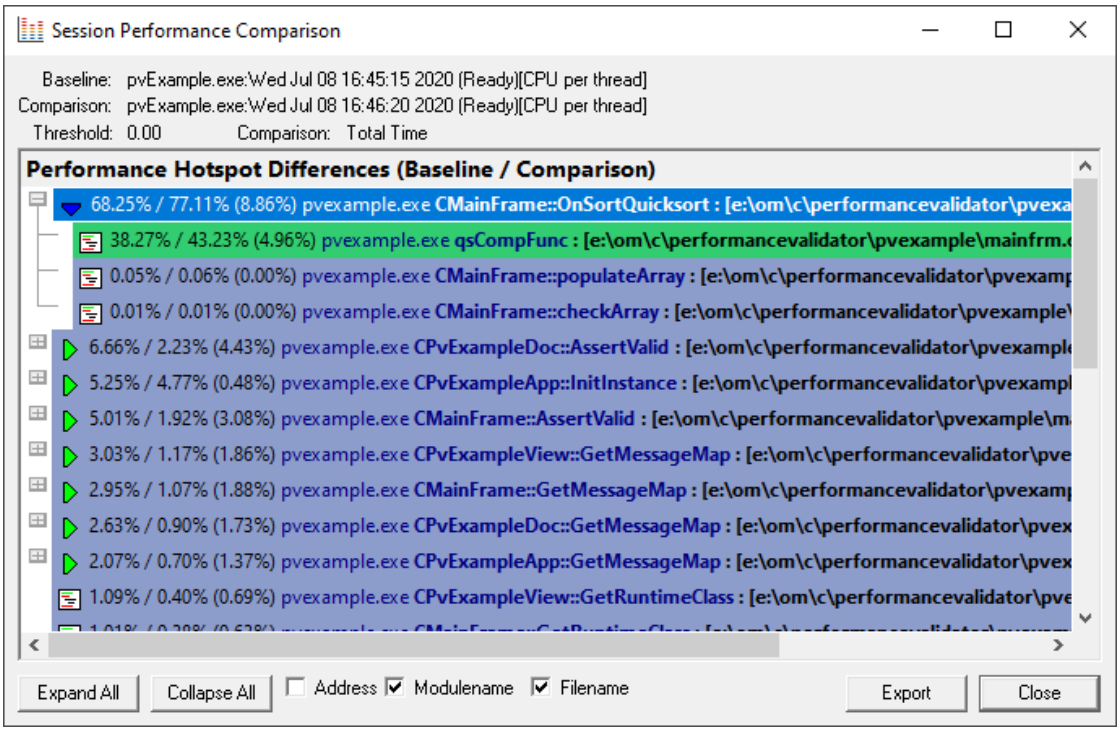
- **Relative to** › choose whether comparisons are made using timings relative to total run time or 'parent time'.

Depending upon the threshold chosen and whether you opt for total or parent timing, the comparison results can differ quite widely for the same datasets.

Try experimenting with the values to determine those most appropriate for producing meaningful comparisons for your application.

- **Compare** › starts the comparison process and then shows the **Session Performance Comparison** dialog

The Session Performance Comparison dialog

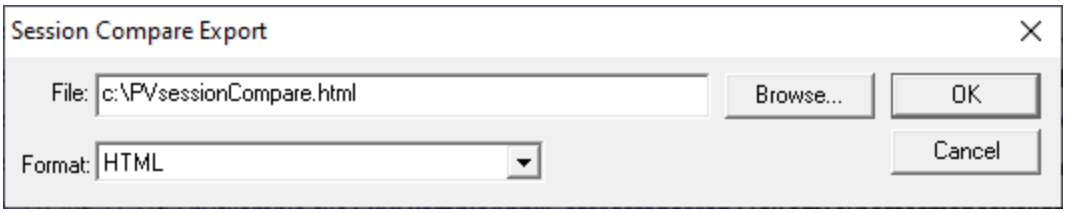


At the top of the dialog you'll see your chosen threshold and comparison method below the baseline and comparison sessions details.

The call tree displays the results of the comparison.

- **Expand / Collapse All** › show or hide every node in the tree
- **Address / Filename / Modulename** › optionally include the function details on each line of the tree
- **Export** › show the Session Compare Export dialog

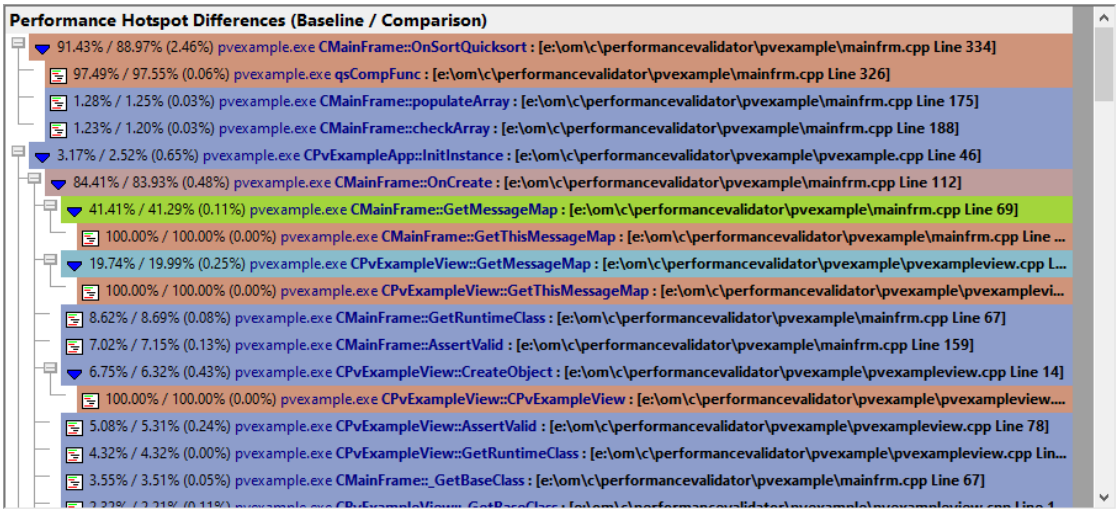
  Choose a filename and export the comparison results as HTML or XML:



A context menu is available on the tree control to allow you to expand and collapse entries and edit source code.

- **Edit Source Code...** > open the source code using the built in editor or your favourite editor if set
- **Collapse / Expand Entry** > hide or show all the tree nodes below the selected item
- **Collapse / Expand All** > hide or show every node in the tree

The session comparison call tree



Each item in the call tree shows

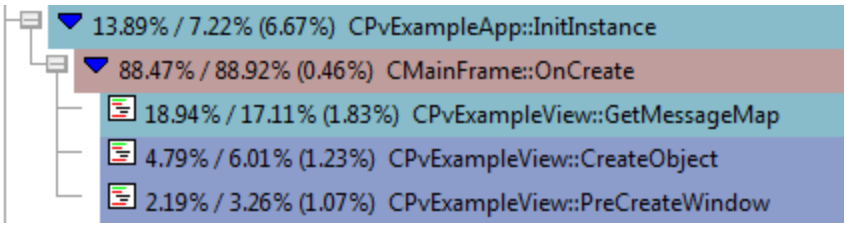
- baseline / comparison statistics
- difference between baseline and comparison statistics (in brackets)
- function address, optional
- class::function name
- filename, optional [in square brackets]

Functions appearing below the threshold?

Functions are only hidden if their own timing *and that of each of their child functions* fall below the threshold.

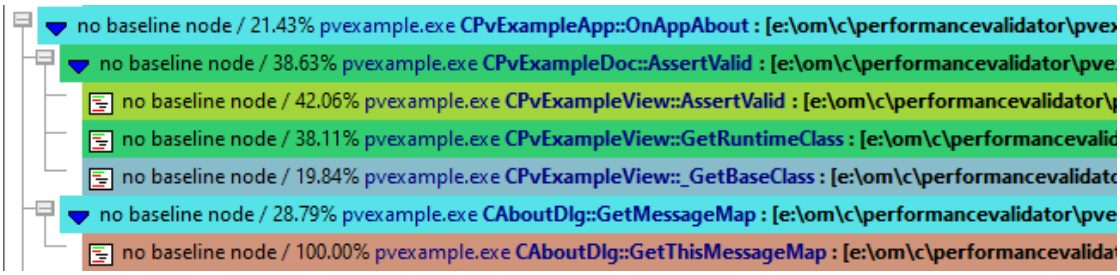
In the example below, the threshold was set at 1%.

The `OnCreate` function, which had a difference of 0.46% is still shown since three of its child functions differed by more



Functions only called in one of the session

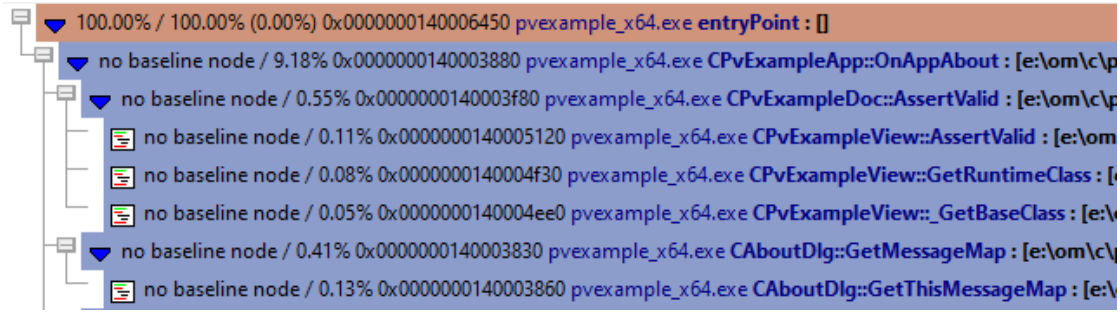
Where no function timings exist in one of the sessions, you'll see `no baseline node` or `no comparison node` instead of the function statistics.



By setting the threshold to 100%, you may be able to get a rough guide as to what parts of your program were called in one session but not in the other.

The example below shows the example application compared with 100% threshold.

You can see the About dialog was shown in the comparison session, while the user chose how many items to sort in the baseline session.



Comparing timing statistics

Use caution when making timing comparisons.

There are many reasons why one run may differ to another - here's just a few:

- Virtual memory paging

A previous run may have resulted in various data caches being populated (at Operating System or database level), resulting in faster runs thereafter.

- Thread scheduling

  The Operating System may schedule the threads differently, e.g. because of current loading, hardware device interrupts, etc.

- User interaction timing

  Parts of your program relying on user interactions can have relatively large timing discrepancies between runs.

- Network access timing

  Program areas reliant on network access (local network or Internet) will have timing discrepancies due to network latency and loading, TCP/IP data loss retransmission and related issues.

Experiment with the **Threshold for change** setting above to filter out noise in your results due to these effects.

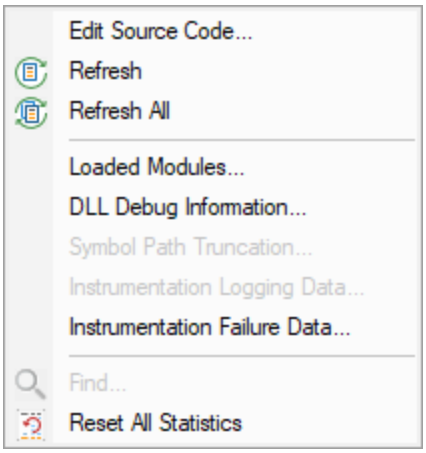
3.12 Tools

Tools

The Tools menu provides access to a few different tools including a couple not found on the Tools toolbar:

- A list of the modules loaded by your target application
- A list of the debug information status of modules loaded by your application
- A log of files, classes, functions, methods, or modules not instrumented, and reasons why not


Click on a menu item in the picture of the Tools Menu below to find out more:



3.12.1 Editing Source Code

Source code editing

The editing settings let you set an editor of your choice to view or edit source code. Performance Validator's built-in editor is one of those options.

The built-in editor can be started from the data views or from the tools menu:

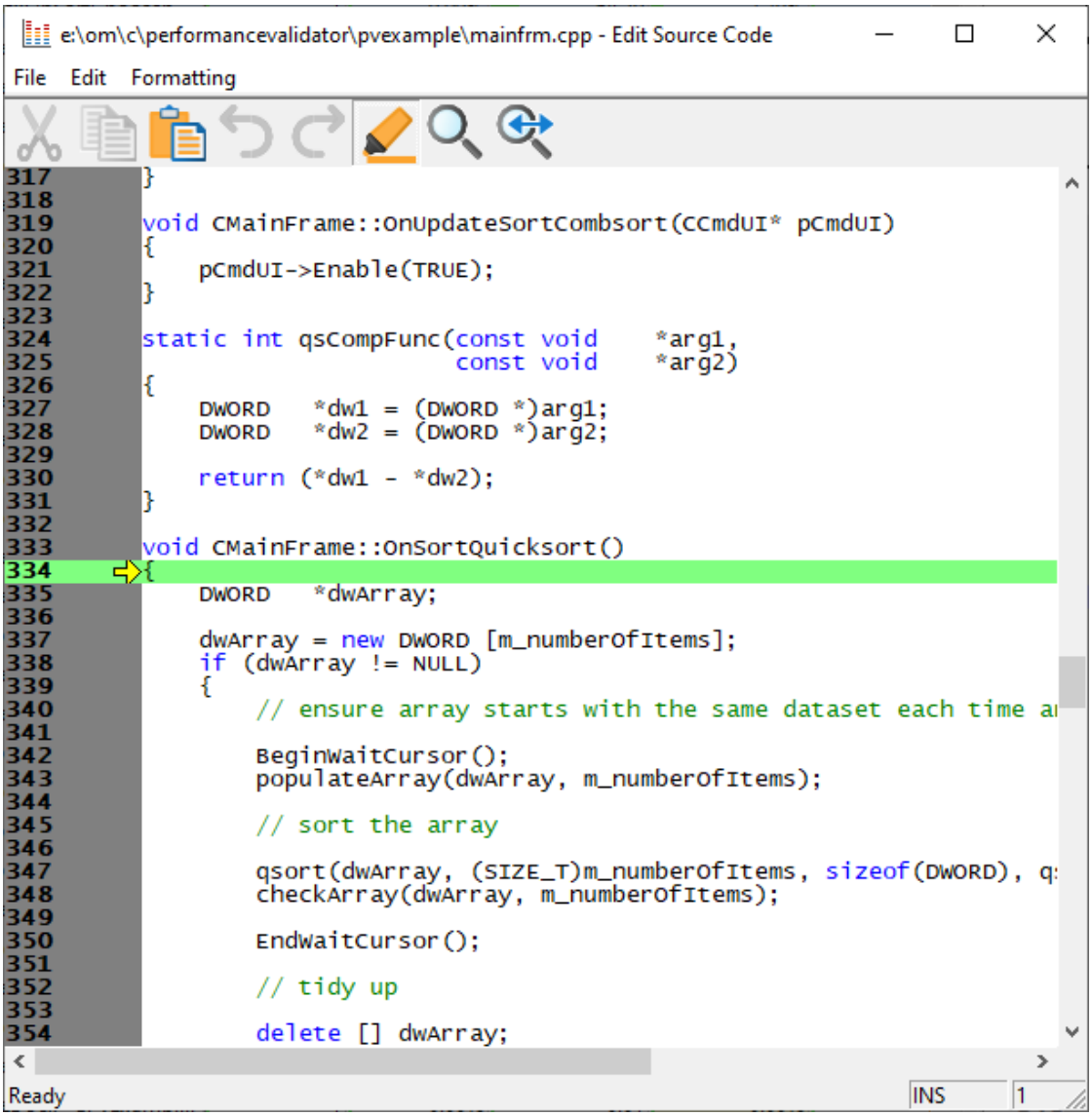
- **popup** menu › **Edit Source Code...**
- **Tools** menu › **Edit Source Code...**

Using the built-in editor

The built-in editor supports the basic operations expected for editing source code:

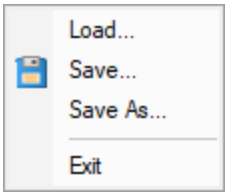
The highlighting is identical to that in the source code views of the main tabs:

- The lines in green (for this colour scheme) have been visited
- Lines that have not been *visited* are displayed in pink
- Lines with a green tick next to them indicate that they have been successfully hooked
- Lines that could not be *hooked* have a red cross against them
- An arrow indicates the source code line of interest when the source code editor was displayed



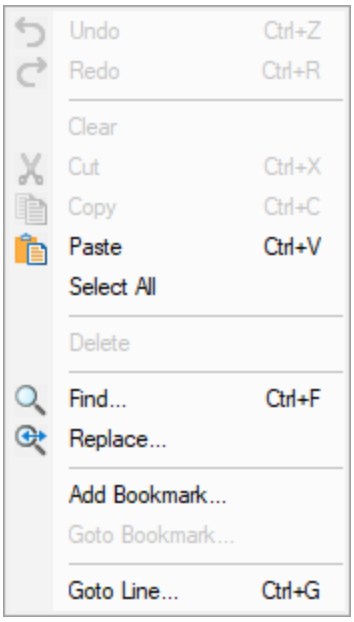
File menu

The file options need no explanation:



Edit menu

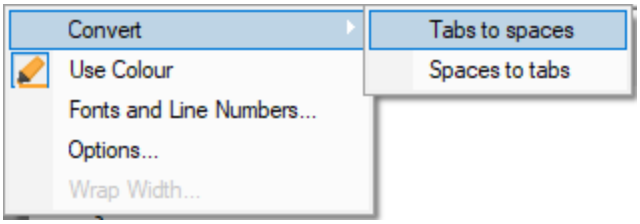
All the following edit options should also be familiar:



Undo/Redo is unlimited by default, but this can be changed in the options below.

Formatting menu

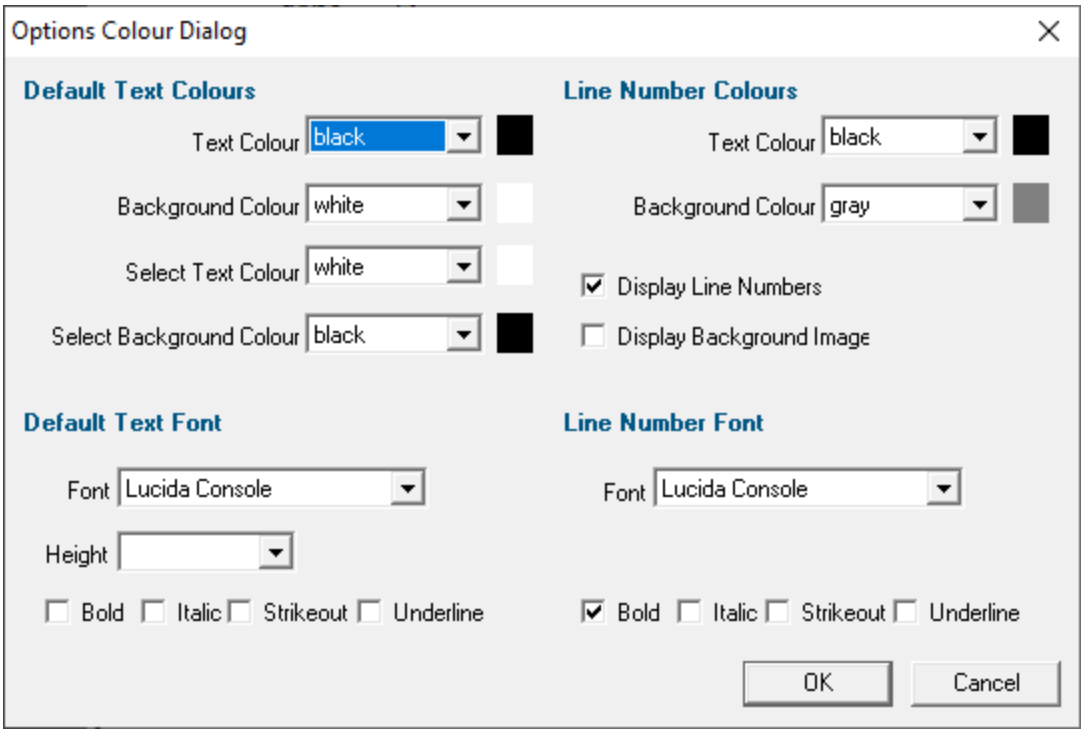
The formatting menu has general display and editing options



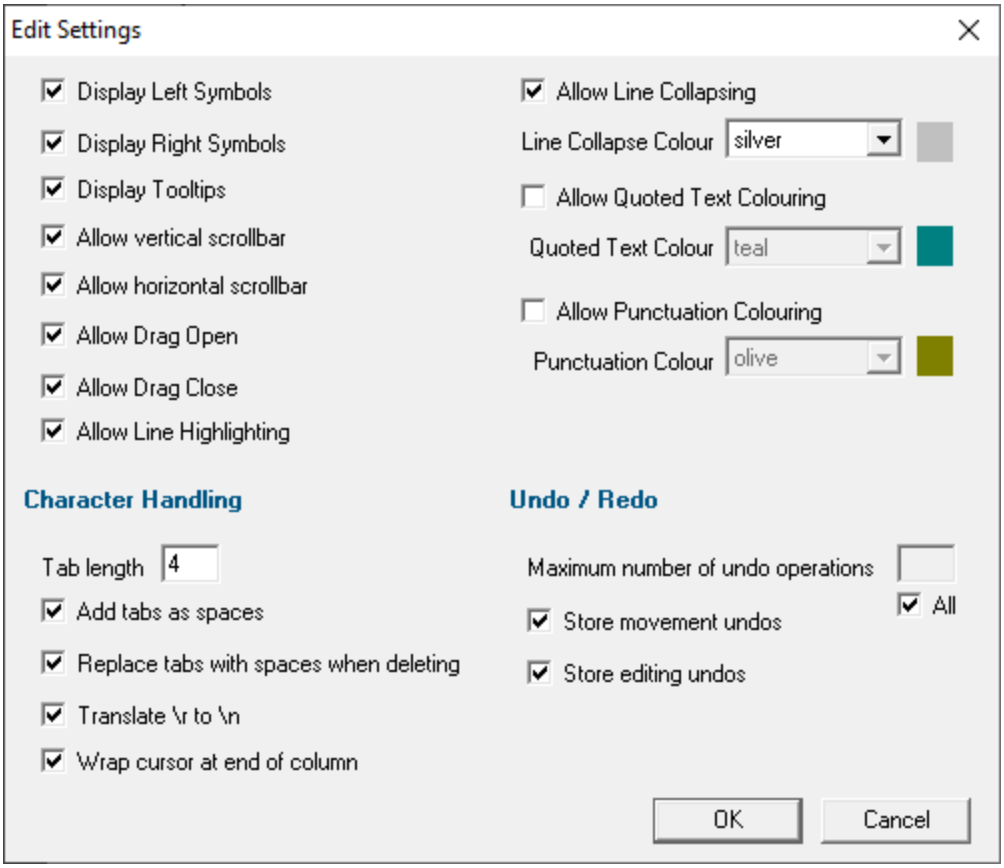
- **Convert** › **Tabs to spaces** › turns all tabs into spaces
- **Convert** › **Spaces to tabs** › turns all spaces into spaces

- **Use Colour** › toggles the colour coded display

- **Fonts and Line Numbers...** › change text colours, fonts and line numbers



- **Options...** › set tab length and other options



- **Wrap Width...** › changes the column width at which lines will wrap in the display

Status bar

The status bar shows help text at the bottom as you hover over menu and toolbar options.

To the right of the status bar are insert mode, column number and line number.

Line collapsing

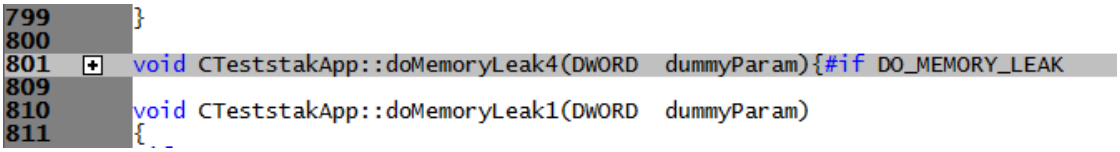
You can temporarily collapse sections of code as follows:

- **Left click** in the margin to start the section › **Drag** to define the length › **Release** to set the end of the section

  Click anywhere on the resulting indicator to collapse, and on the + to expand a section.

Expanded:

Collapsed:



Line collapsing is *temporary* and not remembered between edit sessions.

3.12.2 Refresh and Refresh All

Refreshing data

You have the option in some views to automatically update the view at an interval of your choice.

Sometimes you need to refresh the data when *you* want to, especially while inspecting the data.

Most views have a local refresh button, which updates the data.

The same function is found in the Tools menu, as well as an option to update all views at once:

Tools menu > **Refresh** > refresh the data displayed only on the current tabbed view

Tools menu > **Refresh All** > refresh the data on *all* the tabbed views

Or use the **Refresh** and **Refresh All** icons on the Tools toolbar.

3.12.3 Loaded Modules

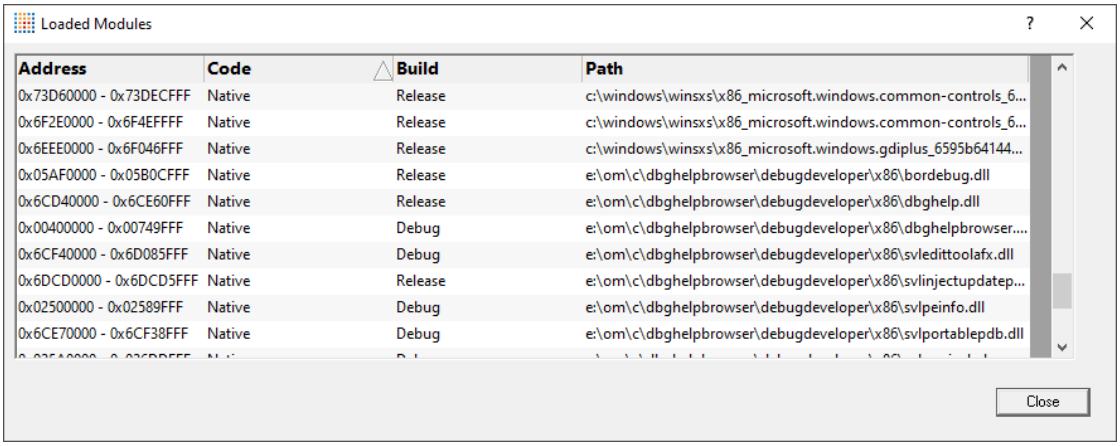
Viewing the loaded modules

You can view a list of the modules which are loaded by your target application.

Tools menu > **Loaded Modules...** > shows the **Loaded Modules** dialog

The dialog shows:

- the **Address** space occupied by the module (DLL or EXE)
- the type of **Code** in the module (native, managed, mixed mode or resources only
- the type of **Build** - is the code debug or release?
- the **Path** the module was loaded from



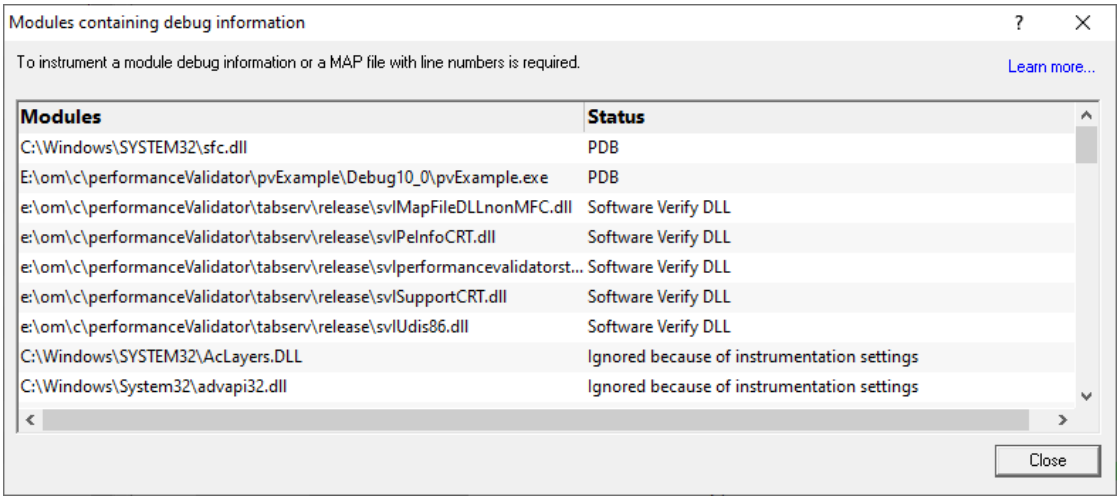
3.12.4 DLL Debug Information

Viewing the DLL debug information

If you are having problems collecting performance data for a particular EXE/DLL the problem may be that the debug information that is required to perform the instrumentation of the software cannot be found.

You can view a list of the debug information status of modules loaded by your target application.

Tools menu > **DLL Debug Information...** > shows the DLL Debug Information dialog below



The dialog shows:

- the path from which **Modules** (DLL or EXE) were loaded
- the debug **Status** (below)
- if any symbol server is not reachable (offline or doesn't exist) a message will be shown in red at the bottom of the dialog. You can edit the symbol server definitions here.

Debug status

There are various reasons why a module may not have its debug information read.

The dialog shows a comment or reason in the status column. Examples might be:

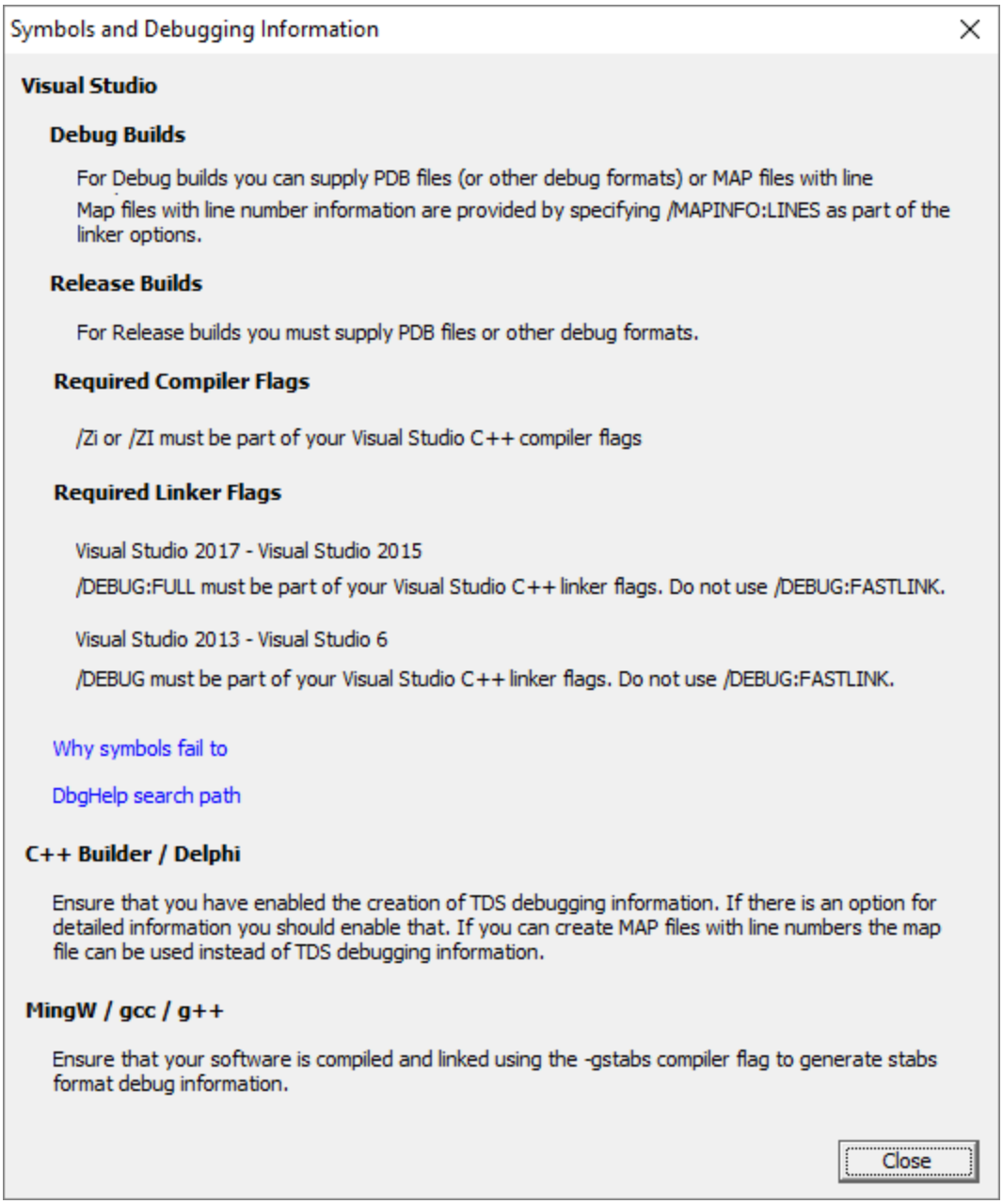
- PDB or MAP if the debug information *was* found and used
- Debug information not present

- A reason for being ignored
- Module is a part of the C Run-time Library (CRT) or Standard Template Library (STL)
- Location is a system directory
- Ignored due to Hooked DLLs advanced settings
- File is a Software Verify own module
- Module has been specified as a 3rd party
- No executable code is contained
- The module only has GUI resources

More information about PDB and MAP files

Clicking on the **Learn more...** link at the top right of the dialog shows some more details with additional links to topics in this help.

 Click the links below to see read more in our frequently asked questions.

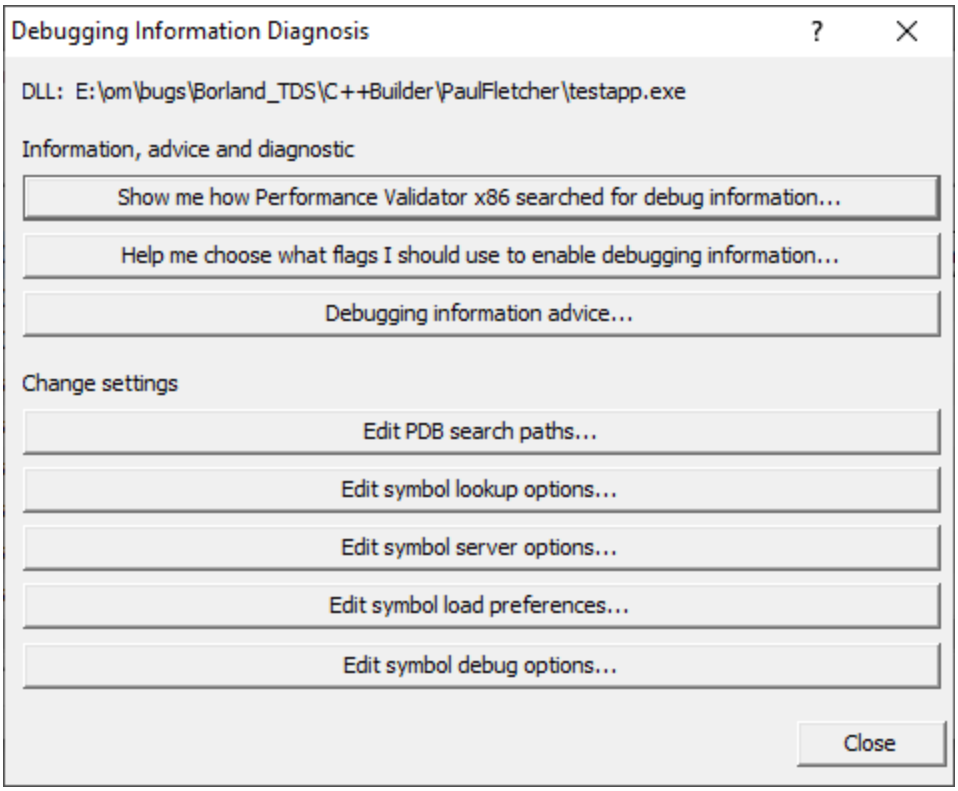


Finding out more using the Debugging Information Diagnosis Dialog

When debug information is not present for a given module the DLL Debug Information dialog (above) may display a button in the Status column to show the Debugging Information Diagnosis dialog.

The dialog shows:

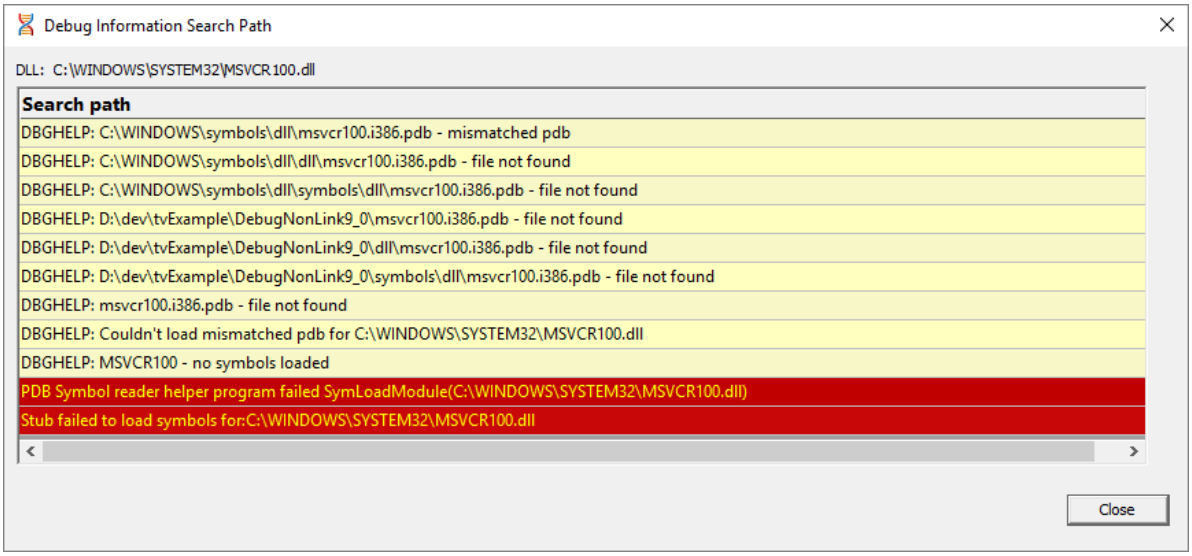
- Information, advice, and diagnostic help
- Quick links to change settings



The information options include:

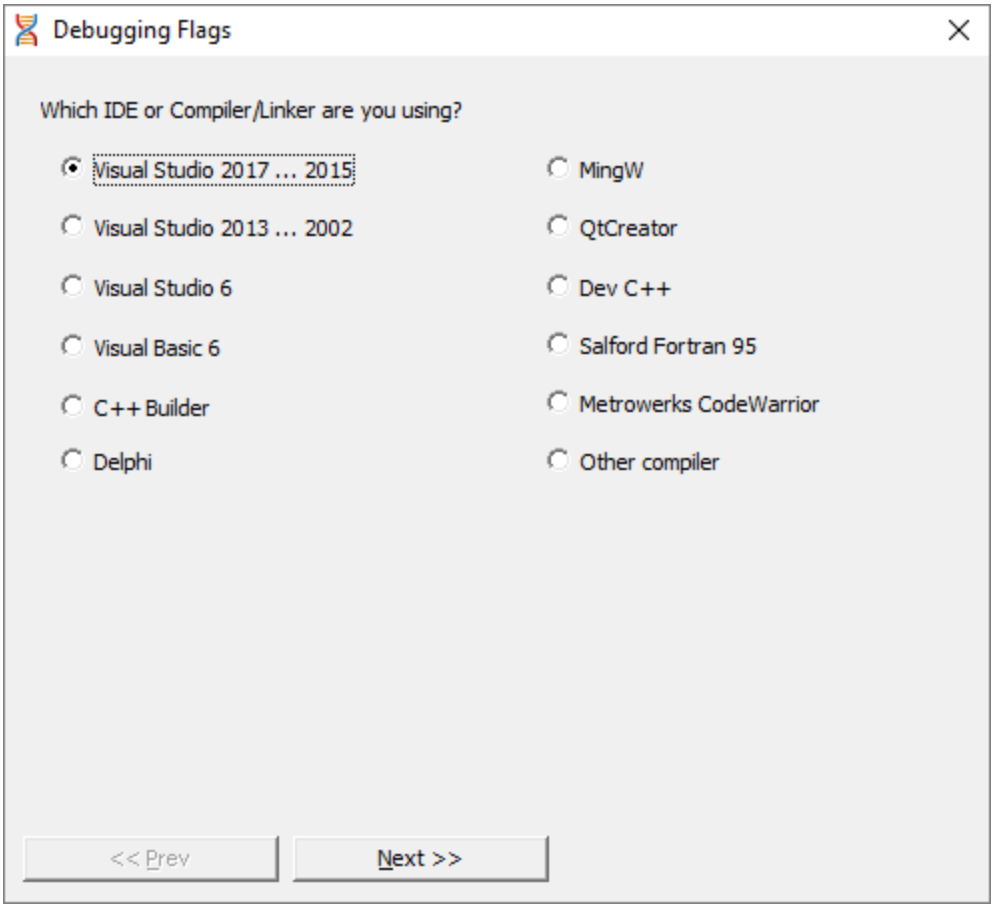
- **Show me how debug information was searched for...** › shows the Debug Information Search Path dialog

This information is extracted from the Diagnostic tab and shows only the relevant information for the module selected in the DLL Debug Information dialog.

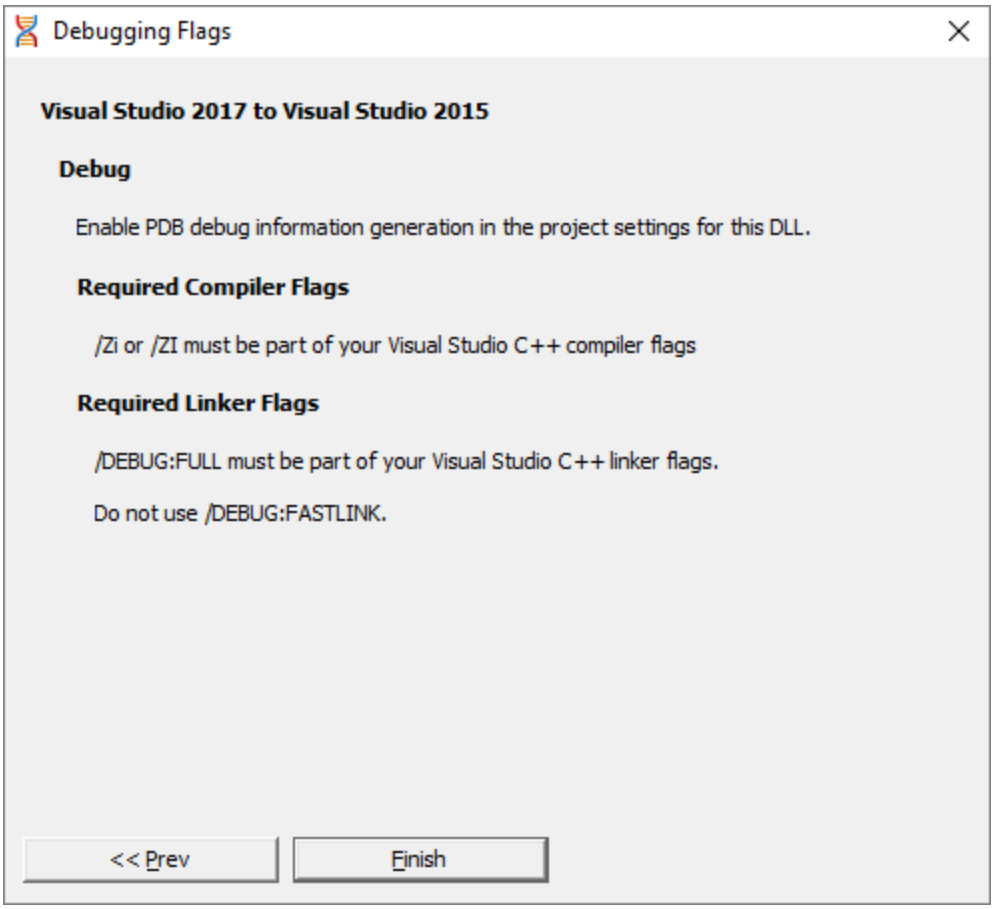


- **Help me choose what flags...** › shows the Debugging Flags wizard

  Use the wizard to first select the compiler or linker you're using



Next >> › Provides the relevant debug compiler and linker flags. An example for Visual Studio 2017 to 2015 is below:



- **Debugging information advice...** › shows the Symbols and Debugging Information dialog above.

The options for changing settings include quick links to the following pages from the Global Settings Dialog

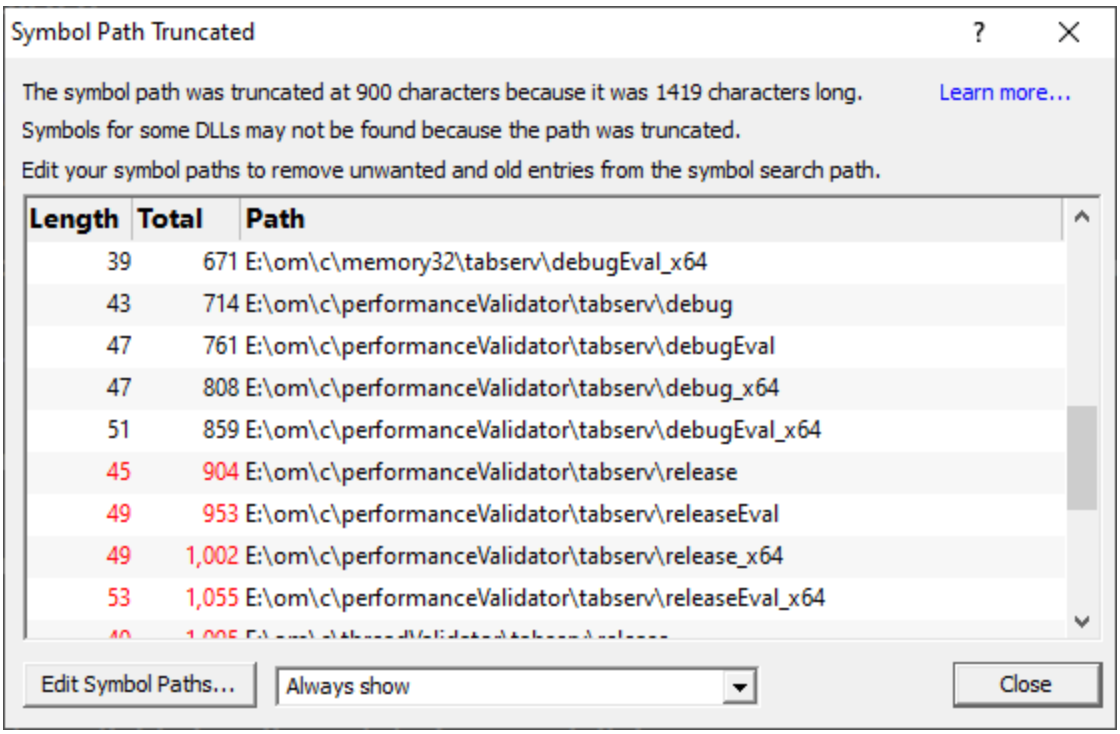
- **Edit PDB search paths...** › shows the File Location settings page for PDB files.
- **Edit symbol lookup options...** › shows the Symbol Lookup settings page
- **Edit symbol server options...** › shows the Symbol Servers settings page
- **Edit symbol load preferences...** › shows the Symbol Load Preferences settings page
- **Edit symbol debug options...** › shows the Symbol Misc settings page

3.12.5 Symbol Path Truncation

Tools menu › **Symbol Path Truncation...** › shows the Symbol Path Truncation dialog

The Symbol Path Truncated warning dialog

The symbol path truncated warning dialog is displayed to warn you when the symbol path is too long.



- **Edit Symbol Paths...** › shows the file locations dialog so that you can edit the paths used for subsequent runs of the program.

You can choose when this dialog is displayed.

- **Always show** › The dialog is always shown when the symbol path is too long.
- **Show when path changes** › The dialog is shown when the symbol path is too long, but only if the symbol path is different than last time this warning was shown.
- **Never show** › The dialog is never shown.

Whether this dialog is displayed or not there is always a warning message written to the diagnostic window when the symbol path is truncated.

The display lists each path with it's length (including the unshown ';' path separator) and the total length so far so that you can see which paths exceed the truncation point (length and total displayed in red).

Any paths that don't exist on this computer are displayed in red.

Why is this dialog displayed?

You may see a Symbol Path Truncated warning dialog in some rare circumstances.

This dialog is displayed when the symbol path that has been calculated to pass to DbgHelp.dll to load Microsoft debugging symbols (found in .PDB files) is too long.

If the symbol path has been truncated because it is too long it is possible this may mean that some symbol searches will fail, resulting in failure to load some symbols. We display this dialog so that you are aware that the symbol path is too long and would benefit from editing to make the symbol path shorter.

Passing a symbol path that is too long to DbgHelp.dll will cause the program being tested to end with an EXCEPTION_INVALID_CRUNTIME_PARAMETER C runtime error. This happens because internally DbgHelp.dll is using a fixed length array to format a string. To prevent this fatal termination of the test program we limit the length of the path passed to DbgHelp.dll.

Typically if a path that is long enough to cause this problem is passed to DbgHelp it's because the number of paths in the calculated path contain paths not relevant to finding symbols for the test program. We use the Symbol Path Truncated warning dialog to show you the calculated paths so that you can work out which paths to delete.

The calculated symbol paths come from several places:

- File locations PDB paths
- Symbol server symbol storage directories
- Symbol handling environment variables

Fixing the symbol path

For this example, we are testing the program **E:\om\c\3RD_SRC\cdplayer\Release\cdplayer.exe**

In the image shown above you can see that seven paths exceed the truncation limit, one of the 7 paths doesn't exist.

To work out what to do we need to do several actions:

1. Looking at the environment variable settings shows that none of the environment variables are being used. We do not need to consider the content of these environment variables.

2. Examining the symbol servers shows that **C:\Users\Admin** is a local symbol storage location. We should keep this path.

3. We should delete the path that doesn't exist: **E:\om\c\testApps\testStdinStdoutRedirectEx\Release**. We do this using the file locations dialog by clicking **Edit Symbol Paths...** then click **Delete invalid**.

4. Examining the paths in the file locations dialog we can identify any paths not relevant to the program we are testing. In this case the following paths are not relevant and can be deleted.

   E:\om\c\testApps\testStdinStdoutRedirect\Release
   E:\om\c\testApps\testAppTheReadsFromStdinAndWritesToStdout\Release
   E:\om\c\testApps\testSimpleMemoryLeak\Release
   e:\om\c\3rd_src\cppunit-1.12.1\examples\cppunittest\release

e:\om\c\3rd_src\cppunit-1.12.1\examples\cppunittest\releasedll

3.12.6 Instrumentation Logging Data

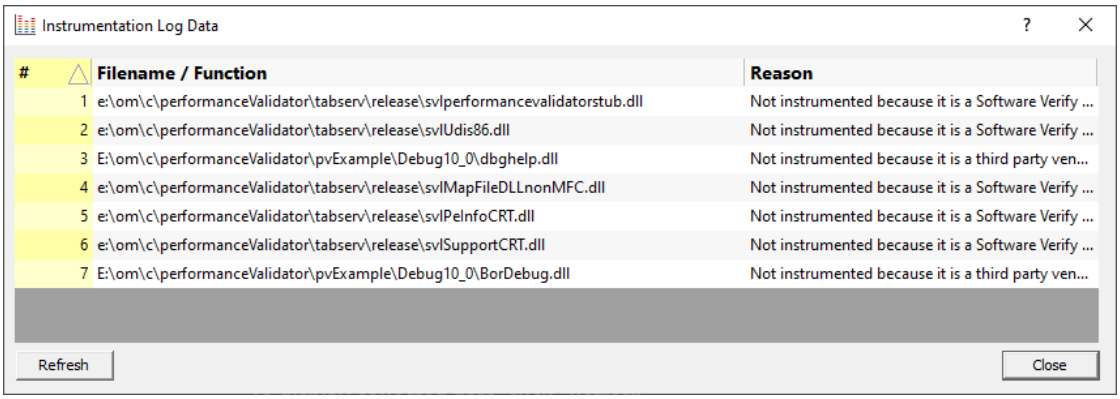
Instrumentation Log Data

It can be very useful to know why your code hasn't been instrumented. For example, a file or part of a file you were expecting to receive coverage information may have been excluded by one or more of the class, file, DLL or or other filters in the Global Settings dialog.

To log details of why dlls, source files, classes, methods and functions are not instrumented, first switch on the instrumentation logging settings.

Once enabled, and a session has started, you can view a list of the files that have not been instrumented via the Tools menu.

Tools menu › **Instrumentation Logging Data...** › shows the Instrumentation Log Data dialog



The dialog shows:

- log order
- the name of the item that hasn't been instrumented
- the reason why each item wasn't instrumented

Example reasons why an item might not be instrumented include the following:

- MFC file ignored
- Microsoft C Runtime file ignored
- Microsoft DLL ignored
- CRT DLL ignored

- Software Verify's own DLL ignored
- Class or function excluded by class and function filters
- File extension excluded by hook source file type filters
- Files excluded by source files filters

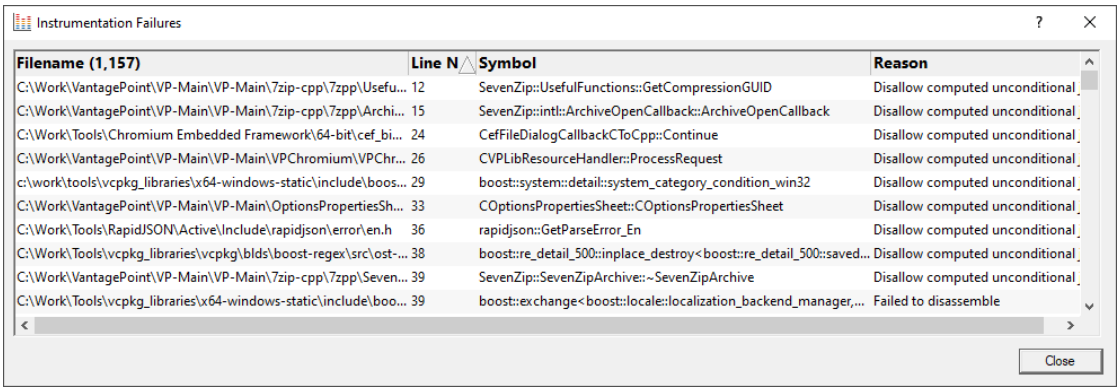
3.12.7 Instrumentation Failure Data

Instrumentation Failure Data

It can be very useful to know which functions in your code failed instrumentation.

You can view a list of the functions that have failed instrumentation via the Tools menu.

Tools menu › **Instrumentation Failure Data...** › shows the Instrumentation Failures dialog



The dialog shows:

- the file name of the item that hasn't been instrumented
- the line number of the item that hasn't been instrumented
- the symbol name of the item that hasn't been instrumented
- the reason why each item wasn't instrumented

Example reasons why an item might not be instrumented include the following:

- Disallow computed unconditional jmp
- Failed to disassemble
- Found privileged instruction

3.12.8 Find

Finding data in the views

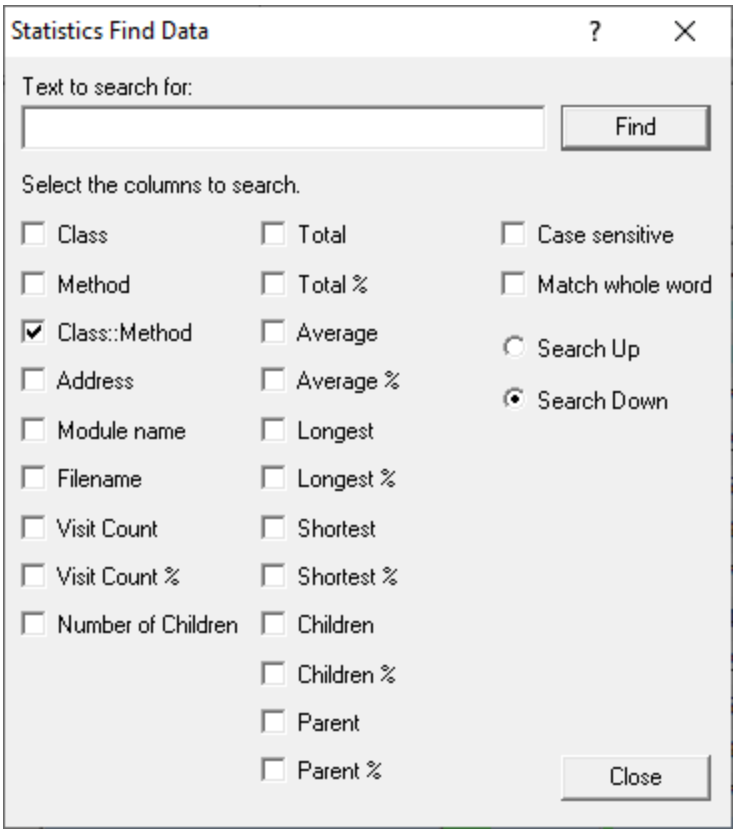
In most views it's useful to be able to search the statistics for data of interest.

Tools menu › **Find...** › search for text in the current tabbed view

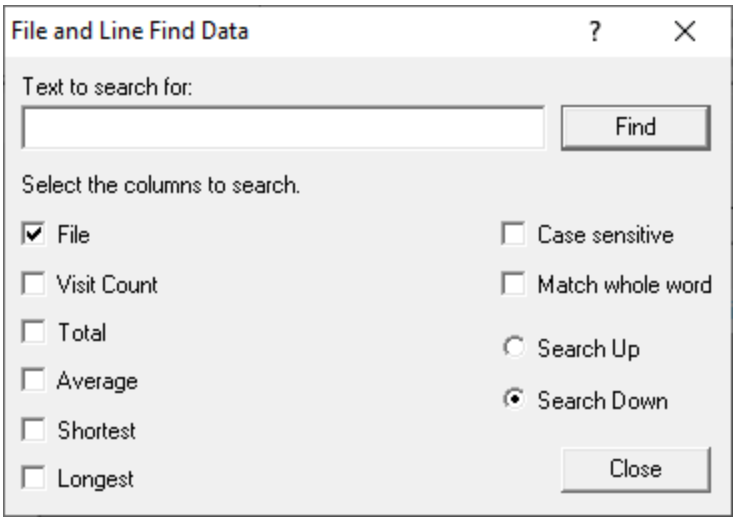
Or use the **Find** icons on the Tools toolbar.

The find dialog will be displayed. Depending on the active main tab, you'll see one of three different versions.

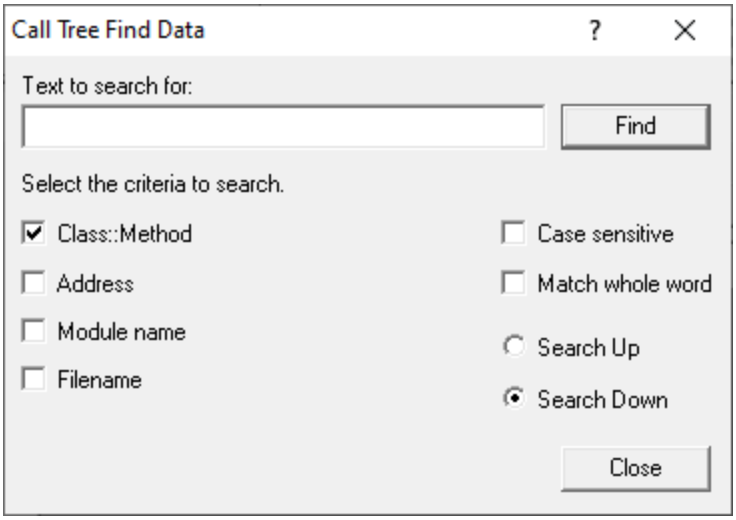
The Statistics and Relations tabs show a find dialog like the one below, with many different columns to search in:



The Line Times version shows a similar looking dialog, but with fewer columns in which to search:



The Call Tree, Call Graph and Analysis views all show fewer criteria with which to search the tree data.



The dialogs all have a similar behaviour, differing only in the list of checkboxes for each searchable criteria in each tab.

The dialogs don't block interaction with the data views so you can keep them open while you inspect the results or continue searching.

Common options on all find dialogs

The controls on the right of each find dialog are the same in each version.

- **Text to search for** › enter the search terms
- **Case sensitive** › tick to make the search match the case of the search terms exactly
- **Match whole word** › tick to match the terms only if they're not part of longer words

If searching for numerical values, entering something like `1,330.71` would count as one 'word'.

- **Search Up/Down** › set the search direction relative to the currently selected row in the data
- **Find** › highlights the next matching row, or beeps to indicate no match found

Controls unique to each find dialog

The left hand options on each dialog are labeled with one of the following:

- the name of a column of data - for tabs with tabulated data
- the name of an item of information - for tabs with tree data formats

Tick one or more boxes matching the criteria you want to search.

3.12.9 Reset All Statistics

Resetting statistics

It's not uncommon to want to clear all the performance data gathered during the session so far, and then continue monitoring without restarting the session.

Resetting the statistics does exactly that.

Tools menu › **Reset All Statistics** › reset all the collected statistics

Or use the **Reset All Statistics** icons on the Session toolbar.

The way this works is that a message gets sent to the stub monitoring the target program.

All threads in the target program get suspended whilst the statistics are reset.

Once reset, all the threads are resumed and new values for the statistics are calculated.

There may be a slight pause before the statistics are reset.

3.13 Software Updates

This topic covers the three items on the Software Updates menu:

- checking for software updates

- configuring your update schedule
- renewing your software maintenance
- setting your software update credentials
- setting the software update directory

Software updates

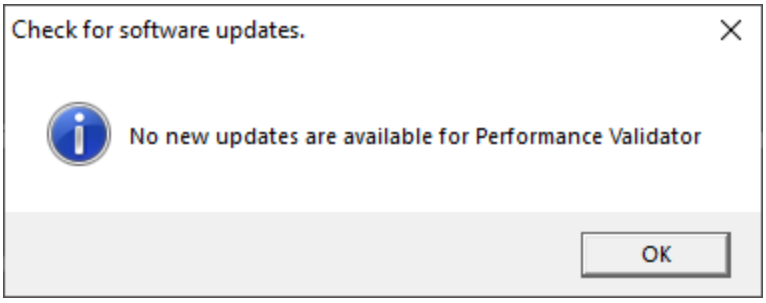
If you've been notified of a new software release to Performance Validator or just want to see if there's a new version, this feature makes it easy to update.

Software Updates menu › **Check for software updates** › checks for updates and shows the software update dialog if any exist

An internet connection is needed to be able to make contact with our servers.

Before updating the software, close the help manual, and end any active session by closing target programs.

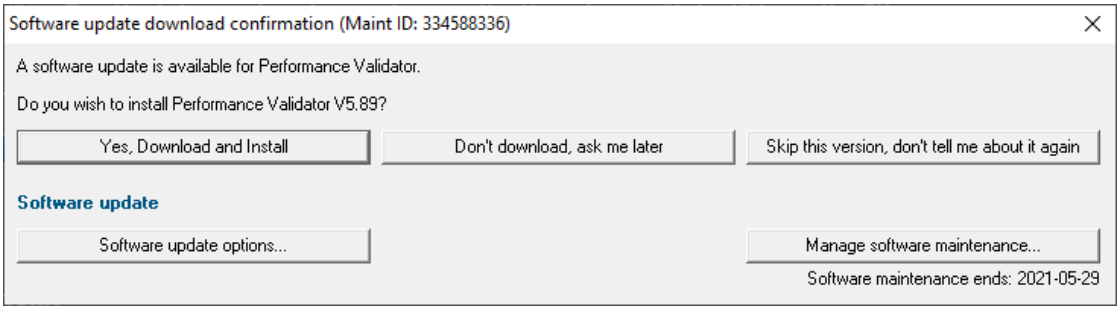
If no updates are available, you'll just see this message:



Note that evaluation versions cannot be updated.

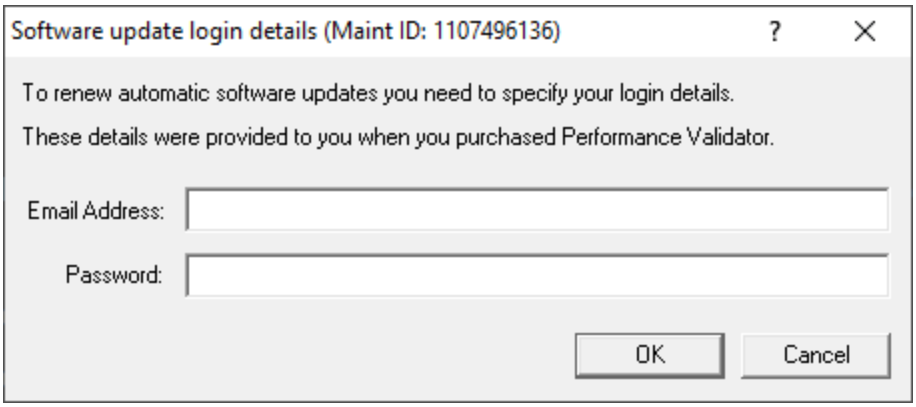
Software Update dialog

If a software update is available for Performance Validator you'll see the software update dialog, unless your maintenance has expired.

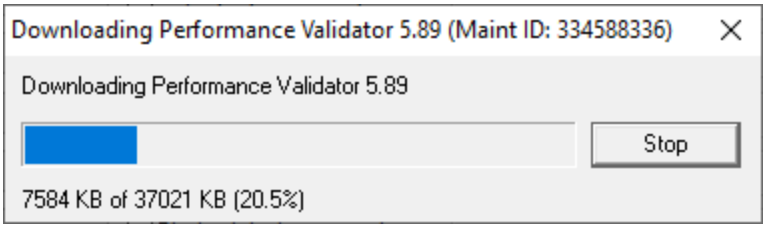


- **Download and install** › prompts you for log-in details if not known, and then downloads the update, showing progress

  If you haven't set login credentials, you may be asked for your user email and password, which you'll have received when you purchased Performance Validator or subsequent update email.



  Once logged in, the download will start:



  Once the update has downloaded, Performance Validator will close, run the installer, and restart.

  You can stop the download at any time, if necessary.

- **Don't download...** › Doesn't download, but you'll be prompted for it again next time you start Performance Validator
- **Skip this version...** › Doesn't download the update and doesn't bother you again until there's an even newer update
- **Software update options...** › edit the software update schedule
- **Manage software maintenance...** › opens your browser ready for maintenance renewal

Problems downloading or installing?

If you see an error dialog indicating that a connection can't be found and you're sure you're online, try restarting Performance Validator and try again.

If for whatever reason, automatic download and installation fails to complete:

- Log in to https://www.softwareverify.com/authdownload.php with the details provided when you purchased Performance Validator
- Download the latest installer manually, via one of the .exe, .xyz or .zip files that are available

Make some checks for possible scenarios where files may be locked by Performance Validator as follows:

- Ensure any open sessions are completed
- Ensure any target programs started by Performance Validator are closed
- Ensure Performance Validator and its help manual is also closed
- Ensure any error dialogs from the previous installation are closed
- Check the `svlHtmlHelpHelper.exe` process is not running

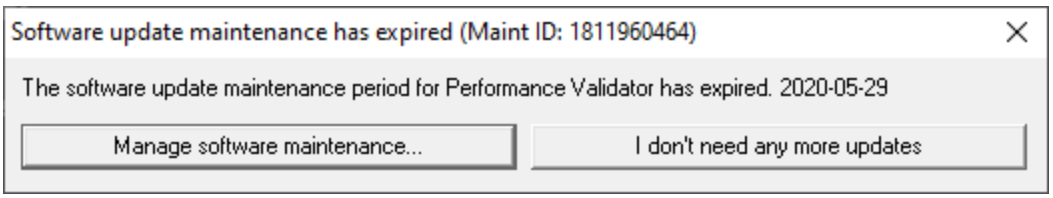
Have your license details handy as you may need to copy information into the license dialog.

You should now be ready to run the new version.

Software maintenance expiry

If the software maintenance period has expired you won't be able to automatically update Performance Validator as above.

Instead, you'll see the software update maintenance expiry dialog:



You can manage your software maintenance or choose to stop receiving any more software updates.

Software update schedule

Performance Validator can automatically check to see if a new version of Performance Validator is available for downloading.

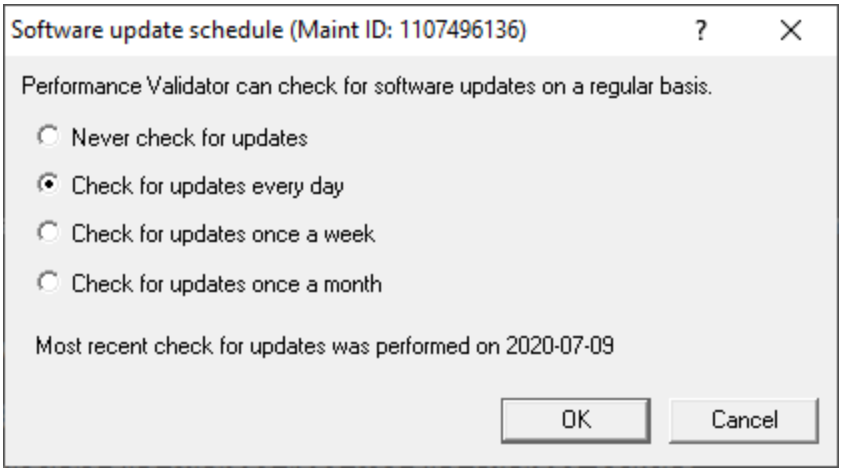
Software Updates menu > **Configure software updates** > shows the software update schedule dialog

The update options are:

- never check for updates
- check daily (the default)

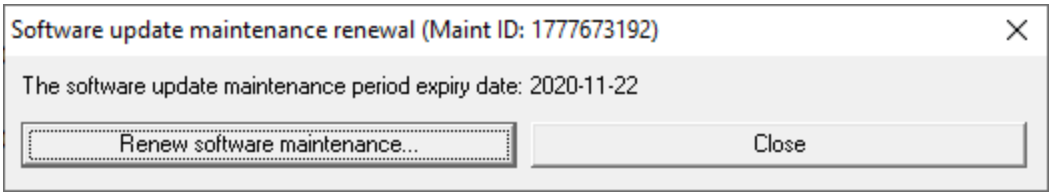
- check weekly
- check monthly

The most recent check for updates is shown at the bottom.



Managing software maintenance

Software Updates menu › **Renew software updates** › shows the software update maintenance renewal dialog



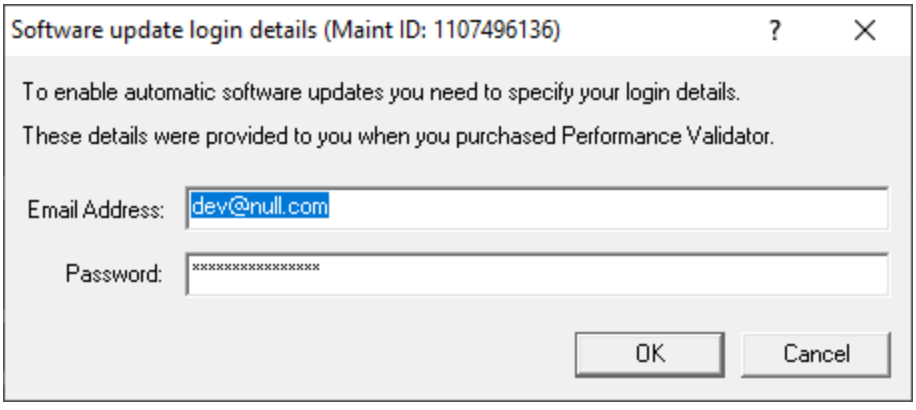
Your maintenance expiry date is shown. If you don't need to do anything just **Close** the dialog.

- **Renew software maintenance** › Opens your browser, logging you in to our website from which you can purchase maintenance

Managing software update credentials

You can configure your software update credentials within the application.

Software Updates menu › **Set software update credentials** › shows the Software update login details dialog

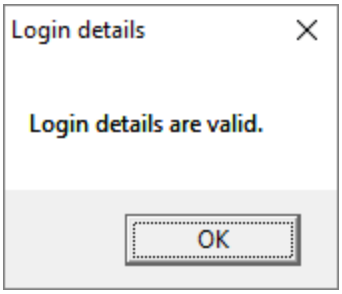


The text will be shown in red if the email address looks incorrectly formatted.

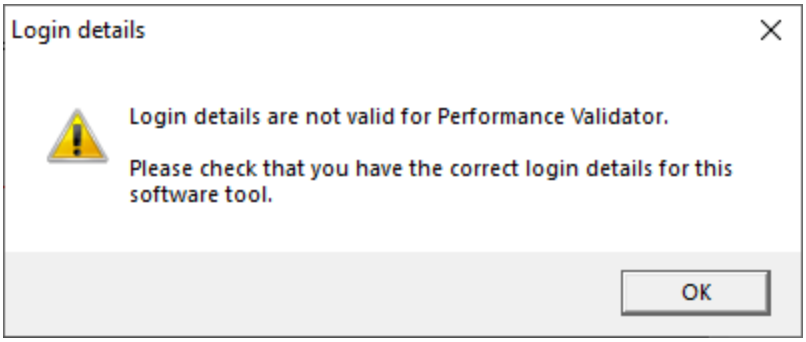
Testing the login details checks they're valid:

- **Test login details** › check your entered details are valid (requires an internet connection)

Valid details will be confirmed:



Invalid details may mean you entered credentials for another application in the Validator suite, or they could have been entered incorrectly.



You should have received the correct credentials when you purchased Performance Validator, or with any software update emails.

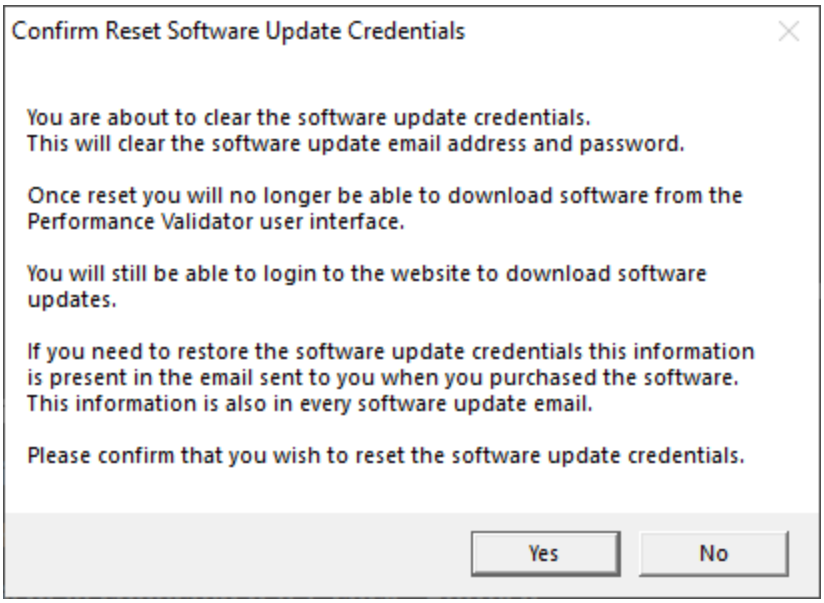
If you experience problems, check with your system administrator or contact Software Verify.

If you need to clear the update credentials, you can do this directly from the menu.

Software Updates menu › **Reset software update credentials** › clears the email and password details stored in the application

You will be asked to confirm the reset. After resetting the credentials, no software updates will occur.

If you later need to restore your credentials, you should have received that information when you purchased Performance Validator, or with any software update emails.

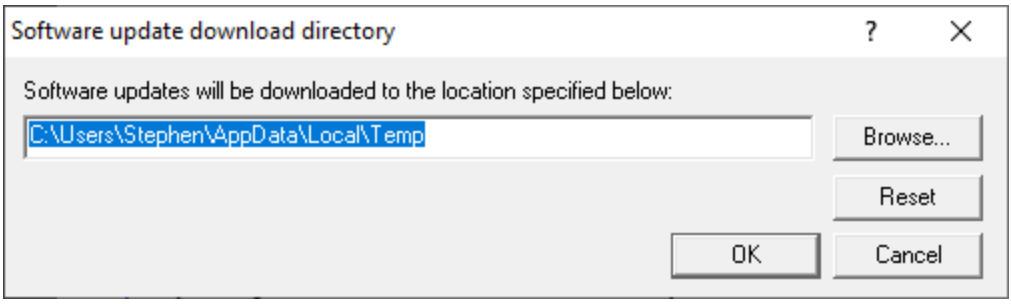


Software update directory

It's important to be able to specify where software updates are downloaded to because of potential security risks that may arise from allowing the `TMP` directory to be executable. For example, to counteract security threats it's possible that account ownership permissions or antivirus software blocks program execution directly from the `TMP` directory.

The `TMP` directory is the default location but if for whatever reason you're not comfortable with that, you can specify your preferred download directory. This allows you to set permissions for `TMP` to deny execute privileges if you wish.

Software Updates menu › **Set software update directory** › shows the Software update download directory dialog



An invalid directory will show the path in red and will not be accepted until a valid folder is entered.

Example reasons for invalid directories include:

- the directory doesn't exist
- the directory doesn't have write privilege (update can't be downloaded)
- the directory doesn't have execute privilege (downloaded update can't be run)

When modifying the download directory, you should ensure the directory will continue to be valid. Updates may no longer occur if the download location is later invalidated.

- **Reset** › reverts the download location to the user's `TMP` directory

  The default location is `c:\users\[username]\AppData\Local\Temp`

3.14 Sessions: Load, Save, Export, Close

Working with sessions

Sessions with Performance Validator can be saved to and loaded from a file so that you can:

- share the session with a colleague
- examine the session at a later date
- compare the session with another session
- create baseline sessions for use in regression tests

Sessions can be even exported in HTML and XML formats.

You can have multiple sessions open at once, which is necessary for comparing loaded sessions.

Closing a session

When you've finished working with a session it can be closed.

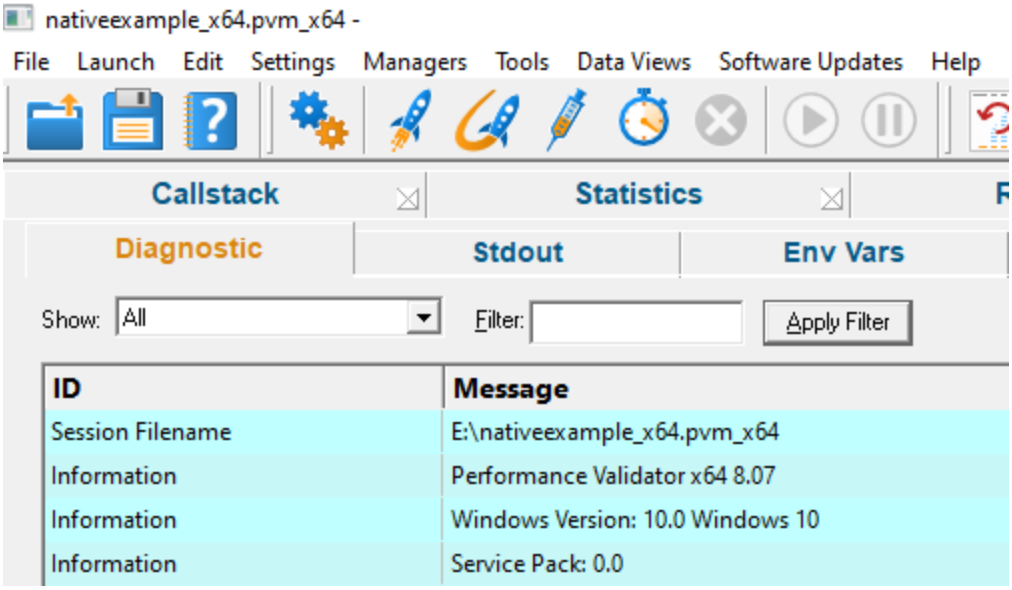
File menu › **Close Session...** › closes the session, clearing the displays

Closing a session may happen automatically if you start a new session and the session count limit is 1.

If the maximum session count allows, closed sessions still appear in the Session Manager, where they can be reopened or deleted.

Session Filename

The session filename is displayed as the first line of the diagnostic data on the Diagnostic tab.



3.14.1 Loading & Saving Sessions

Loading sessions

Load a session using any of the following options.

File menu › **Open Session...** › open a previously saved session from file (*.pvm)

Or click on the Open Session icon on the standard toolbar.

Or use the shortcut:

Ctrl + O Open session

If you have a limit of one session to be open at a time, any open session will be closed first, otherwise you can open multiple sessions at a time.

Saving sessions

Save a session using any of the following options.

File menu › **Save Session...** › saves all the session data to a file (*.pvm), prompting for a file name if necessary

File menu › **Save As...** › saves the session to a new file

Or click on the Save Session icon on the standard toolbar.

Or use the shortcut:

Ctrl + S Save session

Unlike exports, there are no options here, as all the session data is saved.

3.14.2 Exporting Sessions

Exporting to HTML or XML

Exporting sessions allows you to use external tools to analyse or view session data for whatever reasons you might need.

You can export to HTML or XML format:

File menu › **Export Session...** › Choose an **HTML** or **XML** Report › shows the Export Session dialog below

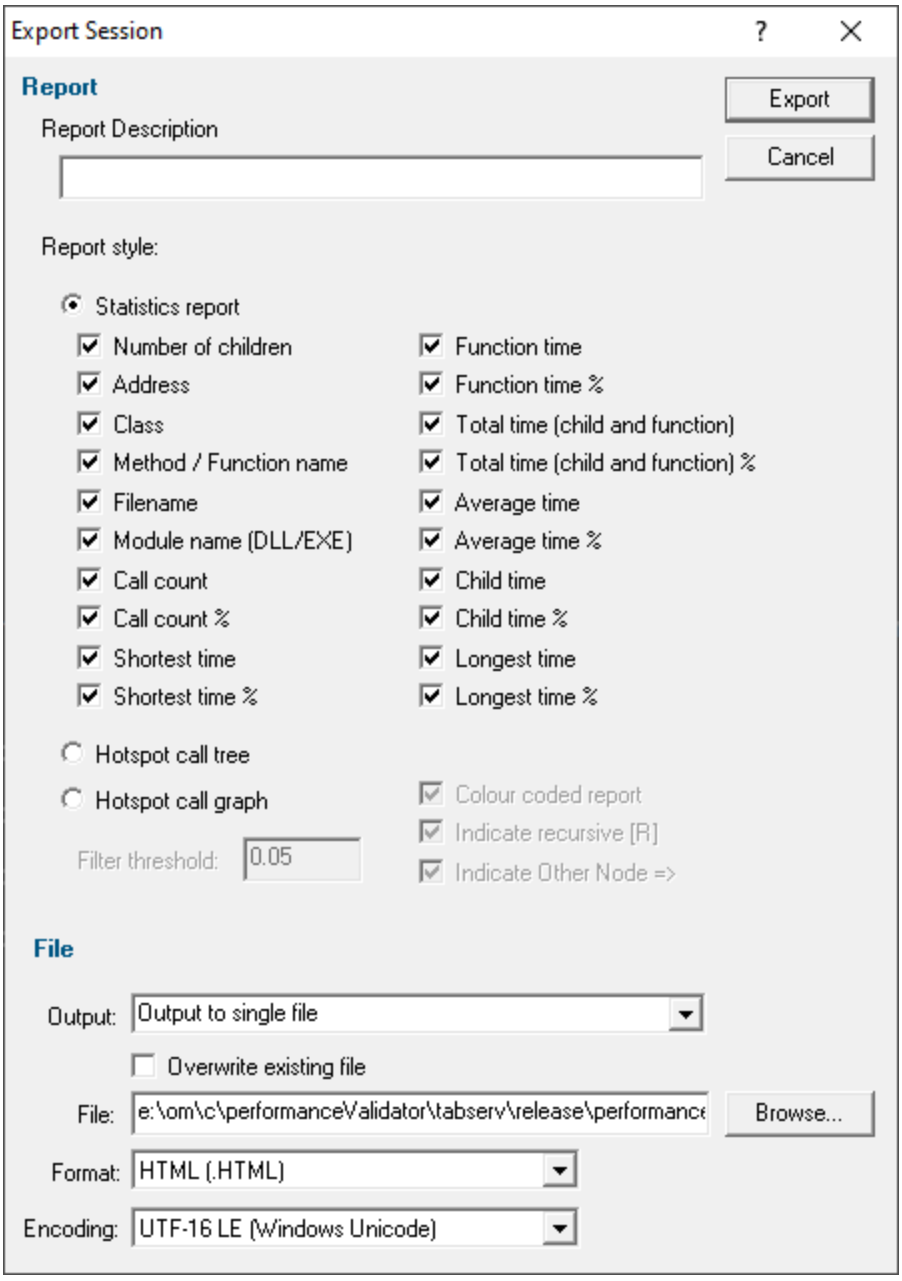
Exporting is not saving

You can't import session data.

Use save and load if you want to save session data for loading back into Performance Validator at a later date.

The HTML and XML export session dialog

For HTML or XML export, the same dialog is used, but the call tree and call graph options are disabled for XML.



Report description

The optional description is included at the top of the exported html in the description field.

- **Description** › enter a meaningful description or just leave blank

  If no text is entered the description is omitted from the export.

Report Type

- **Colour Coded Report** › generate a colour coded report

  Only HTML reports can be colour coded:

  Colours used will be those set for use in the various displays.

Report style

The report can take the form of a table of statistics or a hierarchical call tree or graph:

- **Statistics report** › exports tabulated data with all the checked items below, similar to the Statistics tab view

  The exported report can be generated on a per source-file basis, or as a concatenated set of performance data - see the File section below.

- **Hotspot call tree** › exports hierarchical data similar to the Call Tree tab view
- **Hotspot call graph** › exports hierarchical data similar to the Call Graph tab view

Options when exporting trees and graphs

Exported HTML trees and graphs are interactive in that items can be expanded and collapsed and are colour coded according to the current colour scheme.

You may not want to export functions that are below a certain threshold contribution to the total time

- **Filter threshold** › enter a threshold percentage value between 0.00 and 1.00

  Any functions below the threshold will not be exported.

Trees and graphs can produce colour coded reports and may have recursive nodes:

- **Colour coded report** › produce a coloured or monochrome export

  The colours used are the same as in the various displays in C++ Performance Validator.

- **Indicate recursive** › mark recursive nodes in the report with `[R]`

When exporting as a call graph the items can also indicate linked nodes:

- **Indicate Other Node** › mark nodes found elsewhere in the graph with **=>**

Statistics report content

When exporting a statistics report, all the ticked items on the dialog will be included.

Function details (names and locations)

- **Number of children** › number of child functions
- **Address** › function address
- **Class** › class name
- **Method / Function name** › method name (or function name if no class
- **Filename** › filename containing the function
- **Module name** › name of the module containing the function

Statistics (counts and timings)

- **Call count** › number of times the function is called
- **Call count%** › as a percentage of all function calls made
- **Function time** › the time a function takes to execute
- **Function time %** › as a percentage of runtime
- **Total time** › the time a function and its child functions take to execute
- **Total time %** › as a percentage of runtime
- **Average time** › average time a function takes to execute
- **Average time %** › as a percentage of runtime
- **Child time** › the time a function's child functions take to execute
- **Child time %** › as a percentage of runtime
- **Shortest time** › the shortest time a function and its child functions take to execute
- **Shortest time %** › as a percentage of runtime
- **Longest time** › the longest time a function and its child functions take to execute
- **Longest time %** › as a percentage of runtime

File section

- **Output** › Choose whether to export everything to a single file, or one output per source file

  For multi-file reports an additional index.html or index.xml file is also created.

  This only applies to the statistics report, not the call tree or graph output.

- **Overwrite existing file** › check if you *don't* want to be warned about overwrites when exporting as a single file

- **File/Directory** › type the export location or **Browse** to a location

  Enter the filename for single file export, or the directory path for multi-file export.

- **Format** › set whether exporting HTML or XML

  This defaults to the original menu option selected, but is included here to more easily export one format and then the other.

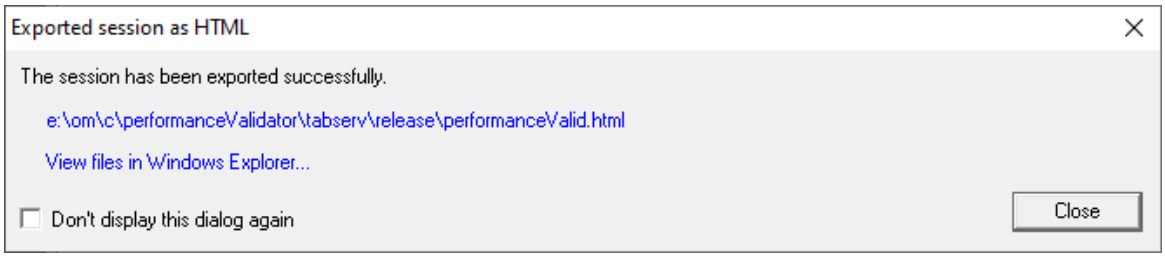
   If you need to customise your HTML, we recommend first exporting a detailed XML report and using that to generate an HTML report styled as required.

- **Encoding** › set whether UTF-16 LE, UTF-8 or ASCII encoding. By default the exported file is saved in the Windows Unicode format UTF-16 little endian. You can also save in UTF-8 and ASCII. ASCII has no byte order mark at the start of the file.

Ready to export?

- **OK** (at top right) › start exporting the session data

Once the export is complete, a confirmation dialog will be displayed.



The links in the dialog provide direct access to either the export directory in Windows Explorer, or to open the exported file itself using the default application for xml or html files.

If you produced a multi-file export then the browser link will be for the index file, as above.

3.14.2.1 XML Export Tags

The XML tags used to export session data from Performance Validator are outlined below.

This information may be useful to reformat the details for use in another tool or application. Alternatively if you need a custom HTML format, you can first export the XML and use that to generate the HTML.

Application and program details

An exported XML file starts with a few details about Performance Validator and the target program:

```
<XML>
  <VALIDATORINFO>Performance Validator information online</VALIDATORINFO>
  <VALIDATOR>Product name</VALIDATOR>
  <VALIDATORVERSION>Version</VALIDATORVERSION>
  <VALIDATORDATE>Build date</VALIDATORDATE>
  <VALIDATORTIME>Build time</VALIDATORTIME>
  <TITLE>Target program name</TITLE>
  <EXITCODE>Program exit status code and description (if collected)</EXITCODE>
  <INFO>Information about the report type</INFO>
  ...
```

Performance data

The header information above is followed by a series of **`Performance Data`** tags containing the statistics that were selected for export.

Below is a typical example from the example program - see the Export Session Dialog for an explanation of each item.

```
<PERFORMANCE_DATA>
 <NUM_CHILDREN>3</NUM_CHILDREN>
 <ADDRESS>0x0000000000415940</ADDRESS>
 <CLASS>CNativeExampleDoc</CLASS>
 <METHOD>AssertValid</METHOD>
 <MODULE>nativeExample.exe</MODULE>
 <FILENAME>c:\program files (x86)\software verification\c++ performance validator\examples\na
 <FUNCTION>1,929.20</FUNCTION>
 <FUNCTION_PERCENT>1.88</FUNCTION_PERCENT>
 <AVERAGE>0.02</AVERAGE>
 <AVERAGE_PERCENT>0.00</AVERAGE_PERCENT>
 <CHILD>1,886.08</CHILD>
 <CHILD_PERCENT>1.84</CHILD_PERCENT>
 <CALL_COUNT>253,598</CALL_COUNT>
 <CALL_COUNT_PERCENT>0.81</CALL_COUNT_PERCENT>
 <TOTAL>3,815.28</TOTAL>
 <TOTAL_PERCENT>3.71</TOTAL_PERCENT>
 <LONGEST>0.09</LONGEST>
 <LONGEST_PERCENT>0.00</LONGEST_PERCENT>
 <SHORTEST>0.00</SHORTEST>
 <SHORTEST_PERCENT>0.00</SHORTEST_PERCENT>
</PERFORMANCE_DATA>
```

3.15 Starting your target program

Starting options

There are seven ways to start a target program and have Performance Validator collect data from it.

- Launch your program in a specified directory, with as many command line arguments as you want
- Inject Performance Validator into an already running program
- Wait until a specific program starts to run before attaching to it - e.g. for programs started as an OLE server
- Monitor a service
- Monitor IIS and ISAPI
- Use the Native API to start Performance Validator from code that you control
- Start Performance Validator from the command line, allowing you to automate your use of Performance Validator

Modules without PDB files and without MAP files

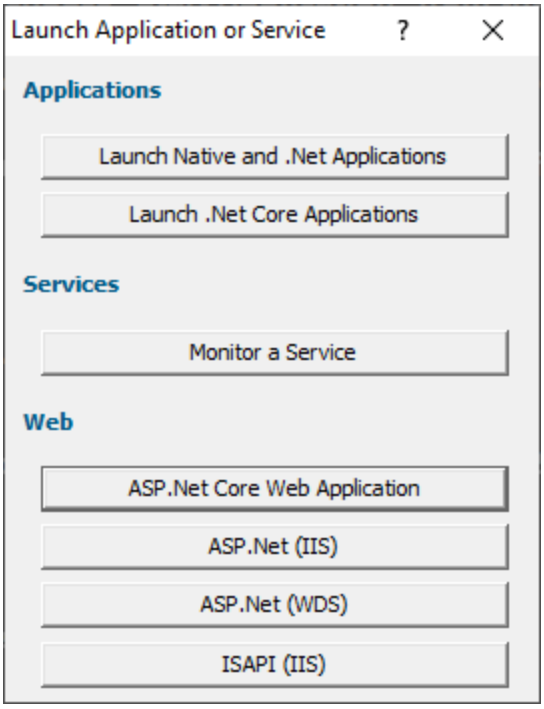
For your application to be processed for performance data, each module to be monitored must have a PDB file with debug data, or a MAP file with line number data.

Use the Debug DLLs dialog to see whether debug information was not found for any modules, and check the Diagnostics tab for failure messages.

3.15.1 Launch Chooser

The launch chooser is displayed when you click on the rocket icon on the toolbar.

There are multiple application types and services that you may wish to use. The launch chooser provides the mechanism for making that choice.



Each button will display the launch dialog associated with the instruction displayed on the button.

Applications

- Launch Native and .Net Applications
- Launch .Net Core Applications

Services

- Monitor a Service

Web

- ASP.Net Core Web Application
- ASP.Net with IIS
- ASP.Net with Web Development Server
- ISAPI with IIS

You can repeat the choice made using the launch chooser by using Ctrl + F4

3.15.2 Launching the program (native and .Net)

Launching the application

Having Performance Validator launch your program is the most common way to start up

When you're ready to start running a target program:

Launch menu › **Applications** › **Launch Application...** › Shows the launch program wizard or dialog below

Or use the shortcut:

F4 Start application

➡ You can easily re-launch the most recently run program.

User interface mode

There are two interface modes used while starting a program

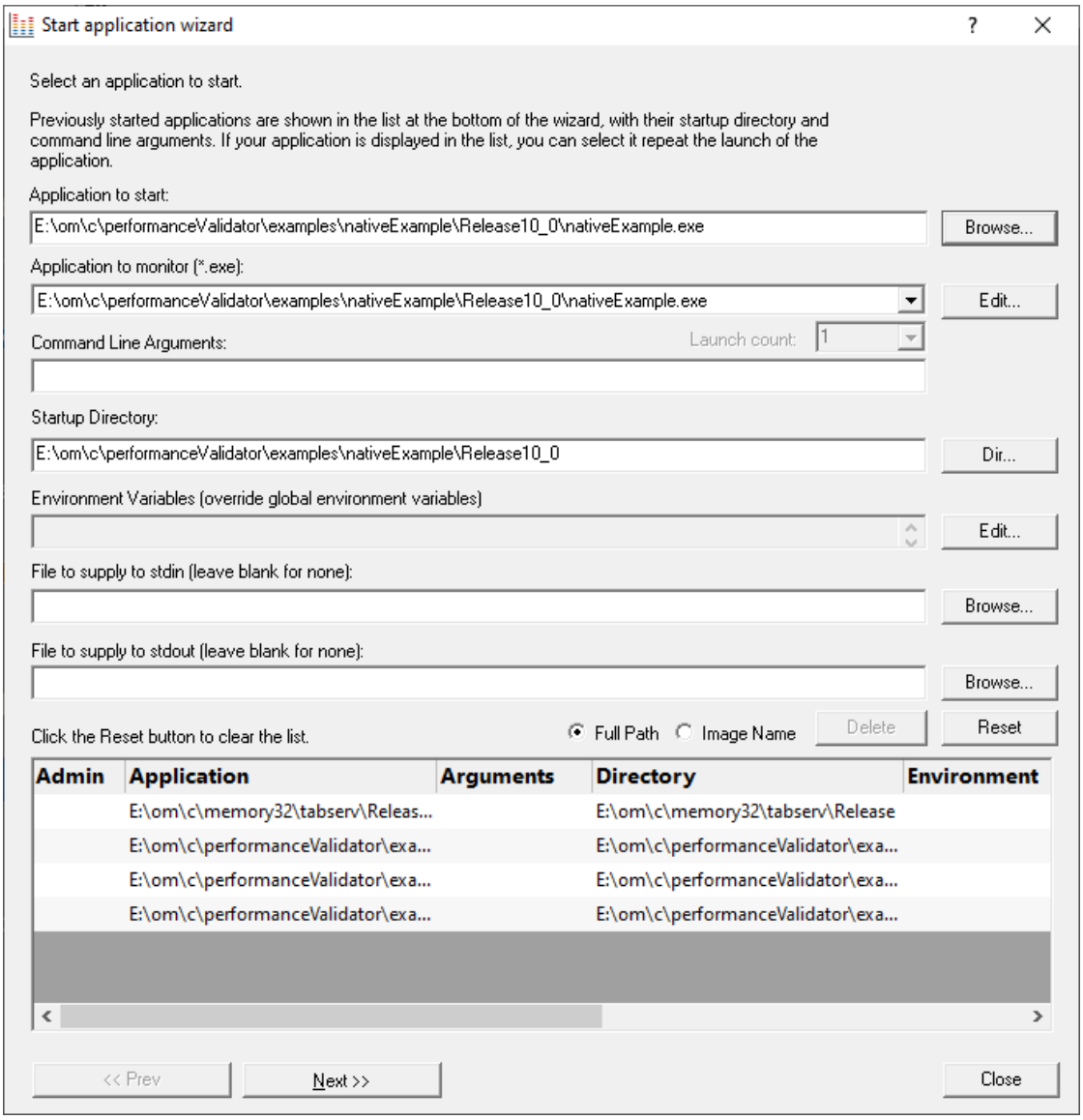
- **Wizard** mode guides you through the tasks in a linear fashion
- **Dialog** mode has all options contained in a single dialog

All the options are the same - just in different places.

In this section we'll cover the Wizard mode first and the Dialog mode later.

The start application wizard

On first use, the wizard appears with fields cleared, but here's an example with a few fields set:



Enter the details for your program, or if you want to run a previous program select it from the application list to repopulate the details.

After entering the details click **Next >>** for the next page of the wizard.

Administrator privileges when launching your program

The following applies only if you did *not* start Performance Validator in administrator mode.

Anywhere you see the  icon indicates that administrator privileges will be required to proceed.

If you started Performance Validator in administrator mode, you won't see any of these warnings, and everything will behave as normal.

Page 1: Entering details

- **Application to start** › type or **Browse** to set the program name to launch

  You can also choose a batch file and the first executable started in the batch file will be launched.

  You can also choose a powershell script and the first executable started in the powershell script will be launched.

  Manually typing a path will show red text until a valid path is entered, after which the text becomes black.

- **Application to monitor** › choose the application that actually gets monitored

  This will typically just be the program that you set to start - unless otherwise specified.

  Alternatively you can monitor another application which will get launched by the start program.

  If the start application has already been added to the Applications to Monitor settings with a default application then that default will be entered here automatically.

  Otherwise, if nothing has been set up yet, you can do it from here:

  - **Edit...** › set the child applications that can be monitored for the start program

    This uses the Applications to Monitor dialog - which is exactly equivalent to using the Applications to Monitor settings page.

  A fallback option is to start monitoring `<<Any application that is launched>>`.

  If in doubt, just use the same as the start application.

  ➜ See also: Application to Monitor settings

- **Launch Count** › when monitoring a *child* application, set its n^{th} invocation as the one to monitor

  If the application to start is the same as the application to monitor then this is set to 1 and cannot be changed.

  This will be reset to 1 every time the Application to Monitor field selection changes.

  If in doubt, leave it set to 1.

  ➜ See also: Launch Count.

- **Command Line Arguments** › enter program arguments exactly as passed to the target program

- **Startup Directory** › enter or click **Dir...** to set the directory for the program to start in

When setting your target program, this will default to the location of the executable

- **Environment Variables** › click **Edit...** to set any additional environment variables before your program starts

  These are managed in the Environment Variables Dialog.

- **File to supply to stdin** › optionally enter or **Browse** to set a file to be read and piped to the standard input of the application

- **File to supply to stdout** › optionally enter or **Browse** to set a file to be written with data piped from the standard output of the application

Page 1: Using details from a previous run

The list at the bottom of the wizard shows previously run programs.

Selecting an item in the list populates all the details above as used on the last run for that program.

You can still edit those details before starting.

- **Full path** › shows the full path to the executable in the list
- **Image Name** › shows the short program name without path
- **Delete** › removes a selected program from the list
- **Reset** › clears all details in the wizard - including the list of previously run applications below

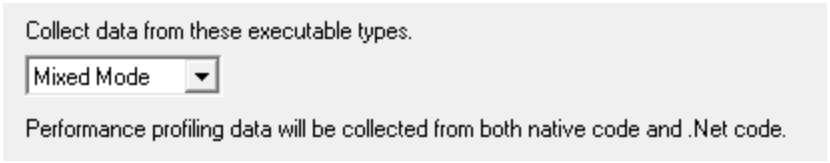
The **Admin** column in the list of previous runs may show a  symbol to indicate a requirement for administrator privileges in order to run the program. This is automatically detected from the program's manifest.

Page 2: Data collection and redirection

Depending on your application, and what you want to test, you may want to start collecting data immediately, or do it later.

If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

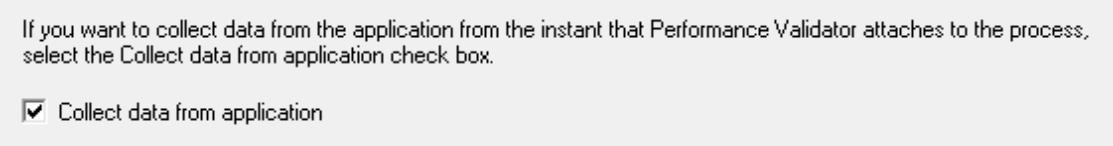
- **Type of data collection** › Are you only interested in Native data, .Net data or both Native data and .Net data?



- **Native Only** › Ignore all .Net data in the target application.
- **.Net Only** › Ignore all Native data in the target application.
- **Mixed Mode** › Collect both Native and .Net data from the target application

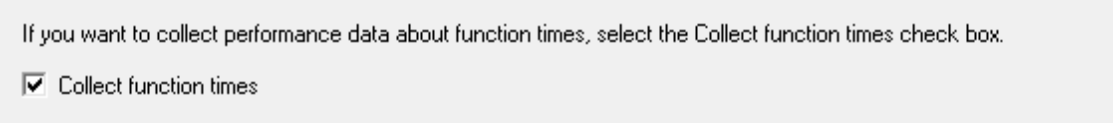
This setting cannot be changed after the application is launched

- **Collect data from application** › if it's the startup performance you want to monitor, then obviously start collecting data from launch

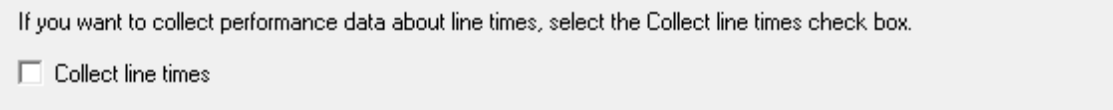


➜ See the section on controlling data collection for how to turn collection on and off after launch.

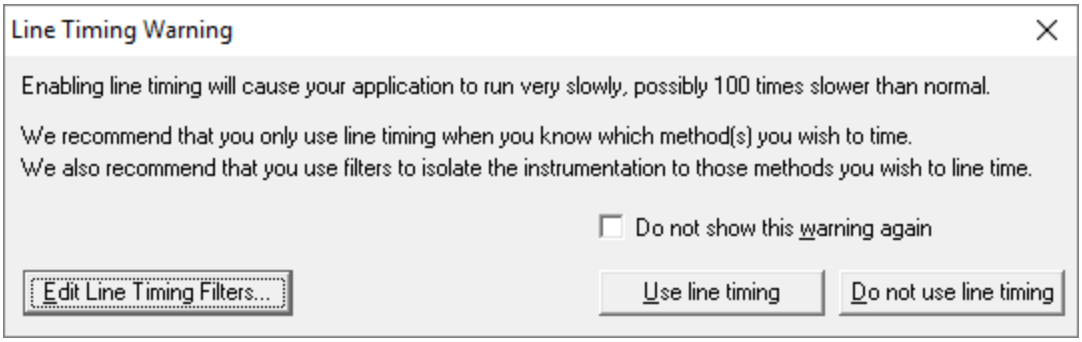
- **Collect function times** › tick to collect data that will allow overall function timings to be calculated



- **Collect line times** › tick to allow individual line timings to be calculated



A warning dialog *may* be displayed to remind you of the possible performance slowdown when using line timing.



This warning only appears if the Enable line timing warning option on the Performance settings is checked.

The option at the bottom to edit line timing filters can be used to set specific classes, methods and functions to be included in, or excluded from, the hooking process and is identical to the Line Timing Filters page of the global settings dialog.

- **Redirect standard output** › Controls redirection of stdout and stderr

  Use this option if you want to collect the output of stdout and stderr for later analysis.

  Be aware that if the output of the program under test generates a lot of data via stdout or stderr that this data will need to be stored in memory and could exhaust Performance Validator's memory.

- **Display command prompt** › Shows or hides the launched application.

  If you are collecting stdout and stderr you may not be interested in viewing the application (or the command prompt if it is a console application). This provides you the option to hide the application when it is running.

  Be aware that if you hide a command prompt you will not be able to type anything into the application.

 Unchecking function *and* line times means not collecting any data at all!

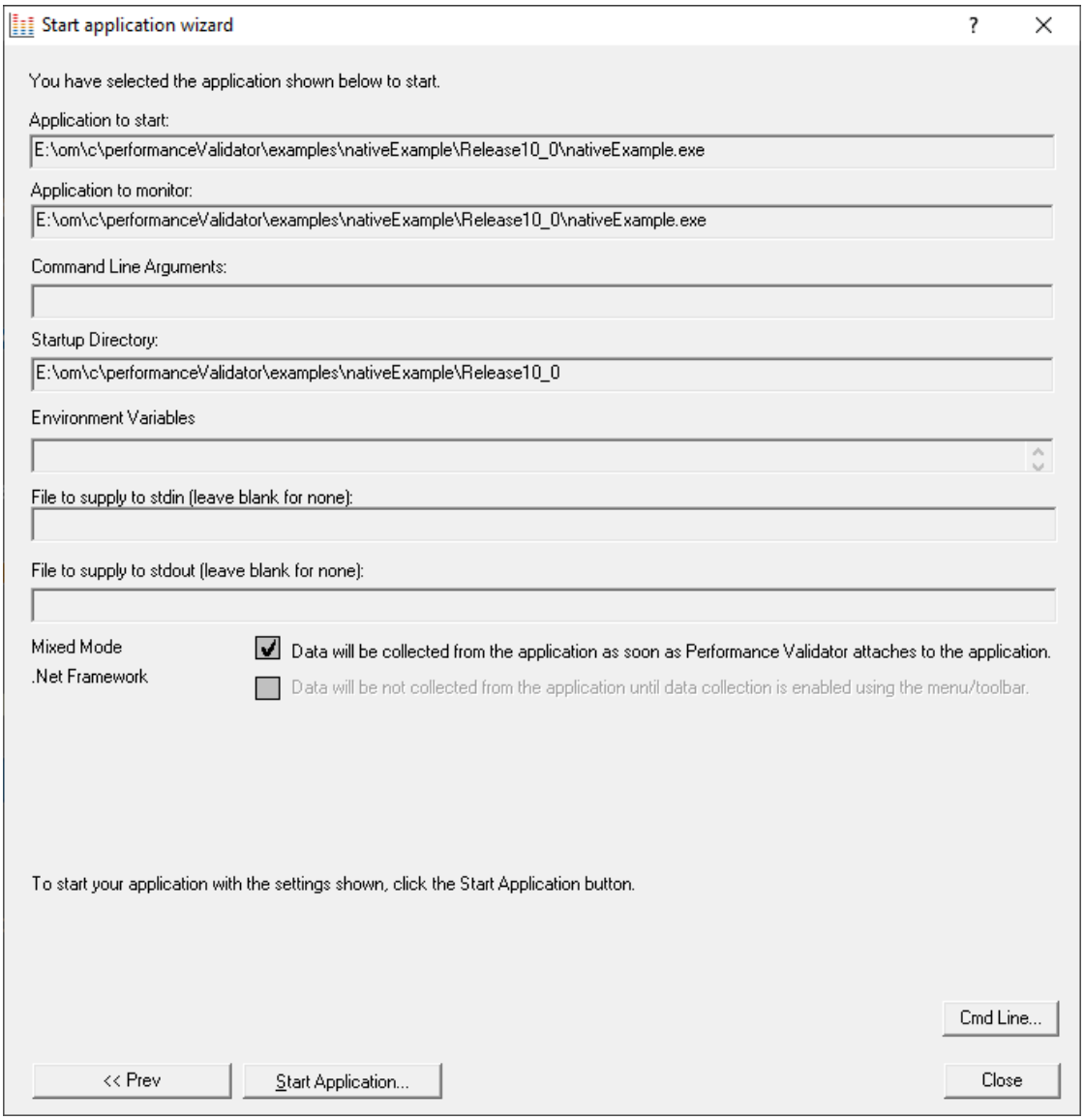
Page 3: Summary and starting your program

The last page is just a summary of the options you have chosen.

 Something missing? The choice of launch method is no longer necessary and has been removed.

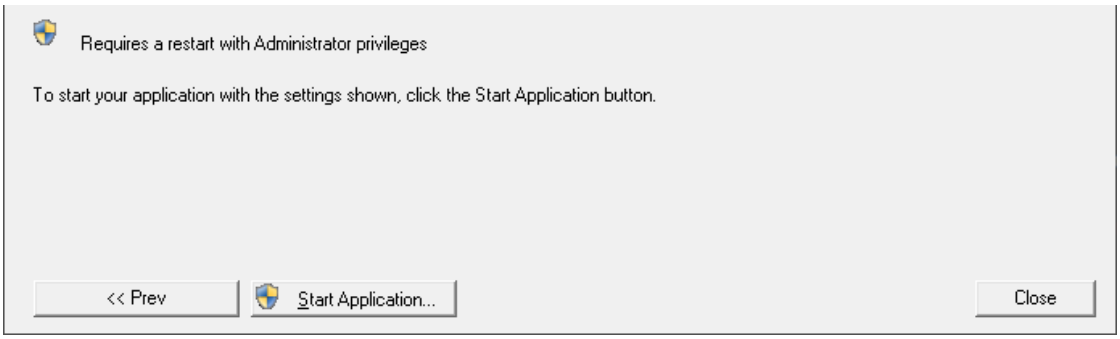
If you're happy with the settings, go ahead:

- **Start Application...** › start your program and attach Performance Validator to it
- **Cmd Line...** › display the command line builder

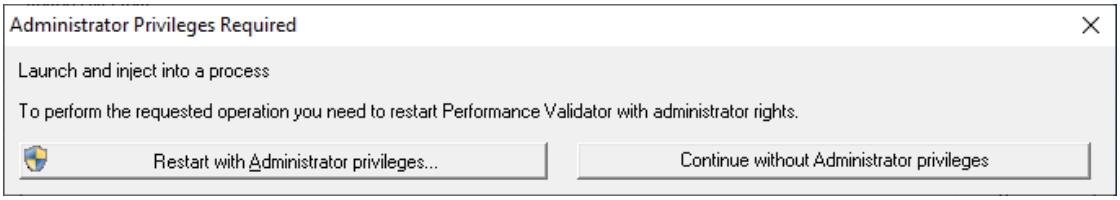


Administrator privileges in wizard mode

If administrator privileges are required you'll be reminded of the need to restart here:



- **Start Application...** › shows the Administrator Privileges Required confirmation dialog before restarting



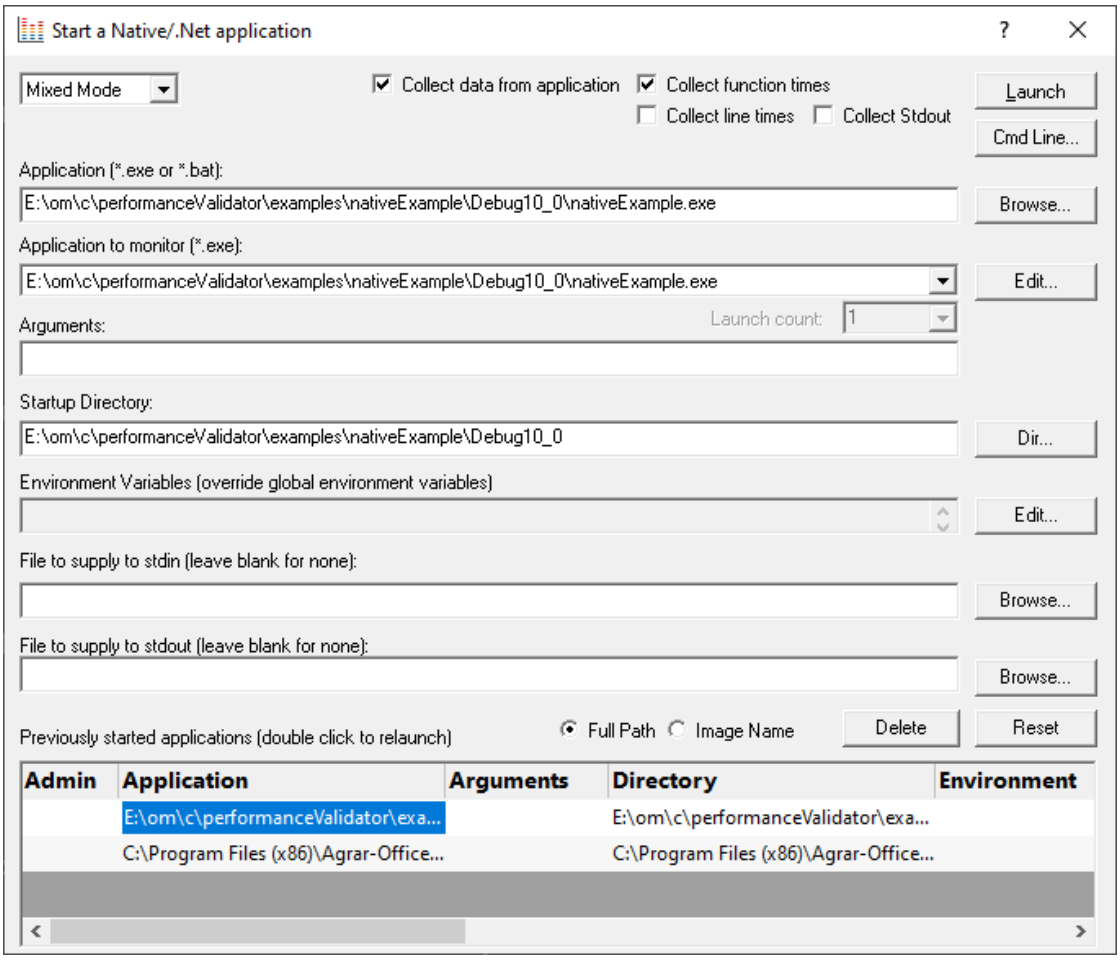
Dialog mode

In Dialog mode, all the settings are in one dialog which looks very much like the first page of the launch wizard above.

At the top are the options to collect line times and to start collecting data immediately.

- **Launch** › start your program and attach Performance Validator to it
- **Cmd Line...** › display the command line builder

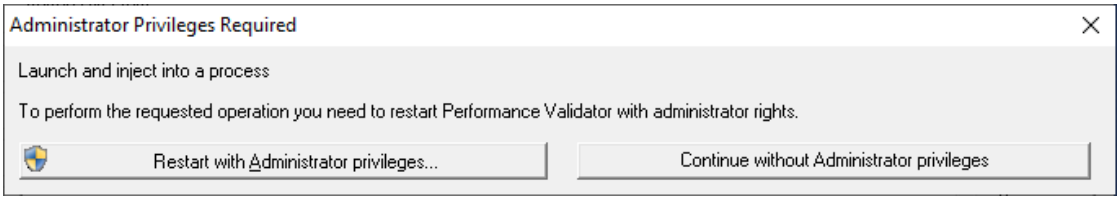
  Double clicking a program in the list will also start it immediately.



Administrator privileges in dialog mode

If administrator privileges are required, the Launch button will show the privileges icon reminding you of the need to restart.

- Launch › shows the Administrator Privileges Required confirmation dialog before restarting.



If you started Performance Validator in administrator mode, you won't see any of these warnings, and everything will behave as normal.

How do I use Application to Monitor and Launch Count?

The three fields **Application to Start**, **Application to Monitor** and **Launch Count** work together to control which application actually gets monitored by Performance Validator.

Let's say we have a program **P**.

In the simplest case, simply:

- *start* **P**
- *monitor* **P**
- the Launch Count defaults to **1** and cannot be changed.

If **P** launches an application and you just want to monitor whatever that is:

- *start* **P**
- *monitor* `<<Any application that is launched>>`
- leave the Launch Count at **1**

If **P** launches an application **A** and maybe others as well, and you specifically want to monitor only **A** as it's launched:

- use the Application to Monitor settings to add a definition for P and child applications **A**
- *start* **P**
- *monitor* **A**
- leave the Launch Count at **1**

If **P** launches an application **A** many times and you specifically want to monitor the third invocation:

- use the Application to Monitor settings to add a definition for P and child applications **A**
- *start* **P**
- *monitor* **A**
- set the Launch Count to **3**

3.15.3 Launching the program (.Net Core)

Launching the application

Having Performance Validator launch your program is the most common way to start up

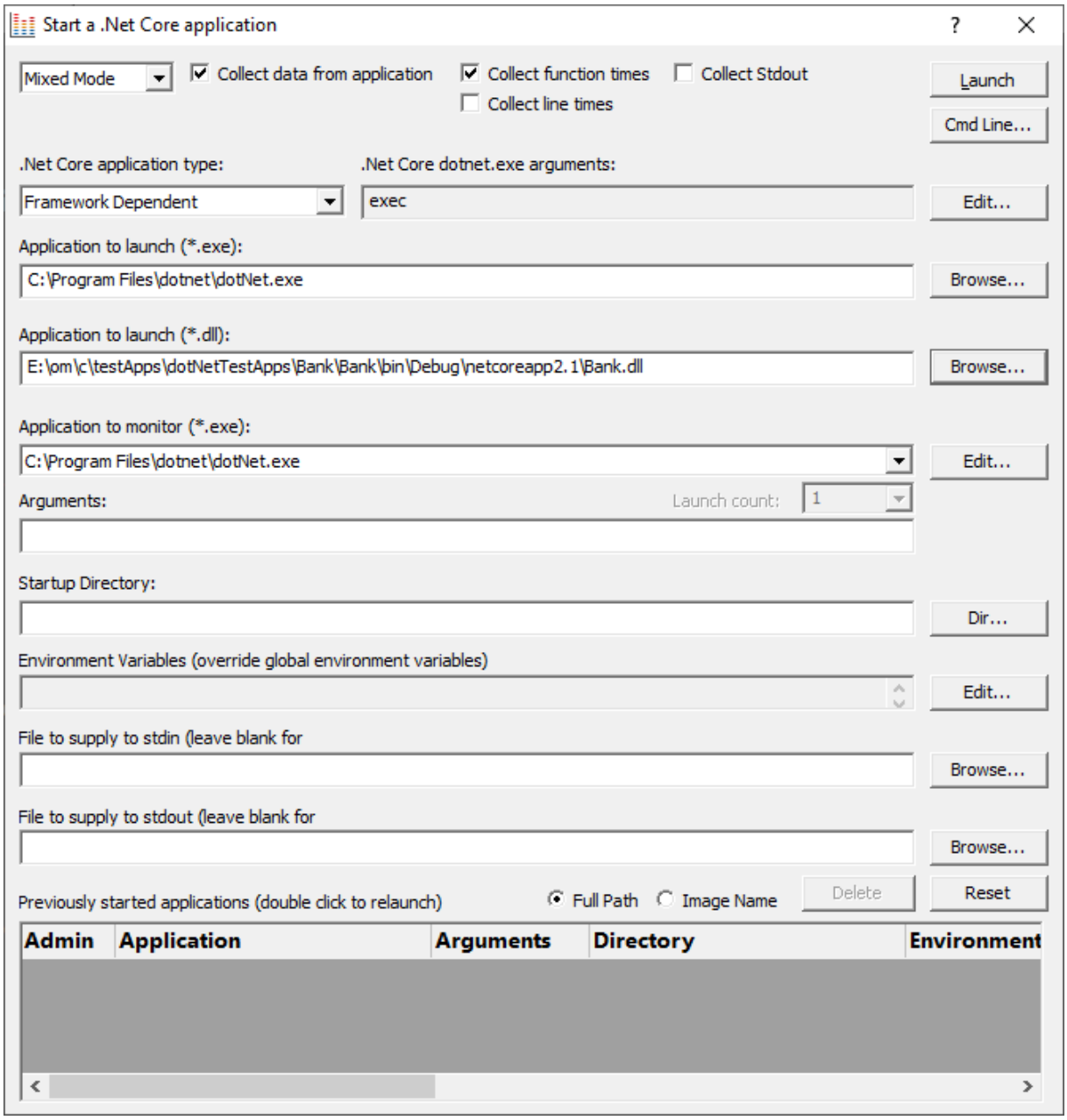
When you're ready to start running a .Net Core program

Launch menu › **Applications** › **Launch .Net Core Application** › Shows the .Net Core launch dialog below

Or use the shortcut

Shift + F4 Launch .Net Core Application

➜ You can easily re-launch the most recently run program.



.Net Core Application Type

.Net Core applications can be self contained or framework dependent. This changes how the launch dialog works.

- **.Net Core application type** › choose which type of .Net Core application you are launching

.Net Core Self Contained Application

- **Application to launch (*.exe)** › type or **Browse** to set the program name (*.exe) to launch

  When you set this value the Application to launch DLL field will be automatically populated to have the same name as the EXE field but with a .DLL extension.

- **Application to launch (*.dll)** › type or **Browse** to set the program name (*.dll) to launch

- **Application to monitor** › choose the application that actually gets monitored

  This will typically just be the program that you set to start - unless otherwise specified.

  Alternatively you can monitor another application which will get launched by the start program.

  If the start application has already been added to the Applications to Monitor settings with a default application then that default will be entered here automatically.

  Otherwise, if nothing has been set up yet, you can do it from here:

  - **Edit...** › set the child applications that can be monitored for the start program

    This uses the Applications to Monitor dialog - which is exactly equivalent to using the Applications to Monitor settings page.

  A fallback option is to start monitoring `<<Any application that is launched>>`.

  If in doubt, just use the same as the start application.

  ➔ See also: Application to Monitor settings

.Net Core Framework Dependent Application

- **Application to launch (*.exe)** › type or **Browse** to set the program name (*.exe) to launch

  We don't auto-populate this field when you choose the Framework dependent application type. This because you may have your .Net Core runtime stored in a location that we can't auto-detect.

  To accommodate alternate locations for the .Net Core runtime we only auto-populate this field if it is empty when you choose the application DLL.

- **Application to launch (*.dll)** › type or **Browse** to set the program name (*.dll) to launch

If you set this when Application to launch EXE field is empty, the EXE field will be automatically populated with the path to the system .Net Core framework dependent runtime.

This is typically **c:\program files\dotnet\dotnet.exe**.

- **Application to monitor** › choose the application that actually gets monitored

  This will typically just be the program that you set to start - unless otherwise specified.

  Alternatively you can monitor another application which will get launched by the start program.

  If the start application has already been added to the Applications to Monitor settings with a default application then that default will be entered here automatically.

  Otherwise, if nothing has been set up yet, you can do it from here:

  - **Edit...** › set the child applications that can be monitored for the start program

    This uses the Applications to Monitor dialog - which is exactly equivalent to using the Applications to Monitor settings page.

  A fallback option is to start monitoring `<<Any application that is launched>>`.

   If in doubt, just use the same as the start application.

  ➜ See also: Application to Monitor settings

- **.Net Core dotnet.exe arguments** › any arguments that will be passed to the .Net Core runtime to control how the .Net Core runtime behaves.

- **Edit...** › displays the .Net Core runtime arguments editor

Fields common to all .Net Core applications

- **Launch Count** › when monitoring a *child* application, set its n^{th} invocation as the one to monitor

  If the application to start is the same as the application to monitor then this is set to 1 and cannot be changed.

  This will be reset to 1 every time the Application to Monitor field selection changes.

   If in doubt, leave it set to 1.

  ➜ See also: Launch Count.

- **Command Line Arguments** › enter program arguments exactly as passed to the target program

- **Startup Directory** › enter or click **Dir...** to set the directory for the program to start in

  When setting your target program, this will default to the location of the executable

- **Environment Variables** › click **Edit...** to set any additional environment variables before your program starts

  These are managed in the Environment Variables Dialog.

- **File to supply to stdin** › optionally enter or **Browse** to set a file to be read and piped to the standard input of the application

- **File to supply to stdout** › optionally enter or **Browse** to set a file to be written with data piped from the standard output of the application

Using details from a previous run

The list at the bottom of the wizard shows previously run programs.

Selecting an item in the list populates all the details above as used on the last run for that program.

You can still edit those details before starting.

- **Full path** › shows the full path to the executable in the list
- **Image Name** › shows the short program name without path
- **Delete** › removes a selected program from the list
- **Reset** › clears all details in the wizard - including the list of previously run applications below

Data collection and redirection

- **Type of data collection** › Are you only interested in Native data, .Net data or both Native data and .Net data?
  - **Native Only** › Ignore all .Net data in the target application.
  - **.Net Only** › Ignore all Native data in the target application.
  - **Mixed Mode** › Collect both Native and .Net data from the target application

  This setting cannot be changed after the application is launched

- **Collect data from application** › If it's the startup procedure you want to validate, obviously start collecting data from launch.

  Depending on your application, and what you want to validate, you may want to start collecting data immediately, or do it later.

  If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

➜ See the section on controlling data collection for how to turn collection on and off after launch.

- **Redirect standard output** › Controls redirection of stdout and stderr

  Use this option if you want to collect the output of stdout and stderr for later analysis.

  Be aware that if the output of the program under test generates a lot of data via stdout or stderr that this data will need to be stored in memory and could exhaust Performance Validator's memory.

- **Display command prompt** › Shows or hides the launched application.

  If you are collecting stdout and stderr you may not be interested in viewing the application (or the command prompt if it is a console application). This provides you the option to hide the application when it is running.

  Be aware that if you hide a command prompt you will not be able to type anything into the application.

The option to start collecting data is at the top.

- **Launch** › start your program and attach Performance Validator to it

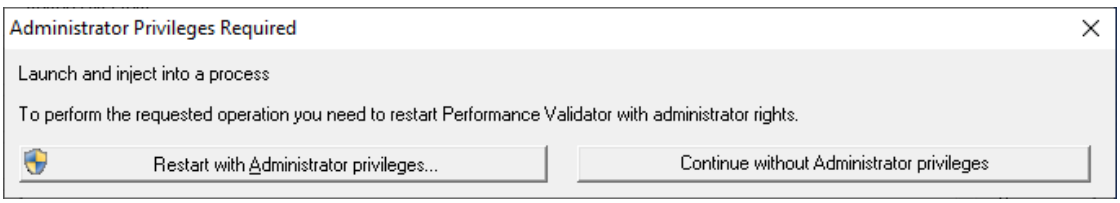
  Double clicking a program in the list will also start it immediately.

- **Cmd Line...** › display the command line builder

Administrator privileges in dialog mode

If administrator privileges are required, the Launch button will show the privileges icon reminding you of the need to restart.

- **Launch** › shows the Administrator Privileges Required confirmation dialog before restarting



If you started Performance Validator in administrator mode, you won't see any of these warnings, and everything will behave as normal.

How do I use Application to Monitor and Launch Count?

The three fields **Application to Start**, **Application to Monitor** and **Launch Count** work together to control which application actually gets monitored by Performance Validator.

Let's say we have a program **P**.

In the simplest case, simply:

- *start* **P**
- *monitor* **P**
- the Launch Count defaults to **1** and cannot be changed.

If **P** launches an application and you just want to monitor whatever that is:

- *start* **P**
- *monitor* `<<Any application that is launched>>`
- leave the Launch Count at **1**

If **P** launches an application **A** and maybe others as well, and you specifically want to monitor only **A** as it's launched:

- use the Application to Monitor settings to add a definition for P and child applications **A**
- *start* **P**
- *monitor* **A**
- leave the Launch Count at **1**

If **P** launches an application **A** many times and you specifically want to monitor the third invocation:

- use the Application to Monitor settings to add a definition for P and child applications **A**
- *start* **P**
- *monitor* **A**
- set the Launch Count to **3**

3.15.4 Re-Launching the program

Re-launching the application

It's very easy to start another session using the most recently run program and settings:

Launch menu › **Applications** › **Re-Start Application...** › starts the most recently launched program

or click on the re-launch icon on the session toolbar.

or use the shortcut

F5 Re-start application

If the previously launched program was Native, .Net or .Net Core the application will be restarted immediately. No wizards or dialogs appear.

If the previously launched program was a service the appropriate monitor service dialog will be displayed.

➡ In the general questions see *Why might Inject or Launch fail?* for troubleshooting launch problems.

There is no difference between wizard and dialog interface mode when re-launching.

3.15.5 Injecting into a running program

Injecting into a running program

Performance Validator attaches to a running process by injecting the stub into the process so it can start collecting data.

Choose one of these methods of starting the injection:

Launch menu › **Applications** › **Inject...** › shows the Attach to Running Process wizard or dialog below

Or click on the Inject icon on the session toolbar.

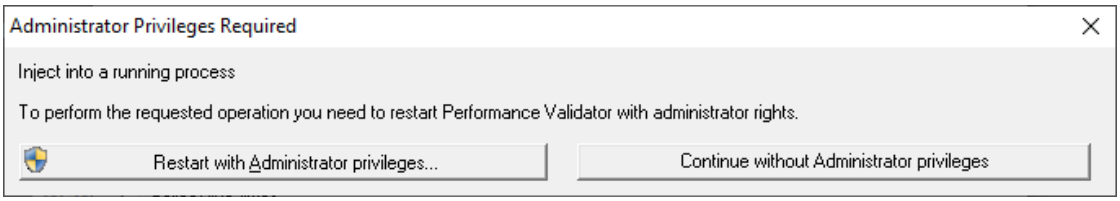
Or use the shortcut

F3 Inject into running application

Administrator privileges

The following applies only if you did *not* start Performance Validator in administrator mode.

When choosing the inject method described in this topic, a restart of Performance Validator with administrator privileges will be required to proceed.



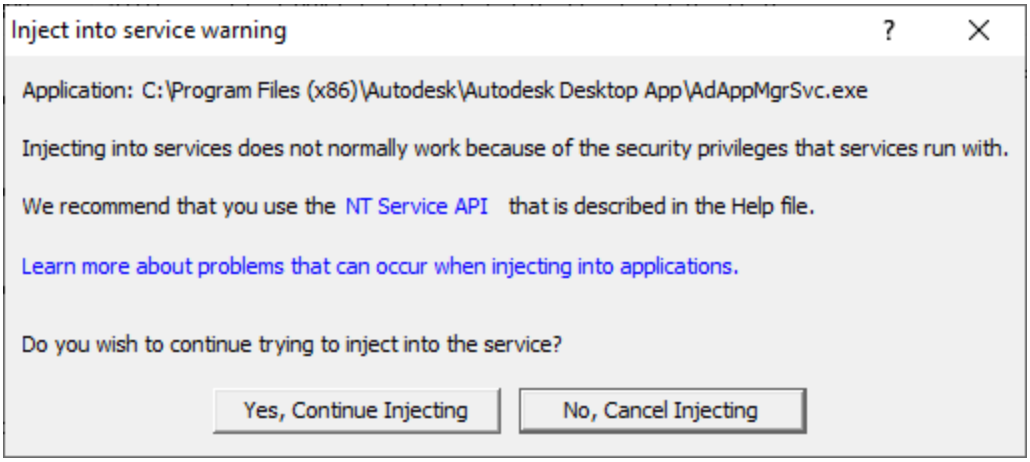
Injecting into a service?

If your process is a service, Performance Validator won't be able to attach to it.

Services can't have process handles opened by third party applications, even with Administrator privileges.

In order to work with services, you can use the NT service API and monitor the service

You may see this warning dialog when trying to inject into a service:



User interface mode

There are two interface modes used while starting a program

- **Wizard** mode guides you through the tasks in a linear fashion
- **Dialog** mode has all options contained in a single dialog

All the options are the same - just in slightly different places

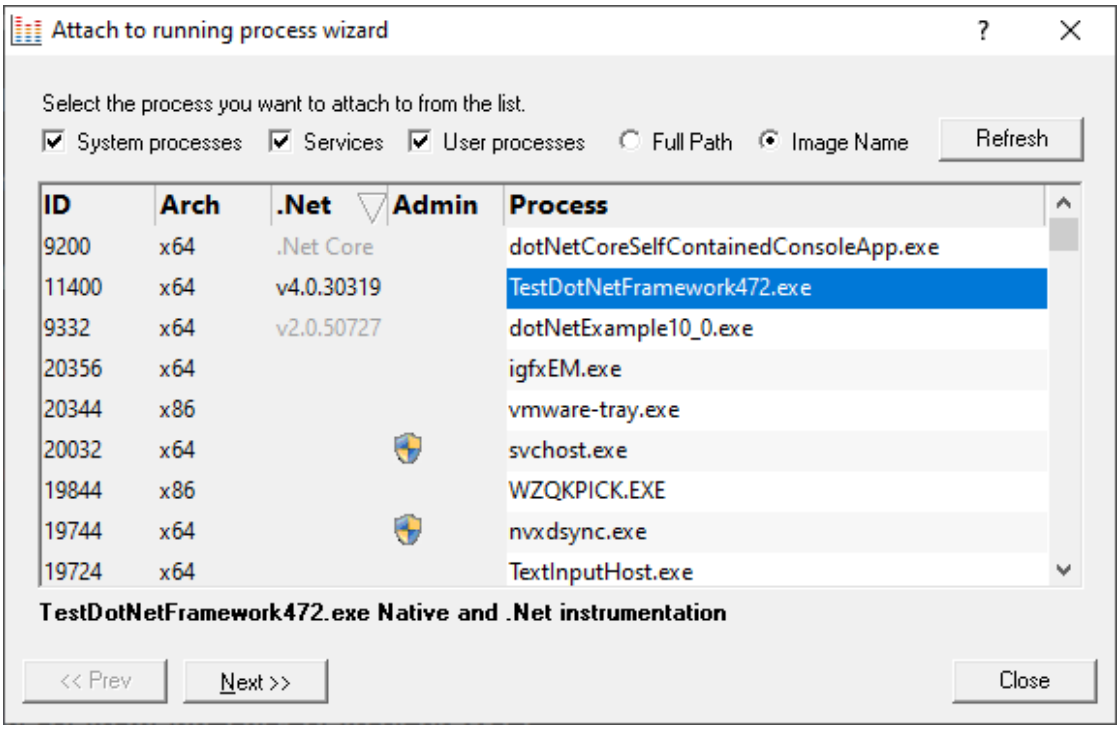
In this section we'll cover the Wizard mode first and the Dialog mode later.

The attach to running process wizard

The first page of the wizard shows a list of running system and user processes.

The **Arch** column is not shown when running 32 bit Performance Validator because only 32 bit processes are listed.

Any processes that have grayed out **.Net** values cannot instrument the .Net part of the application (native components will be instrumented).



The list shows the following information:

- **ID** › The process ID
- **Admin** › may show a symbol to indicate a requirement for administrator privileges in order to run the program.

  This requirement is automatically detected from the manifest for the process.
- **Process** › The process executable name

Choose a process before continuing:

- **Next >>** › move to the next page of the wizard

  The button will show the symbol if you have selected a process which requires elevated privileges to run.

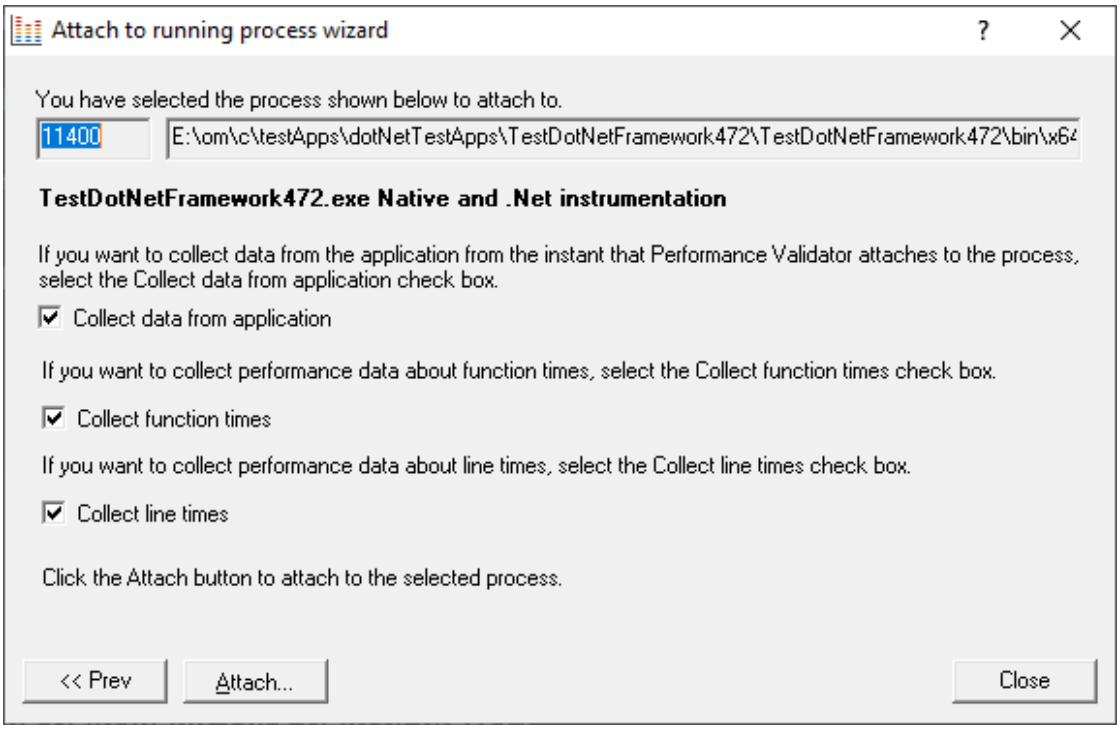
Page 1: Choosing the process

- **System processes / Services / User processes** › show any or all of services and system or user processes in the list
- **Full path** › shows the full path to the process executable in the list
- **Image Name** › shows the short program name without path
- **Refresh** › update the list with currently running processes

Clicking on the headers of the list will sort them by ID or by name using the full name or short name, depending on what's displayed.

Page 2: Data collection

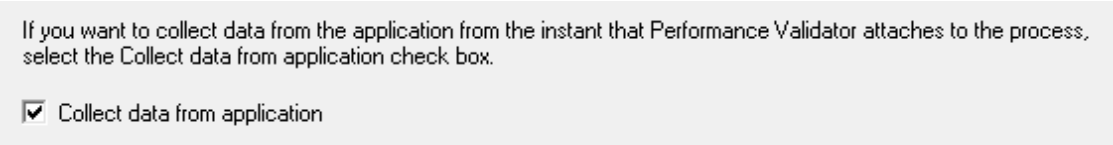
The second page controls what information to collect and when to start collecting it.



Depending on your application, and what you want to test, you may want to start collecting data as soon as injection happens, or do it later.

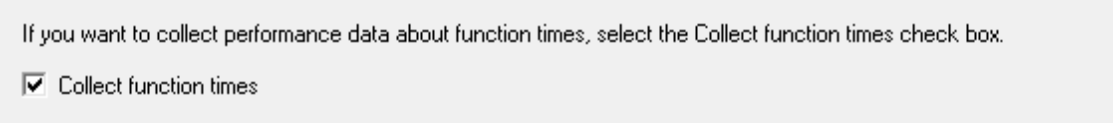
If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

- **Collect data from application** › if it's the startup performance you want to monitor, then obviously start collecting data from launch

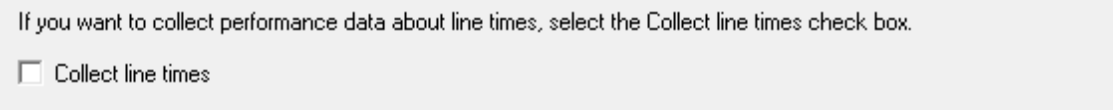


➜ See the section on controlling data collection for how to turn collection on and off after launch.

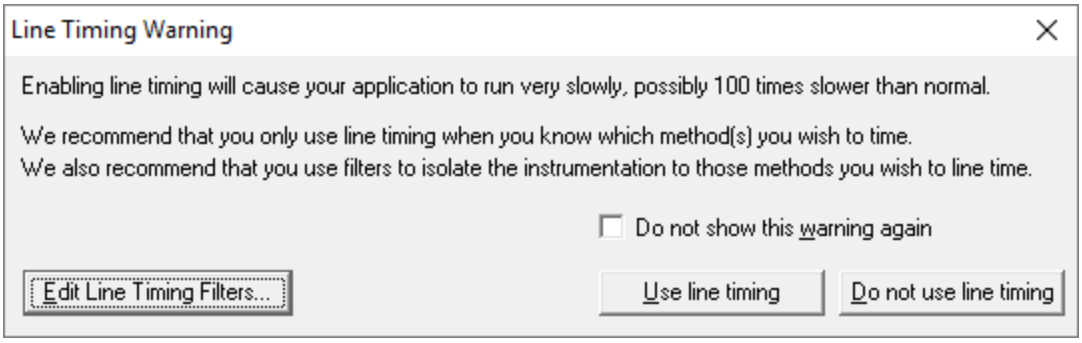
- **Collect function times** › tick to collect data that will allow overall function timings to be calculated



- **Collect line times** › tick to allow individual line timings to be calculated



A warning dialog *may* be displayed to remind you of the possible performance slowdown when using line timing.



This warning only appears if the Enable line timing warning option on the Performance settings is checked.

The option at the bottom to edit line timing filters can be used to set specific classes, methods and functions to be included in, or excluded from, the hooking process and is identical to the Line Timing Filters page of the global settings dialog.

Unchecking function *and* line times means not collecting any data at all!

Currently we only support attaching to native applications and the native part of mixed mode applications.

Summary and starting your program

The second page also confirms at the top which process you have selected to inject into, and prompts you to attach:

- **Attach...** › injects Performance Validator into the specified process, showing progress status

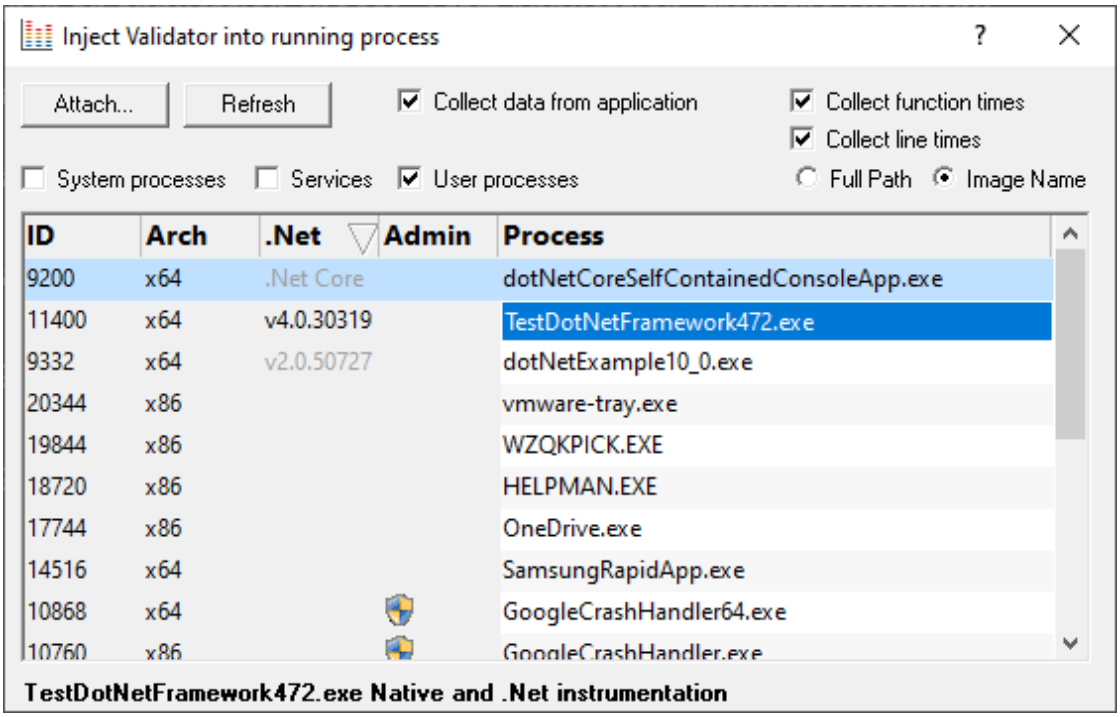
  The button will show the symbol if you have selected a process which requires elevated privileges to run.

➜ In the general questions see *Why might Inject or Launch fail?* for troubleshooting launch problems.

Dialog mode

In Dialog mode, all the settings are in one dialog but which still looks similar to the first page of the wizard above.

The option of when to start collecting data, and whether to collect function and line times is at the top, as is the **Attach...** button itself.



3.15.6 Waiting for a program

Waiting for a program

Waiting for a program is essentially the same as injection except that instead of injecting into a running program, Performance Validator watches for the process starting up and *then* injects.

If the process is a service, Performance Validator won't be able to attach to it as services can't have process handles opened by third party applications, even with Administrator privileges.

Choose one of these methods of waiting:

Launch menu > **Applications** > **Wait for Application...** > shows the Wait for application wizard or dialog below

or click on the Wait (timer) icon on the session toolbar.

or use the shortcut

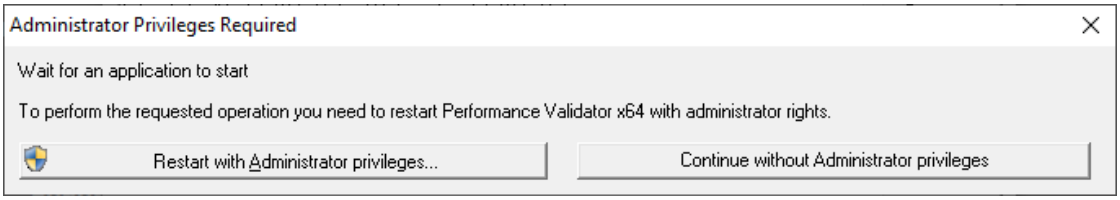
F2 Wait for application

Administrator privileges

The following applies only if you did *not* start Performance Validator in administrator mode.

If the application you want to wait for is running with Administrator privileges, Performance Validator will also need to run with Administrator privileges.

When choosing the 'wait for program' method described in this topic, a restart of Performance Validator with administrator privileges will be required to proceed.



Waiting for a service?

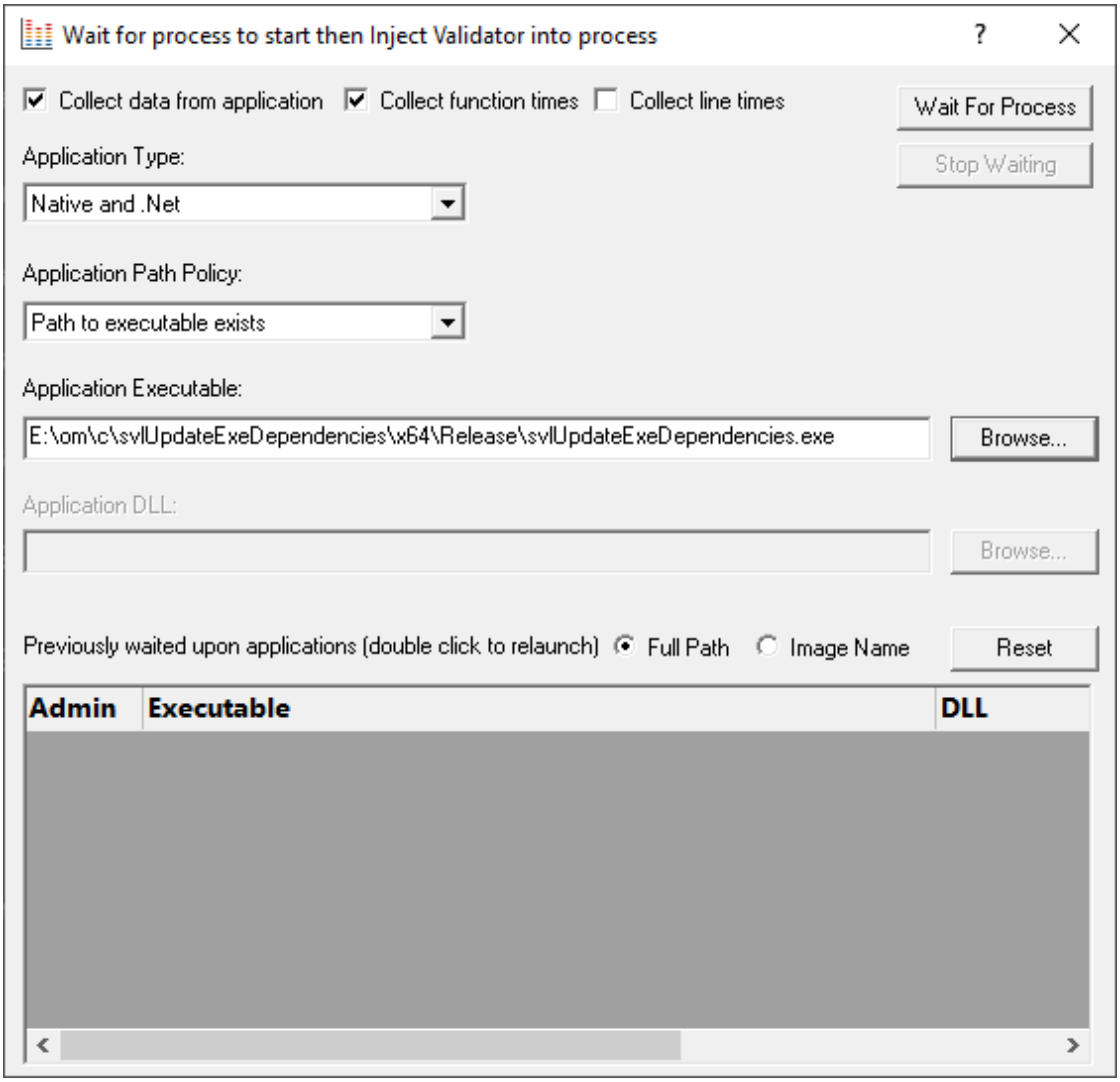
If your process is a service, Performance Validator won't be able to attach to it.

Services can't have process handles opened by third party applications, even with Administrator privileges.

In order to work with services, you can use the NT service API and monitor the service

The wait for application dialog

The wait for application dialog lets you specify the application or choose one that you've waited for previously.



- **Collect data from application** › do want to collect data from the instant you attach to the application?

  Depending on your application, and what you want to validate, you may want to start collecting data as soon as injection has happened, or do it later.

  If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

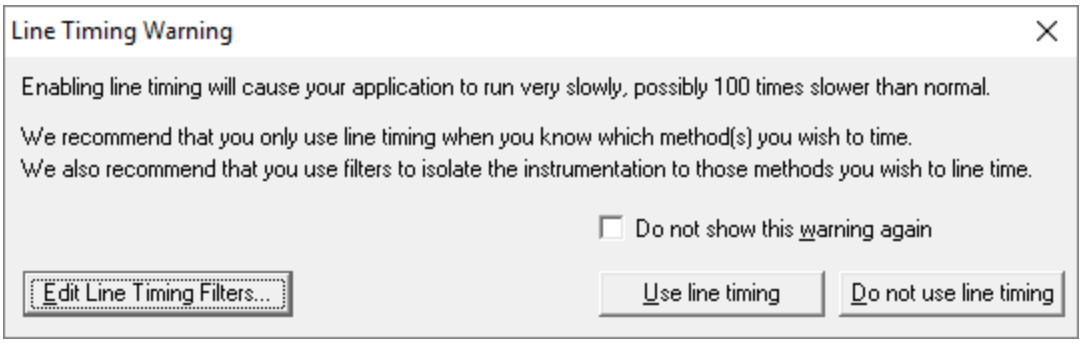
  If it's the startup procedure you want to validate, obviously start collecting data from launch.

  ➡ See the section on controlling data collection for how to turn collection on and off after launch.

- **Collect function times** › tick to collect data that will allow overall function timings to be calculated

- **Collect line times** › tick to allow individual line timings to be calculated

  A warning dialog *may* be displayed to remind you of the possible performance slowdown when using line timing.



  This warning only appears if the Enable line timing warning option on the Performance settings is checked.

  The option at the bottom to edit line timing filters can be used to set specific classes, methods and functions to be included in, or excluded from, the hooking process and is identical to the Line Timing Filters page of the global settings dialog.

  Unchecking function *and* line times means not collecting any data at all!

- **Application Path Policy** › specify how the specified executable is treated
  - Path to executable exists › the executable will be checked that it exists and is appropriate for Performance Validator to work with
  - Path to executable is created dynamically › most pre-wait checks are not performed - use this if the path the executable is on does not exist at the time you start waiting for the process to start

- **Application type** › choose the type of application
  - Native and .Net
  - .Net Core (Framework Dependent)
  - .Net Core (Self Contained)

- **Application Executable** › edit or **Browse...** the application to wait to start.

  The name of the executable. For example **c:\unitTests\test.exe** or **test.exe**.

  If Application Path Policy is **Path to executable exists** this must be the full path to the executable. For example **c:\unitTests\test.exe**.

  For native applications this is the application executable.

  For .Net Framework applications this is the application executable.

For .Net Core Framework-dependent applications this is most likely going to be **c:\program files\dotnet\dotnet.exe**.

For .Net Core Self-contained applications this is the application executable.

- **Application DLL** › edit or **Browse...** the application DLL to wait to start. This field is only needed for .Net Core applications.

  The name of the DLL. For example **c:\unitTests\test.dll** or **test.dll**.

  If Application Path Policy is **Path to executable exists** this must be the full path to the dll. For example **c:\unitTests\test.dll**.

  For native applications this is not used.

  For .Net Framework applications this is not used.

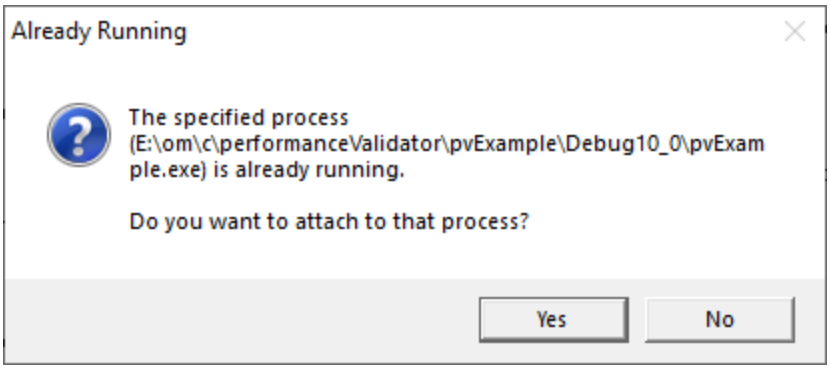
  For .Net Core Framework-dependent applications this is the application dll. (the name of the dll that you would pass to dotnet.exe on the command line).

  For .Net Core Self-contained applications this is the dll that has the same name as the application executable. (for theApp.exe, the dll name is theApp.dll).

- **Full path** › shows the full path to the process executable in the list
- **Image Name** › shows the short program name without path
- **Reset** › clears the list
- **Wait for Process...** › starts waiting and then injects Performance Validator into the specified process, showing progress status
- **Stop Waiting** › stops the wait

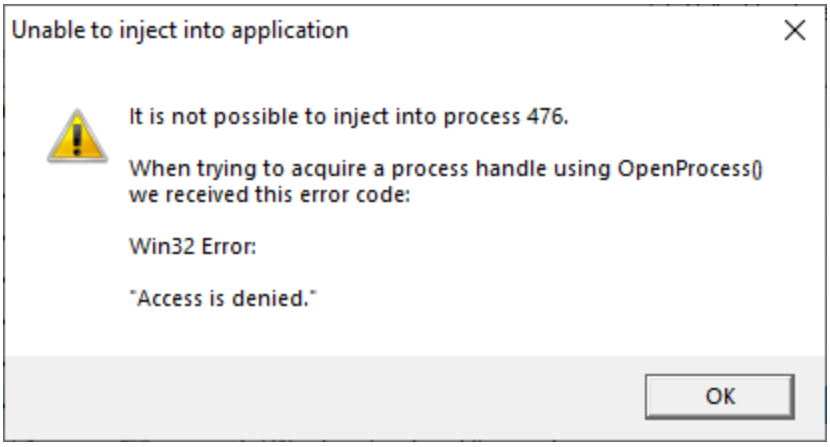
What could go wrong?

The program you're waiting for might already be running, in which case you'll be given the option to cancel or attach to the existing process:



Timing issues are inherit with native injecting into a program as it starts up.

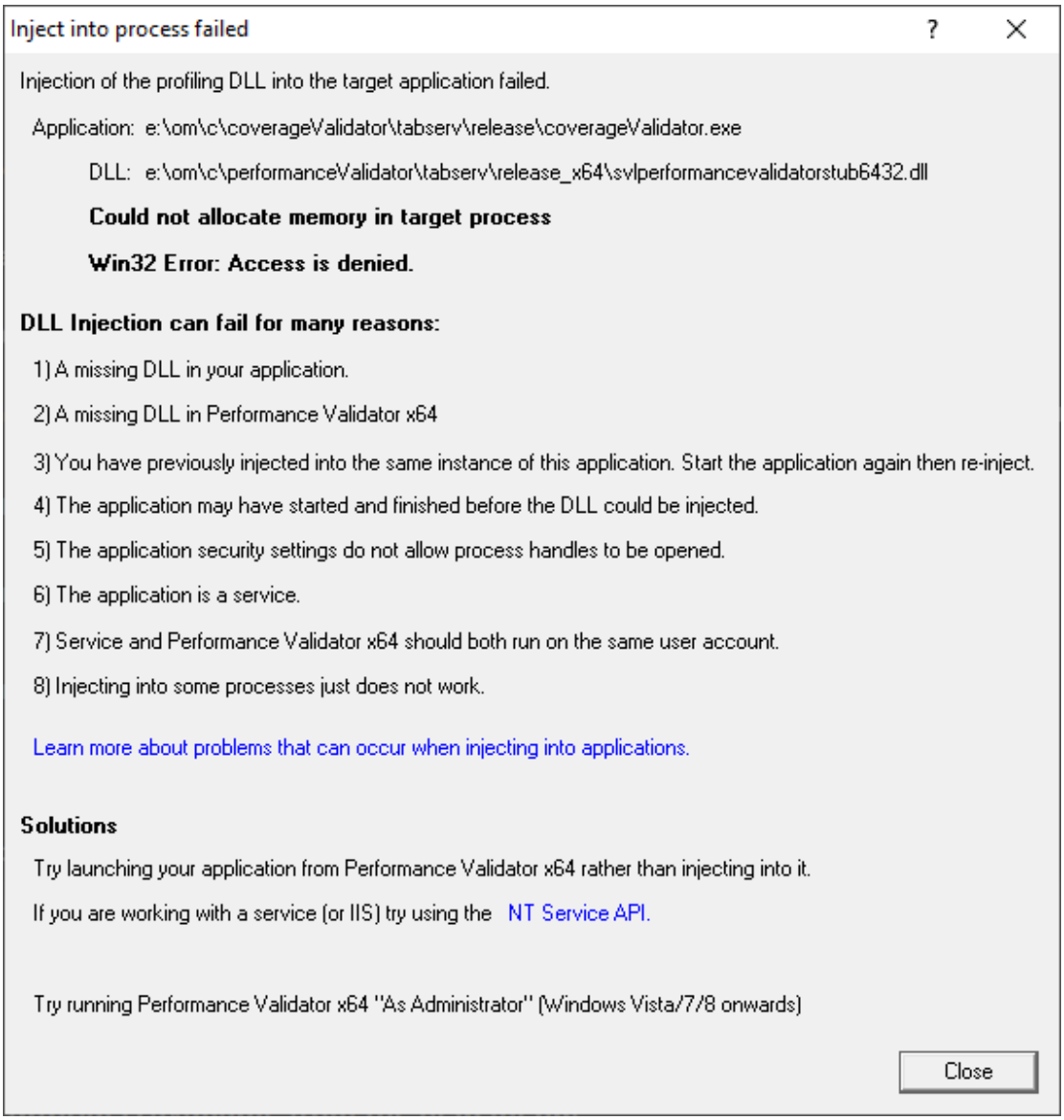
This could cause the injection to fail in unpredictable ways and you may see dialogs like that below:



One case when this dialog can occur is if the program needs to run at an elevated privilege and is waiting for the user to give permission via the UAC dialog.

Injection may fail for different reasons and you might see the following information dialog showing:

- messages relating to the specific failure
- a selection of reasons why failure might be occurring
- some possible solutions to the problem

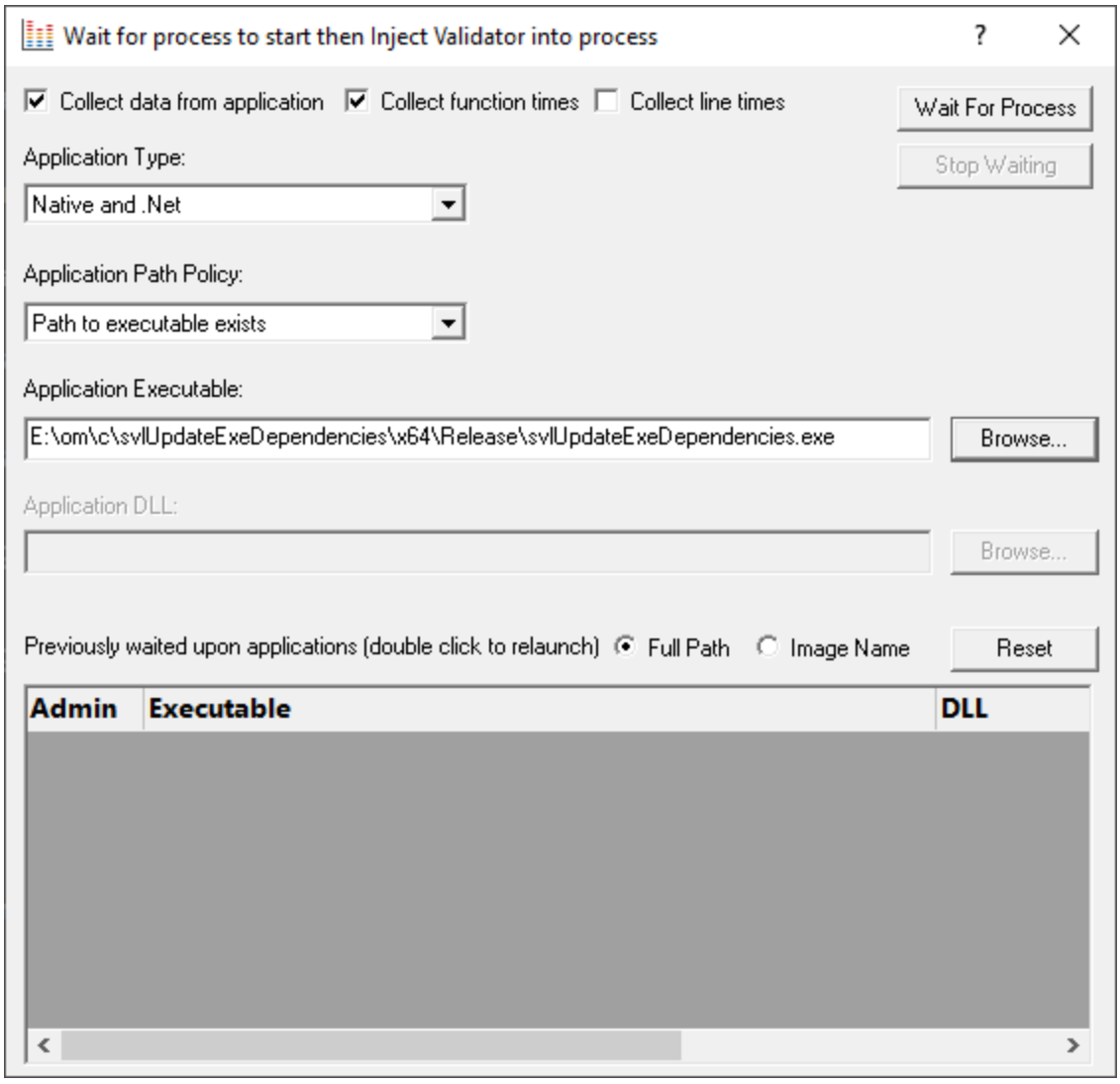


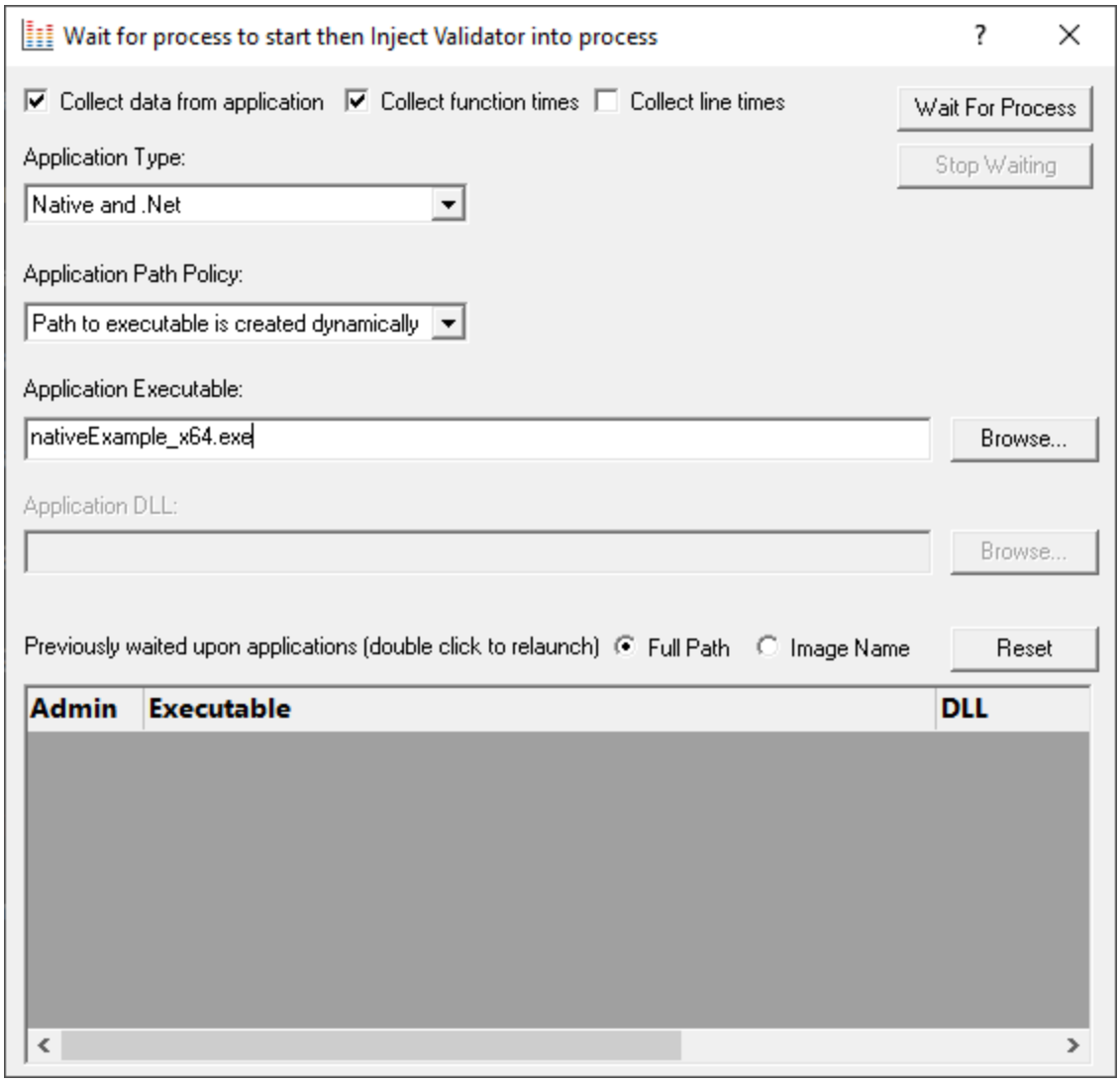
Sometimes retrying a few times might catch a better moment for attaching to the process.

➡ In the general questions see *Why might Inject or Launch fail?* for troubleshooting launch problems.

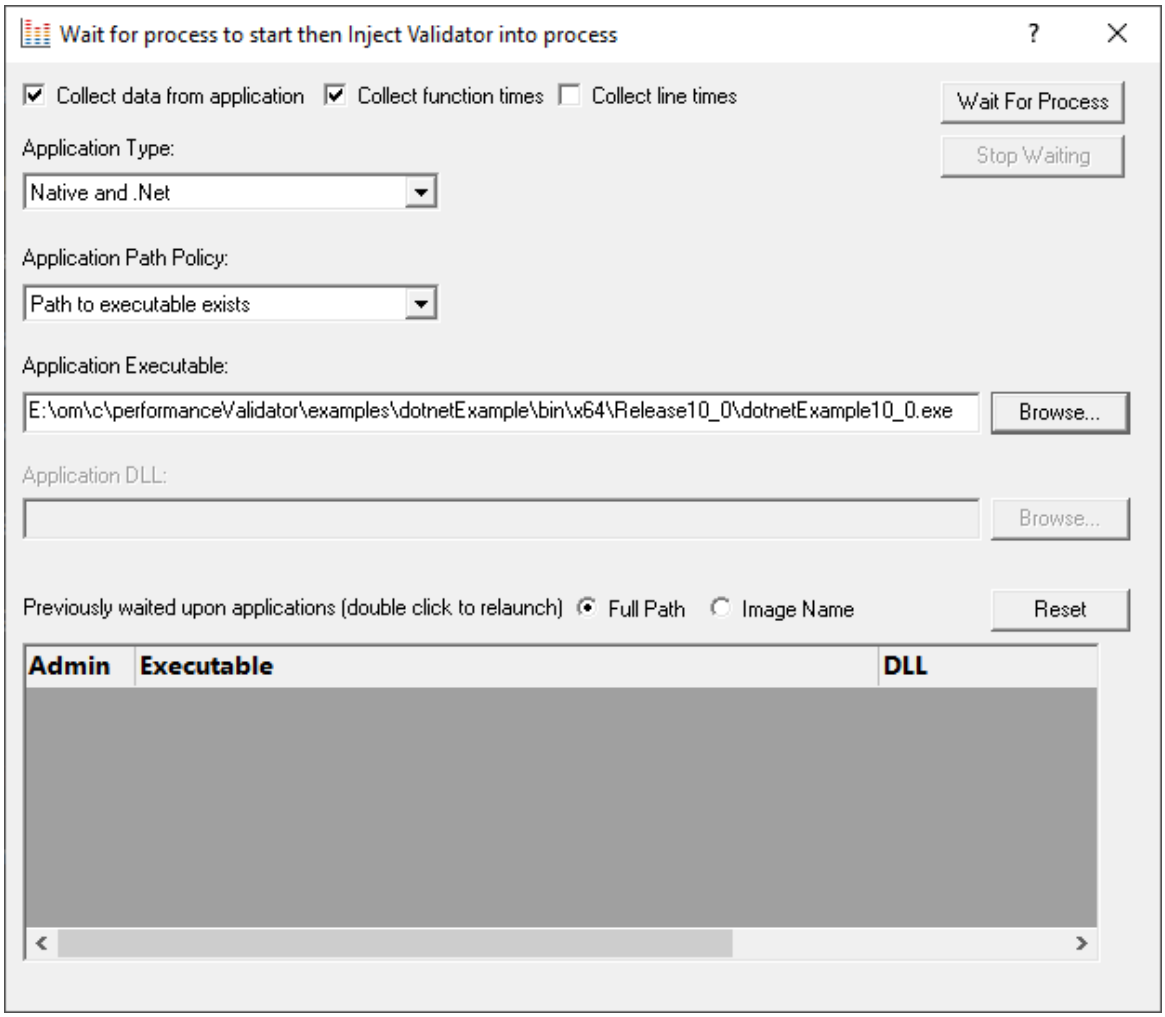
Example Dialogs

Native

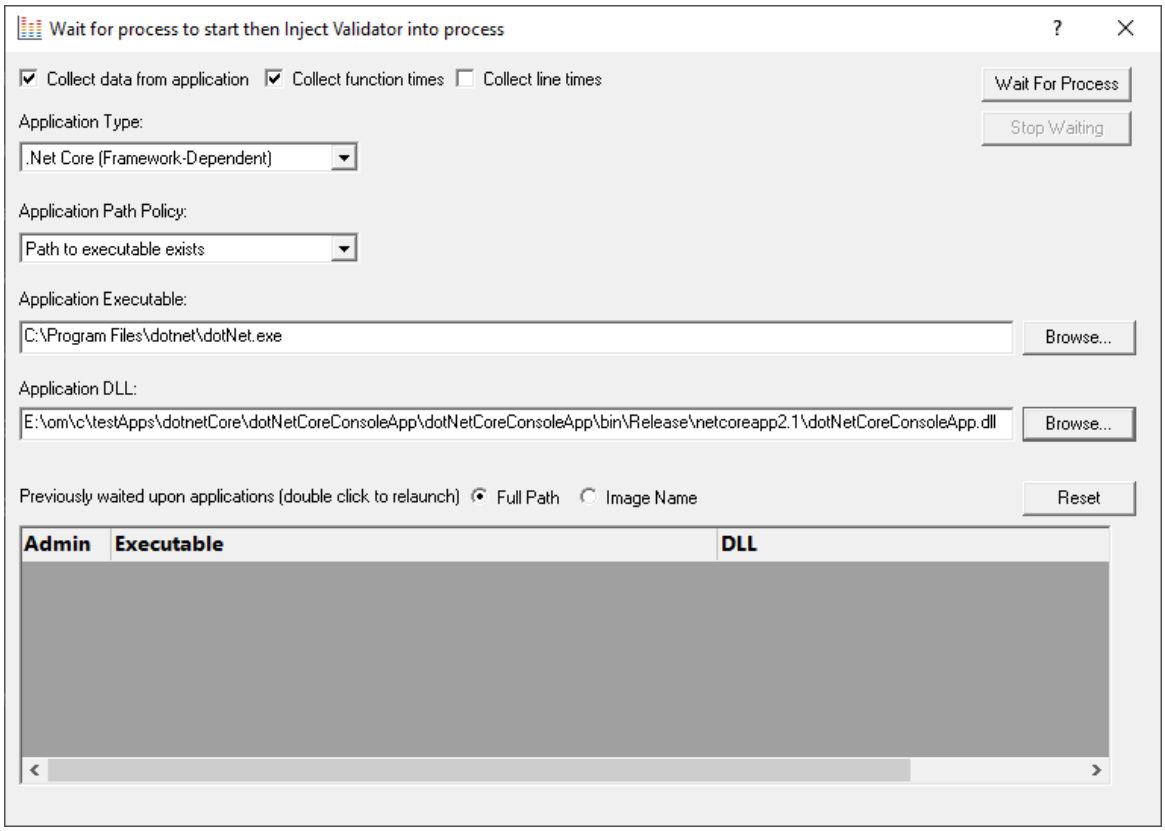




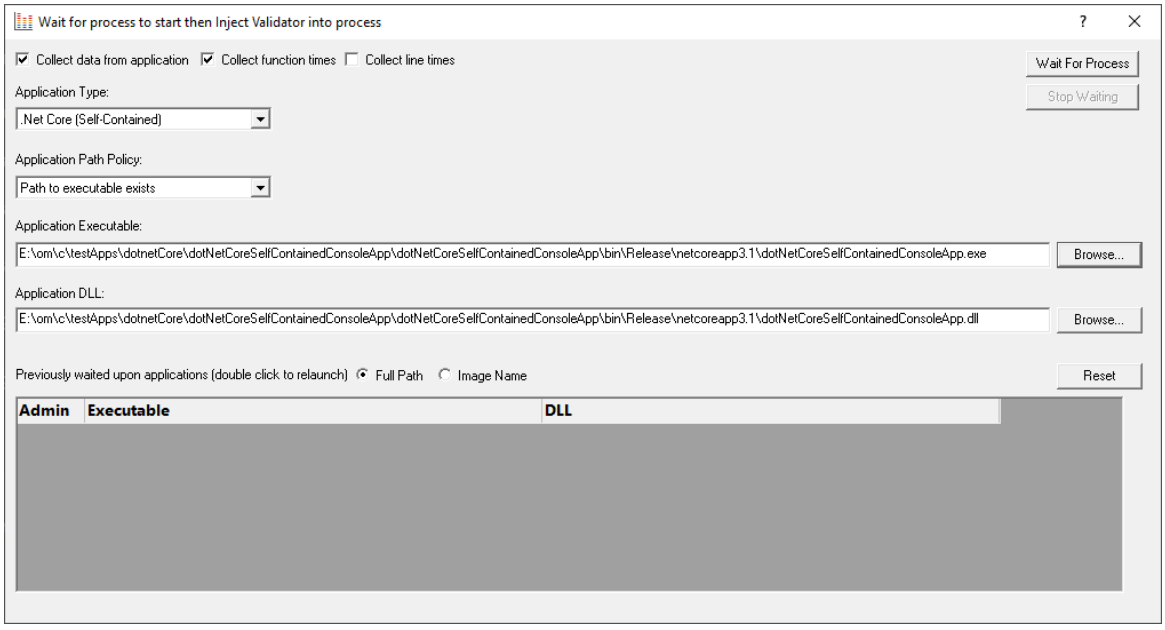
.Net



.Net Core (Framework-dependent)



.Net Core (Self-contained)



3.15.7 Monitor a service

Monitoring a service

Monitoring a service works for:

- Native services
- .Net services
- Mixed mode services.

Native Services

If you are working with native services you must use the NT Service API in your service *as well as* using the Monitor a service method below.

.Net Services

Performance Validator won't attach until some .Net code is executed.

If there is native code being called prior to the .Net code, Performance Validator won't monitor that code, only the native code called after the first .Net code that is called.

To monitor any native code called *prior* to your .Net code, use the NT Service API.

Mixed Mode .Net Services

You don't need to use the NT Services API.

If you are working with a .Net service that loads native DLLs, or a mixed mode service, Performance Validator will recognize the service when the .Net runtime starts executing the .Net service main.

 When working with Performance Validator and services, you still start the service the way you normally do - e.g. with the service control manager.

The code that you have embedded into your service then contacts Performance Validator, which you should have running before starting the service.

To start monitoring a service:

 **Launch** menu > **Services** > **Monitor a service...** > shows the Monitor a service dialog below

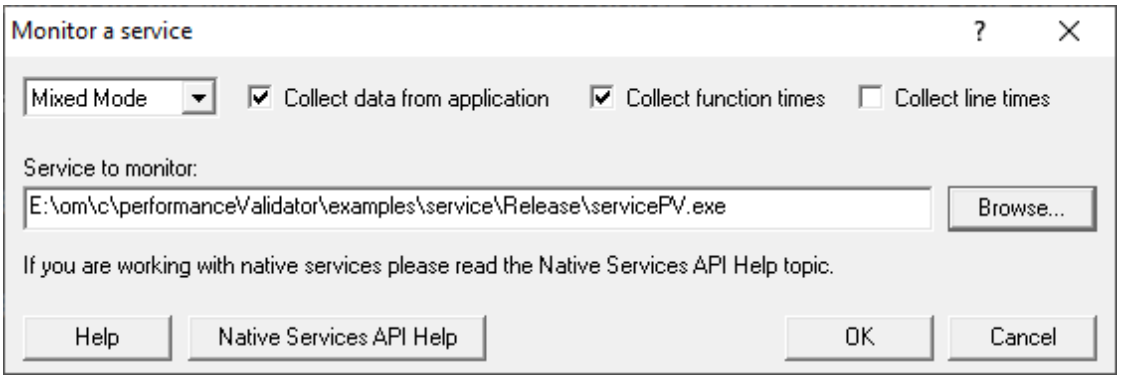
Or use the shortcut

 Monitor a service

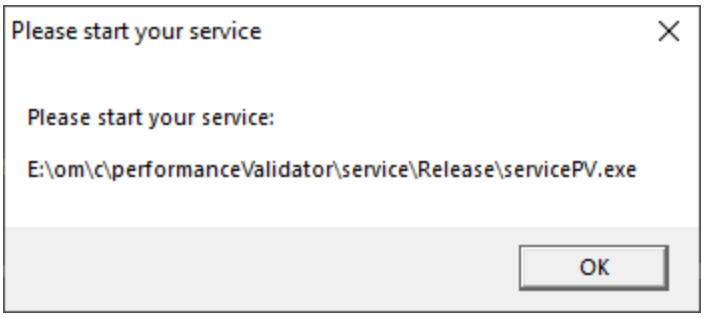
The monitor a service dialog

First ensure the service is installed, but not running.

Set the service to monitor, choose whether to start collecting data right away, and click OK.



- **Service to monitor** › type or **Browse** to set the service name to monitor
- **OK** › performs some brief setup work and then prompts you to start the service



Click OK to close the dialog and then start your native service or .Net service.

Start the service in the normal manner, e.g. from the control panel, the command line or programmatically.

Data collection

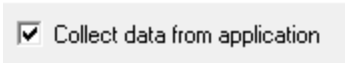
- **Type of data collection** › Are you only interested in Native data, .Net data or both Native data and .Net data?
  - **Native Only** › Ignore all .Net data in the target application.
  - **.Net Only** › Ignore all Native data in the target application.
  - **Mixed Mode** › Collect both Native and .Net data from the target application

  This setting cannot be changed after the application is launched
- **Collect data from application** › If it's the startup procedure you want to validate, obviously start collecting data from launch.

Depending on your application, and what you want to validate, you may want to start collecting data immediately, or do it later.

If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

➜ See the section on controlling data collection for how to turn collection on and off after launch.

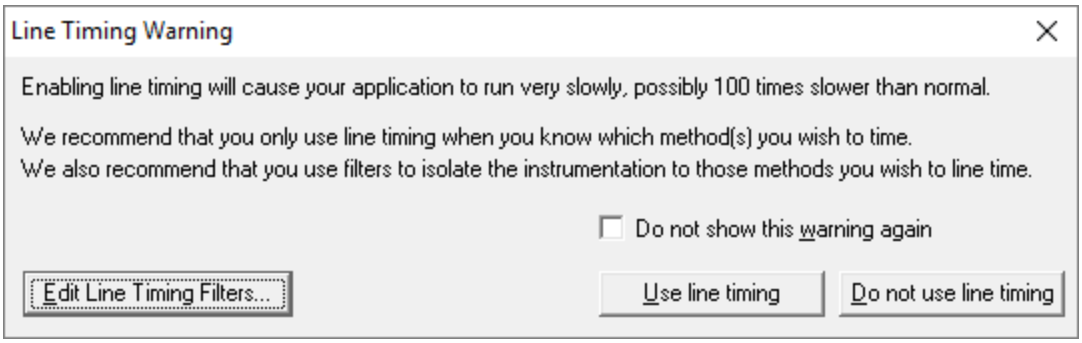


➜ See the section on controlling data collection for how to turn collection on and off after launch.

- **Collect function times** › tick to collect data that will allow overall function timings to be calculated

- **Collect line times** › tick to allow individual line timings to be calculated

A warning dialog *may* be displayed to remind you of the possible performance slowdown when using line timing.



This warning only appears if the Enable line timing warning option on the Performance settings is checked.

The option at the bottom to edit line timing filters can be used to set specific classes, methods and functions to be included in, or excluded from, the hooking process and is identical to the Line Timing Filters page of the global settings dialog.

Slow Startup

The first time you work with Web Development Server and Performance Validator you may experience a delay during startup. This is most like because symbols are being downloaded from Microsoft's symbol servers to match the DLLs and assemblies on your machine.

Examples

Example demonstrating how to monitor a service.

Example demonstrating how to monitor an application launched from a service (how to monitor any application running on a service account).

3.15.8 IIS

3.15.8.1 Monitor IIS and ISAPI

Monitoring ISAPI

Monitoring ISAPI works for:

- Native ISAPI extensions.

Native ISAPI

If you are working with native ISAPI you must use the NT Service API in your service *as well as* using the Monitor ISAPI method below.

To start monitoring ISAPI:

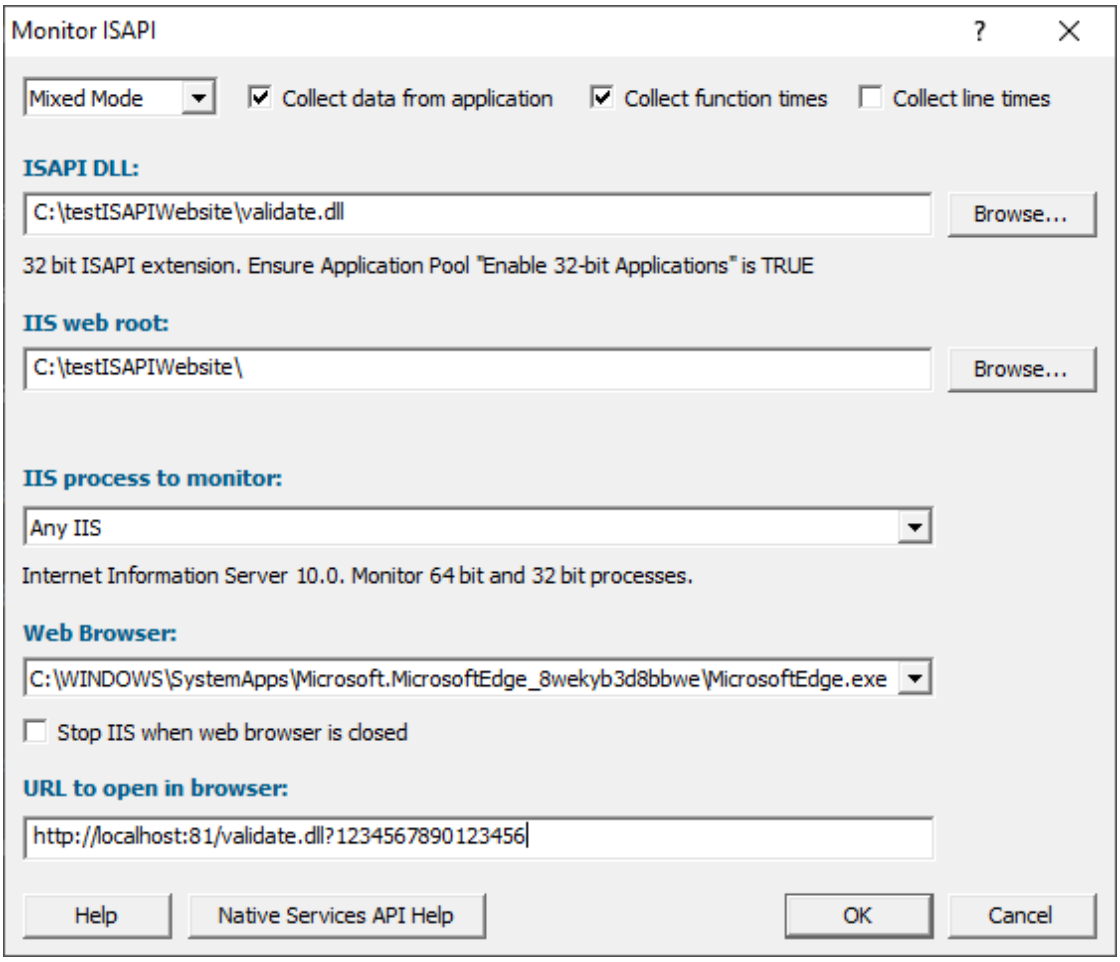
Launch menu › **Services** › **Monitor IIS and ISAPI...** › shows the Monitor ISAPI dialog below

Or use the shortcut

F7 Monitor IIS and ISAPI

The monitor ISAPI dialog

Set the dll to monitor, the web root, the IIS process, an optional web browser to use and an optional url to launch, and click OK.



- **ISAPI DLL** › type or **Browse** to set the ISAPI DLL that we're monitoring
- **IIS web** › type or **Browse** to set the web root for the IIS website we're working with
- **IIS process to monitor** › select the IIS process we're working with
- **Web Browser** › select the web browser that you're going to use to load the web page
- **URL to open in browser** › type the web page and arguments you want to load to cause the ISAPI to be loaded in IIS
- **OK** › resets IIS, setups all the variables, copies DLLs and settings into the web root and starts the web browser to load the specified web page

IIS is a protected process and can only execute, read and write files in specific directories. That's why Performance Validator copies data to the web root so that it can be read, written or executed.

Data collection

- **Type of data collection** › Are you only interested in Native data, .Net data or both Native data and .Net data?
  - **Native Only** › Ignore all .Net data in the target application.
  - **.Net Only** › Ignore all Native data in the target application.
  - **Mixed Mode** › Collect both Native and .Net data from the target application

  This setting cannot be changed after the application is launched

- **Collect data from application** › If it's the startup procedure you want to validate, obviously start collecting data from launch.

  Depending on your application, and what you want to validate, you may want to start collecting data immediately, or do it later.

  If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

  ➜ See the section on controlling data collection for how to turn collection on and off after launch.

  ➜ See the section on controlling data collection for how to turn collection on and off after launch.

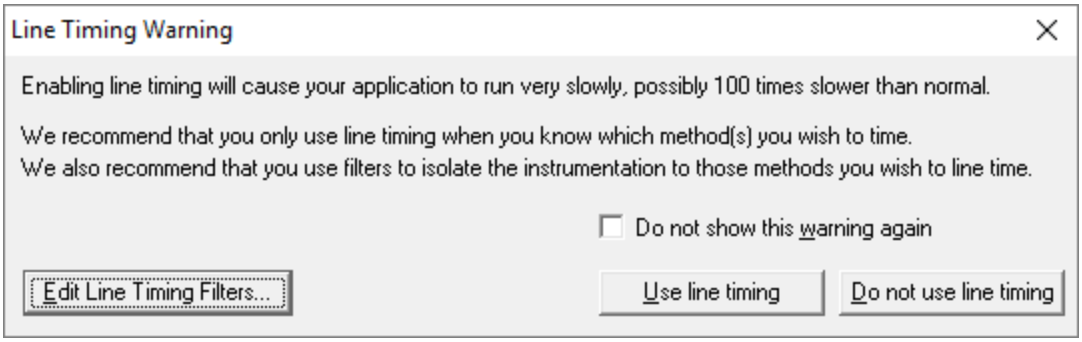
- **Collect function times** › tick to collect data that will allow overall function timings to be calculated

- **Collect line times** › tick to allow individual line timings to be calculated

  A warning dialog *may* be displayed to remind you of the possible performance slowdown when using line timing.

This warning only appears if the Enable line timing warning option on the Performance settings is checked.

The option at the bottom to edit line timing filters can be used to set specific classes, methods and functions to be included in, or excluded from, the hooking process and is identical to the Line Timing Filters page of the global settings dialog.

Slow Startup

The first time you work with Web Development Server and Performance Validator you may experience a delay during startup. This is most like because symbols are being downloaded from Microsoft's symbol servers to match the DLLs and assemblies on your machine.

3.15.8.2 Monitor IIS and ASP.Net

Monitoring ASP.Net Application (IIS)

To start monitoring ASP.Net application running in IIS:

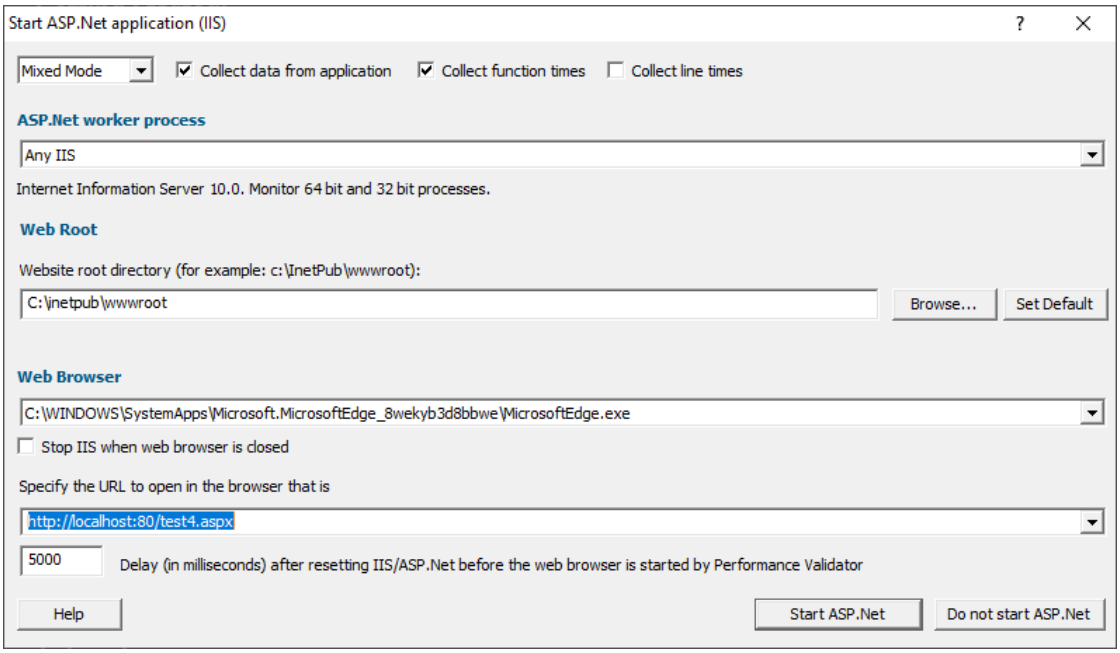
Launch menu › **Services** › **Monitor IIS and ASP.Net...** › shows the Start ASP.Net Application dialog below

Or use the shortcut

Monitor IIS and ASP.Net

The Start ASP.Net application dialog

Set the asp worker process, the web root, an optional web browser to use and an optional url to launch, and click OK.



- **ASP.Net worker process** › select the IIS process we're working with. This can be any ASP.Net process or a specific one. The default is **Any IIS**.
- **IIS web** › type or **Browse** to set the web root for the IIS website we're working with
- **Web Browser** › select the web browser that you're going to use to load the web page
- **URL to open in browser** › type the web page and arguments you want to load to cause the ISAPI to be loaded in IIS
- **OK** › resets IIS, setups all the variables, copies DLLs and settings into the web root and starts the web browser to load the specified web page

IIS is a protected process and can only execute, read and write files in specific directories. That's why Performance Validator copies data to the web root so that it can be read, written or executed.

Data collection

- **Type of data collection** › Are you only interested in Native data, .Net data or both Native data and .Net data?
  - **Native Only** › Ignore all .Net data in the target application.
  - **.Net Only** › Ignore all Native data in the target application.
  - **Mixed Mode** › Collect both Native and .Net data from the target application

  This setting cannot be changed after the application is launched

- **Collect data from application** › If it's the startup procedure you want to validate, obviously start collecting data from launch.

  Depending on your application, and what you want to validate, you may want to start collecting data immediately, or do it later.

  If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

  ➜ See the section on controlling data collection for how to turn collection on and off after launch.

  ➜ See the section on controlling data collection for how to turn collection on and off after launch.

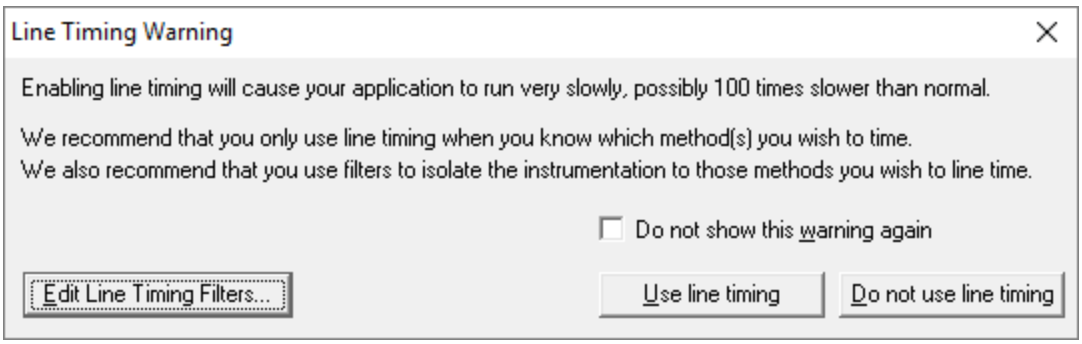
- **Collect function times** › tick to collect data that will allow overall function timings to be calculated

- **Collect line times** › tick to allow individual line timings to be calculated

  A warning dialog *may* be displayed to remind you of the possible performance slowdown when using line timing.

  This warning only appears if the Enable line timing warning option on the Performance settings is checked.

  The option at the bottom to edit line timing filters can be used to set specific classes, methods and functions to be included in, or excluded from, the hooking process and is identical to the Line Timing Filters page of the global settings dialog.

Slow Startup

The first time you work with IIS and Performance Validator you may experience a delay during startup. This is most like because symbols are being downloaded from Microsoft's symbol servers to match the DLLs and assemblies on your machine.

3.15.8.3 Reset & Stop IIS

Reseting IIS

Launch menu › **Services** › **Reset IIS** › resets Internet Information Server (stops it and starts it again).

The session is not discarded when IIS is reset.

Stopping IIS

Launch menu › **Services** › **Stop IIS** › stops Internet Information Server.

The session is not discarded when IIS is stopped.

3.15.9 Web Development Server

3.15.9.1 Monitor Web Development Server and ASP.Net

Monitoring ASP.Net Application (WDS)

To start monitoring ASP.Net application running in IIS:

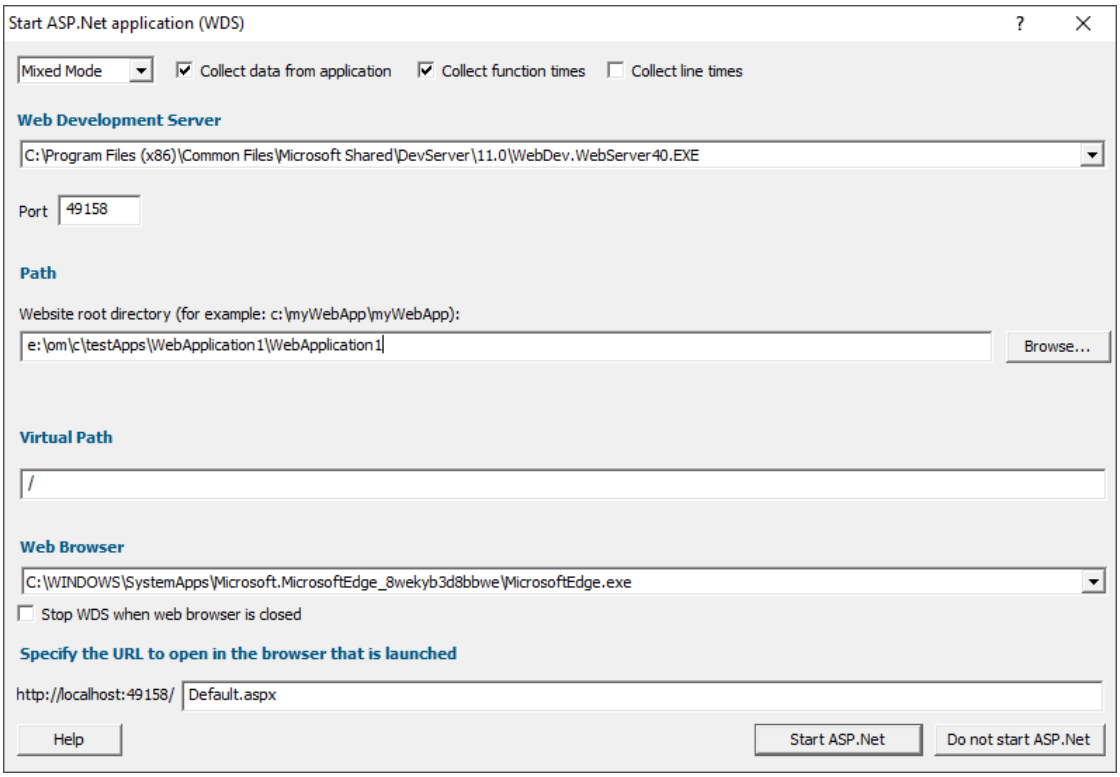
Launch menu › **Services** › **Monitor Web Development Server and ASP.Net...** › shows the Start ASP.Net Application dialog below

Or use the shortcut

F9 Monitor Web Development Server and ASP.Net

The Start ASP.Net application dialog

Set the web development server, the port to use, path to the web application, virtual path, an optional web browser to use and an optional url to launch, and click OK.



- **Web Development Server** › select the WDS process we're working with. The default is the most recent version installed on the computer.
- **Port** › select the port that the server will serve pages on. The default is 49158 (the same value that Visual Studio uses).
- **Path** › type or **Browse** to set the path to the ASP.Net application.
- **Virtual Path** › type the path on the server that corresponds to the web application. The default is /.
- **Web Browser** › select the web browser that you're going to use to load the web page.
- **URL to open in browser** › type the web page and arguments you want to load to cause the ISAPI to be loaded in IIS.
- **OK** › resets IIS, setups all the variables, copies DLLs and settings into the web root and starts the web browser to load the specified web page.

Web Development Server is not a protected process like IIS. This can make working with WDS much easier than working with IIS.

Data collection

- **Type of data collection** › Are you only interested in Native data, .Net data or both Native data and .Net data?

- **Native Only** › Ignore all .Net data in the target application.
- **.Net Only** › Ignore all Native data in the target application.
- **Mixed Mode** › Collect both Native and .Net data from the target application

This setting cannot be changed after the application is launched

- **Collect data from application** › If it's the startup procedure you want to validate, obviously start collecting data from launch.

  Depending on your application, and what you want to validate, you may want to start collecting data immediately, or do it later.

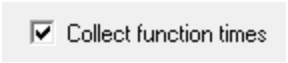
  If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

  ➜ See the section on controlling data collection for how to turn collection on and off after launch.

  ➜ See the section on controlling data collection for how to turn collection on and off after launch.

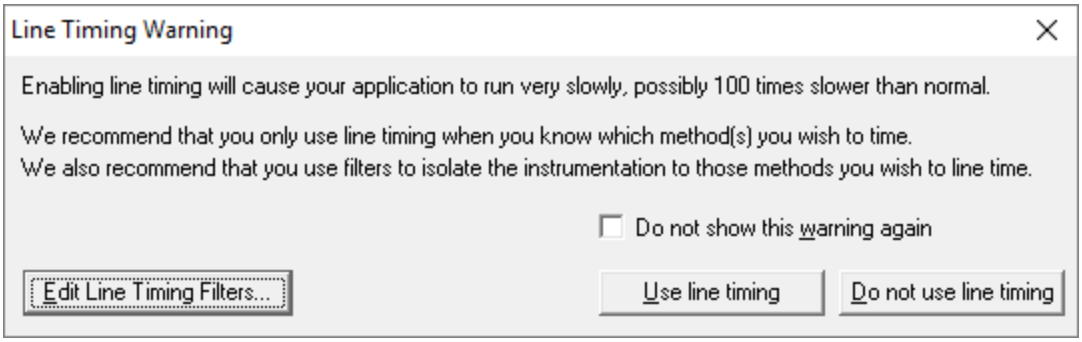
- **Collect function times** › tick to collect data that will allow overall function timings to be calculated

- **Collect line times** › tick to allow individual line timings to be calculated

  A warning dialog *may* be displayed to remind you of the possible performance slowdown when using line timing.

  This warning only appears if the Enable line timing warning option on the Performance settings is checked.

The option at the bottom to edit line timing filters can be used to set specific classes, methods and functions to be included in, or excluded from, the hooking process and is identical to the Line Timing Filters page of the global settings dialog.

Slow Startup

The first time you work with Web Development Server and Performance Validator you may experience a delay during startup. This is most like because symbols are being downloaded from Microsoft's symbol servers to match the DLLs and assemblies on your machine.

3.15.9.2 Stop Web Development Server

Stopping Web Development Server

Launch menu › **Services** › **Stop Web Development Server** › stops Web Development Server.

The session is not discarded when Web Development Server is stopped.

3.15.10 ASP.Net Core Web Application

Enter topic text here.

3.15.10.1 Start ASP.Net Core Web Application

Monitoring ASP.Net.Core Web Application

To start monitoring ASP.Net application running in IIS:

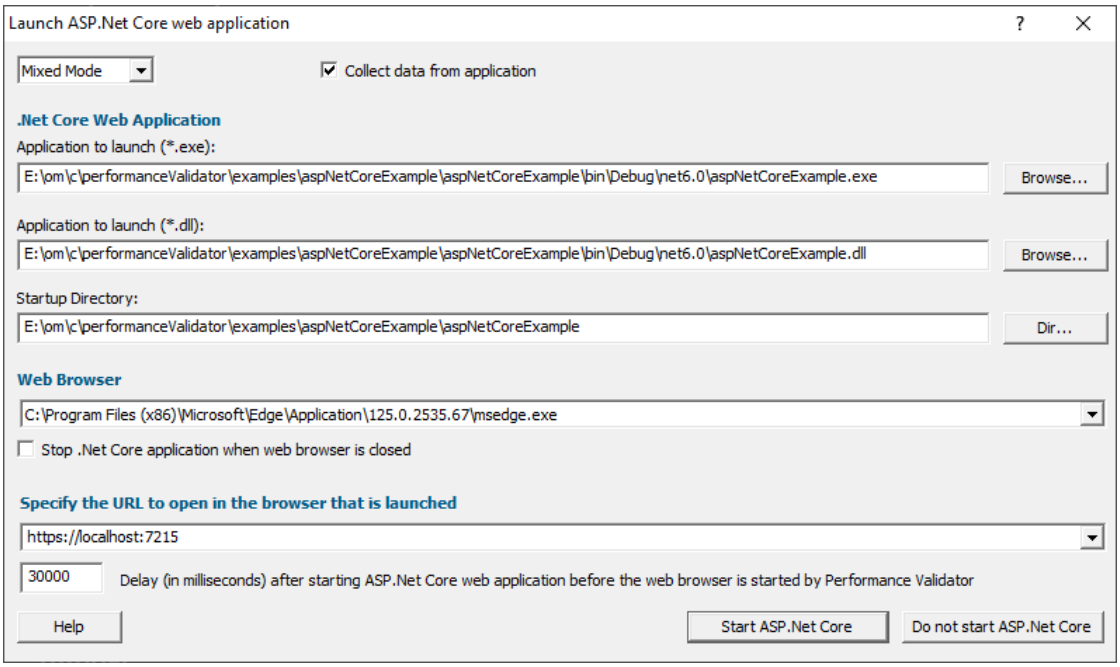
Launch menu › **Web** menu › **ASP.Net Core Web Application...** › shows the Start ASP.Net Core Web Application dialog below

Or use the shortcut

F7 Start ASP.Net Core Web Application

The Start ASP.Net Core application dialog

Set the web development server, the port to use, path to the web application, virtual path, an optional web browser to use and an optional url to launch, and click OK.



- **.Net Core Web Application (exe)** › select your ASP.Net Core web application to launch.
- **.Net Core Web Application (dll)** › select your ASP.Net Core web application to launch.
- **Startup Directory** › type or **Dir...** to set the path to the ASP.Net application.

  This value will be auto-populated based on the path you specify for your application.
- **Web Browser** › select the web browser that you're going to use to load the web page.
- **URL to open in browser** › type the web page, port and arguments you want to load to cause the ISAPI to be loaded in IIS.

  This value will be auto-populated based on the path you specify for your application.

  Example: https://localhost:7215
- **Start ASP.Net Core** › starts your ASP.Net web application, then starts the web browser to load the specified web page.

Data collection

- **Type of data collection** › Are you only interested in Native data, .Net data or both Native data and .Net data?
  - **Native Only** › Ignore all .Net data in the target application.
  - **.Net Only** › Ignore all Native data in the target application.

- **Mixed Mode** › Collect both Native and .Net data from the target application

  This setting cannot be changed after the application is launched

- **Collect data from application** › If it's the startup procedure you want to validate, obviously start collecting data from launch.

  Depending on your application, and what you want to validate, you may want to start collecting data as soon as injection has happened, or do it later.

  If your program has a complex start-up procedure, initialising lots of data, it may be much faster *not* to collect data until the program has launched.

  If it's the startup procedure you want to validate, obviously start collecting data immediately.

  ➡ See the section on controlling data collection for how to turn collection on and off after launch.

Slow Startup

The first time you work with ASP.Net Core and Performance Validator you may experience a delay during startup. This is most like because symbols are being downloaded from Microsoft's symbol servers to match the DLLs and assemblies on your machine.

3.15.10.2 Stop ASP.Net Core Web Application

Stopping ASP.Net Core Web Application

Launch menu › **Web** menu › **Stop ASP.Net Core Web Application** › stops ASP.Net Core web application.

The session is not discarded when the ASP.Net Core web application is stopped.

3.15.11 Environment Variables

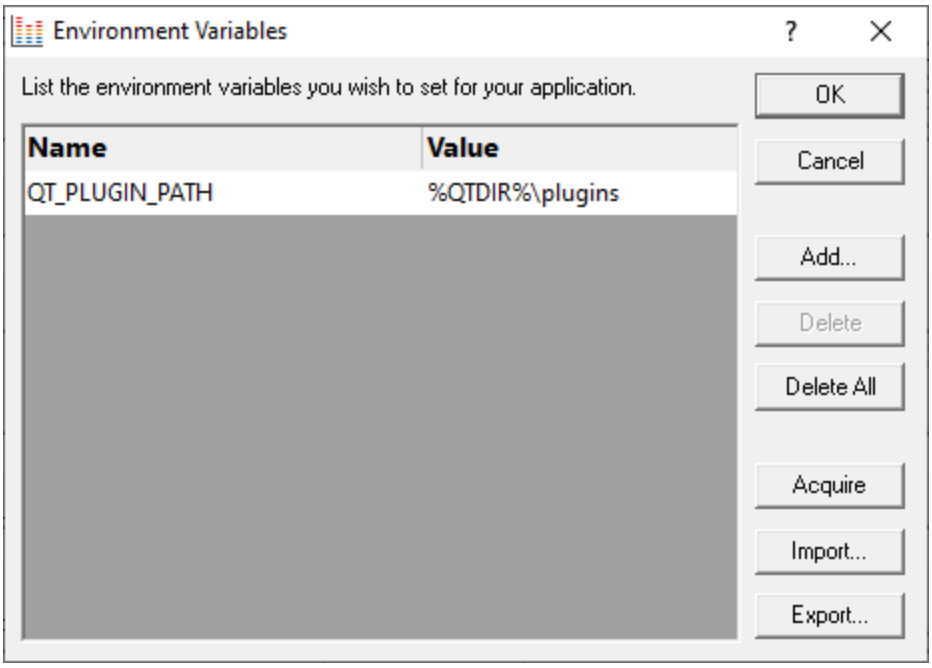
When launching an application, you might want to pass in some environment variables to your program.

The Environment Variables dialog lets you manage name/value pairs, including importing and exporting for use between programs or sessions.

The Environment Variables dialog

The dialog initially has no entries.

The example below shows the equivalent of `set QT_PLUGIN_PATH=%QTDIR%\plugins`



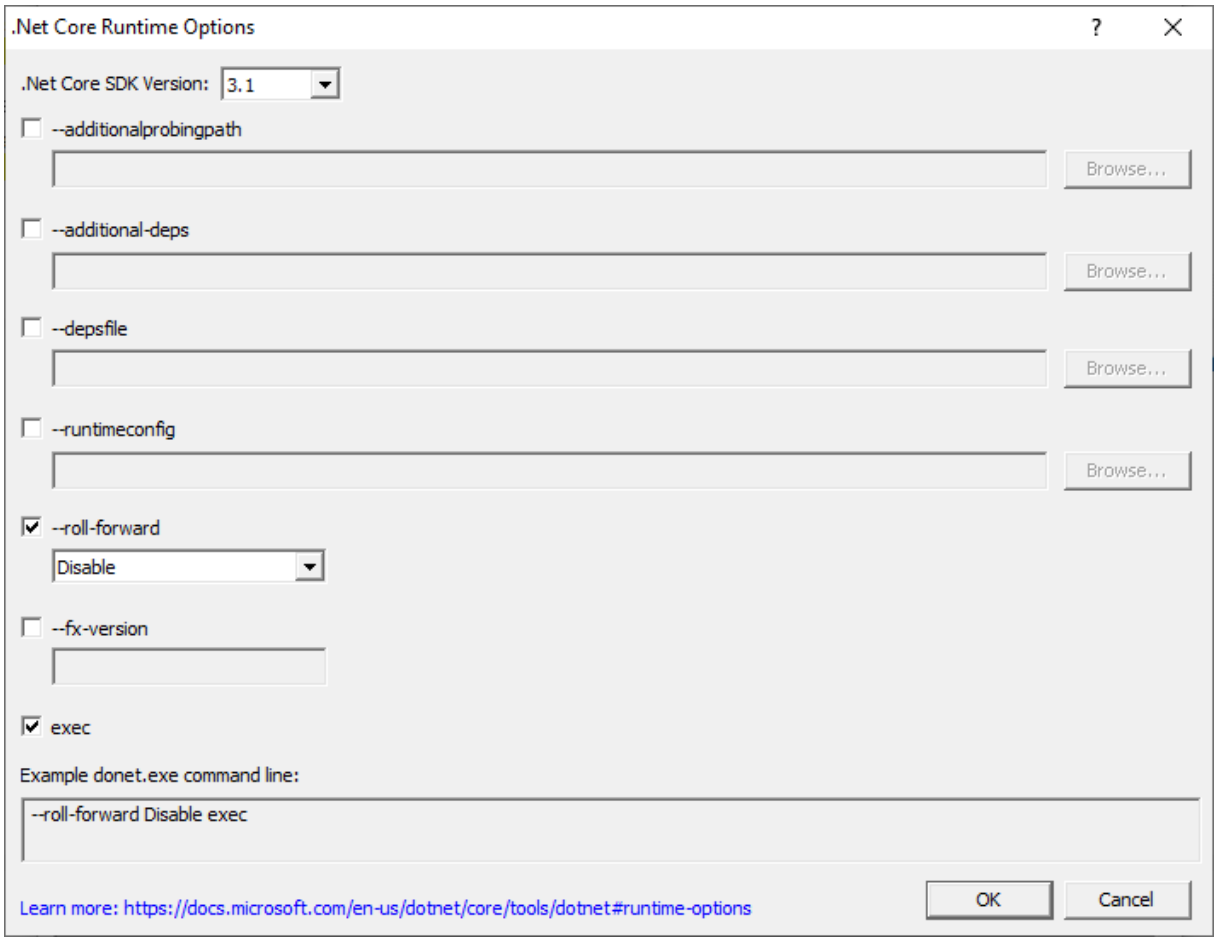
- **Add...** › adds a new item to the list › enter name in the first column, value in the second
- **Delete** › deletes a selected item in the list
- **Delete All** › clears the list
- **Acquire** › fetches all system environment variables, *adding* them to the list
- **Import...** › loads variables from a previously exported file, *adding* them to the list
- **Export...** › saves all entries in the list to a file of your choice

  The exported file is a simple ascii file with one entry per line of the form `name=value`
- **OK** › accepts all changes
- **Cancel** › ignores changes

3.15.12 .Net Core Runtime Arguments Editor

The .Net Core runtime arguments editor allows you to choose which options you pass to the .Net Core runtime.

Typically no arguments or just "exec" are passed to the runtime, assuming everything that is needed is in the same directory.



Enabling each check box will add the appropriate option to the runtime arguments.

The field can populated using the **Browse...** button to display a file or folder browser, or edited directly if you wish to add more than one path.

Some fields change depending on the SDK version chosen.

- **--additionalprobingpath** › path containing probing policy and assemblies to probe
- **--additional-deps** › path to an additional .deps.json file
- **--depsfile** › path to the deps.json file.
- **--runtimeconfig** › path to a runtimeconfig.json file
- **--roll-forward** › how to apply roll forward for .Net Core SDK 3.0 and above
- **--roll-forward-on-no-candidate-fx** › how to apply roll forward for .Net Core SDK 2.x
- **--fx-version** › version of .Net runtime to use to run the application
- **exec** › adds the "exec" keyword at the end of the arguments list

If you don't know what these options are you should read the .Net runtime options document shown in the link below before changing any of them.

We cannot advise you on how to set these values - except to say that if you're not setting them when using .Net Core outside of this software tool you shouldn't be setting them when using this software tool.

.Net Core Runtime Options

.Net Core provides some options that allow you to control how .Net Core performs.

Detailed information on these options is provided by Microsoft at https://docs.microsoft.com/en-us/dotnet/core/tools/dotnet#runtime-options.

3.16 Stopping your target program

Stopping the application

You can stop or kill your program at any time using the task manager, or debugger.

You can also stop your program from within Performance Validator.

File menu › **Abandon Application...** › stop the target program

or click on the red cross icon on the session toolbar.

The target program is ended using `ExitProcess()` from inside the stub.

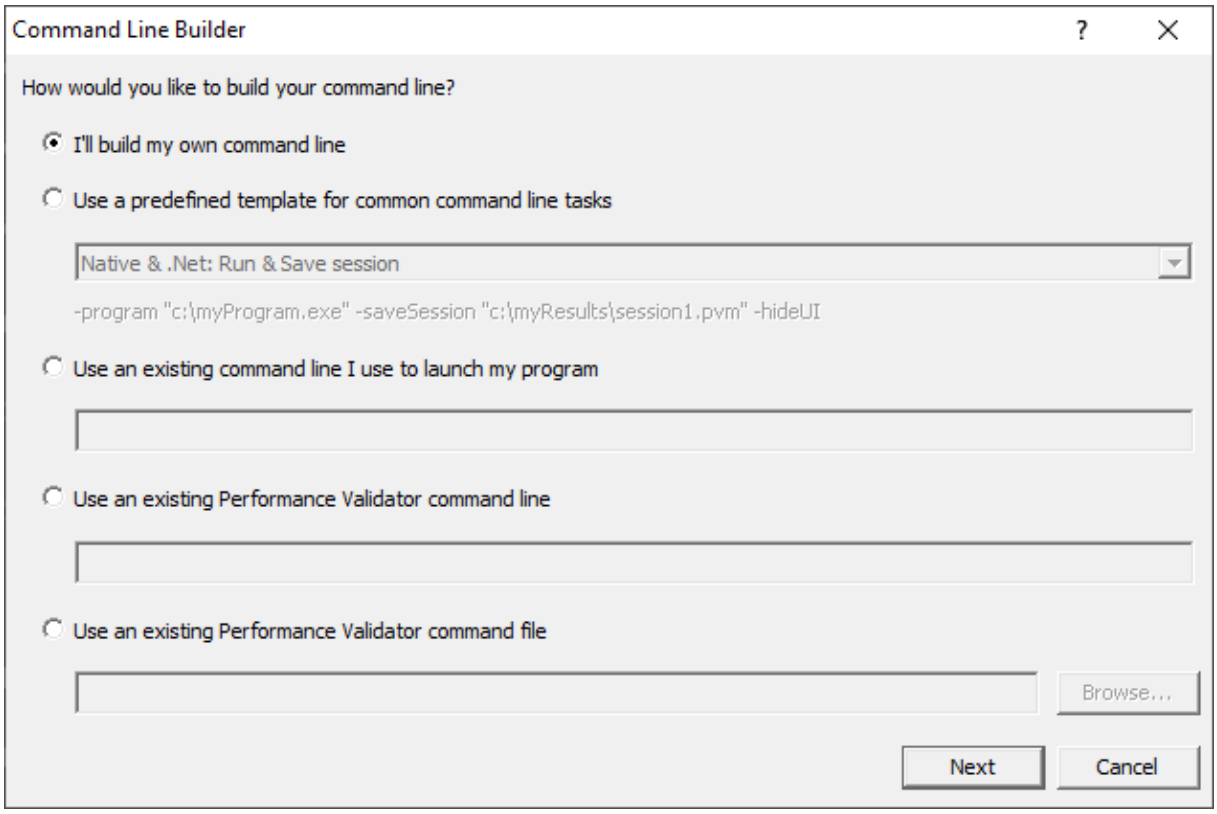
Since the session is discarded, using Performance Validator to stop the target program is usually quicker and more convenient than external stop methods.

➡ You can easily re-launch the program again using the same settings as before.

3.17 Command Line Builder

The command line builder helps you create command lines with valid options.

The command line builder is a two stage process, the first stage helping your choose how you want to build the command line, and the second stage actually building the command line based on the choices in the first stage.



There are five options for building your command line:

- **I'll build my own** › you'll build your command line from scratch, with no predefined options
- **Use a predefined template** › choose from a list of predefined command lines that you can customize

The predefined templates cover a range of tasks you may want to perform from the command line. These include running sessions, saving sessions, exporting to HTML, XML, and comparing performance data.

Examples are provided for both Native and .Net applications, and .Net Core applications.

- **Use an existing command line** › use the command line you use to start the tool you want to collect profiling data for

Example: `e:\dev\paintpot\release\paintpot.exe e:\testimages\venn.png -invert -mirror -phaseChange`

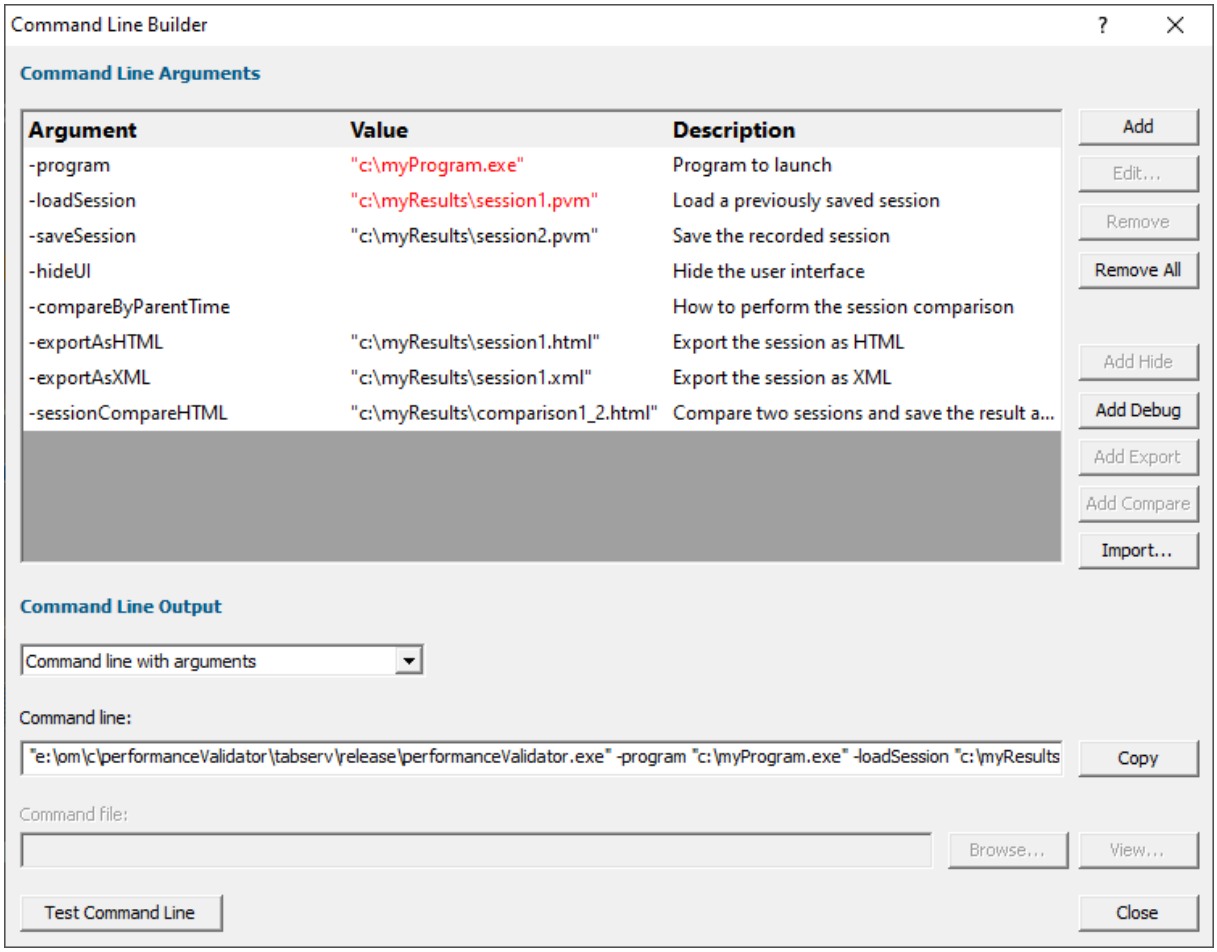
- **Use an existing Performance Validator command line** › use an existing Performance Validator command line and customize that

Example: `-program e:\dev\paintpot\release\paintpot.exe -hideUI -exportAsHTML e:\testResults\gannt.html -allArgs e:\testimages\gantt.png -inflate:3`

- **Use an existing Performance Validator command file** › use an existing Performance Validator command file and customize that

  Example: `-commandFile e:\commandFiles\paintpot_gantt.cf`

When you have made your choice the **Next** button moves you to the customization part of the command line builder.



The image above shows the command line builder populated with one of the predefined template choices. You can see a few entries refer to directories and files that do not exist on disk (they are red).

These are items you will need to customize to match the program you are testing.

For example, the **-loadSession** session will need to have been created (by saving an appropriate session from Performance Validator) created before you run the test.

Any entries that will only exist after they have been created by the test will also be shown in red.

Editing

To edit an argument, double click the argument. A combo box will display a list of valid arguments you can choose.

To edit a value, double the value. If the argument type has a list of known values a combo box will be provided, directories will display a directory chooser, files will display a file chooser, numbers will only allow numeric editing. All other values will be edited as text.

- **Add** › add a new argument to the grid
- **Remove** › remove the selected item
- **Remove All** › removes all items in the grid
- **Add Hide** › adds a -hideUI argument which will cause Performance Validator to hidden when running. Performance Validator will close after the target program finishes running
- **Add Debug** › adds various arguments which will cause Performance Validator to display error messages if there are problems with the command line.
- **Add Export** › adds export options that will cause Performance Validator to export html and/or xml reports after the target program finishes running
- **Add Compare** › adds compare options that will cause Performance Validator to load a session and compare sessions after the target program finishes running
- **Import...** › you can import a command file, the contents of which will replace all the items in the grid

Command Line Output

There are two command line output styles.

- **Command line with arguments** › generates a command line containing all arguments and values shown in the grid
- **Command line with command file** › generates a command file containing all arguments and values shown in the grid, and a command line that references the command file

  When this option is chosen the command file edit field and the **Browse...** and **View...** buttons are enabled, allowing you to specify a command file name, and to view it's contents.

  If a command file has not been specified when this option is selected you will be prompted to select a name for the command file.

  When the command file name is selected the command file will be created with the arguments and values shown in the grid.
- **Copy** › copies the command line to the clipboard so that you can paste the command line in cmd prompts, batch files and automated scripts (Jenkins etc)

- **Browse...** › opens a Windows file dialog to allow you to specify the command file location
- **View...** › opens the command file using the Windows shell, this allows you to view the command file in your favourite editor

Testing

If you wish to test the command line, you have two options:

- **Manual test** › use the **Copy** button to copy the command line, then paste it into a cmd prompt and press return.
- **Test Command Line** › a new instance Performance Validator is started with the specified command line.

3.18 Data Collection

Collecting data

Once you've launched or injected into a program, you can stop and start data collection whilst the program is running.

This is a high level switch that controls *all* data collection, regardless of any other settings such as Performance Collectors.

With data collection off, the target program runs at close to normal speed.

Temporarily turning off collection can be a good idea if you need to take actions to get the program into the right state for validation.

You can also turn data off from the start and only turn it on when you need it.

Starting and stopping data collection

File menu › **Start collecting data...** › starts collecting data immediately

or click on the green icon on the session toolbar to start collecting.

File menu › **Stop collecting data...** › stops collecting

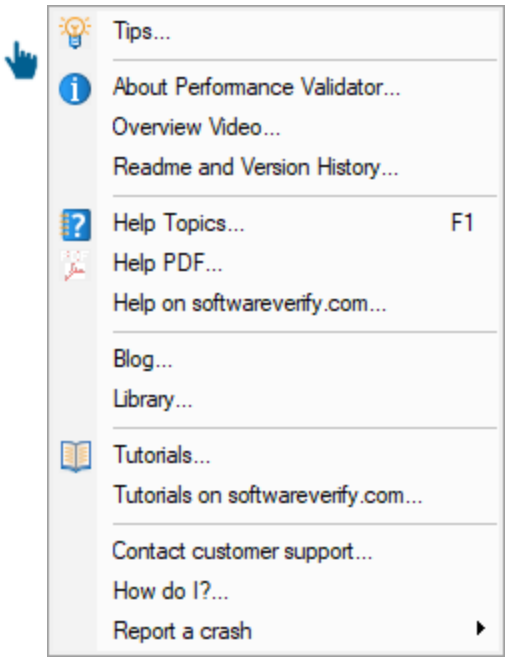
or click on the red icon on the session toolbar to stop.

3.19 Help

The help menu

The help menu provides access to useful help, tips and tutorials.

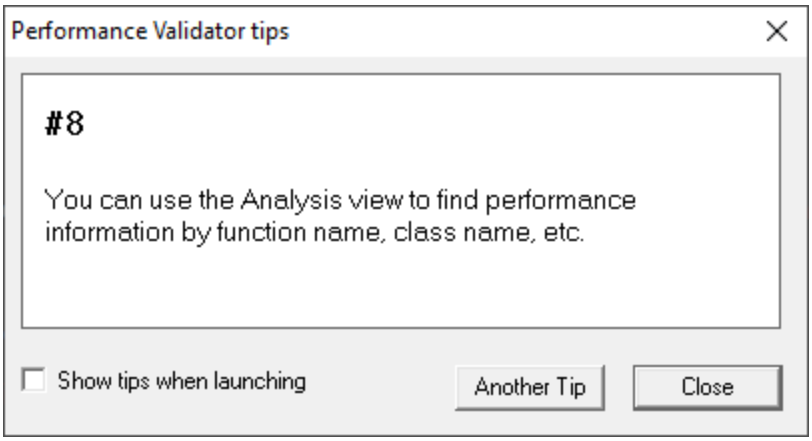
Each item is covered briefly below, in menu order.



Tips

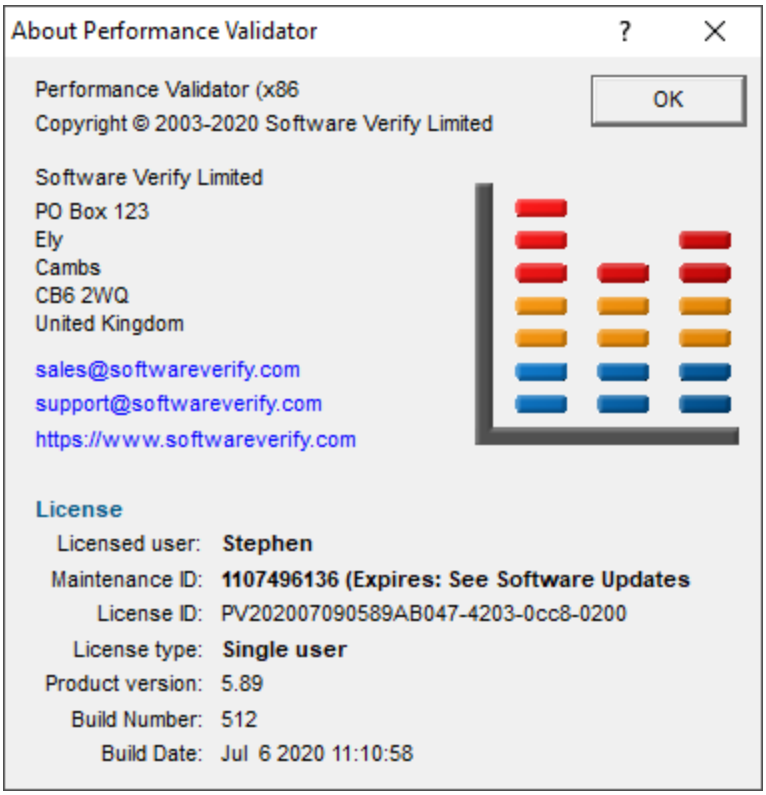
Help menu › **Tips...** › shows the tip dialog where you can browse tips in random order

Here you can also choose whether to display the tips dialog while launching programs.



About box

Help menu › **About Performance Validator...** › shows contact and copyright information, as well as details of your license

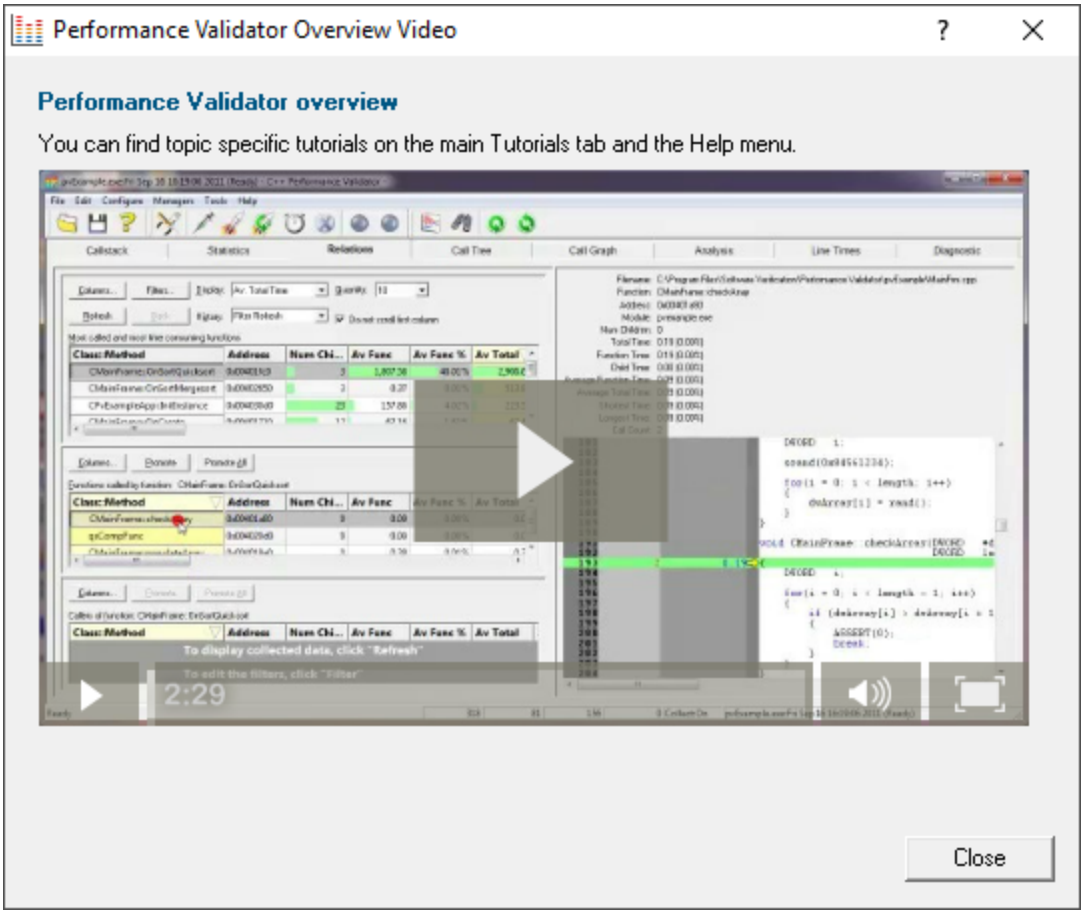


Overview video

Help menu › **Overview Video...** › opens a new dialog showing a short video

The video has sound and does not play automatically.

The video is also available on the product website. Visit https://www.softwareverify.com/products.php and find the product link for Performance Validator.



Read-me and version history

Help menu › **Readme...** › opens the readme.html (from your installation) in your browser.

The readme file contains all the latest information about Performance Validator including:

- basic information about getting started and where to go for support
- known issues
- version history

To see what's changed since the version you have installed see the latest version history.

Help HTML

Help menu › **Help topics...** › shows the HTML help dialog

You might be reading this right now!.

Or click on the question mark icon on the standard toolbar:

The F1 key also shows the help, but has the added bonus of jumping directly to the page relevant for the current view or dialog.

We occasionally get reports of customers seeing exception errors while viewing the HTML help. Unfortunately, we don't have a solution for this!

Help PDF

Help menu › **Help PDF** › shows the PDF version of this help

You will need a suitable PDF reader such as Adobe Acrobat Reader, but do beware of unwanted add-on installs.

PDF help for *all* our products are online.

Help on softwareverify.com

Help menu › **Help on softwareverify.com** › shows the online version of this help

Blog

Help menu › **Blog** › shows the Software Verify Blog.

Library

Help menu › **Library** › shows the Software Verify Library - all our best articles organised into related topics for easy access.

Tutorials

The tutorials are intended to guide you through learning how to use aspects of Performance Validator.

All the tutorials are available online in the form of short videos and examples covering popular topics.

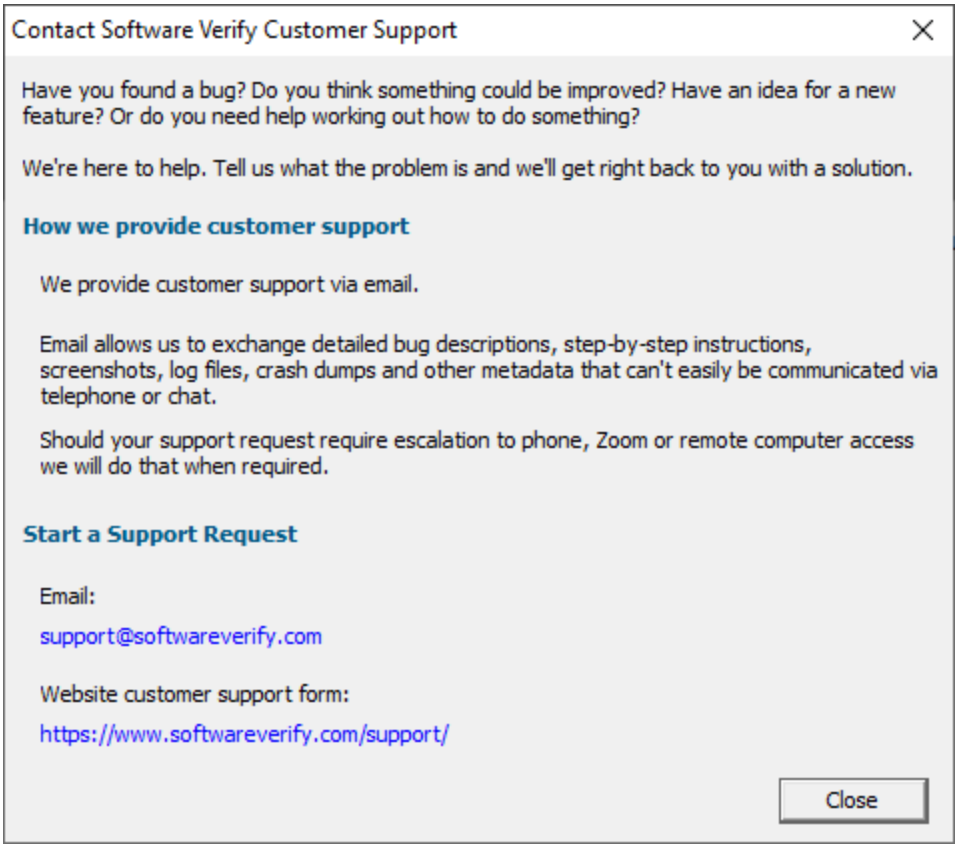
Help menu › **Tutorial...** › simply selects the Tutorial tab to show a list of the tutorials

Double click on the row of a tutorial in the list to open it in a browser.

Help menu › **Tutorials on softwareverify.com...** › opens the home the online tutorials in a browser

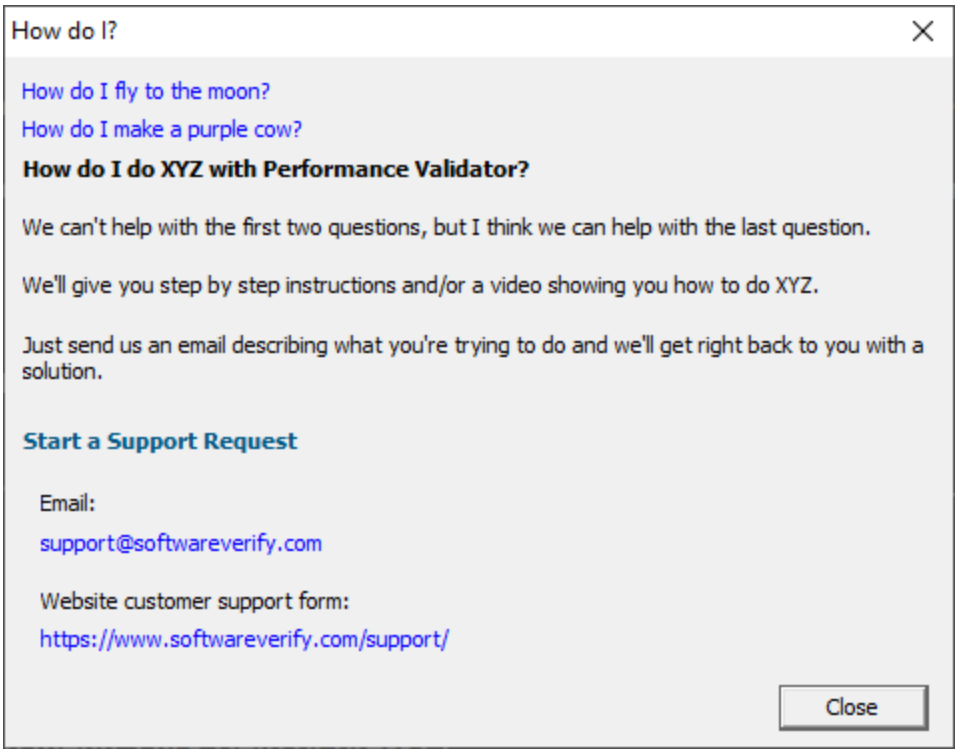
Contact customer support

Help menu › **Contact customer support** › shows the Contact customer support dialog.



How do I?

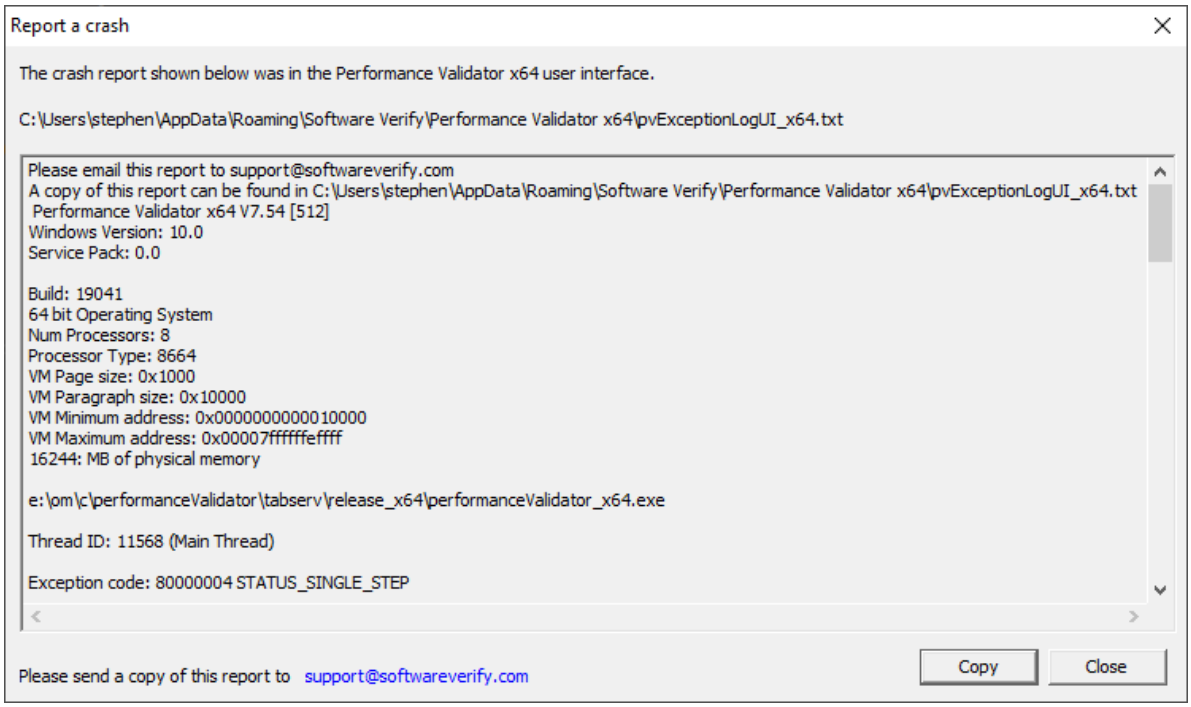
Help menu › **How do I?** › shows the How do I? dialog.



Report a crash

Help menu › **Report a crash** › displays the options for reporting a crash.

If an exception report for the Performance Validator user interface, or an exception report for an application that Performance Validator was monitoring is available it will be displayed with options to copy it to the clipboard and contact customer support at Software Verify.



Part

4 Command Line Interface

Performance Validator provides a command line interface to allow you to perform automated performance data collection.

To run 32 bit performance validator run **`C:\Program Files (x86)\Software Verify\Performance Validator x86\performanceValidator.exe`**

To run 64 bit performance validator run **`C:\Program Files (x86)\Software Verify\Performance Validator x64\performanceValidator_x64.exe`**

Automated performance data collection

Potential uses for automated code performance analysis are:

- In the regression test suite to ensure code performance of a certain level
- In unit testing to ensure code performance of a certain level
- Quality assurance

Results from performance data collection sessions can be compared to assess regressions and improvements in your tests.

Typically, command line options allow Performance Validator to run by specifying:

- the target program to run
- arguments to pass to the target program
- the working directory to run in
- whether to run with or without the user interface
- a baseline session to compare with
- where and how to save results
- what to include or exclude from hooking
- how to compare results

Usually Performance Validator would exit between automated tests, but it can be made to stay running if necessary.

➜ See the command line reference for an alphabetical listing all the available commands.

Command line argument usage

There are a few basic rules to remember when using the command line arguments:

- separate arguments by spaces
- quote arguments if they contain spaces
- some arguments are only useful in conjunction with others
- some arguments are incompatible with others

If your command line is very long, consider using **-commandFile** to specify a command file for your arguments.

Unrecognised arguments

Any unrecognised arguments found on the command line are simply ignored, whether or not they are prefixed with a hyphen.

Arguments intended for your program will not conflict with the Performance Validator arguments in this manual as you should use -arg to redirect them to your program.

Need some help building the command line?

If you find creating command lines from nothing to be a bit daunting we've created a Command Line Builder tool to help you build command lines.

You'll still need to complete some details, but the builder will help prevent you making some mistakes.

Command Lines and Floating Licences

Performance Validator works from the GUI and from the command line with all types of software licence (floating licences and non-floating licences).

When floating licences are being used Performance Validator will wait to acquire a floating licence before proceeding to process the command line options.

There are no options to:

- Checkout a floating licence
- Release a floating licence
- Query for available licences

These options are managed automatically by Performance Validator, there is no need for such options to be manually controlled from the command line.

4.1 Example Command Lines

Typical command line examples

The following examples demonstrate a few different scenarios in which you might want to use Performance Validator via the command line.

To run 32 bit performance validator run **`C:\Program Files (x86)\Software Verify\Performance Validator x86\performanceValidator.exe`**

To run 64 bit performance validator run **`C:\Program Files (x86)\Software Verify\Performance Validator x64\performanceValidator_x64.exe`**

Example 1 - running a session (native or .Net)

This example starts the application (native or .Net), showing no progress dialog whilst attaching to the process.

On completion, the resulting session is saved, and some tabs are refreshed.

The last tab refreshed is displayed, resulting in the Functions tab being the current tab.

performanceValidator_x64.exe **-program** "c:\myProgram.exe" **-saveSession** "c:\myResults\session1.pvm_x64" **-displayUI -refreshStatistics -refreshAnalysis -refreshCallTree**

A brief explanation of each argument:

Option	Argument	Description
-program	"c:\myProgram.exe"	The target program to launch
-saveSession	"c:\myResults\session1.pvm_x64"	After the application finishes, the session should be saved in this file
-displayUI		Show the user interface during the performance test
-refreshStatistics		Main data tabs should be refreshed when the test completes, including the Summary Results
-refreshAnalysis		
-refreshCallTree		Performance Validator will be left open at the Call Tree tab.

Example 2 - running a session (native or .Net) and exiting

This example starts the application (native or .Net), showing no progress dialog whilst attaching to the process.

On completion, the resulting session is saved, and Performance Validator exits.

The last tab refreshed is displayed, resulting in the Functions tab being the current tab.

performanceValidator_x64.exe **-program** "c:\myProgram.exe" **-saveSession** "c:\myResults\session2.pvm_x64" **-hideUI**

A brief explanation of each argument:

Option	Argument	Description

-program	"c:\myProgram.exe"	The target program to launch
-saveSession	"c:\myResults\session2.pvm_x64"	After the application finishes, the session should be saved in this file
-hideUI		Hide the user interface during the performance test and close the user interface when the test application finishes.

Example 3 - running a session (.Net Core, Self Contained)

This example starts a .Net Core application, showing no progress dialog whilst attaching to the process.

On completion, the resulting session is saved, and some tabs are refreshed.

The last tab refreshed is displayed, resulting in the Functions tab being the current tab.

performanceValidator_x64.exe **-program** "c:\myDotNetCoreApp.exe" -dotNetCoreLaunchType SelfContained **-saveSession** "c:\myResults\session3.pvm_x64" **-displayUI -refreshStatistics -refreshAnalysis -refreshCallTree**

A brief explanation of each argument:

Option	Argument	Description
-program	"c:\myDotNetCoreApp.exe"	The target program to launch
-dotNetCoreLaunchType	SelfContained	The .Net Core program is self contained
-saveSession	"c:\myResults\session3.pvm_x64"	After the application finishes, the session should be saved in this file
-displayUI		Show the user interface during the performance test
-refreshStatistics		Main data tabs should be refreshed when the test completes, including the Summary Results
-refreshAnalysis		
-refreshCallTree		Performance Validator will be left open at the Call Tree tab.

Example 4 - running a session (.Net Core, Framework Dependent)

This example starts a .Net Core application, showing no progress dialog whilst attaching to the process.

On completion, the resulting session is saved, and some tabs are refreshed.

The last tab refreshed is displayed, resulting in the Functions tab being the current tab.

performanceValidator_x64.exe **-program** "c:\dotNetCoreApp.dll" -dotNetCoreLaunchType FrameworkDependent **-saveSession** "c:\myResults\session3.pvm_x64" **-displayUI** -**refreshStatistics** -**refreshAnalysis** -**refreshCallTree**

A brief explanation of each argument:

Option	Argument	Description
-program	"c:\dotNetCoreApp.dll"	The target program to launch with the .Net runtime
-dotNetCoreLaunchType	FrameworkDependent	The .Net Core program is framework dependent
-saveSession	"c:\myResults\session4.pvm_x64"	After the application finishes, the session should be saved in this file
-displayUI		Show the user interface during the performance test
-refreshStatistics		Main data tabs should be refreshed when the test completes, including the Summary Results
-refreshAnalysis		
-refreshCallTree		Performance Validator will be left open at the Call Tree tab.

Example 5 - running and comparing a session

Add the following to the first example to load a previous session, and after the application has finished and this session saved and exported as HTML, compare it with the loaded session, saving the results:

-directory "c:\testarea" **-sessionLoad** "c:\myResults\session1.pvm_x64" **-compareByParentTime** **-exportAsHTML** "c:\myResults\session2.html" **-sessionCompareHTML** "c:\myResults\comparison_1_2.html"

Option	Argument	Description
-directory	"c:\testarea"	Set the working directory in which the program is executed

-sessionLoad	"c:\myResults\session1.pvm_x64"	Loads this previously saved session into the session manager
-compareByParentTime		The loaded session is to be compared with the newly recorded session recorded *after* the application has terminated, using parent function timings as the basis for comparison
-exportAsHTML	"c:\myResults\session2.html"	The recorded session should be saved here in HTML format
-sessionCompareHTML	"c:\myResults\comparison_1_2.html"	The comparison results should be saved here in HTML format

4.2 Environment variables

Environment variables can be referenced on the command line.

This allows you to set an environment variable outside of Performance Validator (cmd prompt, batch file, etc) and then reference it on the command line.

For example:

```
-program %BUILD_DIR%\testProgram.exe
```

If the BUILD_DIR environment variable is set to e:\dev\debug the above would evaluate to `-program e:\dev\debug\testProgram.exe`

What if I can't set an environment variable?

There are situations where you it isn't desirable, or possible to set the environment variable value prior to starting Performance Validator.

In those situations you can set the environment variable on the command line using -setenvironment.

```
-setenvironment BUILD_DIR=e:\dev\debug -program %BUILD_DIR%\testProgram.exe
```

Problems with environment variable substitution

If you are running from a command prompt, or batch file, or any process that will handle environment variable substitution using %ENV_VAR% you will find that referencing the environment variable on the command line won't work when using -setenvironment, because by the time Performance Validator sees the command line the %ENV_VAR% values have already been substituted.

To get around this, using ENV_VAR instead of %ENV_VAR%.

```
-setenvironment BUILD_DIR=e:\dev\debug -program $BUILD_DIR$\testProgram.exe
```

-setenvironment

Set environment variables for Performance Validator, as a series of name/value pairs.

Use this option once for each environment variable you wish to set.

Usage of **-setenvironment** for any environment variable must appear on the command line prior to any reference to that environment variable on the command line.

To pass quotes along with the string, escape a pair of inner quotes like the example below

Examples:

-setenvironment APP_FLAG=ON;
-setenvironment "APP_FAG=ON;"
-setenvironment "APP_COMMS=ON; APP_DEBUG=OFF;"
-setenvironment "APP_MSG=\"A quoted string with spaces\";"
-setenvironment BUILD_DIR=e:\dev\debug

Note that this is not the same as -environment, which allows you to specify environment values that you can pass to the program being launched.

4.3 Development environment

The following options allow you to specify the development environment you used to build the application being tested.

-devIDE

Specifies the development environment or compiler used to build the application being tested.

These values correspond to the values on the Symbol Lookup part of the settings dialog.

- clang
- codeWarrior
- cppBuilder
- delphi
- devC++
- mingw
- other
- rust
- salfordFortran
- visualBasic6
- visualStudio. If you specify this you also need to specify **-devVisualStudioVersion** or **-devVisualStudioYear**
- visualStudioCustomDLL
- visualStudioDontSet

Examples:

-devIDE visualStudio
-devIDE delphi

-devVisualStudioVersion

If **-devIDE** has been specified as **visualStudio** then **-devVisualStudioVersion** can be used to specify the version of Visual Studio.

The version of Visual Studio needs to be installed on the machine for this to work.

The following versions are valid:

- 6
- 7
- 7.1
- 8
- 9
- 10
- 11
- 12
- 14
- 15
- 16
- 17

Examples:

-devVisualStudioVersion 6
-devVisualStudioVersion 10
-devVisualStudioVersion 17

*If you use **-devVisualStudioVersion** then you don't need to use **-devVisualStudioYear**.*

-devVisualStudioYear

If **-devIDE** has been specified as **visualStudio** then **-devVisualStudioYear** can be used to specify the version of Visual Studio.

The version of Visual Studio needs to be installed on the machine for this to work.

The following years are valid:

- 1996
- 2002
- 2003
- 2005
- 2008
- 2010
- 2012
- 2013

- 2015
- 2017
- 2019
- 2022

Examples:

-devVisualStudioYear 1996
-devVisualStudioYear 2010
-devVisualStudioYear 2022

*If you use **-devVisualStudioYear** then you don't need to use **-devVisualStudioVersion**.*

4.4 Target Program & Start Modes

Specifying the target application

The following options let you launch a program (with various start-up modes), inject into a running program or wait for a program to start before attaching.

Launching a program

-program

Specifies the full file system path of the executable target program to be started by Performance Validator, *including any extension*.

Not compatible with -injectName, -injectID, -waitName or -monitorAService.

See -arg below to pass arguments to your program, and -directory to set where it runs.

Examples:

-program c:\testbed.exe
-program "c:\new compiler\version2\testbed.exe"

If you specify the file *without* a path then:

- If you used -directory to set a startup directory then the filename in that directory is used if it exists
- Otherwise, the directories in the PATH environment variable are used to look for the filename

-programToMonitorEXE
-programToMonitor

-programToMonitor has been replaced by **-programToMonitorEXE**. **-programToMonitor** will be honoured to provided backward compatibility.

Specifies the full path of the program from which the data is collected, but *does not change* which process is initially launched. *Include the extension*.

This program will be monitored by Performance Validator only when the program specified using -program starts it.

If no path is specified, the first child process that has the same name will be monitored.

To monitor *any* program that is launched specify `<<Any>>` as the program argument. In batch files and powershell scripts you will need to quote this to get it accepted by the file parser.

See -programToMonitorLaunchCount to change which instance of the program is monitored.

Only valid in conjunction with -program.

Examples:

-programToMonitorEXE c:\testbed-child-process.exe
-programToMonitorEXE "c:\new compiler\version2\testbedChildProcess.exe"
-programToMonitorEXE testbed-child-process.exe
-programToMonitorEXE "<<Any>>"

-program c:\testbed.exe **-programToMonitorEXE** c:\testbed-child-process.exe

In this last example `c:\testbed.exe` is launched but not monitored. Only when `testbed.exe` launches a child process `c:\testbed-child-process.exe` is that child process monitored.

-programToMonitorDLL

This option provides a qualifying DLL to identify different .Net Core processes, which are typically launched using the same .Net Core runtime. *Include the dll extension*.

Only valid in conjunction with -program and -programToMonitorEXE.

Examples:

-programToMonitorDLL c:\test\dotNetCoreApp.dll

-program c:\testbed.exe **-programToMonitorEXE "**c:\program files\dotnet\dotnet.exe" **-programToMonitorDLL** c:\test\dotNetCoreApp.dll

In this last example `c:\testbed.exe` is launched but not monitored. Only when `testbed.exe` launches a child process `c:\program files\dotnet\dotnet.exe` to run the application `c:\test\dotNetCoreApp.dll` is that child process monitored.

-programToMonitorLaunchCount

Specify the n^{th} invocation of the program specified by -programToMonitor which is to have its data collected.

Any value which is invalid (including anything less than 1) will default to 1.

Only valid in conjunction with -programToMonitor and consequently also -program.

Examples:

-programToMonitorLaunchCount 1
-programToMonitorLaunchCount 34

-program c:\testbed.exe **-programToMonitor** c:\testbed-child-process.exe -**programToMonitorLaunchCount 1**

In the above example c:\testbed.exe is launched but not monitored. As soon as testbed.exe launches a child process c:\testbed-child-process.exe then that child process monitored.

If the value 1 was changed to a 2, then only the second invocation of c:\testbed-child-process.exe would get monitored, with the first invocation being ignored.

-arg

Passes the following element on the command line to the target program.

-arg can be used multiple times, or you can use -allArgs

 To pass quotes along with the string, escape a pair of inner quotes like the example below

Only valid with: -program

Examples:

-arg myProgram.exe
-arg "c:\Program Files\myApp\myProgram.exe"
-arg "-in infile -out outfile"
-arg "\"a quoted string\""

-allArgs

Passes the remainder of the command line (after -allArgs) to the program being launched.

Unlike -arg above, there is no need to escape the quotes as the content is passed verbatim.

Only valid with: -program

Example:

-allArgs anything put here is passed to the target program "even stuff in quotes" is passed

-directory

Sets the working directory in which the program is executed. If -directory is not specified the program is run in its current directory.

Only valid with: -program

Examples:

-directory c:\development\
-directory "c:\research and development\"

-environment

Environment variables for program, as a series of name/value pairs. Not to be confused with -setenvironment.

Use this option once for each environment variable you wish to set.

 To pass quotes along with the string, escape a pair of inner quotes like the example below

Only valid with: -program

Examples:

-environment APP_FLAG=ON;
-environment "APP_FAG=ON;"
-environment "APP_COMMS=ON; APP_DEBUG=OFF;"
-environment "APP_MSG=\"A quoted string with spaces\";"

-dataCollectType

Specifies the type of data collection that you want. Native, .Net or mixed mode (both native and .Net).

Valid with -program and -monitorAService.

Examples:

-dataCollectType native
-dataCollectType dotNet
-dataCollectType mixedMode

-stdin

Specifies a file to be read and piped to the standard input of the application being tested.

If the filename contains spaces, the filename should be quoted.

An error occurs if the file does not exist. See **-ignoreMissingStdin** to avoid this error.

Examples:

-stdin c:\settings\input.txt
-stdin "c:\reg tests settings\input.txt"

-stdout

Specifies a file to be written with data piped from the standard output of the application being tested.

If the filename contains spaces, the filename should be quoted.

An error occurs if the file does not exist. See **-ignoreMissingStdout** to avoid this error.

Examples:

-stdout c:\settings\output.txt
-stdout "c:\reg tests results\output.txt"

-ignoreMissingStdin

If this flag is specified and the file specified by **-stdin** does not exist, no error is reported.

-ignoreMissingStdout

If this flag is specified and the file specified by **-stdout** does not exist, no error is reported.

Target program startup modes

-createProcessStartupThread
-normalStartupThread
-idleStartupThread
-suspendStartupThread
-pauseStartupThread
-noSuspendInStubDuringAttach

All these options are obsolete and will be ignored if present on command lines or in command files.

Injecting into a program

-injectName

Sets the name of the process for Performance Validator to attach to.

Not compatible with -program, -injectID, -waitName or -monitorAService.

Examples:

-injectName c:\testbed.exe
-injectName "c:\new compiler\version2\testbed.exe"

-injectID

Sets the numeric (decimal) id of a process for Performance Validator to attach to.

Not compatible with -program, -injectName, -waitName or -monitorAService.

Example:

-injectID 1032

Waiting for a program

-waitNameEXE
-waitName

-waitName has been replaced by **-waitNameEXE**. **-waitName** will be honoured to provided backwards compatibility.

Sets the name of a process that Performance Validator will wait for.

When the named process starts Performance Validator will attach to the process.

Not compatible with -program, -injectName, -injectID or -monitorAService.

Examples:

-waitNameEXE c:\testbed.exe
-waitNameEXE "c:\new compiler\version2\testbed.exe"

-waitNameDLL

Sets the name of a process DLL that Performance Validator will wait for.

When the named process starts Performance Validator will attach to the process.

Examples:

-waitNameDLL c:\dotNetApp.dll
-waitNameDLL "c:\new compiler\version2\dotNetApp.dll"

For use with -waitNameEXE when you want to wait for .Net Core applications.

-waitNameEXE "c:\program files\dotnet\dotnet.exe" **-waitNameDLL** "c:\testApps\dotNetCoreApp\release\dotNetCoreApp.dll"

Monitoring a service

-monitorAService

Sets the full file system path of a service *including any extension*.

Performance Validator will wait for the service to start and attach to it.

Not compatible with -program, -injectName, -injectID or -waitName.

Examples:

-monitorAService c:\service.exe
-monitorAService "c:\new compiler\version2\service.exe"

.Net Core specific arguments

-dotNetCoreArg

Specifies and argument to pass to the .Net Core runtime. You can specify -dotNetCoreArg as many times as you need to pass as many arguments as you need.

See this Microsoft document for the list of .Net Core runtime configuration options https://docs.microsoft.com/en-us/dotnet/core/tools/dotnet#runtime-options.

Use this argument with -program.

Examples:

-dotNetCoreArg "--roll-forward LatestPatch"
-dotNetCoreArg "--runtimeconfig ./configUnitTest.json"

-dotNetCoreLaunchType

Specifies the type of program being launched by the .Net Core runtime. You can specify -dotNetCoreLaunchType once. If specified more than once, the last definition is used.

Use this argument with -program.

Examples:

-dotNetCoreLaunchType SelfContained
-dotNetCoreLaunchType FrameworkDependent

Data Collection

-collectData

Enables or disables the collection of flow tracing data

Examples:

-collectData:On
-collectData:Off

-collectFunctionTimes

Enables or disables the collection of timing information for functions

Examples:

-collectFunctionTimes:On
-collectFunctionTimes:Off

-collectLineTimes

Enables or disables the collection of timing information for lines

Examples:

-collectLineTimes:On
-collectLineTimes:Off

-collectStdout

Enables or disables the collection of standard output (stdout)

Examples:

-collectStdout:On
-collectStdout:Off

4.5 User interface visibility

User interface visibility

You can choose to hide or show Performance Validator during the test, as well as the window of the target application.

-displayUI

Forces the Performance Validator user interface to be displayed during the test.

This is useful for debugging a command line session that is not working, for example inspecting the Diagnostic tab for messages related to the test.

You wouldn't normally use this option when running unattended performance tests.

-doNotInteractWithUser

Never display dialog boxes in the target application that is being profiled.

 This applies even for warning and error dialog boxes.

The intended use for this option is for when you are running command line sessions on unattended computers and you have automated processes that may kill the Performance Validator user interface if something goes wrong. Actions such as this then cause the stub to recognise the user interface has gone away and display an error warning.

-hideUI

Hides the Performance Validator user interface during the test.

-launchAppHide
-launchAppHidden

Hides the target application during the test.

 Depending on your application, this may not work and may not even be suitable.

This is equivalent to setting the `wShowWindow` member of the `STARTUPINFO` struct to `SW_HIDE` when using the Win32 `CreateProcess()` function.

It's useful if you're testing console applications that have no user interaction, as it prevents the console/command prompt from being displayed.

For GUI applications this option very much depends on how your application works.

For interactive applications, it's clearly has no use, but for some, hiding the GUI may help prevent various windows messages from being processed.

Typically, for complex applications, it's better to design this capability into your application and control it via a command line, which can be passed in from Performance Validator via the **-arg** option.

-launchAppShow

Shows the target application during the test.

This is equivalent to setting the `wShowWindow` member of the `STARTUPINFO` struct to `SW_SHOW` when using the Win32 `CreateProcess()` function.

-launchAppShowMaximized
-launchAppShowMinimized
-launchAppShowMinNoActive
-launchAppShowNA
-launchAppShowNoActivate

-launchAppShowNormal

As well as the previous two options to show or hide the target application during the test there are other options equivalent to values that can be used in the `STARTUPINFO` struct.

The options are equivalent to the setting the `wShowWindow` member to the following values

Option	wShowWindow member	Launched application is shown...
-launchAppShowMaximized	`SW_SHOWMAXIMIZED`	Maximized and activated
-launchAppShowMinimized	`SW_SHOWMINIMIZED`	Minimized and activated
-launchAppShowMinNoActive	`SW_SHOWMINNOACTIVE`	Minimized and not active
-launchAppShowNA	`SW_SHOWNA`	Shown at current size and position but not activated
-launchAppShowNoActivate	`SW_SHOWNOACTIVATE`	Show at most recent size and position but not activated
-launchAppShowNormal	`SW_SHOWNORMAL`	Show at original size and position and activated

Refreshing the interface after test completion

You can run automated tests that leave the user interface open after completion,

The following options are used to automatically refresh the main data tabs in Performance Validator once a test is complete.

-refreshStatistics
-refreshCallTree
-refreshCallGraph
-refreshAnalysis

4.6 Session Management

Session management

The following options let you control the sessions during testing

-baseline

Allows a previously created session to be loaded into Performance Validator to act as the baseline session against which other sessions are compared.

-baseline c:\baselineRegTests\testMacro1.pvm
-baseline "c:\baseline regression tests\testMacro1.pvm"

-numSessions

Sets the number of sessions that can be loaded at once.

This is equivalent to the same setting in the session manager and can't be less than 1.

Example:

-numSessions 2

-saveSession

Saves the session data when all data has finished being collecting from the target program.

Performance Validator 32 and 64 bit use the file extension .pvm and .pvm_64 respectively.

A missing or incorrect filename extension will be corrected automatically

Examples:

-saveSession c:\results\testMacro1.pvm
-saveSession "c:\test results\testMacro1.pvm_x64"
-saveSession c:\results\testMacro1

-sessionLoad

Loads a previously created session to be compared with the performance data from the session being *recorded*.

These options might be used when a series of tests have already been performed and their sessions saved.

Performance Validator 32 and 64 bit use the file extension .pvm and .pvm_64 respectively.

A missing or incorrect filename extension will be corrected automatically

Examples:

-sessionLoad c:\results\testMacro1.pvm
-sessionLoad "c:\test results\testMacro1.pvm"
-sessionLoad c:\results\testMacro1

Ensure your session manager is configured to hold at least 2 or 3 sessions or use **-numSessions** to specify how many sessions to use.

Session comparison

-sessionCompareHTML
-sessionCompareXML

Compare two sessions, producing an HTML or XML report detailing any performance regression and improvements.

The topic on exporting sessions has a description of the XML tags.

The two sessions can be loaded using one of these options:

-baseline and **-sessionLoad**

-baseline and running a program using one of **-program**, **-injectName**, **-injectID**, or **-waitName**

Examples:

-sessionCompareXML c:\regtests\testMacro1.xml
-sessionCompareHTML "c:\reg tests\testMacro1.html"

Ensure your session manager is configured to hold at least 2 sessions or use **-numSessions** to specify how many sessions to use.

-compareByParentTime
-compareByTotalTime

During session comparison these options indicate whether to use the percentage of the parent's execution time or the total time as the comparator.

There are no arguments to these options.

-thresholdPC

Set the percentage threshold to be used when performing session comparisons.

Differences in percentage less than the threshold will be ignored and will not be considered a difference.

The argument is a floating pointer number, and if not specified will default to 1%.

Examples:

-thresholdPC 1

-thresholdPC 1.0000
-thresholdPC 2.5
-thresholdPC 0.0005

4.7 Session Export Options

Below are options for exporting sessions and session comparisons

Session export format - HTML or XML

-exportAsHTML
-exportAsXML

Export the session performance statistics as an HTML or XML file when Performance Validator has finished collecting data from the target program.

Example:

-exportAsHTML c:\results\html\testMacro1.html
-exportAsXML "c:\test results\xml\testMacro1.html"

Session export encoding - HTML or XML

These options allow you to export the session data as UTF-16, UTF8 or ASCII. UTF-16 and UTF-8 will add a byte order mark (BOM) to the start of the exported file.

-exportAsHTML_BOM

The exported HTML will be exported with the appropriate format.

-exportAsHTML_BOM ASCII
-exportAsHTML_BOM UTF8
-exportAsHTML_BOM UTF16

-exportAsXML_BOM

The exported XML will be exported with the appropriate format.

-exportAsXML_BOM ASCII
-exportAsXML_BOM UTF8
-exportAsXML_BOM UTF16

HTML and XML export options

The following options control settings for both HTML and XML export of the recorded session results.

-exportDescription

Includes the specified description string as part of the exported HTML/XML.

Example:

-exportDescription "Quality control test 2a"

Don't forget the quotes as this option is likely to contain spaces.

HTML-only export options

The following options are only for HTML export of the recorded session results

-exportAsCallGraphHTML
-exportAsCallTreeHTML

Exports the session data as a HTML file containing a call graph or a call tree when Performance Validator has finished collecting data from the target program.

Example:

-exportAsCallGraphHTML c:\callGraphs\testMacro.html
-exportAsCallTreeHTML "c:\call trees\test macro1.html"

-exportThreshold

Sets the minimum overall percentage contribution that a function must have in order to be included in a call tree or call graph export.

Example:

-exportThreshold 0.10

Session comparison export options

The following options are only used for export of session comparisons.

-comparisonShowAddress
-comparisonShowArgs
-comparisonShowFilename
-comparisonShowModulename
-comparisonShowReturnType

During the export of a session comparison these options indicate whether to show each corresponding function detail.

Each option takes an **:On** or **:Off** parameter

Examples:

-comparisonShowAddress:On
-comparisonShowFilename:Off

4.8 Filter and Hook options

Class and function hooks

-classAndFunctionFile

Points to a file specifying the class and function to be hooked for the test.

If the filename contains spaces, the filename should be quoted.

The settings dialog Class and Function Filter tab provides options for creating a ready made class and function hook file by using the **Export...** button on the dialog.

Examples:

-classAndFunctionFile c:\settings\testMacroClassAndMethods.pvxc
-classAndFunctionFile "c:\reg tests settings\testMacroClassAndMethods.pvxc"

Class and function file format

The first line of text in the DLL hooks file is *one* of the following:

- `Rule:DoNotHookSpecificClasses` DLLs marked as enabled *will not* be hooked. All other DLLs will be hooked
- `Rule:HookSpecificClasses` DLLs marked as enabled *will* be hooked. All other DLLs will not be hooked
- `Rule:HookAllClasses` All DLLs will be hooked regardless of the settings in the list

Capitalization is important.

The remaining lines list one class and method per line.

Class and method are separated by `::` or omit the method name if all methods in the class are wanted..

To name a method and no class, use `::` to prefix the method.

Example:

Two methods in the `pageMemoryUsageTracker` class should be hooked, along with all methods in the class `rightMenuAnalysis`, and all methods and functions named `resizeData`.

```
Rule:HookSpecificClasses
pagedMemoryUsageTracker::setPage
pagedMemoryUsageTracker::reset
resizeData
rightMenuAnalysis::
```

Example:

Two methods in the `pageMemoryUsageTracker` class are not to be hooked.

```
Rule:DoNotHookSpecificClasses
pagedMemoryUsageTracker::setPage
pagedMemoryUsageTracker::reset
```

Example:

All classes and methods will be hooked.

```
Rule:HookAllClasses
```

The file can be ANSI or UNICODE text and paths with spaces do not need quotes.

Source file hooks

-sourceFileFilterHookFile

Points to a file specifying the source files to be hooked for the test.

If the filename contains spaces, the filename should be quoted.

The settings dialog Hooked Source Files tab provides options for creating a ready made source file filter hook file by using the **Export...** button on the dialog.

Examples:

-sourceFileFilterHookFile c:\settings\testMacroFiles.pvxft
-sourceFileFilterHookFile "c:\reg tests settings\testMacroFiles.pvxft"

Source file filter format

The first line of text in the DLL hooks file is *one* of the following:

- `Rule:DoNotHook` > Source files that follow *will not* be hooked. All other files will be hooked
- `Rule:DoHook` > Source files that follow *will* be hooked. All other files will not be hooked

Capitalization is important.

The remaining lines list one source file (or source directory) per line.

The file is named with a path or without a path, i.e. the same way that Performance Validator discovers the path.

Example:

Most files are listed with a full path but constituent files of MFC might be listed without a path.

```
Rule:DoNotHook
"C:\Program Files\Software Verification\C++ Performance Validator\examples\nativ
appmodule.cpp
```

Example:

Using paths with and without spaces:

```
Rule:DoHook
"C:\Program Files\Software Verification\C++ Performance Validator\examples\nativ

Rule:DoHook
E:\OM\C\PerformanceValidator\examples\nativeExample
```

Example:

Using environment variables.

```
Rule:DoHook
%ENV_VAR%\examples\nativeExample
```

Using wildcards.

```
Rule:DoHook
c:\test\*\nativeExample
```

The file can be ANSI or UNICODE text and paths with spaces do not need quotes.

Win32 API hooks

-win32API

Specifies the type of Win32 API data collection that you want.

- **None** › No Win32 API hooking
- **All** › Hook Win32 API functions in all DLLs
- **NonOS** › Hook Win32 API functions in non operating system DLLs
- **NonMS** › Hook Win32 API functions in non Microsoft DLLs
- **DebugOnly** › Hook Win32 API functions only in DLLs that have debug information
- **DebugOnlyNonMS** › Hook Win32 API functions only in non Microsoft DLLs that have debug information

Examples:

-win32API None
-win32API All
-win32API NonOS
-win32API NonMS
-win32API DebugOnly
-win32API DebugOnlyNonMS

4.9 File Locations

File Locations

When using the command line it's convenient to store settings and options in files that can be easily referenced.

Those files include:

- Global settings files
- File locations for source, PDB or MAP files
- DLL hook files

Each of these file types can be saved or exported from Performance Validator.

The **-settings** option is used to specify the settings to be used for the test. If the filename contains spaces, the filename should be quoted. This option is the same as **-loadSettings** and is provided for backwards compatibility.

Loading global settings from a file

Global settings are usually stored in the registry, but you can save a specific set of settings for use in performance tests:

- **Settings** menu › **Save settings...**

-loadSettings
-settings

Points to a previously saved settings file to be used for the test.

Examples:

-loadSettings c:\settings\testMacro1.pvs
-loadSettings "c:\performance test settings\testMacro1.pvs"


The -settings option is identical to -loadSettings and is provided only for backwards compatibility

File locations for source, PDB or MAP files

File location files can be easily generated by exporting file locations from the File Locations page of the settings dialog.

-fileLocations

Specify a plain text file listing file locations to be used during testing. See the format of the file below.

Each set of file types (one per line) is preceded by a header line in the file.

- **[Files]** › Source files
- **[Third]** › Third party source files
- **[PDB]** › PDB files
- **[MAP]** › MAP files

Example:

-fileLocations c:\performanceTests\testFileLocations1.pvxfl

Example file:

```
[Files]
c:\work\project1\
[Third]
d:\VisualStudio\VC98\Include
[PDB]
c:\work\project3\debug
c:\work\project3\release
[MAP]
c:\work\project3\debug
c:\work\project3\release
```

Files listing classes and functions to hook

Set class and function names that are to be hooked or not hooked using -classAndFunctionFile in the Filter and Hook options.

Files listing DLLs to hook

DLL hook files can be easily generated by exporting DLL hooks from the Hooked DLLs page in the Filters section of the settings dialog.

-dllHookFile

Points to a file listing the DLLs to be hooked for the test.

Examples:

-dllHookFile c:\settings\testMacroDLLs.pvx

-dllHookFile "c:\performance tests settings\testMacroDLLs.pvx"

The first line of text in the DLL hooks file is one of the following:

- Rule:DoNotHook › DLLs marked as enabled *will not* be hooked. All other DLLs will be hooked
- Rule:DoHook › DLLs marked as enabled *will* be hooked. All other DLLs will not be hooked
- Rule:HookAll › All DLLs will be hooked regardless of the settings in the list

Capitalization is important.

The remaining lines list one DLL filename or folder path and an enabled state on each line.

Example:

```
Rule:DoNotHook
nativeExample.exe enable=FALSE
MFC42D.DLL enable=TRUE
MSVCRTD.dll enable=TRUE
KERNEL32.dll enable=TRUE
ole32.dll enable=TRUE
```

Example:

```
Rule:DoHook
E:\OM\C\performanceValidator\examples\nativeExample\DebugNonLink
enable=TRUE
```

Example:

```
Rule:DoHook
"E:\OM\C\performanceValidator\examples\nativeExample with
spaces\DebugNonLink" enable=TRUE
```

Example:

```
Rule:DoHook
%ENV_VAR%\DebugNonLink enable=TRUE
```

Here, the environment variable `ENV_VAR` is used to replace the text `%ENV_VAR%` in the path definition.

The file can be ANSI or UNICODE text and paths with spaces do not need quotes.

4.10 Command Files

Using a command file

If your command line is very long, consider using **-commandFile** to specify a command file for your arguments.

-commandFile

Specify a file from which to read the command line arguments.

Useful when command lines become unwieldy or longer than the windows command s

limits.

Use -- to insert comments into the file, including when commenting out option.

Examples:

-commandFile c:\performancetests\testMacro1.cf
-commandFile "c:\performance tests\testMacro1.cf"

Example command file

```
-hideUI
-program c:\testbed\testApp.exe

-- arguments for application
-arg argumentOne
-arg argumentTwo
-arg "-s wobble"
-directory c:\testbed\test1
-settings c:\testbed\settings_test1.pvs

-- do export and save of the results
-exportAsHTML c:\testbed\results\test1.html
-saveSession c:\testbed\results\test1.pvm
```

For any argument that can be supplied to a command in a command file, you can also specify an environment variable substitution.

```
-directory %DIR%
-program %DIR%\testProgram.exe
```

The environment variables must have been set prior to starting Performance Validator.

You cannot specify a command with an environment variable substitution.

4.11 Help, Errors & Return Codes

The following options may help with using and debugging the command line driven automated regression testing.

Command line help

-help
-?

Command line help is printed on the standard output.

Debugging command driven testing

If you're having problems with using the command line, check the following, try displaying error messages using the option below, and look at the exit return codes.
.

- separate command line arguments with spaces
- all command line options that include spaces need to have quotes around them
- some arguments are only useful in conjunction with others - check notes against each option
- some arguments are incompatible with others - check notes against each option

-showErrorsWithMessageBox

Forces errors to be displayed using a message box when running from the command line.

This can be very useful when debugging a command line that does not appear to work correctly.

Exit return codes

Performance Validator returns the following status codes when running from the command line.

- **0** › All ok
- **-1** › Unknown error. An unexpected error occurred starting the runtime
- **-2** › Application started ok. You should not see this code returned
- **-3** › Application failed to start. E.g. runtime not present, not an executable or injection dll not present,
- **-4** › Target application is not an application
- **-5** › Don't know what format the executable is, cannot process it
- **-6** › Not a 32 bit application
- **-7** › Not a 64 bit application
- **-8** › Using incorrect MSVCR(8|9).DLL that links to CoreDLL.dll (incorrect DLL is from WinCE)
- **-9** › Win16 app cannot start these because we can't inject into them
- **-10** › Win32 app - not used
- **-11** › Win64 app - not used
- **-12** › .Net application
- **-13** › User bailed out because app not linked to MSVCRT dynamically
- **-14** › Not found in launch history
- **-15** › DLL to inject was not found
- **-16** › Startup directory does not exist
- **-17** › Symbol server directory does not exist
- **-18** › Could not build a command line
- **-19** › No runtime specified, cannot execute script (or Java) (obsolete)

- **-20** › Java arguments are OK - not an error (obsolete)
- **-21** › Java agentlib supplied that is not allowed because Java Performance Validator uses it (obsolete)
- **-22** › Java xrun supplied that is not allowed because Java Performance Validator uses it (obsolete)
- **-23** › Java cp supplied that is not allowed because Java Performance Validator uses it (obsolete)
- **-24** › Java classpath supplied that is not allowed because Java Performance Validator uses it (obsolete)
- **-25** › Firefox is already running, please close it (obsolete)
- **-26** › Lua runtime DLL version is not known (obsolete)
- **-27** › Not compatible software
- **-28** › InjectUsingCreateProcess, no DLL name supplied
- **-29** › InjectUsingCreateProcess, Unable to open PE File when inspecting DLL
- **-30** › InjectUsingCreateProcess, Invalid PE File when inspecting DLL
- **-31** › InjectUsingCreateProcess, No Kernel32 DLL
- **-32** › InjectUsingCreateProcess, NULL VirtualFree() from GetProcAddress
- **-33** › InjectUsingCreateProcess, NULL GetModuleHandleW() from GetModuleHandleW
- **-34** › InjectUsingCreateProcess, NULL LoadLibraryW() from LoadLibraryW
- **-35** › InjectUsingCreateProcess, NULL FreeLibrary() from FreeLibrary
- **-36** › InjectUsingCreateProcess, NULL VirtualProtect() from GetProcAddress
- **-37** › InjectUsingCreateProcess, NULL VirtualFree() from GetProcAddress
- **-38** › InjectUsingCreateProcess, unable to find DLL load address
- **-39** › InjectUsingCreateProcess, unable to write to remote process's memory
- **-40** › InjectUsingCreateProcess, unable to read remote process's memory
- **-41** › InjectUsingCreateProcess, unable to resume a thread
- **-42** › UPX compressed - cannot process such executables
- **-43** › Java class not found in CLASSPATH
- **-44** › Failed to launch the 32 bit svlGetProcAddressHelperUtil.exe
- **-45** › Uknown error with svlGetProcAddressHelperUtil.exe
- **-46** › Couldn't load specified DLL into svlGetProcAddressHelperUtil.exe
- **-47** › Couldn't find function in the DLL svlGetProcAddressHelperUtil.exe
- **-48** › Missing DLL argument svlGetProcAddressHelperUtil.exe
- **-49** › Missing function argument svlGetProcAddressHelperUtil.exe
- **-50** › Missing svlGetProcAddressHelperUtil.exe
- **-51** › Target process has a manifest that requires elevation
- **-52** › svlInjectIntoProcessHelper_x64.exe not found
- **-53** › svlInjectIntoProcessHelper_x64.exe failed to start
- **-54** › svlInjectIntoProcessHelper_x64.exe failed to return error code
- **-55** › getImageBase() worked ok
- **-56** › ReadFile() failed in getImageBase()
- **-57** › NULL pointer when trying to allocate memory
- **-58** › CreateFile() failed in getImageBase()
- **-59** › ReadProcessMemory() failed in getImageBase()
- **-60** › VirtualQueryEx() failed in getImageBase()
- **-61** › Bad /appName argument in svlInjectIntoProcessHelper_x64.exe
- **-62** › Bad /dllName argument in svlInjectIntoProcessHelper_x64.exe
- **-63** › Bad /procId argument in svlInjectIntoProcessHelper_x64.exe
- **-64** › Failed to OpenProcess in svlInjectIntoProcessHelper_x64.exe
- **-65** › A DLL that the .exe depends upon cannot be found
- **-66** › A stdin file was specified, but Validator could not open it
- **-67** › A stdout file was specified, but Validator could not open it
- **-68** › Failed to create the child output pipe
- **-69** › Failed to create a duplicate of the output write handle for the std error write handle. This is necessary in case the child application closes one of its std output handles

  - **-70** › Failed to create the child input pipe
  - **-71** › Failed to create a duplicate output read temporary file
  - **-72** › Failed to create a duplicate input write temporary file
  - **-73** › User was trying to launch a service as an application that was linked to PV APIs. User cancelled when informed of this fact
  - **-74** › Returned by Performance Validator if user performs a baseline comparison and memory leaks are detected
  - **-75** › Shutdown and restart as 32 bit Performance Validator
  - **-76** › Shutdown and restart as 64 bit Performance Validator
  - **-77** › Entry point in executable is NULL.
  - **-78** › Application is .Net Core.
  - **-79** › Entry point is for a .Net application.
- **-80** › VirtualAllocEx() returned NULL
- **-81** › InjectUsingCreateProcess, NULL GetLastError() from GetProcAddress

4.12 Command Line Reference

Command line reference

The following alphabetical list provides a convenient look-up for all the command line arguments used in automated regression testing.

Option	Description
-?	Print command line help on the standard output.
-allArgs	Pass the remainder of the command line (after -allArgs) to the program being launched.
-arg	Pass command line arguments to the target program. Can be used multiple times.
-baseline	Load a previously created session into Performance Validator to act as the baseline session against which other sessions are compared.
-classAndFunctionFile	Points to a file specifying the class and function hook options.
-collectData	Turn data collection on or off
-collectFunctionTimes	Turn the collection of function timing on or off
-collectLineTimes	Turn the collection of line timing on or off
-collectStdout	Turn collection of stdout on or off
-compareByParentTime -compareByTotalTime	During session comparison choose whether to use the percentage of the parent's execution time or the total time as the comparator.
-comparisonShowAddress -comparisonShowArgs -comparisonShowFilename	Control if the each of the function details are shown in an exported session comparison.

-comparisonShowModulename -comparisonShowReturnType	
-createProcessStartupThread	Obsolete and ignored if present.
-devIDE	Specify the development environment used to be the target program.
-devVisualStudioVersion	Specify which version of Visual Studio by year.
-devVisualStudioYear	Specify which version of Visual Studio by version number.
-directory	Set the working directory in which the program is executed.
-displayUI	Force the Performance Validator user interface to be displayed during the test.
-dllHookFile	Points to a file listing the DLLs to be hooked for the test.
-doNotInteractWithUser	Never display dialog boxes in the target application that is being profiled.
-dotNetCoreArg	Specify a runtime configuration option to the .Net runtime.
-dotNetCoreLaunchType	Specify if you are launching a self contained or framework dependent .Net Core application.
-environment	Environment variables for program, as a series of name/value pairs
-exportAsCallGraphHTML -exportAsCallTreeHTML	Exports the session data as a HTML file containing a call graph or a call tree when Performance Validator has finished collecting data from the target program.
-exportAsHTML -exportAsXML	Export the session data as an HTML or XML file when Performance Validator has finished collecting data.
-exportAsHTML_BOM -exportAsXML_BOM	Specify the file encoding for the exported file
-exportDescription	Set the description to be included the exported HTML/XML.
-exportThreshold	Set the minimum overall percentage contribution that a function must have in order to be included in a call tree or call graph export.
-fileLocations	Specify a plain text file listing file locations to be used during testing. See the format of the file below.
-help	Print command line help on the standard output.
-hideUI	Hide the Performance Validator user interface during the test.
-idleStartupThread	Obsolete and ignored if present.
-injectID	Set the numeric (decimal) id of a process for Performance Validator to attach to.
-injectName	Set the name of the process for Performance Validator to attach to.
-launchAppHide	Hide the target application during the test.

-launchAppShow	Show the target application during the test.
-launchAppShowMaximized	Show the target application maximized and activated.
-launchAppShowMinNoActive	Show the target application minimized and activated.
-launchAppShowMinimized	Show the target application minimized and not active.
-launchAppShowNA	Show the target application at current size and position but not activated.
-launchAppShowNoActivate	Show the target application at most recent size and position but not activated.
-launchAppShowNormal	Show the target application at original size and position and activated.
-loadSettings	Points to a previously saved settings file to be used for the test.
-monitorAService	Specify the full file system path to a service to monitor, including any extension. The service is not started by Performance Validator but by an external means.
-normalStartupThread	Obsolete and ignored if present.
-noSuspendInStubDuringAttach	Obsolete and ignored if present.
-numSessions	Set the number of sessions that can be loaded at once.
-pauseStartupThread	Obsolete and ignored if present
-program	Specify the full file system path of the executable target program to be started by Performance Validator, including any extension.
-programToMonitorDLL	Specify the .Net Core DLL that identifies the program being monitored. Use in conjunction with -programToMonitorEXE.
-programToMonitorEXE -programToMonitor	Changes which program the data is collected from but does not change which process Performance Validator initially launches.
-programToMonitorLaunchCount	Specify the n^{th} invocation of the programToMonitor which is to have its data collected.
-refreshAnalysis	Automatically refresh the Analysis tab once a test is complete.
-refreshCallTree	Automatically refresh the Call Tree tab once a test is complete.
-refreshCallGraph	Automatically refresh the Call Graph tab once a test is complete.
-refreshStatistics	Automatically refresh the Statistics tab once a test is complete.
-saveSession	Save the session data when all data has finished being collecting from the target program.
-sessionCompareHTML -sessionCompareXML	Compare two sessions, producing an HTML or XML report detailing any performance regression and improvements.
-sessionLoad	Load a previously created session to be compared with the data from the session being recorded.

-setenvironment	Environment variables for Performance Validator, as a series of name/value pairs
-settings	Points to a previously saved settings file to be used for the test.
-showErrorsWithMessageBox	Force errors to be displayed using a message box when running from the command line.
-sourceFileFilterHookFile	Points to a file specifying the source files to be hooked for the test.
-suspendStartupThread	Obsolete and ignored if present.
-thresholdPC	Set the percentage threshold to be used when performing session comparisons.
-waitNameDLL	Name a .Net Core dll that identifies the process to wait for. Use in conjunction with -waitNameEXE.
-waitNameEXE -waitName	Name a process that Performance Validator will wait for.
-win32API	Specify how to hook Win32 API functions called from the target application.

To run 32 bit performance validator run **`C:\Program Files (x86)\Software Verify\Performance Validator x86\performanceValidator.exe`**

To run 64 bit performance validator run **`C:\Program Files (x86)\Software Verify\Performance Validator x64\performanceValidator_x64.exe`**

4.13 Troubleshooting

Running from the command line can cause some problems, often because you can't be sure that what you put on the command line did what you thought would do.

Ensure the arguments supplied are what you expected.

-echoArgsToUser

If you are testing a console application, make sure you can see it.

-showCommandPrompt

If an errors occur when processing the command line, make sure you can see those.

-showErrorsOnCommandPrompt

-showErrorsWithMessageBox

Look on the diagnostic tab to ensure the diagnostic data collected makes sense.

If you've got -hideUI in your command line, comment it out temporarily (make it -xhideUI so that it's not recognised).

What if the tool hangs?

If you're running from the command line, most likely you'll be running from a cmd prompt, or possibly powershell.

We've only ever had one customer report a hang with any of our tools when running from the command line.

We eventually found the problem, and it wasn't with the software tool.

The problem was that they were running the tool in hidden mode (-hideUI) from a command prompt and for unknown reasons the tool would never exit.

When they added a simple change to their command the problem went away.

They added **cmd /c** to the start of their command line. This opens a new command prompt and instructs it to launch the command line and wait for it to exit.

Problem command line:

```
"c:\program files (x86)\Software Verify\Performance Validator x64\performanceValidator_x64.exe" -p
```

Working command line:

```
cmd /c "c:\program files (x86)\Software Verify\Performance Validator x64\performanceValidator_x64.
```

Part V

5 API

The Performance Validator API

There are some features of Performance Validator that are useful to call directly from your program, including tracking of memory in custom heap managers.

Performance Validator has an API that makes this possible; just include `svlPVAPI.c and svlPVAPI.h` to your codebase. There is no library to link to, dlls to copy.

Source files

The source files can be found in the `API` directory in the Performance Validator install directory.

```
svlPVAPI.h
svlPVAPI.c
```

Just add these files to your project and build.

If you are using precompiled headers you will need to disable them for `svlPVAPI.c`.

Working with services?

If you are working with services you to attach Performance Validator to a service and to start Performance Validator, you should use the NT Service API, not the functions in this API.

All the other functions in this API can be used with applications and with services.

Unicode or ANSI?

All the API functions are provided in Unicode and ANSI variants where strings are used. We've also provided a character width neutral #define in the same fashion that the Windows.h header files do.

For example the function for naming a heap is provided as `pvSetHeapNameA()`, `pvSetHeapNameW()` with the character width neutral `pvSetHeapName()` mapping to `pvSetHeapNameW()` for unicode and `pvSetHeapNameA()` for ANSI.

In this document we're going to use `TCHAR` like the Window.h header files do.

Deploying on a customer machine

You can use the API without incurring any dependency on Performance Validator.

If Performance Validator is not installed on the machine the software runs on, nothing will happen.

This allows you to add the Performance Validator API to your software without need to have a separate build for use with Performance Validator.

Loading the Profiler

For most use cases won't need to load the profiler, as the profiler will have been loaded when your launched your program from Performance Validator, or when you injected into your program using Inject or Wait For Application.

However if you're running your program from outside of Performance Validator and want to load the profiler from inside your program you can use `pvLoadProfiler()` to do that. You'll then need to call `pvStartProfiler()` to start it.

Starting the Profiler

To start the profiler from your API code you need to call the function pvStartProfiler() from your code before you call any API functions. Ideally you should call this function as early in your program as possible.

If you prefer to start the profiler from the user interface or command line you can omit the pvStartProfiler() call. You can leave it present if you wish to start Performance Validator from your program.

Naming threads

You can name threads using the `pvSetThreadNameA()` and `pvSetThreadNameW()` functions.

Turning data collection on and off

You can turn data collection on and off using the `pvSetCollect()` function.

You can use `pvGetCollect()` to inspect the data collection status.

5.1 Native API Reference

Unicode or ANSI?

All the API functions are provided in Unicode and ANSI variants where strings are used. We've also provided a character width neutral #define in the same fashion that the Windows.h header files do.

For example the function for naming a thread is provided as `pvSetThreadNameA()`, `pvSetThreadNameW()` with the character width neutral `pvSetThreadName()` mapping to `pvSetThreadNameW()` for unicode and `pvSetThreadNameA()` for ANSI.

In this document we're going to use `TCHAR` like the Window.h header files do.

All the API functions are declared as `extern "C"`, so they can be used by C users and C++ users.

To use these functions #include `svlPVAPI.h` into your code.

pvLoadProfiler

Loads the profiler DLL into memory, but does not start the profiler.

Use this for:
32 bit applications with a 32 bit Performance Validator GUI
64 bit applications with a 64 bit Performance Validator GUI

For most use cases won't need to load the profiler, as the profiler will have been loaded when your launched your program from Performance Validator, or when you injected into your program using Inject or Wait For Application.

However if you're running your program from outside of Performance Validator and want to load the profiler from inside your program you can use `pvLoadProfiler()` to do that. You'll then need to call `pvStartProfiler()` to start it.

```
extern "C"
int pvLoadProfiler();

Returns:
TRUE   Successfully loaded PV DLL into target application.
FALSE  Failed to load the PV DLL into target application.
        Check that the PATH environment variable points to the Performance
    Validator install directory contains svlPerformanceValidatorStub*.dll.
```

Do not use this function if you are working with services, use the ***NT Service API***.

pvLoadProfiler6432

Loads the profiler DLL into memory, but does not start the profiler.

Use this for:
32 bit applications with a 64 bit Performance Validator GUI

For most use cases won't need to load the profiler, as the profiler will have been loaded when your launched your program from Performance Validator, or when you injected into your program using Inject or Wait For Application.

However if you're running your program from outside of Performance Validator and want to load the profiler from inside your program you can use `pvLoadProfiler6432()` to do that. You'll then need to call `pvStartProfiler()` to start it.

```
extern "C"
int pvLoadProfiler6432();

Returns:
TRUE   Successfully loaded PV DLL into target application.
FALSE  Failed to load the PV DLL into target application.
```

```
        Check that the PATH environment variable points to the Performance
    Validator install directory contains svlPerformanceValidatorStub*.dll.
```

Do not use this function if you are working with services, use the ***NT Service API***.

pvStartProfiler

To start the profiler from your API code you need to call the function `pvStartProfiler()` from your code before you call any API functions. Ideally you should call this function as early in your program as possible.

```
extern "C"
int pvStartProfiler();

Returns:
TRUE   Successfully started PV profiler.
FALSE  Failed to start the PV profiler.
```

If you prefer to start the profiler from the user interface or command line you can omit the `pvStartProfiler()` call. You can leave it present if you wish to start Performance Validator from your program.

Do not use this function if you are working with services, use the ***NT Service API***.

pvSetThreadName()

Sets the name of a thread.

```
extern "C"
void pvSetThreadName(DWORD            threadID
                     const TCHAR      *name);
```

pvSetThreadNameA()

Sets the name of a thread.

```
extern "C"
void pvSetThreadNameA(DWORD           threadID
                      const char      *name);
```

pvSetThreadNameW()

Sets the name of a thread.

```
extern "C"
void pvSetThreadNameW(DWORD           threadID
                      const wchar_t   *name);
```

pvSetCollect()

Enables or disables data collection - i.e. whether data is sent to Performance Validator from your target application.

```
extern "C"
void pvSetCollect(int enable); // TRUE to enable, FALSE to disable
```

pvGetCollect()

Returns whether data collection is on.

```
extern "C"
int pvGetCollect();            // Returns TRUE or FALSE
```

5.2 C# API

The C# API is a wrapper around the native API.

For all of these APIs see the native API for more details.

Adding the API to your application

The C# API is provided as a source code `svlPVAPI.cs` file that you add to your application. The source file is in the API directory in the Performance Validator install directory.

The C# API does not add any dependencies to your application - if Performance Validator is present the API functions work, if Performance Validator is not present the API functions do nothing.

The C# API

The C# API is implemented by the `PerformanceValidator` class in the `SoftwareVerify` namespace.

collectOn()

Turn data collection on.

```
public static void collectOn();
```

collectOff()

Turn data collection off.

```
public static void collectOff();
```

setCollect()

Turn data collection on or off.

```
public static void setCollect(bool enable);
```

getCollect()

Determine if data collection is turned on or off.

```
public static bool getCollect();
```

5.3 Calling the API via GetProcAddress

Calling API functions using GetProcAddress

If you don't want to use the svlPVAPI.c/h files you can use `GetProcAddress()` to find the interface functions in the Performance Validator DLL.

The interface functions have different names and do not use C++ name mangling, but have identical parameters to the API functions.

To determine the function name take any native API name, replace the leading **pv** with **api**. For example `pvSetThreadNameW()` becomes `apiSetThreadNameW();`

Example usage

```
typedef void (*pvSetThreadNameW_FUNC)(const TCHAR   *name);

HMODULE getValidatorModule()
{
   HMODULE   hModule;

   hModule = GetModuleHandle(_T("svlPerformanceThreadValidatorStub6432.dll")); // 32 bit DLL wi
   if (hModule == NULL)
      hModule = GetModuleHandle(_T("svlPerformanceValidatorStub_x64.dll"));           // 64 bit
   if (hModule == NULL)
      hModule = GetModuleHandle(_T("svlPerformanceValidatorStub.dll"));        // 32 bit DLL wi

   return hModule;
}
```

```
HMODULE   hMod;

// get module, will only succeed if Performance Validator launched this app or is injected int

hMod = getValidatorModule();
if (hMod != NULL)
{
    // PV is present, lookup the function and call it to set the current thread's name

    pvSetThreadNameW_FUNC   pFunc;

    // "apiSetThreadNameW" is equivalent to linking against "pvSetThreadNameW"

    pFunc = (pvSetThreadNameW_FUNC)GetProcAddress(hMod, "apiSetThreadNameW");
    if (pFunc != NULL)
    {
        (*pFunc)(threadName);
    }
}
```

API functions and their GetProcAddress names

For any API functions not listed, try looking up the name in `svlPerformanceValidatorStub.dll` using depends.exe or PE File Browser.

Show API functions and GetProcAddress names

API Name	GetProcAddress() Name
pvLoadProfiler	
pvIsValidatorPresent	
pvStartProfiler	
pvSetThreadNameA	apiSetThreadNameA
pvSetThreadNameW	apiSetThreadNameW
pvSetCollect	apiSetCollect
pvGetCollect	apiGetCollect
pvShutdownPerformanc	apiShutdownPerformanceValidator

Other exported functions

You may see some other functions exported from `svlPerformanceValidatorStub.dll(_x64).dll`.

These other functions are for Performance Validator's use. Using them may damage memory locations and/or crash your code. Best not to use them!

5.4 Convenience functions

Convenience functions

One convenience function is provided that will start the Performance Validator GUI (if it is not already running), then load the Performance Validator performance profiler into your process and start profiling it.

```
extern "C"
int loadValidatorIntoApplication();

Returns:
TRUE   Successfully loaded PV DLL into target application and successfully
started the profiler.
FALSE   Failed to load the PV DLL or failed to start the profiler.
```

To use this function #include `loadValidatorIntoApplication.h` into your code.

The source files can be found in the `API` directory in the Performance Validator install directory.

`loadValidatorIntoApplication.h`
`loadValidatorIntoApplication.c`

Just add these files to your project and build.

Part VI

6 Working with IIS and Services

When working with NT services your account must have the appropriate privileges described in the User Permissions topic.

Attaching to your service

To use Performance Validator with NT Services you need to link a small library to your application and call two functions in the library.

The NT Service API

The NT Service API is provided to enable Performance Validator to work with services.

The API works just as well with normal applications, and the same considerations outlined here also apply generally.

When the NT Service API is used, source code symbols are acquired in the stub and sent to the Performance Validator user interface.

Monitoring the service

When working with Performance Validator and services using the NT Service API you don't start the service using Performance Validator.

Instead, you start the service the way you normally start the service - e.g. with the service control manager.

The code that you have embedded into your service then contacts Performance Validator, which you should have running *before* starting the service.

Once you've exercised your service and stopped it, Performance Validator will show the usual performance statistics.

Examples and help

We provide some Example Service Source Code to demonstrate how to embed the service code into your service.

If you have problems using Performance Validator with services, please contact us at support@softwareverify.com.

6.1 NT Service API

The Performance Validator stub service libraries

The NT Service API is very simple, consisting of functions to load, start and unload the Performance Validator DLL.

We have also provided some debugging functions to help you debug the implementation of the NT Service API because getting data into and out of services is not always straightforward.

The stub service libraries used for this are shown in the following table:

	32 bit Performance Validator	64 bit Performance Validator

32 bit service	`svlPVStubService.lib`
	`svlPVStubServiceMD.lib`
	`svlPVStubServiceMT.lib`
		`svlPVStubService6432.lib`

64 bit service	N/A	`svlPVStubService_x64.lib`
		`svlPVStubServiceMD_x64.lib`
		`svlPVStubServiceMT_x64.lib`

All the functions exported from these libraries are exported as `extern "C"` so that C and C++ users can use them.

Library name suffixes

The MD suffix indicates the library was built with the /MD compiler switch.
The MT suffix indicates the library was built with the /MT compiler switch.

Directory Name: 2010 or 2012?

Visual Studio 6 to Visual Studio 2010
If you are using Visual Studio 2010 or earlier, use libraries from a directory with 2010 in the directory name.

Visual Studio 2010 to Visual Studio 2022
If you are using Visual Studio 2012 or later, use libraries from a directory with 2012 in the directory name.

Header files

The header files can be found in the `svlPVStubService` directory in the Performance Validator install directory.

The headers file provide an error enumeration and the NT Service API functions.

```
svlPVStubService.h
svlServiceError.h
```

Linker Problems

Some linkers cannot link the stub service library file. If you have this problem see What do I do if I cannot use svlPVStubService.lib?

Loading the Performance Validator DLL into your service

To load the Performance Validator stub dll `svlPerformanceValidatorStub(_x64).dll` into your service, call `svlPVStub LoadPerformanceValidator()`, *not* `LoadLibrary()`.

If you are monitoring a 32 bit service with the 64 bit Performance Validator user interface you should use `svlPVStub LoadPerformanceValidator6432()`.

Shutting down the Performance Validator DLL from your service.

To shutdown Performance Validator's monitoring of the service , call `svlPVStub ShutdownPerformanceValidator()`.

This sends the shutting down notification and removes any hooks for your process.

Calling this function is optional. You can stop your service without calling this function.

Unloading the Performance Validator DLL from your service.

To unload the Performance Validator stub dll, call `svlPVStub UnloadPerformanceValidator()`, `not FreeLibrary()`.

Calling this function is optional. You can stop your service without calling this function.

Setting a service notification callback

Once you have successfully loaded the Performance Validator DLL you can setup a service callback so that the service control manager can be kept updated during the process of starting the validator.

When a service is starting, Windows requires the service to inform the Service Control Manager (SCM) that is starting at least every ten seconds.

Failure to do so results in Windows concluding that the service has failed to start, and the service is terminated.

Instrumenting your service may well take *more* than 10 seconds, depending on the complexity and size of your service.

The solution is for *Performance Validator* to periodically call a user supplied callback from which you can regularly inform the SCM of the appropriate status.

You can set the service callback with `svlPVStub SetServiceCallback(callback, userParam)`.

Usage

Here is an example callback which ignores the userParam.

```
void serviceCallback(void   *userParam)
{
    static DWORD dwCheckPoint = 1;

    ssStatus.dwServiceType = SERVICE_WIN32_OWN_PROCESS;
    ssStatus.dwServiceSpecificExitCode = 0;

    ssStatus.dwControlsAccepted = 0;

    ssStatus.dwCurrentState = dwCurrentState;
    ssStatus.dwWin32ExitCode = dwWin32ExitCode;
    ssStatus.dwWaitHint = dwWaitHint;

    ssStatus.dwCheckPoint = dwCheckPoint++;

    // Report the status of the service to the service control manager.

    return SetServiceStatus(sshStatusHandle, &ssStatus);
}
```

Once your service is running (rather than starting) your service callback should set the appropriate running status `SERVICE_RUNNING` rather than `SERVICE_START_PENDING`.

```
if (!ReportStatusToSCMgr(SERVICE_RUNNING,       // service state
                         NO_ERROR,              // exit code
                         0))                    // wait hint
{
   dwErr = GetLastError();
   if (bLogging)
      svlPVStub_writeToLogFileW(L"ReportStatusToSCMgr:5\r\n");
   goto cleanup;
}
```

An alternative solution is to prevent the service callback from being called once the service status has been set to running.

```
svlPVStub_SetServiceCallback(NULL, NULL);.
```

Starting Performance Validator DLL in your service

To start Performance Validator profiling your service call svlPVStub_StartPerformanceValidator.

Starting Performance Validator DLL in IIS

To start Performance Validator profiling IIS call svlPVStub_StartPerformanceValidatorForIIS().

Setting a filename for all logging data to be written to

To set the filename for all debugging/logging information to be written to call svlPVStub setLogFileName().

Deleting the logfile

To delete the log file call svlPVStub deleteLogFile().

Writing text to the logfile

To write a standard ANSI character string to the log file call svlPVStub writeToLogFileA(text). The ANSI string will be converted to Unicode prior to writing to the log file.

To write a Unicode character string to the log file call svlPVStub writeToLogFileW(text).

Writing error code descriptions to the logfile

To write a human readable description of the SVL_SERVICE_ERROR error code to the log file call svlPVStub writeToLogFile(errCode).

Writing LastError code descriptions to the logfile

To write a human readable description of the Windows error code to the log file call svlPVStub writeToLogFileLastError(errCode).

Dumping the PATH environment to the logfile

To write the contents of the PATH environment variable to the log file call svlPVStub dumpPathToLogFile().

This can be useful if you want to know what the search path is when trying to debug why a DLL wasn't found during an attempt to load the Validator DLL.

6.1.1 Changes to the NT Service API

API changes - February 2018

To make the API easier to use with services we made the following changes:

- Changed the API by adding many debugging functions to allow you to easily log information.
- We also extended the error enumeration to provide additional error status values.

- We also split the function of loading and starting Performance Validator into two functions - a *load* function and a *start* function.
- We split the functionality so that you could setup a service callback prior to calling the *start* function.

  The service callback allows the service control manager to be informed that the service is still active during time consuming operations, such as starting the Performance Validator when the service is non-trivial in scope.

  Failure to inform the service control manager results in the service being killed by the service control manager because it thinks the service has hung.

  This change in the API is to ensure you get better results from using our software.

What do you need to do to move from the old API to the new API?

Change all SVL_ERROR declarations to SVL_SERVICE_ERROR.

Your previous startup code probably looked like this:

```
SVL_ERROR errCode;

errCode = svlPVStub_LoadPerformanceValidator();
```

Change it to this:

```
SVL_SERVICE_ERROR errCode;

errCode = svlPVStub_LoadPerformanceValidator();

errCode = svlPVStub_SetServiceCallback(serviceCallback, NULL);

errCode = svlPVStub_StartPerformanceValidator();
```

The serviceCallback would look something like this:

```
void serviceCallback(void   *userParam)
{
    static DWORD dwCheckPoint = 1;

    ssStatus.dwServiceType = SERVICE_WIN32_OWN_PROCESS;
    ssStatus.dwServiceSpecificExitCode = 0;

    ssStatus.dwControlsAccepted = 0;

    ssStatus.dwCurrentState = dwCurrentState;
    ssStatus.dwWin32ExitCode = dwWin32ExitCode;
    ssStatus.dwWaitHint = dwWaitHint;
    ssStatus.dwCheckPoint = dwCheckPoint++;

    // Report the status of the service to the service control manager.

    return SetServiceStatus(sshStatusHandle, &ssStatus);
}
```

In the code above we have omitted error handling. To see how to use the new logging function with error handling pleas

Important.

Once your service is running (rather than starting) your service callback should set the appropriate running status `SERVICE_RUNNING` rather than `SERVICE_START_PENDING`.

```
if (!ReportStatusToSCMgr(SERVICE_RUNNING,       // service state
                         NO_ERROR,              // exit code
                         0))                    // wait hint
{
   dwErr = GetLastError();
   if (bLogging)
      svlPVStub_writeToLogFileW(L"ReportStatusToSCMgr:5\r\n");
   goto cleanup;
}
```

An alternative solution is to prevent the service callback from being called once the service status has been set to running.

```
svlPVStub_SetServiceCallback(NULL, NULL);.
```

6.1.2 NT Service API Reference

The API consists of the following functions.

SVL_SERVICE_ERROR Enumeration

```
typedef enum _svlServiceError
{
   SVL_OK,                                                  // Normal behaviour
   SVL_ALREADY_LOADED,                                      // Stub DLL already loaded into serv
   SVL_LOAD_FAILED,                                         // Failed to load stub DLL into serv
   SVL_FAILED_TO_ENABLE_STUB_SYMBOLS,                       // Loaded DLL, but failed to enable
   SVL_NOT_LOADED,                                          // Couldn't unload DLL because DLL n
   SVL_FAIL_UNLOAD,                                         // Couldn't unload DLL because could
   SVL_FAIL_TO_CLEANUP_INTERNAL_HEAP,                       // Couldn't get the internal stub he
   SVL_FAIL_MODULE_HANDLE                                   // Couldn't get the stub DLL handle
   SVL_FAIL_SETSERVICECALLBACK,                             // Couldn't call the set service cal
   SVL_FAIL_COULD_NOT_FIND_ENTRY_POINT,                     // Couldn't find the DLL entry point
   SVL_FAIL_TO_START,                                       // Failed to start the Validator
   SVL_FAIL_SETSERVICECALLBACKTHRESHOLD,                    // Couldn't call the set service cal
   SVL_FAIL_PATHS_DO_NOT_MATCH,                             // Path to service in env vars doesn
   SVL_FAIL_INCORRECT_PRODUCT_PREFIX,                       // Wrong validator
   SVL_FAIL_X86_VALIDATOR_FOUND_EXPECTED_X64_VALIDATOR,     // Found wrong bit depth validator
   SVL_FAIL_X64_VALIDATOR_FOUND_EXPECTED_X86_VALIDATOR,     // Found wrong bit depth validator
   SVL_FAIL_DID_YOU_MONITOR_A_SERVICE_FROM_VALIDATOR,       // Looks like Monitor A Service wasn
   SVL_FAIL_ENV_VAR_NOT_FOUND,                              // Env Var not found
   SVL_FAIL_VALIDATOR_ENV_VAR_NOT_FOUND,                    // Env Var identifying validator not
   SVL_FAIL_VALIDATOR_ID_NOT_SPECIFIED,                     // Validator process not specified
   SVL_FAIL_VALIDATOR_ID_NOT_A_PROCESS,                     // Validator process identified does
   SVL_FAIL_VALIDATOR_NOT_FOUND,                            // Validator process identified does
} SVL_SERVICE_ERROR;
```

svlPVStub_LoadPerformanceValidator

```
extern "C"
SVL_SERVICE_ERROR svlPVStub_LoadPerformanceValidator();
```

To load the `Performance` Validator stub `svlPerformanceValidatorStub.dll` into your service, use `svlPVStub_LoadPerformanceValidator()`, *not* `LoadLibrary()`.

This loads the DLL and sets up a few internal variables in the DLL to ensure that symbols are sent from the stub to the `Performance` Validator user interface.

This is necessary because the `Performance` Validator user interface can't open a process handle to a service and so is unable to get symbols from the process.

To solve this, symbols are sent from the stub to the user interface as needed.

If you just call `LoadLibrary()` on the DLL, symbols will *not* be sent to the `Performance` Validator user interface and you won't get meaningful function names in your stack traces.

This function can be used when monitoring:

- 32 bit services or applications with `Performance` Validator
- 64 bit services or applications with `Performance` Validator x64

If you are monitoring 32 bit applications with `Performance` Validator x64 you should use `svlPVStub_LoadPerformanceValidator6432()`.

Which function you should call is shown in the table below.

	32 bit `Performance` Validator	64 bit `Performance` Validator
32 bit service	`svlPVStub_LoadPerformanceValidator()`	`svlPVStub_LoadPerformanceValidator6432()`
64 bit service	N/A	`svlPVStub_LoadPerformanceValidator()`

svlPVStub_LoadPerformanceValidator6432

```
extern "C"
SVL_SERVICE_ERROR svlPVStub_LoadPerformanceValidator6432();
```

To load the `Performance` Validator stub `svlPerformanceValidatorStub6432.dll` into your service, use `svlPVStub_LoadPerformanceValidator6432()`, *not* `LoadLibrary()`.

This loads the DLL and sets up a few internal variables in the DLL to ensure that symbols are sent from the stub to the `Performance` Validator user interface.

This is necessary because the `Performance` Validator user interface can't open a process handle to a service and so is unable to get symbols from the process.

To solve this, symbols are sent from the stub to the user interface as needed.

If you just call `LoadLibrary()` on the DLL, symbols will *not* be sent to the `Performance` Validator user interface and you won't get meaningful function names in your stack traces.

This function should only be used when monitoring 32 bit services or applications with Performance Validator x64.

svlPVStub_StartPerformanceValidator

```
extern "C"
SVL_SERVICE_ERROR svlPVStub_StartPerformanceValidator();
```

To start Performance Validator inspecting the service call `svlPVStub_StartPerformanceValidator()`.

svlPVStub_StartPerformanceValidatorForIIS

```
extern "C"
SVL_SERVICE_ERROR svlPVStub_StartPerformanceValidatorForIIS();
```

To start Performance Validator inspecting IIS call `svlPVStub_StartPerformanceValidatorForIIS()`.

Example usage.

svlPVStub_ShutdownPerformanceValidator

```
extern "C"
```

```
SVL_SERVICE_ERROR svlPVStub_ShutdownPerformanceValidator();
```

To stop Performance Validator inspecing the service call `svlPVStub_ShutdownPerformanceValidator()`.

This sends the shutting down notification and removes any hooks for your process.

Calling this function is optional. ***You can stop your service without calling this function.***

svlPVStub_UnloadPerformanceValidator

```
extern "C"
SVL_SERVICE_ERROR svlPVStub_UnloadPerformanceValidator();
```

To unload Performance Validator call `svlPVStub_UnloadPerformanceValidator()`, *do not call* `FreeLibrary()`.

Calling this function is optional. ***You can stop your service without calling this function.***

svlPVStub_SetServiceCallback

```
extern "C"
SVL_SERVICE_ERROR svlPVStub_SetServiceCallback(serviceCallback_FUNC callback,
                                               void*                userParam);
```

`svlPVStub_SetServiceCallback` is used to setup a service callback that is used to inform the Windows service cor

`userParam` is a value you can supply which will then be passed to the callback every time the callback is called during instrumentation.

Why is a service callback needed?

When a service is starting, Windows requires the service to inform the Service Control Manager (SCM) that is starting at least every ten seconds.

Failure to do so results in Windows concluding that the service has failed to start, and the service is terminated.

Instrumenting your service may well take *more* than 10 seconds, depending on the complexity and size of your service.

The solution is for *Performance Validator* to periodically call a user supplied callback from which you can regularly inform the SCM of the appropriate status.

We strongly recommend that you setup a service callback. Not setting a service callback can result in failure of your

Debugging functions

The following functions are provided to help you log information about the progress, success or failure of the NT Service API attaching Performance Validator to your service.

We strongly recommend that you use these logging functions so that you can understand why Performance Validator might fail to connect to a service.

To see example usage of these debugging functions please look in `service.cpp` in the `examples\service` directory in the Performance Validator install directory.

svlPVStub_setLogFileName

```
extern "C"
void svlPVStub_setLogFileName(const wchar_t* fileName);
```

Call `svlPVStub_setLogFileName` to set the name of the filename used for logging.

This function must be called before you can use any of the other debugging functions.

Setting this filename also sets the filename used by some of these API functions - you will find additional logging data from those functions that will help debug any issues with the service.

svlPVStub_deleteLogFile

```
extern "C"
void svlPVStub_deleteLogFile();
```

This function deletes the log file.

svlPVStub_writeToLogFileA

```
extern "C"
void svlPVStub_writeToLogFileA(const char* text);
```

This function writes a standard ANSI character string to the log file.

The ANSI string will be converted to Unicode prior to writing to the log file.

svlPVStub_writeToLogFileW

```
extern "C"
void svlPVStub_writeToLogFileW(const wchar_t* text);
```

This function writes a Unicode character string to the log file.

svlPVStub_writeToLogFile

```
extern "C"
```

```
void svlPVStub_writeToLogFile(SVL_SERVICE_ERROR errCode);
```

This function writes a human readable description of the SVL_SERVICE_ERROR error code to the log file.

svlPVStub_writeToLogFileLastError

```
extern "C"
void svlPVStub_writeToLogFileLastError(DWORD errCode);
```

This function writes a human readable description of the Windows error code to the log file.

The errCode parameter is the error code returned from GetLastError().

svlPVStub_dumpPathToLogFile

```
extern "C"
void svlPVStub_dumpPathToLogFile();
```

This function writes the contents of the PATH environment variable to the log file.

This can be useful if you want to know what the search path is when trying to debug why a DLL wasn't found during an attempt to load the Validator DLL.

6.1.3 Troubleshooting

Troubleshooting - Service fails to start

If a service takes too long to start the service control manager kills the service.

The way to stop this is for a service to call `ReportStatusToSCMgr()` to tell the service control manager that the service is still OK.

Performance Validator can't do this for you as the call requires some data from any earlier call you have made.

The solution is that you provide a callback using `svlPVStub_SetServiceCallback()` that Performance Validator can call during the process of attaching to the service, and you can call the appropriate function.

Example code to set the callback:

```
	errCode = svlPVStub_SetServiceCallback(serviceCallback,		// the
callback
						NULL);			// some
user data (we don't have any, so set NULL)
	if (bLogging)
	{
```

```
		if (errCode != SVL_OK)
		{
			svlPVStub_writeToLogFileW(L"Setting service callback failed.
\r\n");
			svlPVStub_writeToLogFile(errCode);
		}

		svlPVStub_writeToLogFileW(L"Starting Performance Validator\r\n");
	}
```

Example callback:

```
static void serviceCallback(void  *userParam)
{
	// just tell the Service Control Manager that we are still busy
	// in this example userParam is not used
	//
	// note that prior to the Validator loading it's DLL ssStatus.dwCurrentState
must have been initialised, most likely to SERVICE_START_PENDING
	// you could pass a fixed value here, but it would need to change once the
service has finished starting up so that you don't unintentionally change the service
state
	// when this callback is called. This callback is called whenever
instrumentation happens (when a DLL is loaded). Thus you can't assume this is only
called during service startup,
	// it may also get called later in the service lifetime.

	ReportStatusToSCMgr(ssStatus.dwCurrentState,    // service state
			    NO_ERROR,                   // exit code
			    3000);                      // wait hint
}
```

We strongly recommend that you set a service callback. It won't harm your program and it will remove any likelihood of your service being killed by the service control manager.

Troubleshooting - Service starts, Performance Validator gets no data

If you have problems getting Performance Validator to monitor your service you'll need to find out what's failing.

Until Performance Validator loads correctly and successfully connects to the graphical user interface you have no way of knowing what is happening.

The solution is to set a log file that Performance Validator can write status messages to. You can also write your own status messages to this log file.

Set the log file using `svlPVStub_setLogFileName`. Write to it using `svlPVStub_writeToLogFile()`, `svlPVStub_writeToLogFileA()`, `svlPVStub_writeToLogFileW()`.

Then when things are not working as expected take a look at the log file to see the errors. The Performance Validator will often suggest what the problem is.

We strongly recommend that you configure the log file and use it when working with services. It has saved us a lot of time.

6.2 Working with IIS

Configuring IIS for use with ISAPI

We assume that you are familiar with IIS. This is not a topic we can provide advice for.

That said, we wrote a blog article about configuring IIS for use with ISAPI.

Example ISAPI

We have provided an example ISAPI extension configured for use with Performance Validator.

This example is provided as source code and project files. You will need to build it yourself, you may need to change an include path to find the appropriate headers. The resulting ISAPI will need to be copied to your website for testing and the website configured to allow the ISAPI to execute (please see the above mentioned blog article for details on that).

You can find the example ISAPI in the **isapiExample** folder in the Performance Validator installation directory.

Using Performance Validator with IIS

IIS is a service application. It runs as one of the more restricted applications on Microsoft Windows.

Performance mapped files created by IIS cannot be opened by user mode programs (Performance Validator, for example). DLLs, executables and files cannot be opened by IIS except if they are in directories which IIS has access to. These are security measures intended to make your computer secure from attack.

These security measures make it hard for tools like Performance Validator to work.

- We have to communicate settings information to Performance Validator via text file
- All DLLs and helper programs we want to use need to be copied to the web root (or a subdirectory within the web root) so that they can be used.
- We need to have our own data transport because our usual high speed memory mapped data transport is not available.

It's also not possible to launch IIS or inject into a running IIS instance.

The only way to work with IIS is by using the NT Service API, and using the `svlPVStub_StartPerformanceValidatorForIIS()` function instead of `svlPVStub_StartPerformanceValidator()`.

We've provide some example code to show you how to attach and detach from your ISAPI extension.

Workflow

1) Start monitoring your ISAPI by using the Monitor ISAPI dialog.

 **Launch** menu > **IIS** menu > **Monitor ISAPI...**

2) When you have finished interacting with the web pages that use the ISAPI component shutdown IIS, wait for Performance Validator's status to indicate "Ready" and examine the results.

 **Launch** menu > **IIS** menu > **Stop IIS**

6.3 Example Source Code

Service Example

Example demonstrating how to monitor a service.

Also see the example service that ships with Performance Validator.

You can find this in the `\examples\service` directory in the Performance Validator install directory.

Also see the example service and child process that ships with Performance Validator.

You can find this in the `\examples\serviceWithAChildProcess` directory in the Performance Validator install directory.

IIS Example

Example demonstrating how to monitor an ISAPI DLL.

Also see the example ISAPI DLL that ships with Performance Validator.

You can find this in the `\examples\isapiExample` directory in the Performance Validator install directory.

6.3.1 Example Service Source Code

Where to put your code

When you use the functions to load and unload Performance Validator from your service, it is important that you put the function calls in the correct place in your software.

The correct place to put them is in a 'balanced' location, such that you would expect no memory leaks to occur between the load and the unload function call, assuming the service was working correctly.

Typically, this means that Performance Validator is:

- loaded as the first action in the `service_main()` function
- unloaded just before the service control manager is informed of the stopped status

The source code shown below shows an example `service_main()` function used in a service, demonstrating where to load and unload Performance Validator.

The long comment covers problems with the way services are stopped and what may be displayed in a debugger if this happens.

➡ The code is extracted from `service\service.cpp`, part of the full example of an NT service, client and a utility for controlling whether the service uses Performance Validator.

Show the C++ example service_main() function

```
void serviceCallback(void   *userParam)
{
   // just tell the Service Control Manager that we are still busy
   // in this example userParam is not used

   static DWORD dwCheckPoint = 1;

   ssStatus.dwServiceType = SERVICE_WIN32_OWN_PROCESS;
   ssStatus.dwServiceSpecificExitCode = 0;

   ssStatus.dwControlsAccepted = 0;

   ssStatus.dwCurrentState = dwCurrentState;
   ssStatus.dwWin32ExitCode = dwWin32ExitCode;
   ssStatus.dwWaitHint = dwWaitHint;
   ssStatus.dwCheckPoint = dwCheckPoint++;

   // Report the status of the service to the service control manager.

   return SetServiceStatus(sshStatusHandle, &ssStatus);
}

//-NAME-------------------------------
// service_main
//.DESCRIPTION.........................
//
// Initializes the service, then calls the function to do the work.
// This function is typically where you will load and unload Performance Validator
//
//.PARAMETERS.........................
//
// dwArgc   - number of command line arguments
```

```
// lpszArgv - array of command line arguments
//
//.RETURN.CODES.........................
//--------------------------------------

void WINAPI service_main(DWORD   dwArgc,
                  LPTSTR   *lpszArgv)
{
   if (bLogging)
   {
      svlPVStub_setLogFileName(SZLOGFILENAME);
      svlPVStub_deleteLogFile();
   }
```

```
   // register our service control handler:

   sshStatusHandle = RegisterServiceCtrlHandler(TEXT(SZSERVICENAME), service_ctrl);
   if (sshStatusHandle != 0)
   {
      DWORD   dwErr = 0;

      // **PV_EXAMPLE** start

      if (bPerformanceValidator)
      {
         // load Performance Validator (but if monitoring a 32 bit service with C++ Pe

         if (bLogging)
         {
            svlPVStub_writeToLogFileW(_T("About to load C++ Performance Validator\r\n")
         }

         SVL_SERVICE_ERROR   errCode;

#ifdef IS6432
         // x86 with x64 GUI
         errCode = svlPVStub_LoadPerformanceValidator6432();
#else   //#ifdef IS6432
         // x86 with x86 GUI
         // x64 with x64 GUI
         errCode = svlPVStub_LoadPerformanceValidator();
#endif   //#ifdef IS6432
         if (bLogging)
         {
            if (errCode != SVL_OK)
            {
               DWORD   lastError;

               lastError = GetLastError();
               svlPVStub_writeToLogFileW(_T("C++ Performance Validator load failed. \r
               svlPVStub_writeToLogFileLastError(lastError);
               svlPVStub_writeToLogFile(errCode);

               svlPVStub_dumpPathToLogFile();
            }
            else
            {
               svlPVStub_writeToLogFileW(_T("C++ Performance Validator load success. \n
            }
         }

         // setup a service callback so that the Service Control Manager knows the ser
         // is starting up even if instrumentation takes longer than 10 seconds (which
         // for a non-trivial application)

         if (bLogging)
            svlPVStub_writeToLogFileW(_T("Setting service callback C++ Performance Val
```

```
      errCode = svlPVStub_SetServiceCallback(serviceCallback,      // the callback
                                             NULL);               // some user data
      if (bLogging)
      {
         if (errCode != SVL_OK)
         {
            svlPVStub_writeToLogFileW(_T("Setting service callback failed. \r\n"));
            svlPVStub_writeToLogFile(errCode);
         }

         svlPVStub_writeToLogFileW(_T("Starting C++ Performance Validator\r\n"));
      }

      errCode = svlPVStub_StartPerformanceValidator();
      if (bLogging)
      {
         if (errCode != SVL_OK)
         {
            DWORD   lastError;

            lastError = GetLastError();
            svlPVStub_writeToLogFileW(_T("Starting C++ Performance Validator failed
            svlPVStub_writeToLogFileLastError(lastError);
            svlPVStub_writeToLogFile(errCode);
         }

         svlPVStub_writeToLogFileW(_T("Finished loading C++ Performance Validator\r\
      }
   }
   else
   {
      if (bLogging)
         svlPVStub_writeToLogFileW(_T("Not using C++ Performance Validator, DLL wil
   }

   // **PV_EXAMPLE** end

   // SERVICE_STATUS members that don't change in example

   ssStatus.dwServiceType = SERVICE_WIN32_OWN_PROCESS;
   ssStatus.dwServiceSpecificExitCode = 0;

   // report the status to the service control manager.

   if (ReportStatusToSCMgr(SERVICE_START_PENDING, // service state
                           NO_ERROR,              // exit code
                           3000))                 // wait hint
   {
      // deliberately allocate some memory so we can see that
      // with Performance Validator

      char   *someLeakedMemory;

      someLeakedMemory = (char *)malloc((SIZE_T)3456);
```

```
         // do work

         dwErr = ServiceStart(dwArgc, lpszArgv);

         // finished doing work
      } //lint !e429 !e550


      // **PV_EXAMPLE** start

      if (bPerformanceValidator)
      {
         // unload Performance Validator here
         // IMPORTANT.
         // Because of the way services work, you can find that this thread which is
trying to gracefully unload
         // PerformanceValidator is ripped from under you by the operating system.
This prevents Performance Validator from
         // removing all its hooks successfully. If Performance Validator does not
remove all of its hooks successfully
         // because this happens, then you may get a crash when the service stops.
         //
         // An alternative fix is to spawn another thread which then unloads
Performance Validator.
         // See the code for ServiceStop() for comments relating to this.
         //
         // A callstack for such a crash is shown below. If you see this type of crash
you need to put you code to
         // unload Performance Validator somewhere else. The stack trace may be
different, but a fundamental point is the
         // code calling through doexit(), exit() and ExitProcess()
         //
         //NTDLL! 77f64e70()
         //SVLPERFORMANCEVALIDATORSTUB!
         //MSVCRT! 78001436()
         //MSVCRT! 7800578c()
         //DBGHELP! 6d55da25()
         //DBGHELP! 6d55de83()
         //DBGHELP! 6d53705d()
         //DBGHELP! 6d51cc69()
         //DBGHELP! 6d51f6e8()
         //DBGHELP! 6d524ebf()
         //DBGHELP! 6d52a7b0()
         //DBGHELP! 6d52b00a()
         //DBGHELP! 6d526487()
         //DBGHELP! 6d5264d7()
         //DBGHELP! 6d5264f7()
         //SVLPERFORMANCEVALIDATORSTUB!
         //SVLPERFORMANCEVALIDATORSTUB!
         //SVLPERFORMANCEVALIDATORSTUB!
         //SVLPERFORMANCEVALIDATORSTUB!
         //SVLPERFORMANCEVALIDATORSTUB!
         //SVLPERFORMANCEVALIDATORSTUB!
```

```
            //SVLPERFORMANCEVALIDATORSTUB!
            //SVLPERFORMANCEVALIDATORSTUB!
            //MSVCRT! 78001436()
            //MSVCRT! 780057db()
            //KERNEL32! 77f19fdb()
            //SVLPERFORMANCEVALIDATORSTUB! ExitProcess hook
            //doexit(int 0x00000000, int 0x00000000, int 0x00000000) line 392
            //exit(int 0x00000000) line 279 + 13 bytes
            //mainCRTStartup() line 345
            //KERNEL32! 77f1b9ea()

            svlPVStub_UnloadPerformanceValidator();
        }

        // **PV_EXAMPLE** end

        // try to report the stopped status to the service control manager.

        (VOID)ReportStatusToSCMgr(SERVICE_STOPPED, dwErr, 0);
    }

    return;
}
```

6.3.2 Example ISAPI Source Code

Where to put your code

When you use the functions to load and unload Performance Validator from your service, it is important that you put the function calls in the correct place in your ISAPI extension.

Typically, this means that Performance Validator is:

- loaded as the first action in the `GetExtensionVersion()` function of your ISAPI extension.
- unloaded in the `TerminateExtension()` function of your ISAPI extension.

Example source code

The source code shown below shows an example `GetExtensionVersion()` and an example `TerminateExtension()` used in an ISAPI, demonstrating where to load and unload Performance Validator.

This example code logs errors. We strongly recommend that you do this in your example. Because IIS is a protected process that can't communicate to the outside world except via HTTP/HTTPS when anything fails during the loading and start of Performance Validator the only means we have of communicating that failure to you is via the log file. Please use the log file, it will make debugging any mistakes very much easier, simpler and quicker than any other method.

This process is almost identical to working with a regular service, except that `svlPVStub_StartPerformanceValidator()` is replaced with `svlPVStub_StartPerformanceValidatorForIIS()`.

This example assumes the web root is located `C:\\testISAPIWebsite`

Show the C++ example ISAPI functions

```
#include "svlPVStubService.h"
#include "svlServiceError.h"

BOOL WINAPI GetExtensionVersion(HSE_VERSION_INFO *pVer)
{
	// some setup work to define what the extension is

	pVer->dwExtensionVersion = HSE_VERSION;
	strncpy(pVer->lpszExtensionDesc, "Validate ISAPI Extension",
HSE_MAX_EXT_DLL_NAME_LEN);

	// load Validator here

	svlPVStub_setLogFileName(L"C:\\testISAPIWebsite\\svl_PV_log.txt");
	svlPVStub_deleteLogFile();

	SVL_SERVICE_ERROR   errCode;
#ifdef IS6432
	// x86 with x64 GUI
	errCode = svlPVStub_LoadPerformanceValidator6432();
#else   //#ifdef IS6432
	// x86 with x86 GUI
	// x64 with x64 GUI
	errCode = svlPVStub_LoadPerformanceValidator();
#endif   //#ifdef IS6432
	if (errCode != SVL_OK)
	{
		DWORD   lastError;

		lastError = GetLastError();
		svlPVStub_writeToLogFileW(L"C++ Performance Validator load failed.
\r\n");
		svlPVStub_writeToLogFileLastError(lastError);
		svlPVStub_writeToLogFile(errCode);

		svlPVStub_dumpPathToLogFile();
	}
	else
	{
		svlPVStub_writeToLogFileW(L"C++ Performance Validator load success.
\r\n");

		errCode = svlPVStub_StartPerformanceValidatorForIIS();
		if (errCode != SVL_OK)
		{
			DWORD   lastError;
```

```
                    lastError = GetLastError();
                    svlPVStub_writeToLogFileW(L"Starting C++ Performance Validator
failed. \r\n");
                    svlPVStub_writeToLogFileLastError(lastError);
                    svlPVStub_writeToLogFile(errCode);
                }

                svlPVStub_writeToLogFileW(L"Finished starting C++ Performance
Validator\r\n");
        }

        return TRUE;
}


BOOL WINAPI TerminateExtension(DWORD     dwFlags)
{
        // unload Validator here

        svlPVStub_UnloadPerformanceValidator();

        return TRUE;
}
```

Part VII

7 Working with VBUnit

This page gives information about using Performance Validator with programs that use VBUnit.

About VBUnit

VBUnit works by spawning a worker service process, `vbUnitTestServer.exe` which works in conjunction with the main process `RunVBUnit.exe`.

Because `vbUnitTestServer.exe` is a service and is not launched directly using `CreateProcess` from `RunVBUnit.exe` we can't monitor and hook this process.

This means that to get the Performance Validator stub dll into your Visual Basic process you'll have to load the stub dll yourself.

At the time of writing, the current VBUnit is VBUnit3.

Using Performance Validator with VBunit

There are two steps: preparing the executable and running the test.

Step 1: Modifying the VB DLL/EXE

To load the Performance Validator stub dll into your Visual Basic process do the following steps:

1) Copy **`svlPerformanceValidatorStub.dll`** to the same directory (or any directory on the **`$PATH`**) as the Visual Basic executable (or DLL) you wish to test.

2) Copy **`DbgHelp.dll`** from the Performance Validator install directory to the same directory (or any directory on the **`$PATH`**) as the Visual Basic executable (or DLL) you wish to test.

> Don't copy the **`DbgHelp.dll`** from elsewhere as you may get an earlier version of the **`DbgHelp.dll`** and not be able to read symbols as a result.

3) Modify the start of your test DLL or exe so that the first thing it does is load the Performance Validator stub DLL.

> Do this as follows:
>
> a) Add these lines to the *start* of your Visual Basic code.

```
   Private Declare Function FreeLibrary Lib "kernel32" (ByVal hLibModule As Long)
As Long
   Private Declare Function LoadLibrary Lib "kernel32" Alias "LoadLibraryA" (ByVal
lpLibFileName As String) As Long
```

b) Add these lines where you wish to *load* the Performance Validator DLL.

```
Dim lbCVStub As Long

lbCVStub = LoadLibrary("svlCoverageValidatorStub")
```

c) Add this line where you wish to *unload* the Performance Validator DLL.

```
FreeLibrary lbCVStub
```

This step is optional, but do it as close to the end of the execution of your DLL or EXE as possible.

4) Ensure each VB exe or DLL has been built with debug symbols. Debug symbols are required so that Performance Validator can monitor each line visit.

Do this as follows:

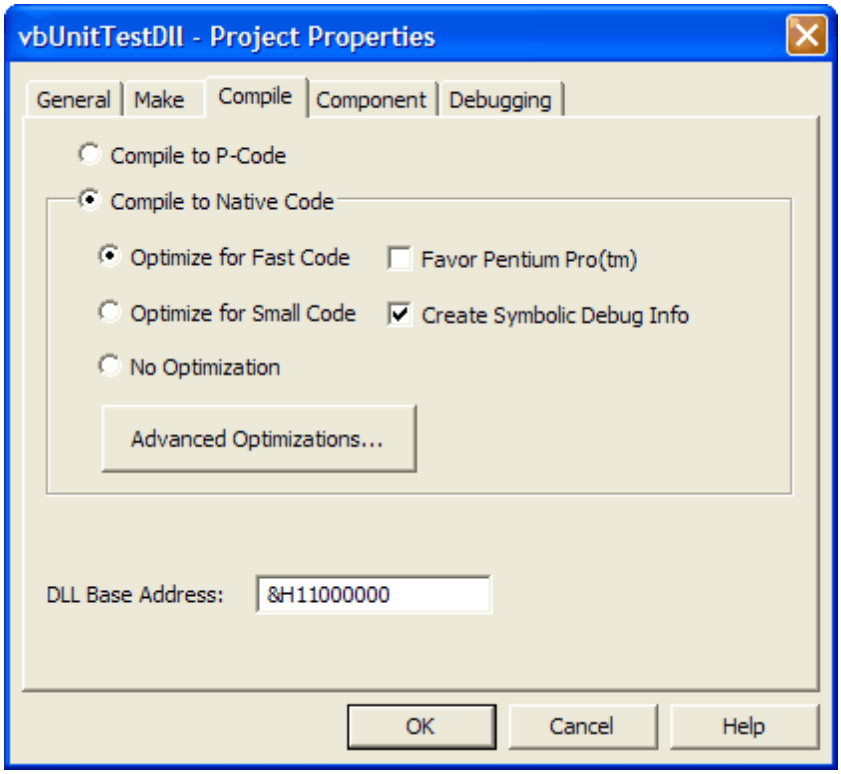
a) Open the Visual Studio properties dialog for the project. **Project** Menu › **Properties...**

b) Go to the **Compile** tab.

c) Select the **Compile to Native Code** radio box.

d) Check the **Create Symbol Debug Info** check box. Click **OK**.

e) Make the project. **File** Menu › **Make** [name of project].



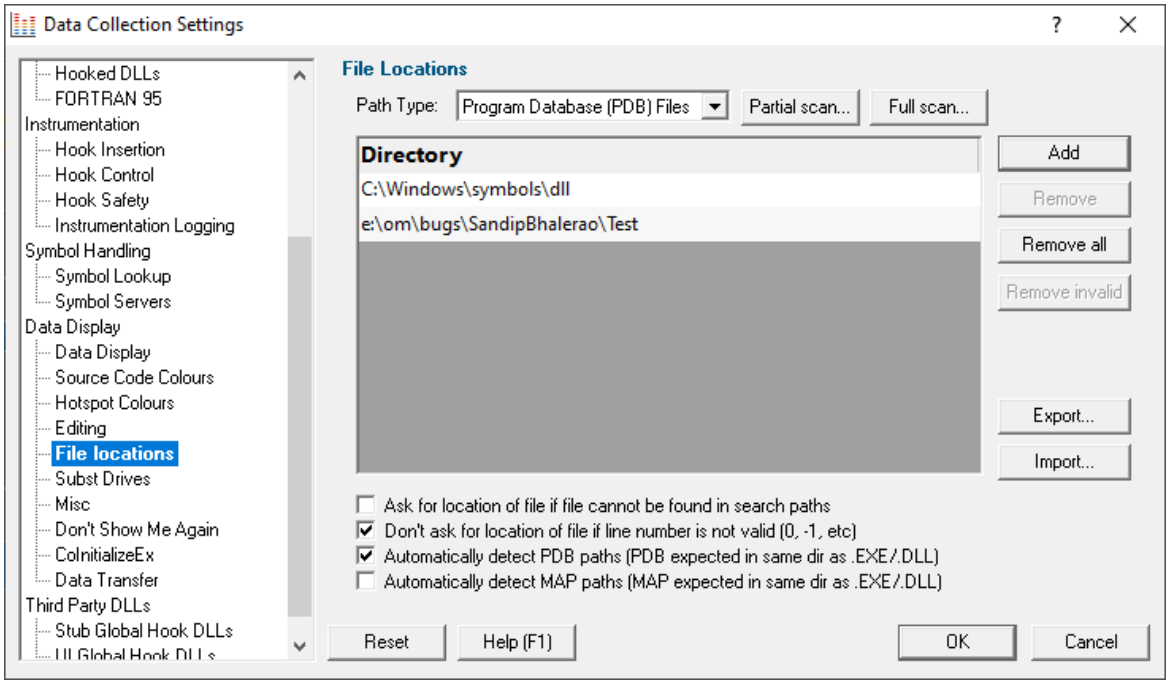
Step 2: Setting up Performance Validator

1) Setup where the Visual Basic PDB files are stored

Do this as follows:

a) Open the settings dialog.

b) Go to **"File Locations"**.



c) Choose "**Program Database (PDB) Files**" in the combo box.

d) Click **Add**. Enter the directory name where the PDB files are located.

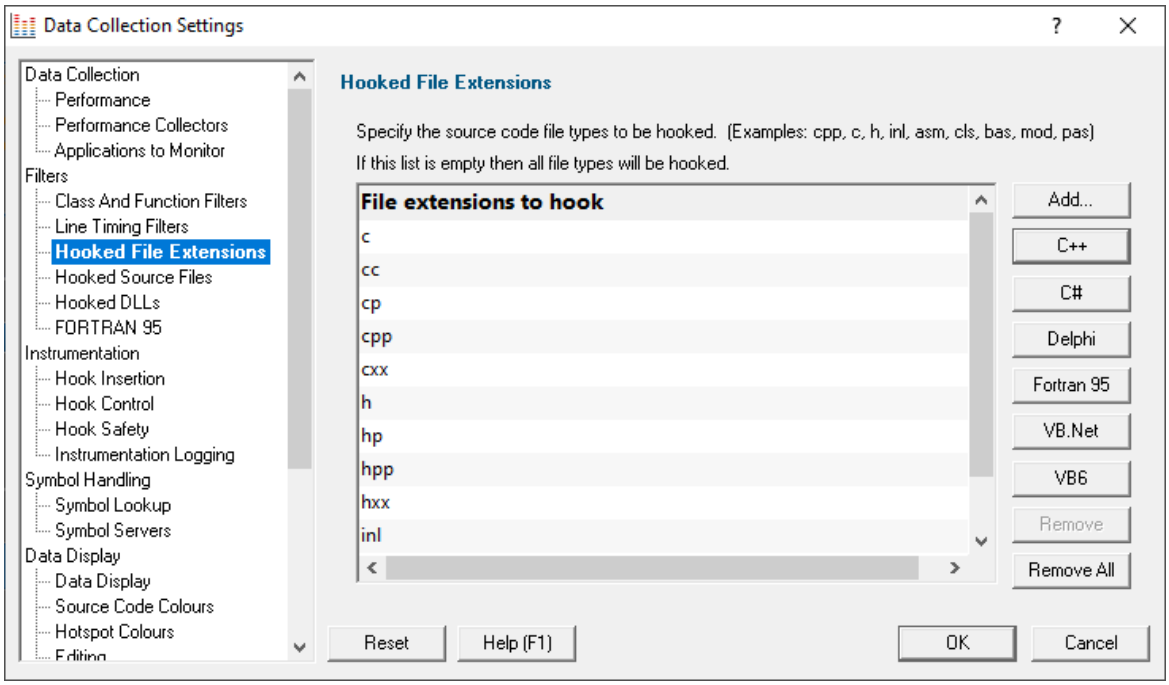
e) Click **OK**.

2) Setup Visual Basic file associations.

Do this as follows:

a) Open the settings dialog.

b) Go to **"Hooked File Extensions"**.



d) Check if the file extensions "cls" and "bas" are present, or remove all file types, If no file types are present every type of file will be instrumented.

e) For any file extension that is not present click **Add** then enter the extension.

e) Click **OK**.

Step 3: Running the test

To run the test do the following:

1) Start Performance Validator.

2) Start your Unit tests from your command line or batch file.

When the Performance Validator DLL loads into your DLL/EXE it will instrument your DLL/EXE.

It will then contact the Performance Validator UI and proceed as if you had launched the unit tests from Performance Validator.

Part

8 Examples

The need for examples

We know Performance Validator is a complex product, but the programs that need to be tested are often even more complex, and are certainly all different.

For this reason, it's important to be able to test and demonstrate the features of Performance Validator in an easy and repeatable way.

Having said that, Performance Validator provides performance information and doesn't detect error conditions, so the example program is quite simplistic.

The example application provides a safe test demonstration:

- It lets you trigger time consuming calculations in your own time so you can observe performance hotspots
- It provides source code to demonstrate usage, correctly or otherwise!

This section has help for the example application followed by some examples of using it in conjunction with Performance Validator.

Some additional projects provide examples of using NT Services.

All example projects are supplied as source code and projects. You'll need to build the example or services before you can use them.

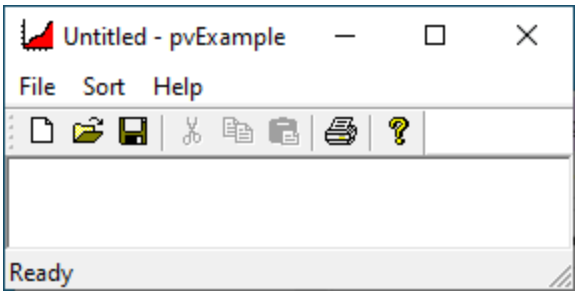
8.1 Example Application

The example application

The example application is a great way to explore the capabilities of Performance Validator.

The source and projects are included in the installation, but you'll need to build the example application yourself.

You can then use nativeExample.exe in conjunction with Performance Validator to monitor the performance of the application as you use it.



How to use these examples

The best way to understand how Performance Validator works is by example.

We recommend launching the example application from Performance Validator and observing how the menu actions affect performance statistics and hotspots.

Examining the source code is the best way to see what's going on in the example application.

Resetting the statistics before and between using the menu items is a good way to easily see exactly what new code was marked as being time consuming.

The example runs some inline tests and some sorting methods. For convenience, below we have provided the source locations where each menu action runs a test.

Most test locations are in the `CMainFrame` class of `nativeExample\mainfrm.cpp`

File menu

File menu › **...**

› **Test inline classes**	`OnFileTestinlineclasses()` Calls a small number of in-lined functions in a tight loop. ➜ See the comment in this function for details about in-line functions and the data collection mode.
› **Exit**	closes the example application

Sort menu

All the sorting routines populate an array with a certain number of items and then validate the result after sorting the array.

Sort menu › **...**

Quick Sort	`OnSortQuicksort()` sorts an array using `qsort`
Comb Sort	`OnSortCombsort()` sorts an array using `doCombSort`
Heap Sort	`OnSortHeapsort()` sorts an array using `heapSort`
Merge Sort	`OnSortMergesort()` sorts an array using `mergeSort_sortCore`
Bubble Sort	`OnSortBubblesort()` sorts an array using quite an inefficient algorithm
Choose how many items to sort...	`OnSortChoosehowmanyitemstosort()` sets the number of items being sorted by each of the above methods

Help menu

Help menu **...**

About nativeExample...	`CNativeExampleApp::OnAppAbout()` Shows a simple information dialog using code in nativeExample.cpp

8.1.1 Building the Example Application

Where to find the example application

The example project is in the **examples\nativeExample** sub-directory of the Performance Validator installation directory.

If the directory is not present, reinstall your software and choose *custom* or *full* installation to include the examples.

Solutions and projects

There are a variety of solutions and projects for different versions:

- **nativeExample.dsp** for Microsoft® Developer Studio® 6.0
- **nativeExample_VSx_x.sln** for Microsoft® Visual Studio / .net

Configurations

There are a small number of configurations in each project:

- **Debug** / **Release**
- **DebugStatic** / **ReleaseStatic**

Using Visual Studio Express?

You might find you can't build the example application with Express versions of Visual Studio because it doesn't provide all the necessary libraries.

If that's the case, try searching for the missing libraries in one of the freely available Windows SDKs from the Microsoft website.

If you use Visual Studio Express to build your *own* application, Performance Validator will still work with it just fine.

8.2 Example NT Service

The example NT Service

As well as the example application, an example *service* is provided along with details about building it.

There's also an example client.

The example service demonstrates how to use the NT Service API to call the two functions required to use Performance Validator with NT Services.

The following tasks are performed when the service is started:

- Loads the Performance Validator stub DLL into the service
- Performs the normal work of the service until it's stopped
- Unloads the Performance Validator stub DLL from the service
- Informs the service control manager that a stop is pending

➡ Read more about working with NT Services.

8.2.1 Building the example service

Example service project files

The example project can be found in the `service` sub-directory in the directory where Performance Validator was installed.

If the directory is not present, reinstall your software and choose custom or full installation.

There are two project files in the directory:

- **service.dsp** › for Microsoft® Developer Studio® 6.0
- **service.vcproj** › for Microsoft® Visual Studio / .net

Configurations

There are just two simple configurations in each project:

- **Debug / Release** › dynamically links to the `svlPVStubService(_x64).lib` demonstrating use with the NT Service API

Using the service

The service is named **PV Simple Service** in the control panel services dialog, and provides the following command line options:

- **-install** › Install the service
- **-remove** › Uninstall the service
- **-start** › Start the service
- **-stop** › Stop the service
- **-debug** › Run as a console application for debugging
- **-?** › Display the help message
- **-help** › Display the help message

Open a cmd prompt in administrator mode, navigate to the location of the service executable, and use one of these commands to install, remove, start, stop the service.

Examples:

```
servicePV.exe -install

servicePV.exe -start

servicePV.exe -stop

servicePV.exe -remove
```

8.2.2 Building the example client

If you've already built the sample service, the process is very similar

Project files

The example project can be found in the `serviceClient` sub-directory in the directory where Performance Validator was installed.

If the directory is not present, reinstall your software and choose custom or full installation.

There are two project files in the directory:

- **serviceClient.dsp** › for Microsoft® Developer Studio® 6.0
- **serviceClient.vcproj** › for Microsoft® Visual Studio / .net

Configurations

There are a small number of configurations in each project:

- **Debug / Release** › dynamically links to the `svlPVStubService(_x64).lib` demonstrating use with the NT Service API

Using serviceClient

The service is named **PV Simple Service** in the control panel services dialog, and provides the following command line options:

- **-string** › Sends the following (optionally quoted) text to the service. If the service is running the service will return the string in reverse order

  For example: `serviceClient.exe -string "The quick brown fox"` returns `"xof nworb kciuq ehT"`

- **-help** › Display the help message

8.2.3 Building the example service utility

The serviceMutex project demonstrates a way of controlling whether Performance Validator is used without having to rebuild your service.

Project files

The example project can be found in the `serviceMutex` sub-directory in the directory where Performance Validator was installed.

If the directory is not present, reinstall your software and choose custom or full installation.

There are two project files in the directory:

- **serviceMutex.dsp** › for Microsoft® Developer Studio® 6.0
- **serviceMutex.vcproj** › for Microsoft® Visual Studio / .net

Configurations

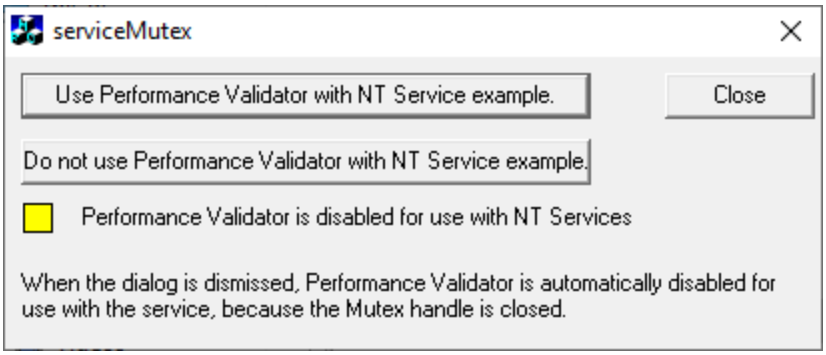
There are just two configurations in each project:

- **Debug / Release** › dynamically links to the `svlPVStubService(_x64).lib` demonstrating use with the NT Service API

Using the service utility

The utility provides a dialog box interface to allow the control over the creation of a mutex object with the name specified in the `service.h` header file.

Only if the service is started with the mutex created, does the service load Performance Validator.



If you don't like using mutexes in this way, you could change the code in the service and the utility to communicate through shared memory, a registry setting or another method of your choice.

8.2.4 Monitoring the service

Once the example service and example client has been built, the next step is to test them using Performance Validator.

Installing the service

If you haven't installed the service, do the following:

- open an administrator mode cmd prompt
- navigate to the directory containing the servicePV.exe to install

- servicePV.exe -install

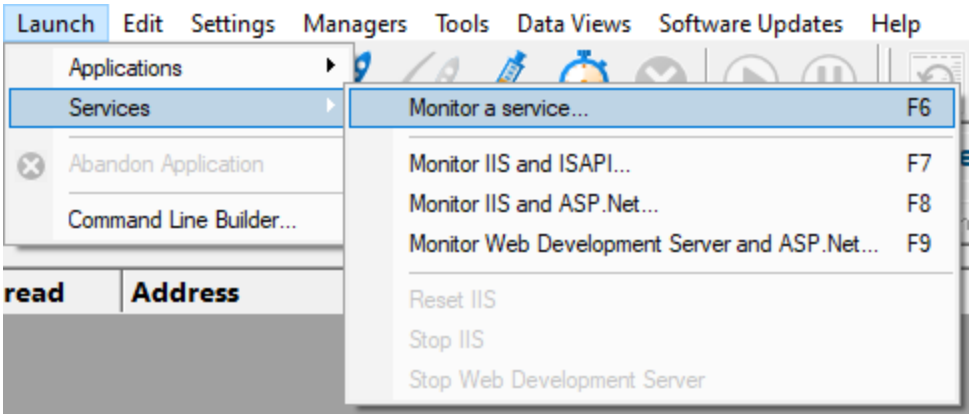
Monitoring the service

Prerequisites

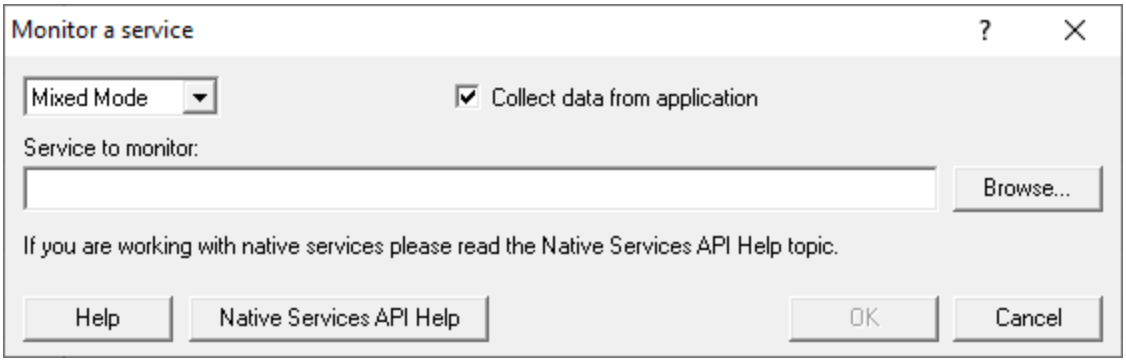
- example service has been installed, but not started (if service has been started, stop the service)
- example service and example client have been built

The following process is used to monitor the application launched by the service:

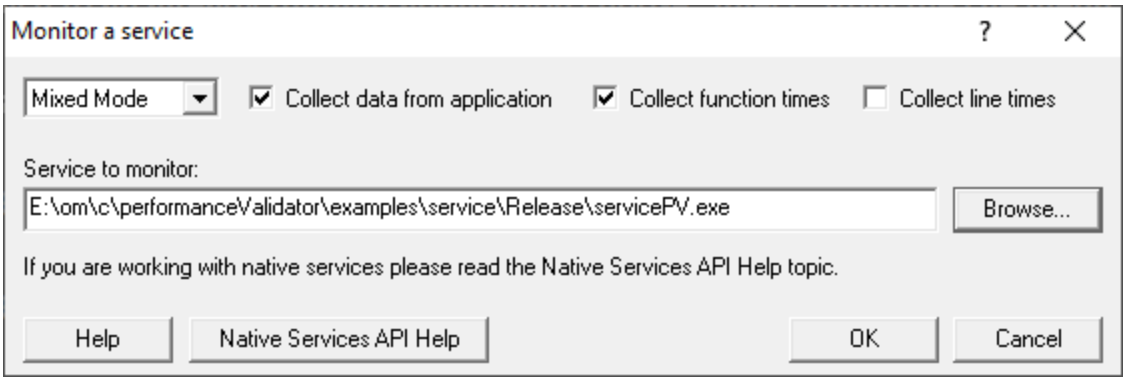
- From the Launch menu choose `Services > Monitor a Service...`



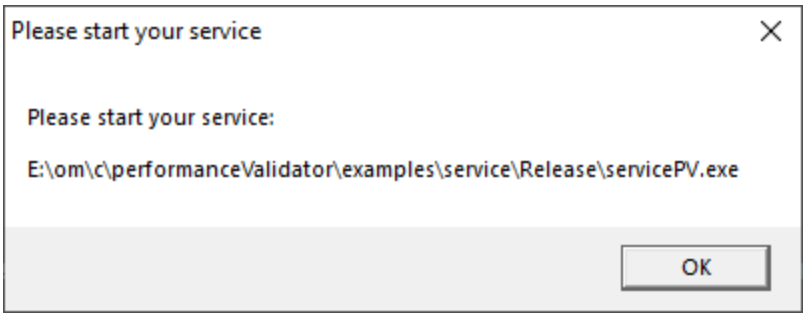
- The Monitor a service dialog is displayed



- Use **Browse...** to open the file chooser dialog and choose the service that will be monitored by Performance Validator.



- Click **OK**
- Performance Validator sets up a variety of parameters then displays a dialog box asking you to start you service. Click **OK** to dismiss the dialog



- Start your service. For the example `servicePV.exe` do the following
  - open an administrator mode cmd prompt
  - navigate to the directory containing the `servicePV.exe` to start
  - `servicePV.exe -start`
  - `servicePV.exe` starts will be monitored by Performance Validator
- The target application contacts Performance Validator
- Data is collected until the service finishes executing
- Performance Validator displays the results

8.3 Example Application Launched from a Service

The example Application launched from a Service

This pair of projects create an application that is launched from a service.

The purpose of this example is to show how to monitor the application that is launched from the service. This is also the same process for monitoring an application launched by an application launched from a service.

This process is subtly different to the method for working with services (see the example service for that).

Service

The service project is `serviceWithAChildProcess.vcxproj`

The following tasks are performed when the service is started:

- the test application is launched from the service

Application

The application project is `serviceChildProcess.vcxproj`

The application's first task is to load Performance Validator into the application.

- Loads the Performance Validator stub DLL into the application
- Configures the NT Service API to communicate to Performance Validator
- Does some work that can be monitored by Performance Validator
- Exits

Implementation Details

For implementation details see `attachToPerformanceValidator();` in `serviceChildProcess.cpp`.

The application will need to link to the NT Service API, for example `..\..\..\svlPVStubService\release_2010_x64\svlPVStubService_x64.lib` (for a release x64 EXE/DLL).

Important. Call `attachToPerformanceValidator() as close to the start of your application as possible, before any threads have been created.`

➡ Read more about working with NT Services.

8.3.1 Building the service and application

Example solution files

The example solution can be found in the `examples\serviceWithAChildProcess` subdirectory in the directory where Performance Validator was installed.

If the directory is not present, reinstall your software and choose custom or full installation.

Example project files

The example projects can be found in the subdirectories in the directory where Performance Validator was installed.

`examples\serviceWithAChildProcess\serviceWithAChildProcess`

- **serviceWithAChildProcess.vcproj** › for Microsoft® Visual Studio / .net

`examples\serviceWithAChildProcess\serviceChildProcess`

- **serviceChildProcess.vcproj** › for Microsoft® Visual Studio / .net

Configurations

There are a small number of configurations in each project:

- **Debug / Release** › dynamically links to the `svlPVStubService(_x64).lib` demonstrating use with the NT Service API

Using the service

The service is named **SVL *** PV Child Process** in the control panel services dialog (*** changes depending on the build configuration), and provides the following command line options:

- **-install** › Install the service
- **-remove** › Uninstall the service
- **-start** › Start the service
- **-stop** › Stop the service
- **-debug** › Run as a console application for debugging
- **-?** › Display the help message
- **-help** › Display the help message

Open a cmd prompt in administrator mode, navigate to the location of the service executable, and use one of these commands to install, remove, start, stop the service.

Examples:

```
serviceWithAChildProcess.exe -install

serviceWithAChildProcess.exe -start

serviceWithAChildProcess.exe -stop

serviceWithAChildProcess.exe -remove
```

8.3.2 Monitoring the application launched from the service

Once the example service and example application are built, the next step is to test them using Performance Validator.

Installing the service

If you haven't installed the service, do the following:

- open an administrator mode cmd prompt
- navigate to the directory containing the serviceWithAProcess.exe to install
- serviceWithAProcess.exe -install

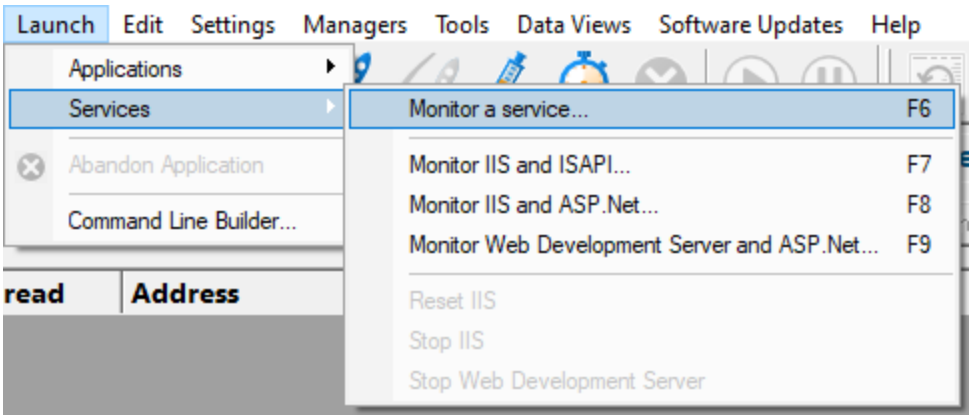
Monitoring the application launched by the service

Prerequisites

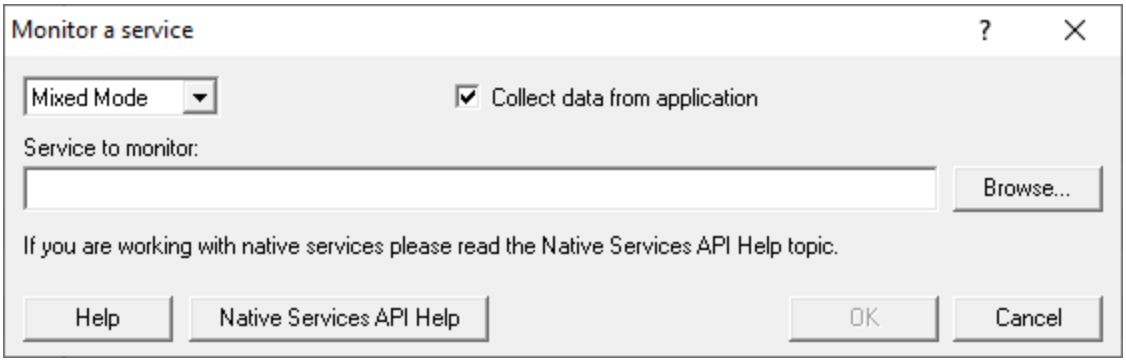
- example service has been installed, but not started (if service has been started, stop the service)
- example service and example application have been built (application must use the NT Service API as demonstrated in attachToPerformanceValidator())
- example application executable is in the same directory as the example service (this is only a requirement for the example)

The following process is used to monitor the application launched by the service:

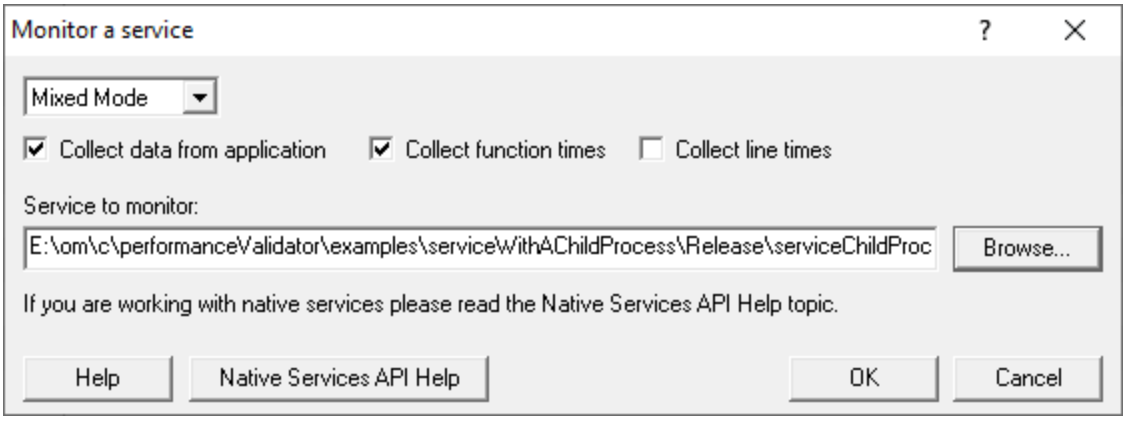
- From the Launch menu choose `Services > Monitor a Service...`



- The Monitor a service dialog is displayed

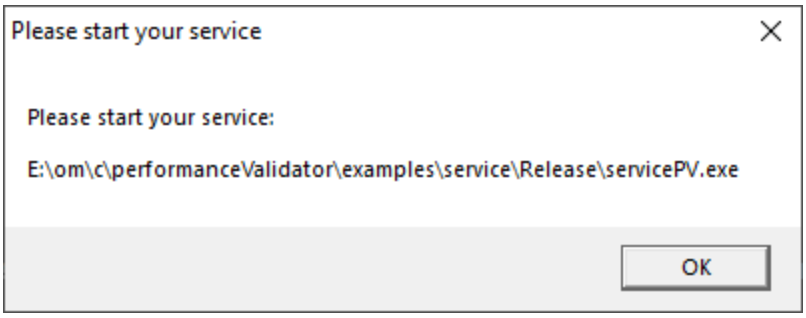


- Use **Browse...** to open the file chooser dialog and choose the application that will be monitored by Performance Validator. This is the application that is launched by the service. Do not choose the service



- Click **OK**

- Performance Validator sets up a variety of parameters then displays a dialog box asking you to start you service. Click **OK** to dismiss the dialog



- Start your service. For the example `serviceWithAChildProcess.exe` do the following
  - open an administrator mode cmd prompt
  - navigate to the directory containing the `serviceWithAProcess.exe` to start
  - `serviceWithAProcess.exe -start`
  - `serviceWithAProcess.exe` starts and launches the child process `serviceChildProcess.exe` that will be monitored
- The target application contacts Performance Validator
- Data is collected until the target process finishes executing
- Performance Validator displays the results

Part

9 Debug Information, Symbols, Filenames, Line Numbers

Depending on which IDE or compiler/linker combination the process to create debug information to ensure that you have symbols, filenames and line numbers is different.

This section shows you what to do to ensure you have symbols for your compiler and linker.

9.1 Visual Studio

Enabling debug information in Visual Studio has changed over the years depending on the version of Visual Studio you are using.

It's generally the same, but there have been some changes in recent versions that can cause confusion.

By default debug configurations create debug information, but for some versions of Visual Studio, release configurations do not create debug information.

You need to set both compiler and linker settings to get debug information. ***Setting just one or the other will not give you debug information you can use.***

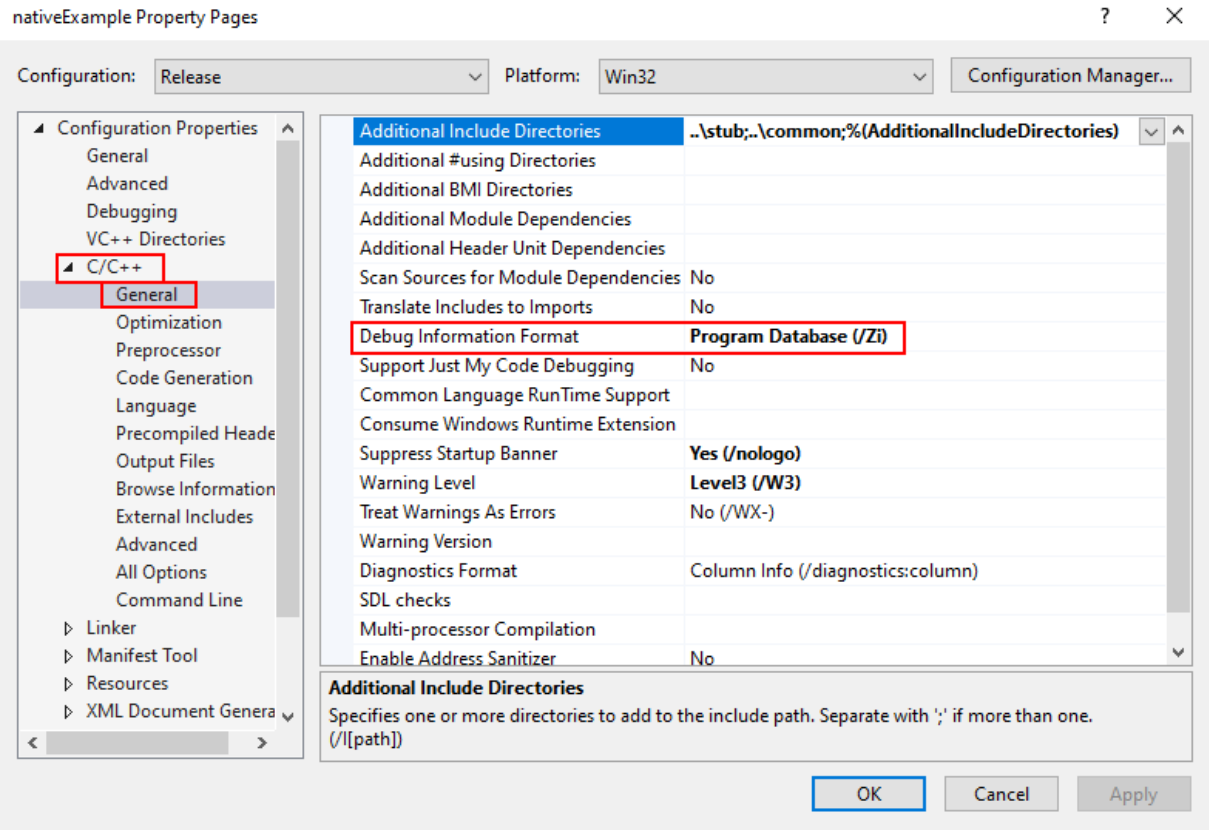
Configurations

In the help below we show you how to modify one configuration, for example Release | Win32.

You need to modify all configurations appropriately. Release, Debug, Win32, Win64 and any other configurations you are using.

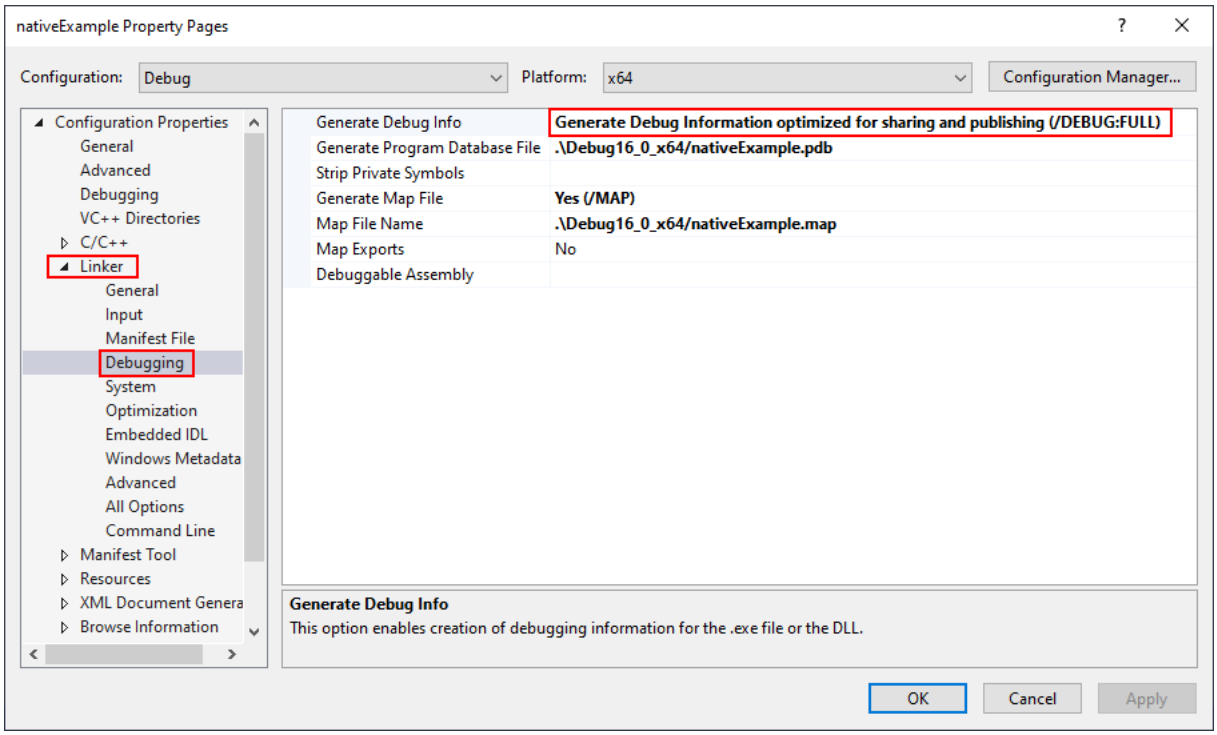
Visual Studio 2017 - 2021

Compiler Settings



Linker Settings

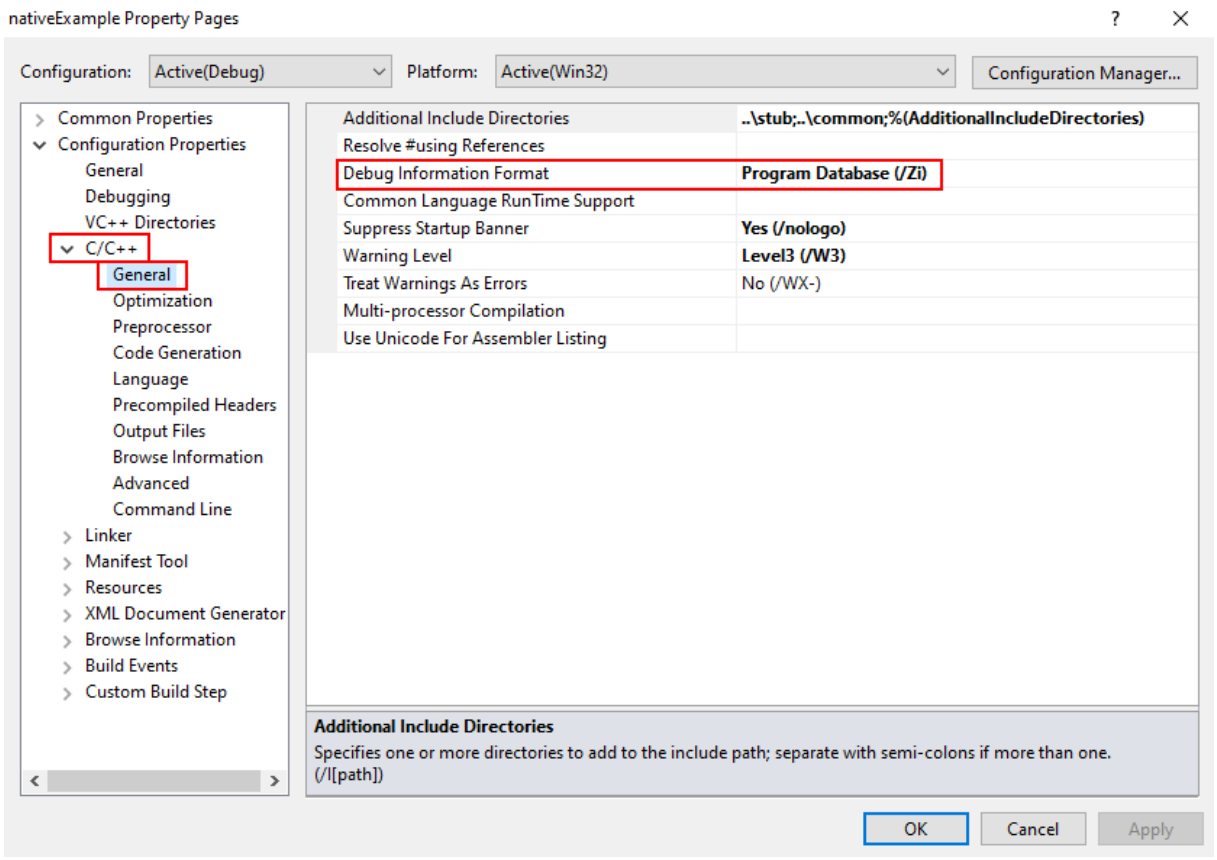
If you're building on a different machine to the machine you're working on (for example a build server), you should choose **/DEBUG:FULL**, not /DEBUG or /DEBUG:FASTLINK.



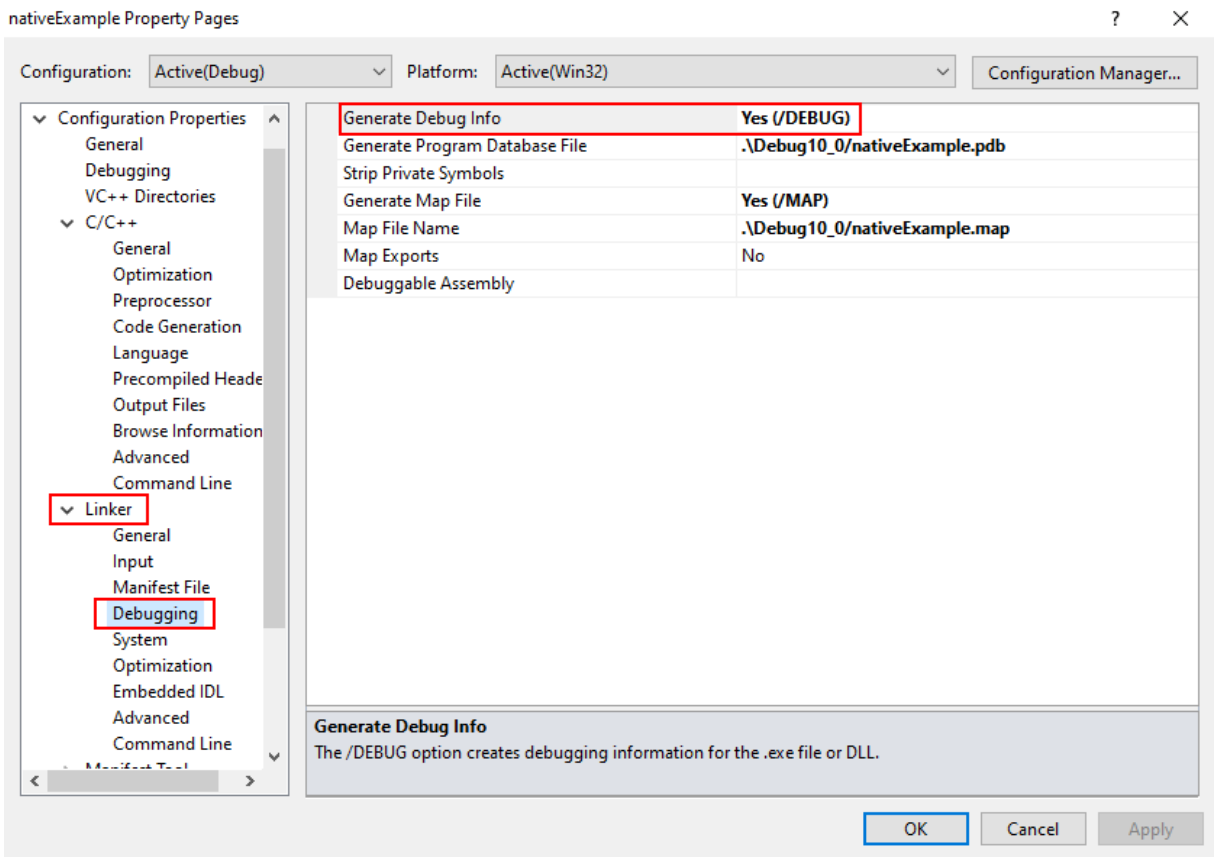
When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

Visual Studio 2010 - 2015

Compiler Settings



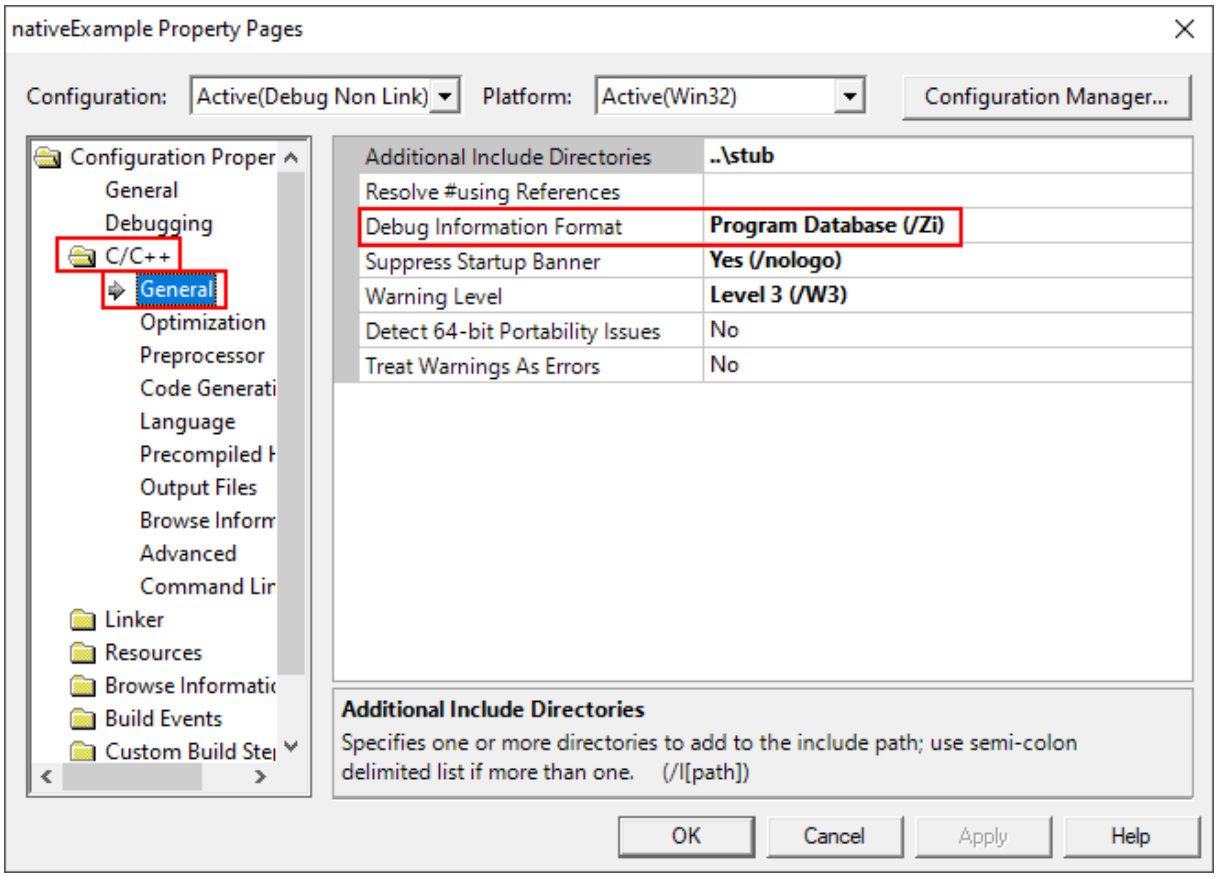
Linker Settings



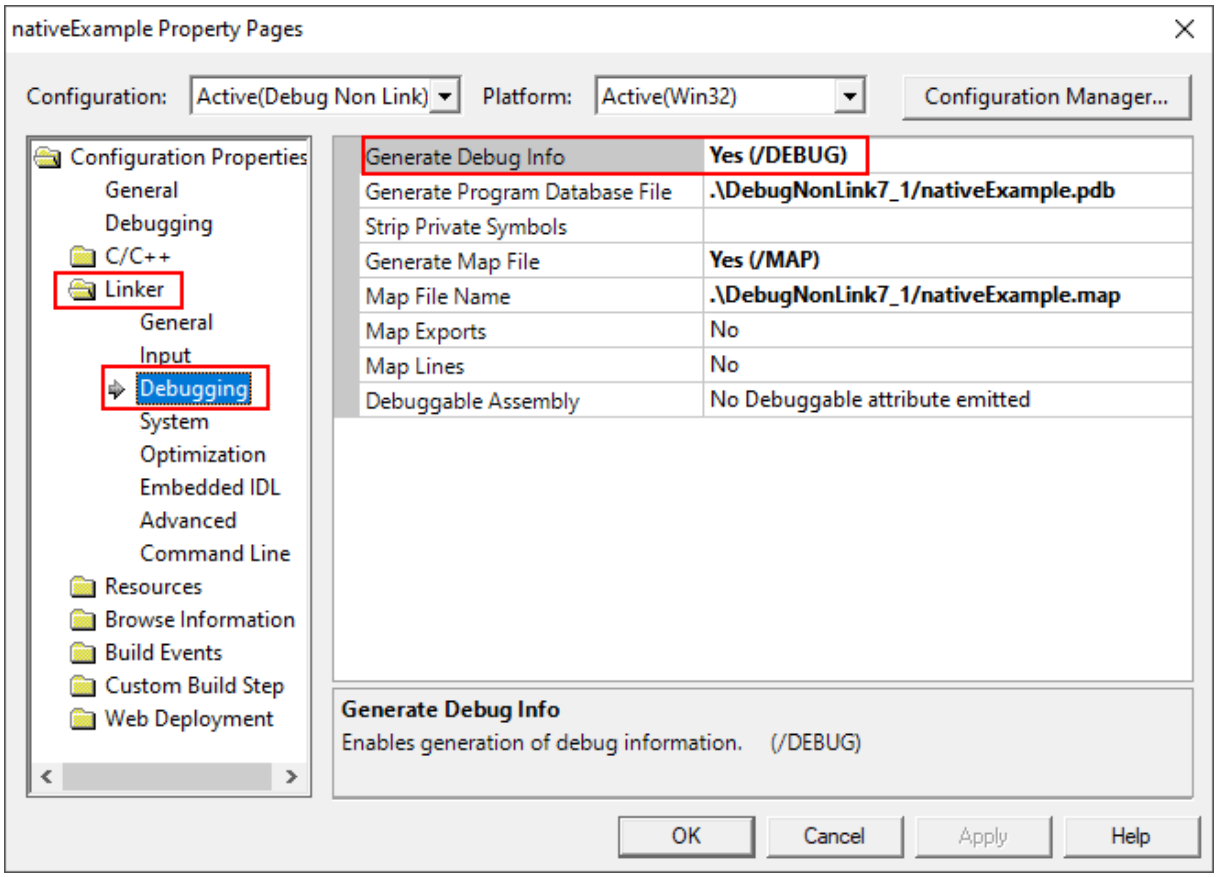
When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

Visual Studio 2002 - 2008

Compiler Settings



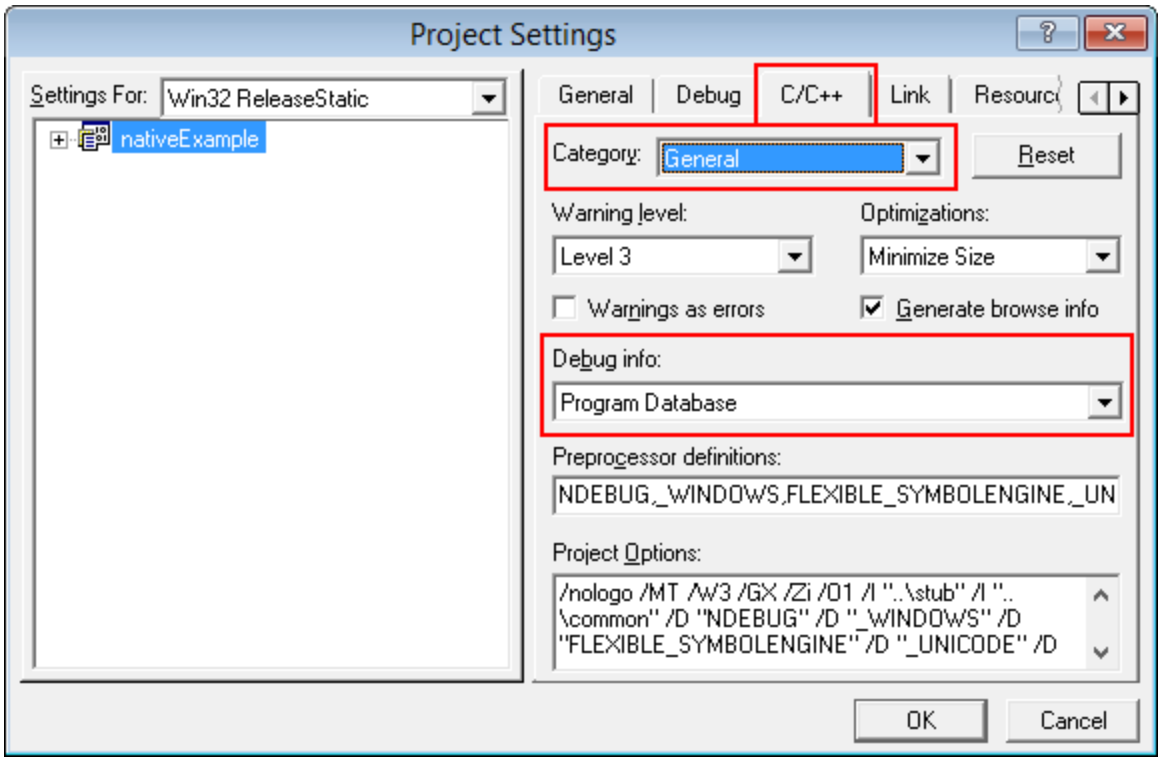
Linker Settings



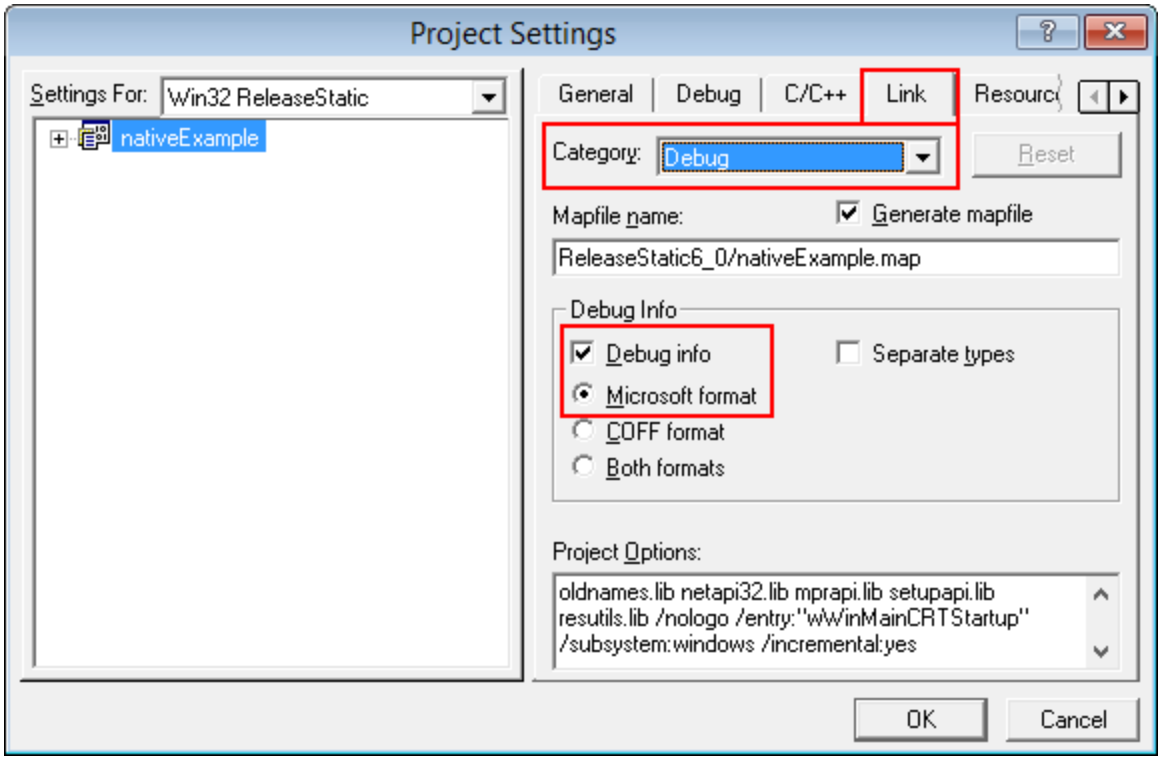
When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

Visual Studio 6.0

Compiler Settings



Linker Settings



When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

9.2 C++ Builder

Debug information can be provided using two methods.

- Debugging information (TDS or DWARF format)
- MAP files

Debugging Information

Debug configurations of C++ Builder projects automatically generate debug information that provides symbols, filenames and line numbers.

However the release configurations of C++ Builder projects do not automatically generate debug information. You need to configure that yourself.

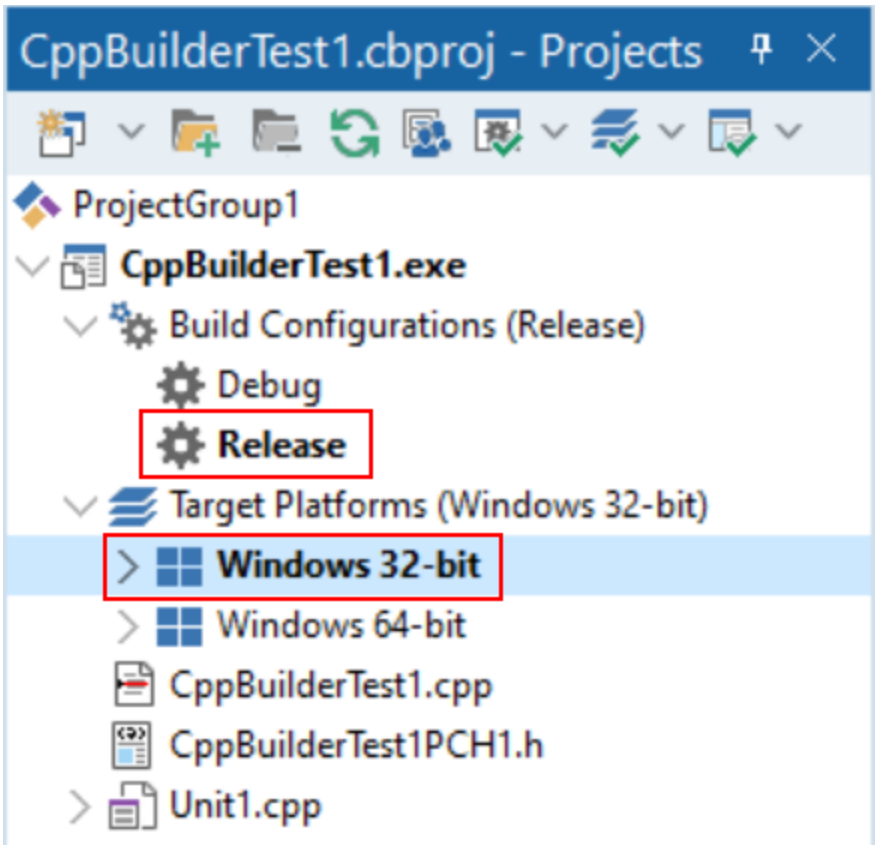
Here's how you do that. It's slightly different if you're building 32 bit applications rather 64 bit applications.

You need to set both compiler and linker settings to get debug information. Setting just one or the other will not give you debug information you can use.

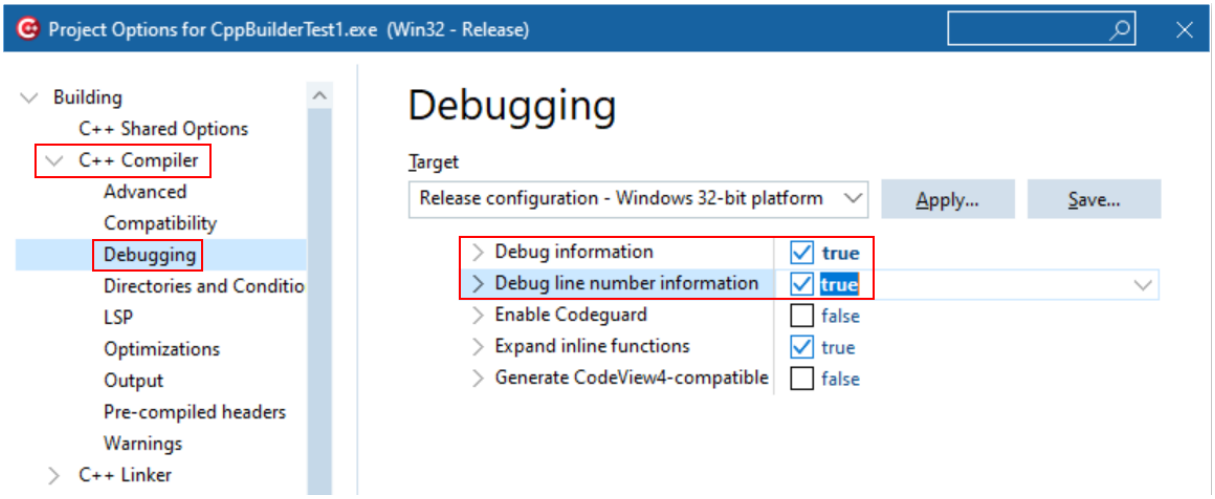
32 bit C++ Builder

Project Configuration

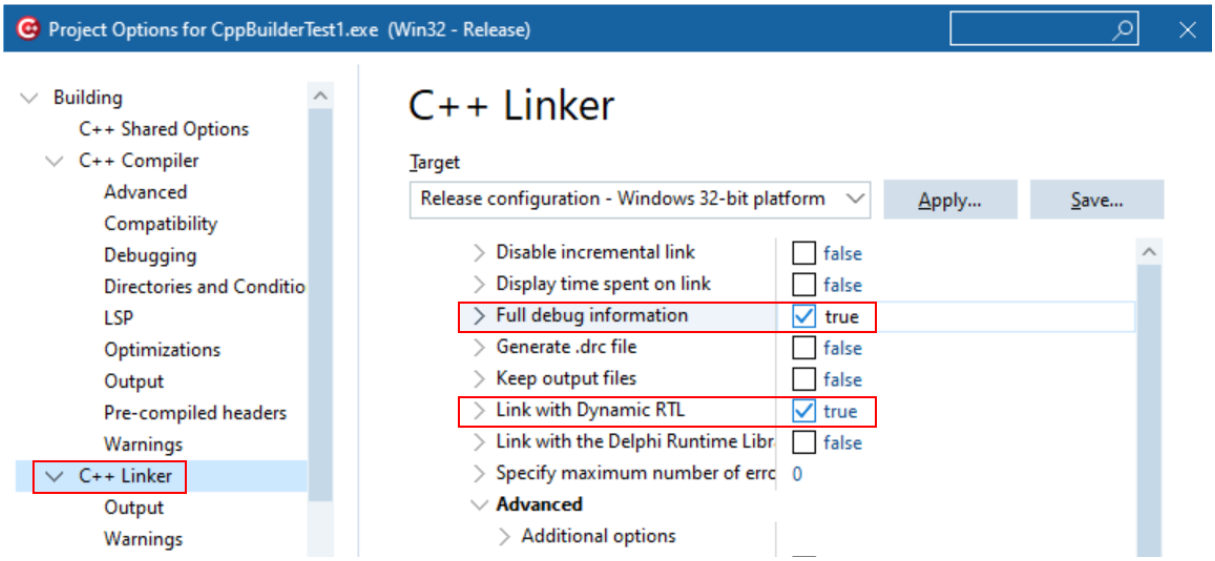
Change your project settings to target 32 bit builds.



Compiler Settings



Linker Settings

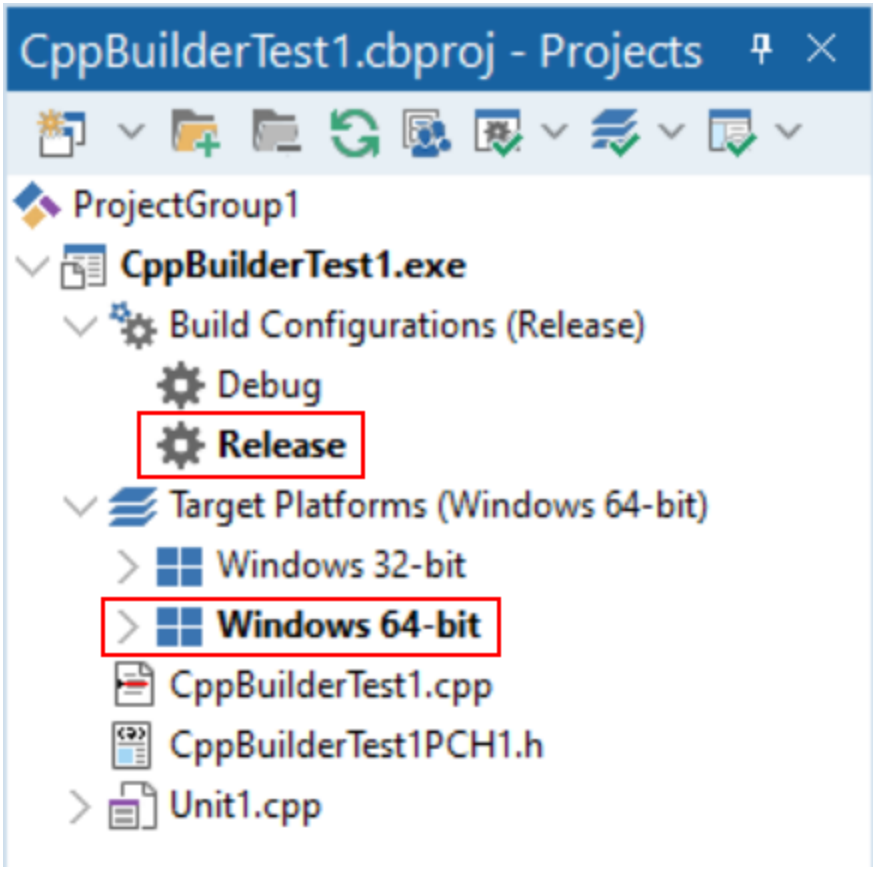


When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

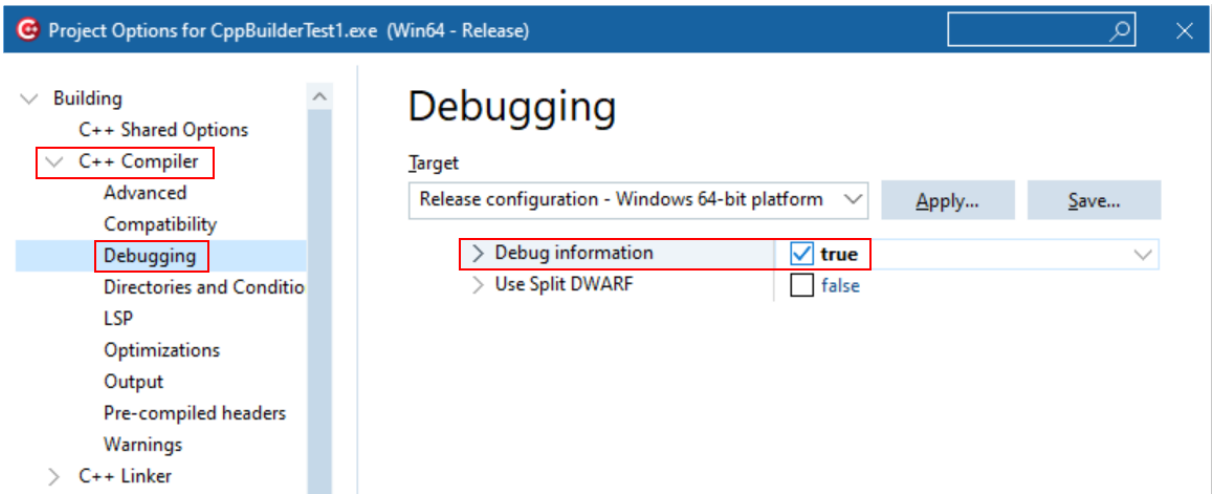
64 bit C++ Builder

Project Configuration

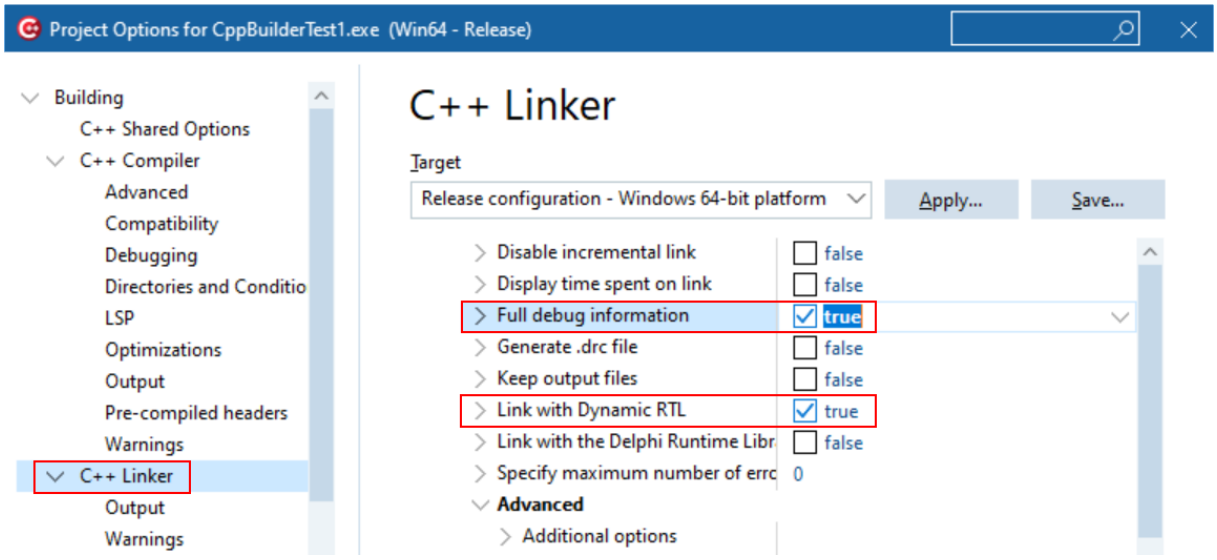
Change your project settings to target 64 bit builds.



Compiler Settings



Linker Settings



When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

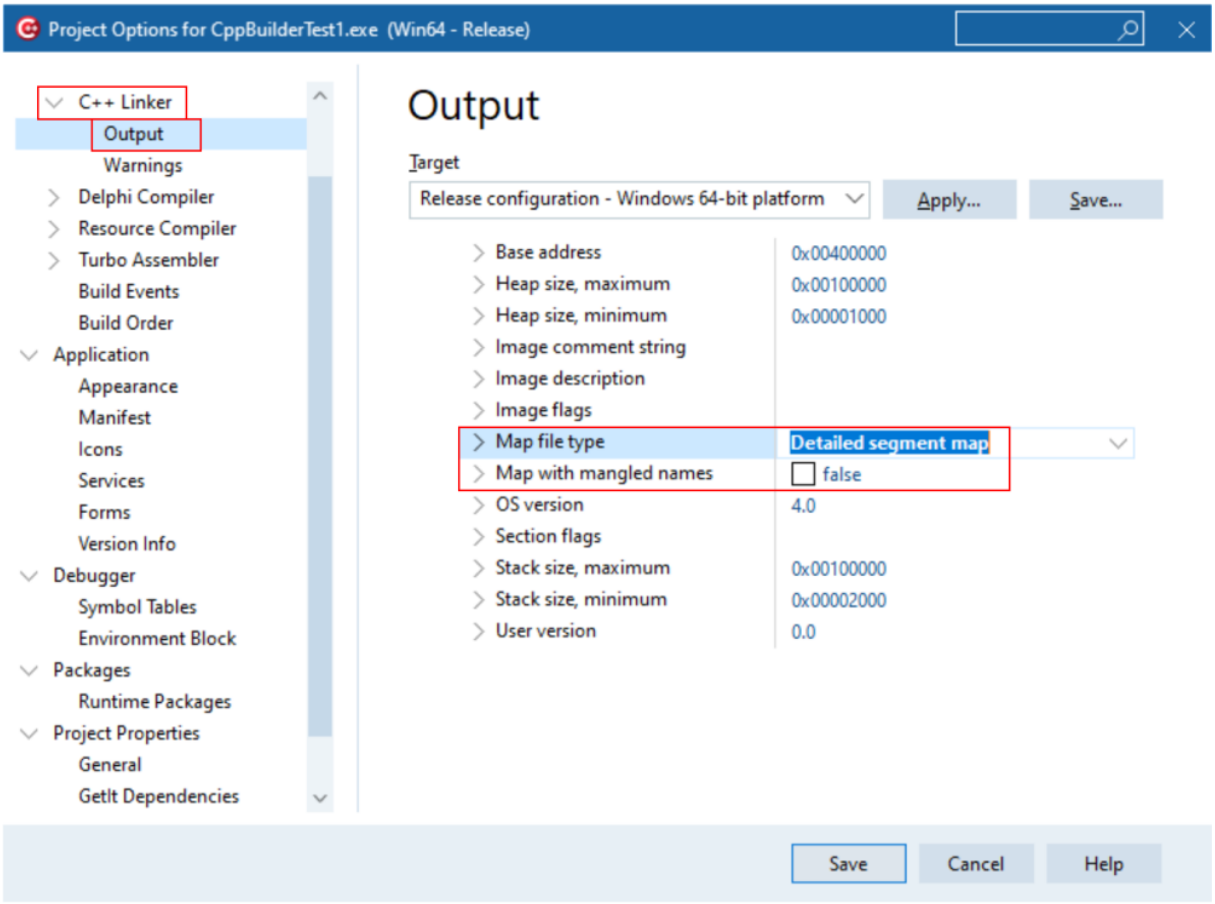
MAP files

MAP files are not generated by default. You need to enable the option to generate a detailed map file.

The method is the same for 32 bit and 64 bit C++ Builder.

Select the project configuration as shown in the Debugging Information section above, then modify the C++ Linker, Output settings.

Linker Settings



When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

Debugging Information or MAP files?

If you can create both debugging information and MAP files which should I use?

Performance Validator uses this information to provide symbols, filenames and line numbers.

For the purposes of instrumenting your modules (EXE / DLL / etc) this information is used to identify functions and to identify line numbers.

For this purpose ***it does*** matter whether you use Debugging Information or MAP files.

Debugging Information

TDS format and DWARF format debugging information both appear to be accurate, in that they reflect the correct location of functions and line numbers in the module they represent.

Some additional data is present in the last symbol in any given source file. Our symbol reader handles this and removes the unwanted information.

MAP files

MAP file information does not appear accurate. It is good enough for resolving addresses into symbols, filenames and line numbers for creating callstacks and crash addresses, but it is not good enough for placing hooks at the correct place for every line in the module. Some modules get instrumented perfectly, while others fail for no apparent reason. Given the lack of information in a MAP file we can only assume that some of the data identified as lines indicating code are in fact lines indicating data in the code segment. Instrumenting data is not going to work - you're corrupting the data. This would explain why instrumenting these modules with MAP file information doesn't work.

Our recommendation

Although in some circumstances working with MAP file data from C++ Builder will work, we strongly recommend that you use TDS debugging information (32 bit builds) and DWARF debugging information (64 bit builds).

9.3 Delphi

Debug information can be provided using two methods.

- Debugging information (TDS or DWARF format)
- MAP files

Debugging Information

Debug configurations of Delphi projects automatically generate debug information that provides symbols, filenames and line numbers.

However the release configurations of Delphi projects do not automatically generate debug information. You need to configure that yourself.

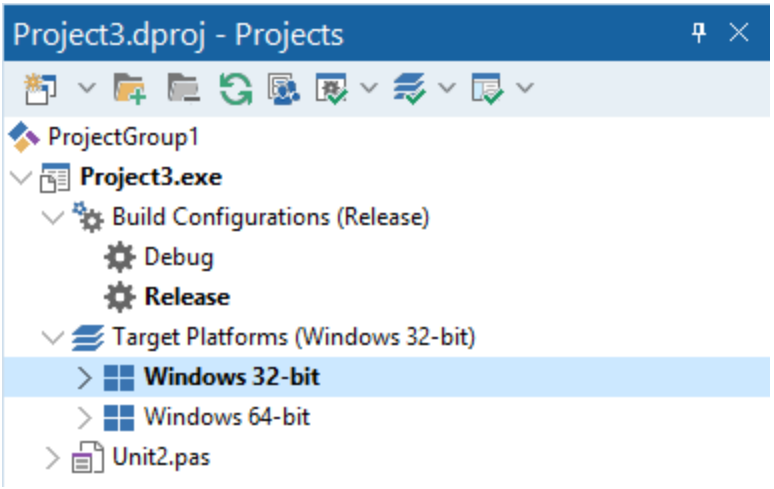
Here's how you do that. It's slightly different if you're building 32 bit applications rather 64 bit applications.

You need to set both compiler and linker settings to get debug information. Setting just one or the other will not give you debug information you can use.

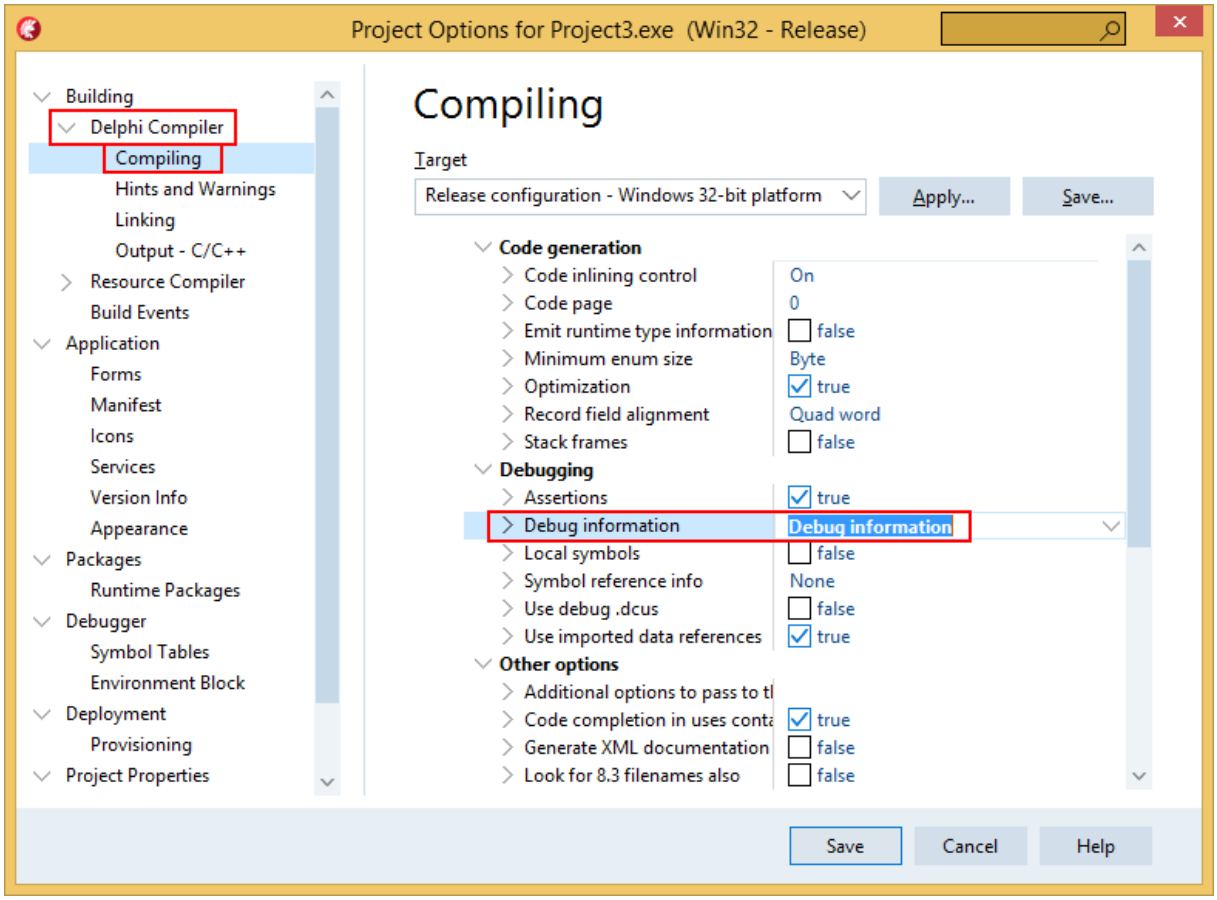
32 bit Delphi

Project Configuration

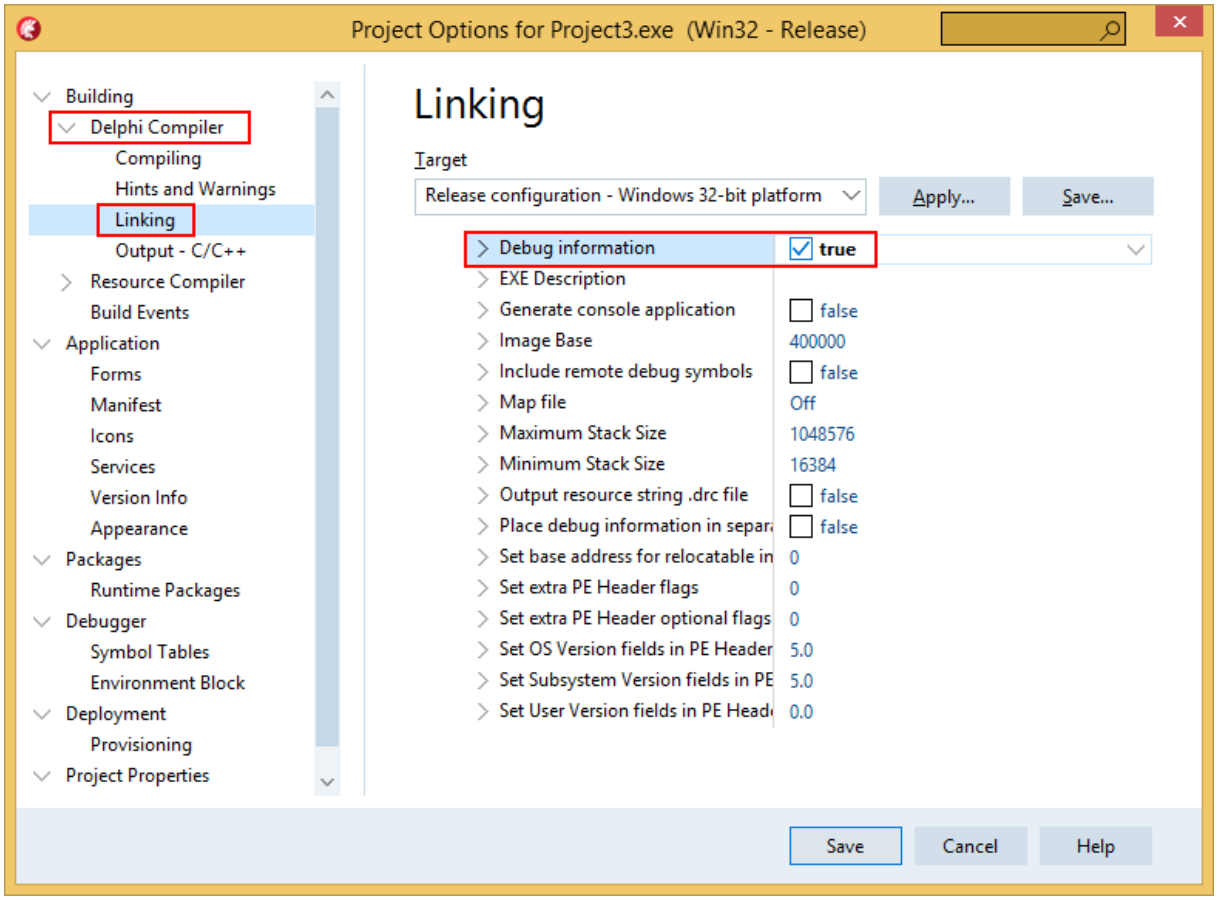
Change your project settings to target 32 bit builds.



Compiler Settings



Linker Settings

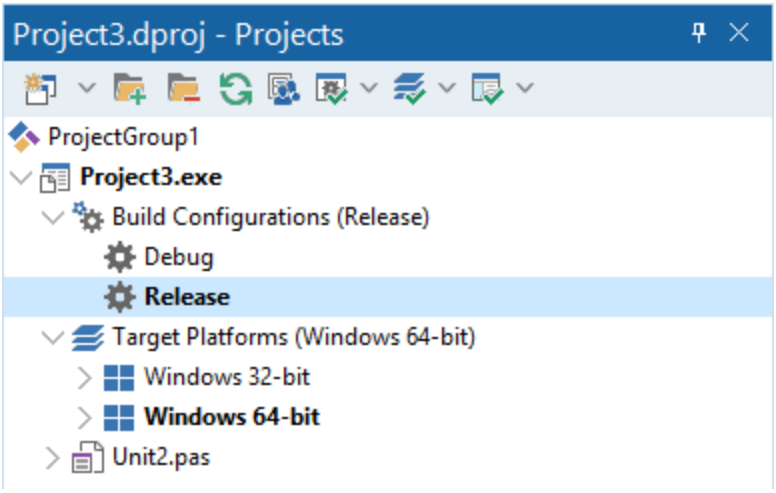


When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

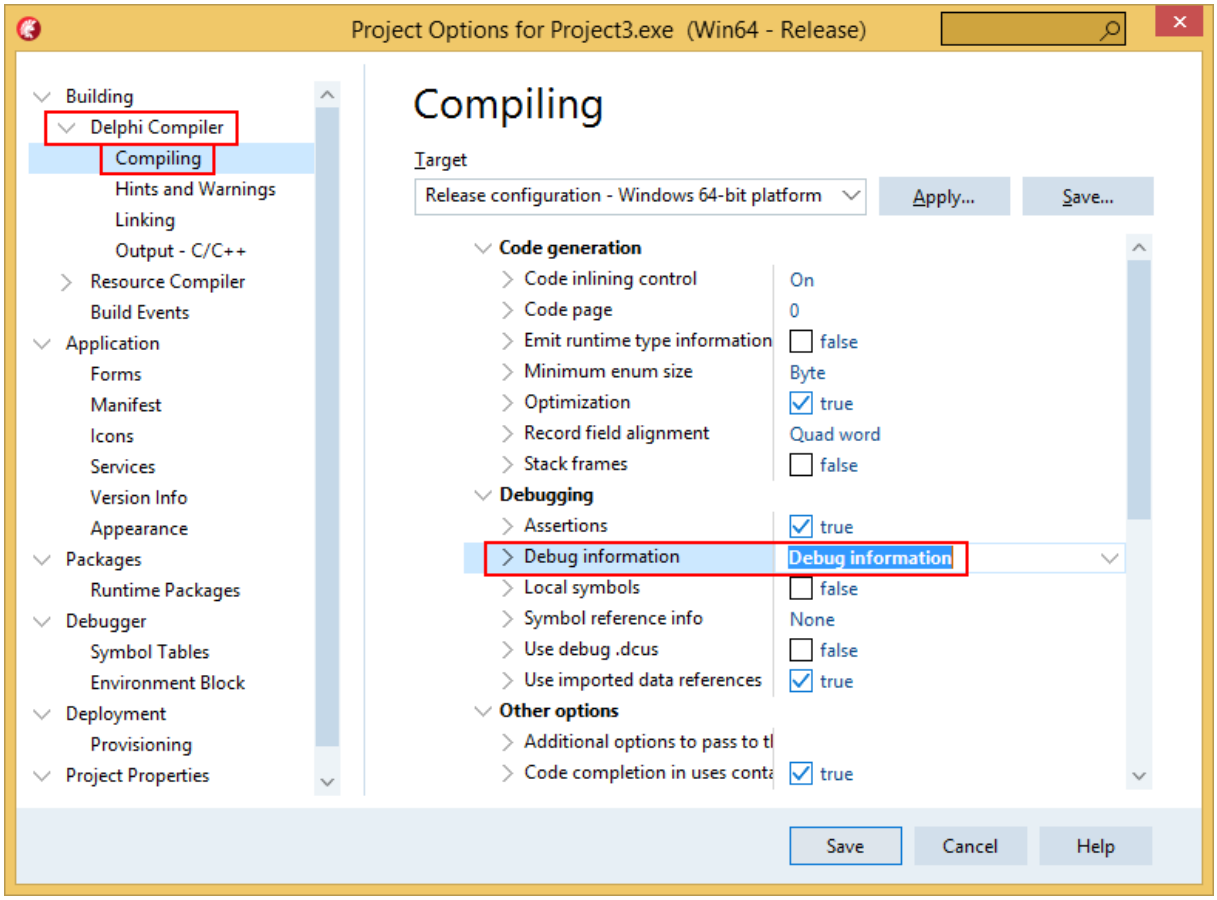
64 bit Delphi

Project Configuration

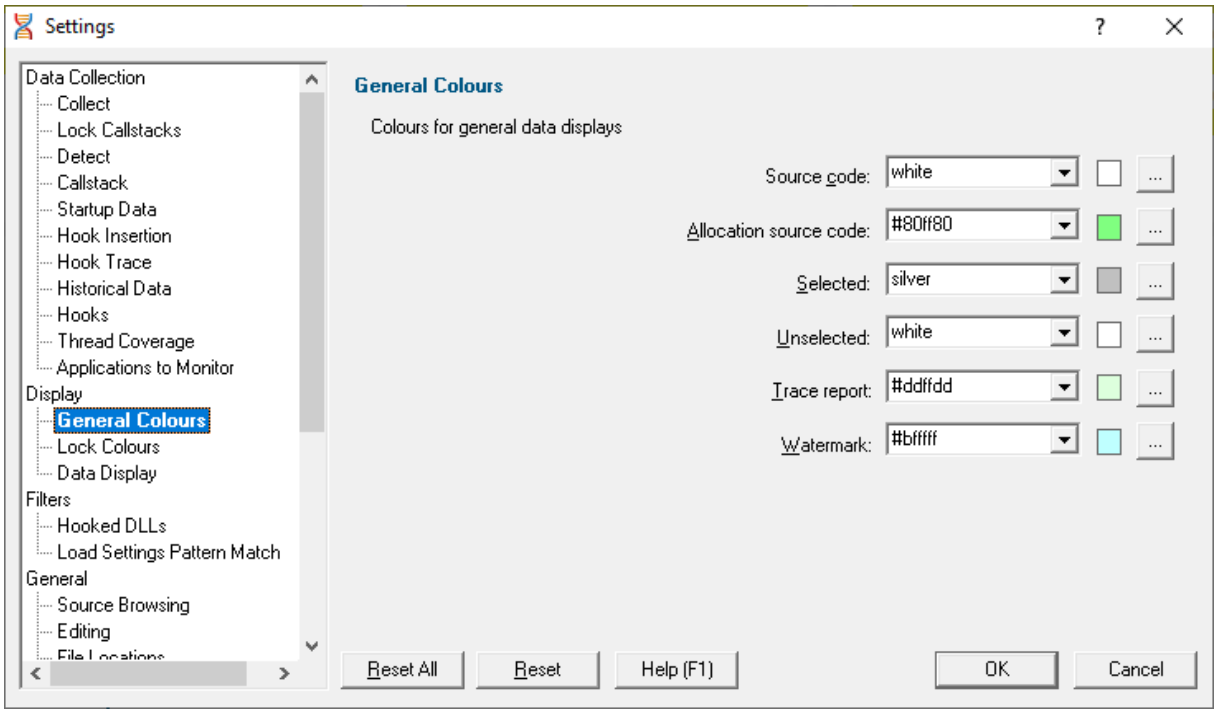
Change your project settings to target 64 bit builds.



Compiler Settings



Linker Settings



When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

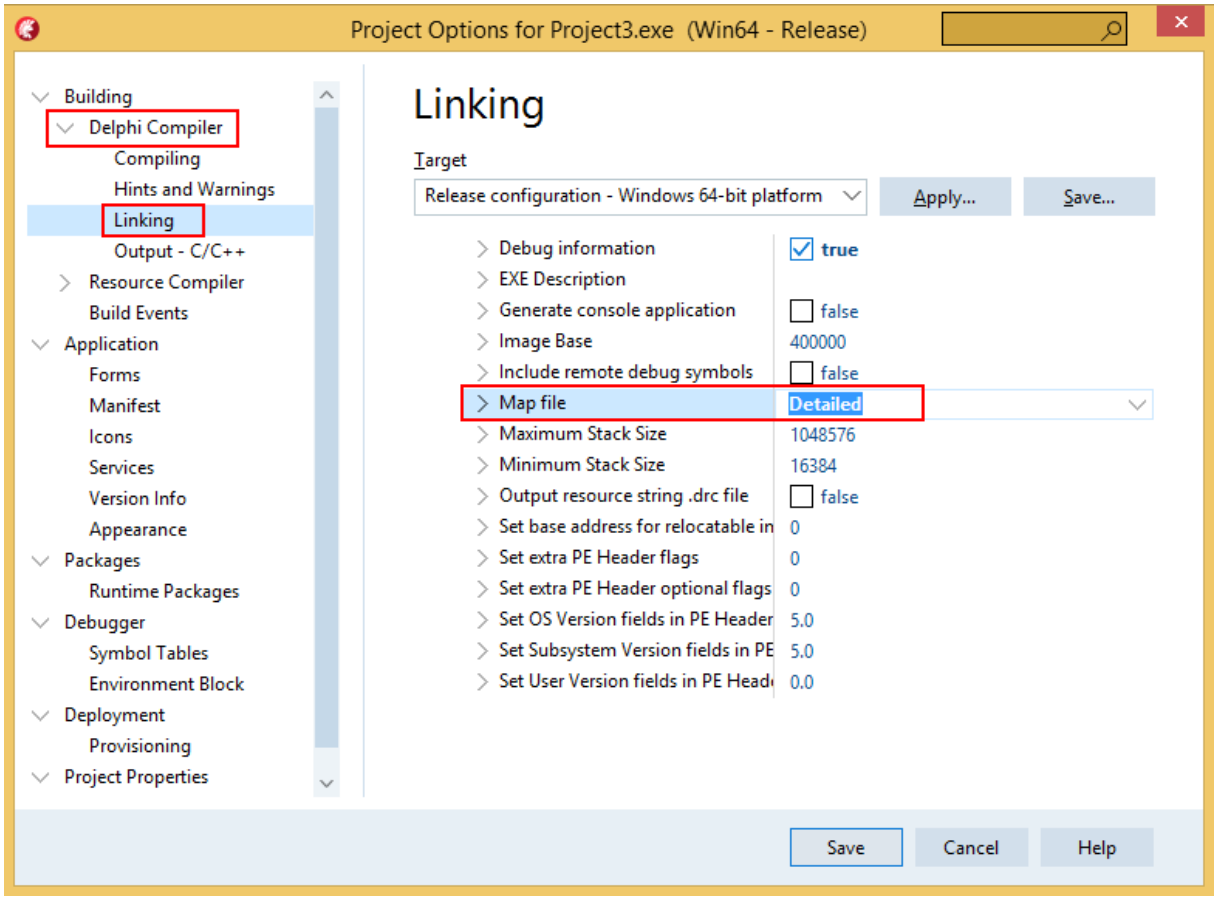
MAP files

MAP files are not generated by default. You need to enable the option to generate a detailed map file.

The method is the same for 32 bit and 64 bit Delphi.

Select the project configuration as shown in the Debugging Information section above, then modify the Delphi Compiler, Linking settings.

Linker Settings



When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

Debugging Information or MAP files?

If you can create both debugging information and MAP files which should I use?

Performance Validator uses this information to provide symbols, filenames and line numbers.

For the purposes of instrumenting your modules (EXE / DLL / etc) this information is used to identify functions and to identify line numbers.

For this purpose ***it does*** matter whether you use Debugging Information or MAP files.

Debugging Information

TDS debugging information appears to be accurate, in that they reflect the correct location of functions and line numbers in the module they represent.

Some additional data is present in the last symbol in any given source file. Our symbol reader handles this and removes the unwanted information.

MAP files

MAP file information does not appear accurate. It is good enough for resolving addresses into symbols, filenames and line numbers for creating callstacks and crash addresses, but it is not good enough for placing hooks at the correct place for every line in the module. Some modules get instrumented perfectly, while others fail for no apparent reason. Given the lack of information in a MAP file we can only assume that some of the data identified as lines indicating code are in fact lines indicating data in the code segment. Instrumenting data is not going to work - you're corrupting the data. This would explain why instrumenting these modules with MAP file information doesn't work.

Our recommendation

Although in some circumstances working with MAP file data from Delphi will work, we strongly recommend that you use TDS debugging information.

9.4 MingW, gcc, g++

The following compiler options are available if you are using MingW, gcc or g++.

-g
This is the default debug format. This will normally choose the DWARF symbol format.

-gdwarf
The DWARF symbol format.

-gstabs
The STABS symbol format.

-gCoff
The COFF symbol format. This does create a lot of unnecessary symbols, making symbol parsing slower.

9.5 Dev C++

Dev C++ uses the gcc and g++ compilers.

The following compiler options are available if you are using gcc or g++.

-g
This is the default debug format. This will normally choose the DWARF symbol format.

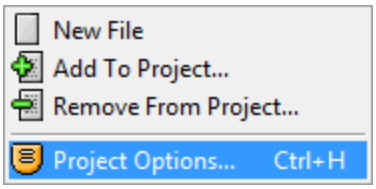
-gdwarf
The DWARF symbol format.

-gstabs
The STABS symbol format.

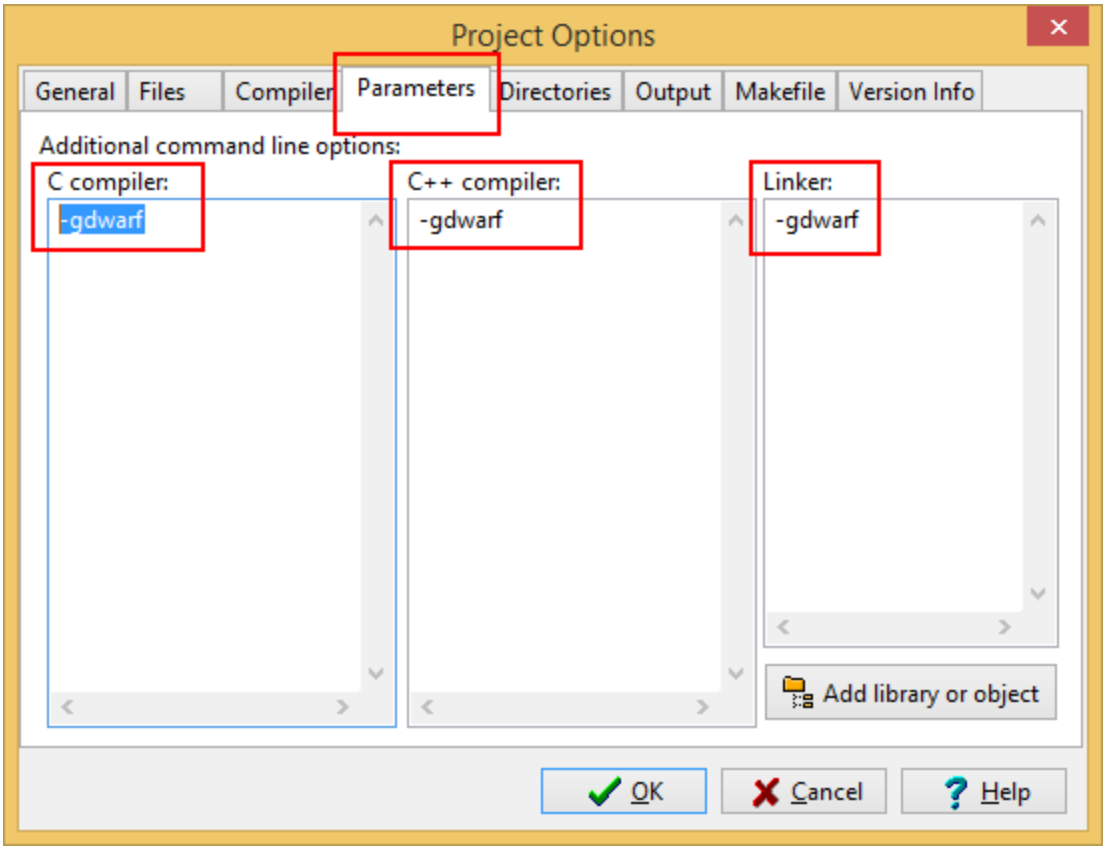
-gCoff

The COFF symbol format. This does create a lot of unnecessary symbols, making symbol parsing slower.

You can edit the compiler and linker options by choosing **Project Options...** from the **Project** menu.



Compiler and Linker options



When you have edited the project options you need to rebuild the software for the options to take effect and create the debug information.

9.6 Salford Software FORTRAN 95

Salford FORTRAN95 symbolic information is embedded in the .exe/.dll as COFF (Common Object File Format) information, with some proprietary extensions to Salford Software (which they have kindly shared with us).

Please consult the documentation for Salford FORTRAN95 to include debug information (including filenames and line numbers) in the COFF information.

If you still have problems, please contact us giving as much detail as possible, including what you've tried.

9.7 Metrowerks

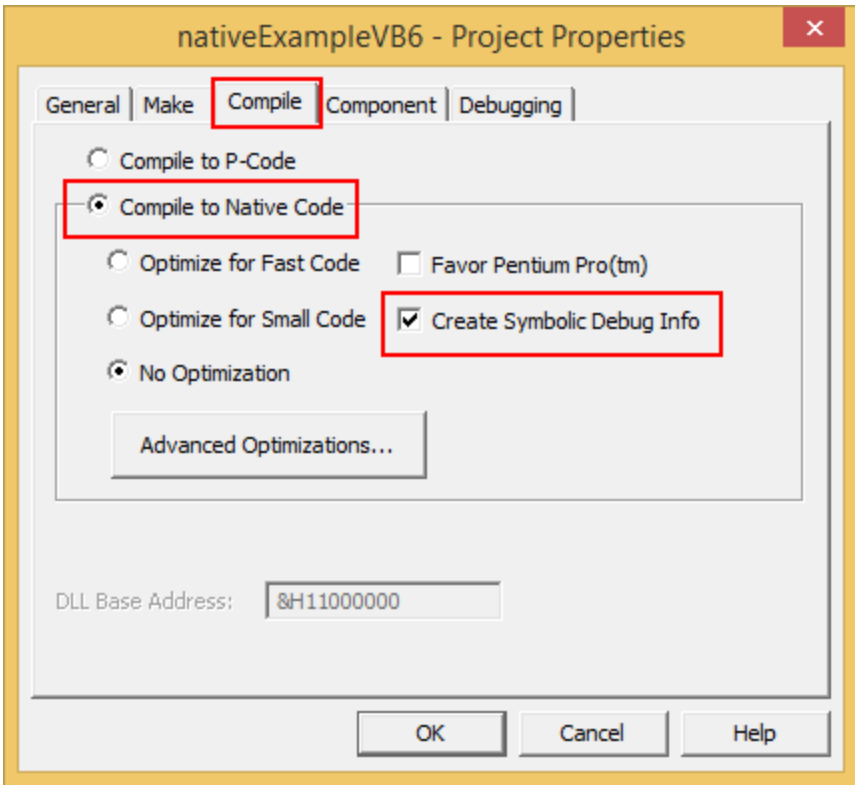
Metrowerks symbolic information is embedded in the .exe/.dll as CodeView information.

Please consult the documentation for CodeWarrior in order to include debug information (including filenames and line numbers) in the CodeView information.

If you still have problems, please contact us giving as much detail as possible, including what you've tried.

9.8 Visual Basic 6

To get debug symbols for Visual Basic you need to open the **Properties** dialog box from the **Project** menu (you'll find it at the bottom of the menu).



When you have changed your project properties you need to build the application.

Go to the **File** menu and choose **Make <projectname.exe>**.

Part

10 Frequently Asked Questions

Here's a brief description about the type of question included in each of the following sections:

- General questions

  How Performance Validator works and how to do a few of the more common tasks.

- Unexpected results

  Missing or unhooked data and not finding the data you expected.

- Crashes and error reports

  Your program crashes with Performance Validator or Performance Validator itself has a problem.

- Debug symbols and DbgHelp

  Symbols not loading, troubleshooting search paths for DbgHelp.dll, and finding or installing different versions.

- System and environment

  Setting up power users, and file extensions used by Performance Validator.

10.1 General Questions

Performance Collectors or Class & Function Filters?

Performance Validator provides performance collectors and class and function filters.

At first glance they appear to do quite similar things - the enabling or disabling of data collection from specific functions.

Performance collectors switch the global data collection state as you enter and leave a function, while filters control instrumentation (and therefore data collection) locally for a function.

The outcomes are that differences lie in:

- how much code is instrumented
- flexibility of conditions for when data is collected
- complexity of targeting the functions of interest

Performance Collectors

Collectors let you keep *all* of your application instrumented, but selectively collect data on different parts of the application at different times.

Whenever instrumented code is executed, the data will be collected for certain functions according to the conditional definitions in the performance collectors.

Performance collectors are more flexible since they allow runtime conditionals.

There are two mindsets for how to use performance collectors:

- they let you collect data for a specified function and all the *called* child functions
- they let you collect data for functions depending on the *calling* functions

Class and function filters

Filters allow you to only instrument certain classes and functions.

Data collection occurs only when code is instrumented as specified by the Class and Function Filter settings.

Class and function filters are more rigid since there are no runtime conditionals.

Instrumentation filters allow code to execute faster since there's less overhead from Performance Validator.

If you're not concerned with the conditional aspects, then you can often achieve the same results using either method, but one way may require you to specify many more functions than the other to include or exclude.

 Rather than setting up collectors or filters early on in your performance monitoring, it may be easier to first use Performance Validator inspect the Call Tree, Relations and other Statistics for your application before determining what functions you need to eliminate from instrumentation and which ones you only need in certain situations.

The help topic for Performance Collector settings shows a simple example of conditionally collecting data from a function depending on the parent function.

Does Performance Validator work with NT Services?

Absolutely. There is a help section on working with NT Services.

Why might Inject or Launch fail?

Not using CreateProcess

The Inject and Wait for Application to Start functionality use `CreateRemoteThread` to inject into an application.

For the reasons below, injection using `CreateRemoteThread` does not always work.

Common reasons for injection failure

- A missing DLL in your application

  Check your application is complete.

- The target application is a .NET application or .NET service

  Check your application or service is not written using .NET technology.

- A missing DLL in Performance Validator

  Check Performance Validator is installed correctly.

- The application may have started and finished before the DLL could be injected

  This only applies if you are *launching* the application.

- The application security settings do not allow process handles to be opened

- The application is a service and is running with different privileges than Performance Validator

  If the application being injected into is a service it is recommended that the service and Performance Validator are both run on the same user account. See the topic on working with NT services.

Application Specific Reasons for Failure

A small percentage of applications/services will not allow any DLL to be injected into them.

The reasons for this are unknown, but our testing shows that the reason for failure to inject is a combination of application, operating system and hardware that causes an inconsistency during injection (we think it is a timing issue) that causes a failure.

Our tests show that on NT 4 about 1% of all applications fail to inject, 2% on Windows 2000 rising to 5% with Windows XP.

We expect that subsequent operating systems (Windows 2003 and Windows Vista) will have higher failure rates.

How do I clear the symbol cache?

Flush the symbol cache files:

- **Settings** Menu › **Settings** › **Hook safety** › **Clean Instrumentation Cache** › **Scan and delete symbol cache files** › **Close** › **OK**

You may also want to disable the on-disk cache of PDB file symbols for functions and lines:

- **Settings** Menu › **Settings** › **Hook safety** › deselect **Cache instrumentation data...** › **OK**

How do I name a thread?

Some features such as the Callstack tab can use thread names to make things a bit more intuitive.

From within your application you can provide a name for use by a debugger or debugging tool by using the Win32 RaiseException() API.

Add the function below to your application. This is based on an example from Microsoft and there are other examples
available on the web; some specify a buffer size of 8 characters and one terminator, others specify no strict buffer
size limit.

Show code

```
// This function is documented as being callable from outside of the thread
which is being
// named, however it appears that it works more reliably if called from within
the code of
// the thread being name, passing a threadId of -1 to indicate "current thread"

void nameThread(const DWORD           threadId,
             const char         *name)
{
    // You can name your threads by using the following code.
    // Performance Validator will intercept the exception and pass it along (so
if you are also running
    // under a debugger the debugger will also see the exception and read the
thread name

    // NOTE: this is for 'unmanaged' C++ ONLY!

    #define MS_VC_EXCEPTION 0x406D1388
    #define BUFFER_LEN          16

    typedef struct tagTHREADNAME_INFO
    {
           DWORD  dwType;       // must be 0x1000
           LPCSTR szName;       // pointer to name (in user address space)
                                // buffer must include terminator character
           DWORD  dwThreadID;   // thread ID (-1 == caller thread)
           DWORD  dwFlags;      // reserved for future use, must be zero
    } THREADNAME_INFO;

    THREADNAME_INFO      ThreadInfo;
    char                 szSafeThreadName[BUFFER_LEN];      // buffer can be any
size,
                                                            // just make sure it
is large enough!

    memset(szSafeThreadName, 0, sizeof(szSafeThreadName)); // ensure all
characters are NULL before
```

```
    strncpy(szSafeThreadName, name, BUFFER_LEN - 1);       // copying name
    //szSafeThreadName[BUFFER_LEN - 1] = '\0';

    ThreadInfo.dwType = 0x1000;
    ThreadInfo.szName = szSafeThreadName;
    ThreadInfo.dwThreadID = threadId;
    ThreadInfo.dwFlags = 0;

    __try
    {
            RaiseException(MS_VC_EXCEPTION, 0, sizeof(ThreadInfo) /
sizeof(DWORD), (DWORD*)&ThreadInfo);
    }
    __except(EXCEPTION_EXECUTE_HANDLER)
    {
            // do nothing, just catch the exception so that you don't terminate
the application
    }
}
```

After adding this function declaration you can call it from inside the thread procedure of any executing thread to name.

```
nameThread(-1, "example");
```

To name a thread from *outside* of the thread procedure pass the thread id instead of -1.

The example application shipped with C++ Performance Validator demonstrates how to use nameThread. See `nativeExample.cpp`.

I have an idea for a feature, can it be added to Performance Validator?

We have tried to add as many features to Performance Validator that we thought would be useful to our users.

In fact, every feature in Performance Validator has been used to solve problems and bugs for clients who consult us, and in our own business, so we know the features we have are useful.

However, maybe we overlooked a feature that you would find very useful.

We'll happily consider most ideas for new features to Performance Validator. But no Quake, FlightSim or Flappy Bird Easter eggs though, sorry!

Please contact us to let us know your thoughts.

10.2 Unexpected results

Some lines are not coloured, why?

You may notice in the source code views that some lines are not coloured to indicate visited, not visited or hook failure. There's a couple of possible reasons for this:

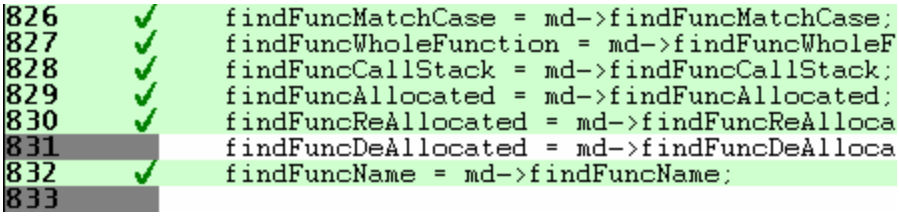
- The source code has not been compiled due to conditional compilation using compiler pragmas or #if, #ifdef, #ifndef statements

Or, if using map files with line information:

- The compiler map file did not include object code addresses for the lines that are not coloured

  When this happens, Performance Validator has no way of accurately determining which object code corresponds to the source code, and so can't hook the object code.

For example, here's a few lines of code:



This shows that line 831 has not been hooked, whilst all those around it have been hooked (and in the example shown, all have been visited). If we now examine the part of the MAP file for the appropriate executable.

```
821 0001:000936e8   822 0001:000936f2   824 0001:00093700   826 0001:00093713
827 0001:00093720   828 0001:0009372c   829 0001:00093738   830 0001:00093745
832 0001:0009374b   834 0001:00093772   866 0001:00093778   867 0001:000938a1
```

There's no entry for line 831, which is why Performance Validator couldn't provide a hook to verify if the line was executed.

At present we don't know why the compiler map file omits information for source code lines that are clearly part of the executable image, and which are identified in the PDB debugging information.

When you find this happening, change the line hooking options so that map files are only used when PDB files can't be found, i.e. use the **Use MAP when no PDB** option.

Why are some lines not hooked?

Performance Validator instruments lines in your application by inserting code to recognise the execution of the start of every line in your application.

Before inserting the code, checks are made to ensure that it is safe to re-write the function lines.

If it is not safe to re-write the lines, they can't be instrumented.

The following items can prevent the function from being hooked:

- Function too short to hook. The function must be at least 5 bytes in length
- The code for the line is too short to hook. The code for the line must be at least 5 bytes in length
- Function cannot be disassembled
- Instruction sequence cannot be hooked

You can improve the likelihood of your function being hooked by enabling the check boxes on the Hook Control settings.

➡ See also the instrumentation logging which details reasons why some code is not instrumented

Why are some functions not hooked?

Performance Validator instruments functions in your application by re-writing the prologue and epilogue of each function in your application, inserting code to monitor performance information.

Before inserting the code, checks are made to ensure that it is safe to re-write the function prologue and epilogue.

If it is not safe to re-write the function epilogue and prologue the function cannot be instrumented.

The following items can prevent the function from being hooked:

- Function too short to hook
- Function has multiple exits
- Function has jumps into epilogue
- Function has jumps into prologue
- Function cannot be disassembled
- Instruction sequence cannot be hooked

You can improve the likelihood of your function being hooked by enabling the check boxes on the Hook Control settings.

➡ See also the instrumentation logging which details reasons why some code is not instrumented

10.3 Crashes and error reports

The program I'm trying to monitor keeps crashing, why?

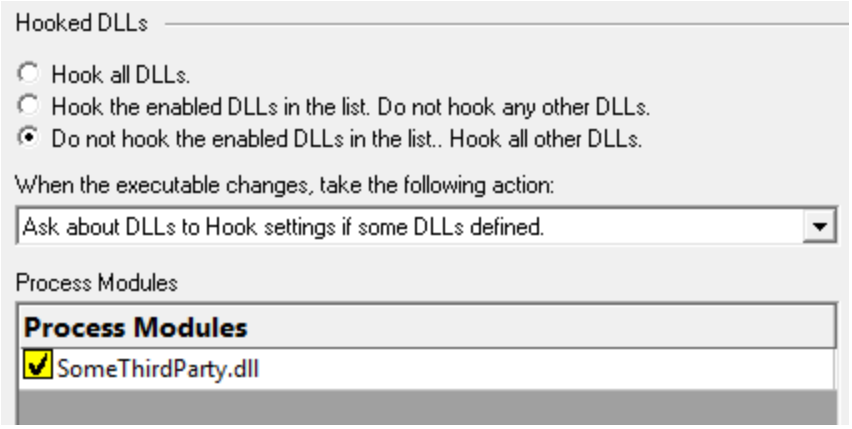
The following assumes your crash is one that only happens when using Performance Validator.

Here's a few scenarios in which your program *might* crash:

- **Third party DLLs are using system wide hooks**

  Some DLLs from third party vendors use system wide hooks and do not interact with Performance Validator and the target program very well.

If you can identify such DLLs, prevent them being hooked by adding the DLL name to the Hooked DLLs page of the global settings dialog as in the example below.



- **Third party DLLs are using global hooks**

  A global hook DLL from a third party vendor could be adversely affecting Performance Validator when hooking your program.

  Read about handling global hooks on the Global Hooks page of the settings dialog.

  Judging by multiple independent error reports, we believe there may be an incompatibility between Performance Validator and the global hooks that come with the Matrox G400 and the Matrox Millenium II PCI video cards released in the late 1990's.

- **There may be a bug in Performance Validator**

  It happens. We've tried to make Performance Validator as robust as possible, but bugs and new scenarios do occur.

  First, ensure that the crash never happens if you are *not* using Performance Validator.

  Second, check all the suggestions above.

  Then drop us a line sending details of the error and we'll try to reproduce the crash with a view to fixing any bugs found in as timely a manner as possible.

Performance Validator gives an Unrecoverable Error?

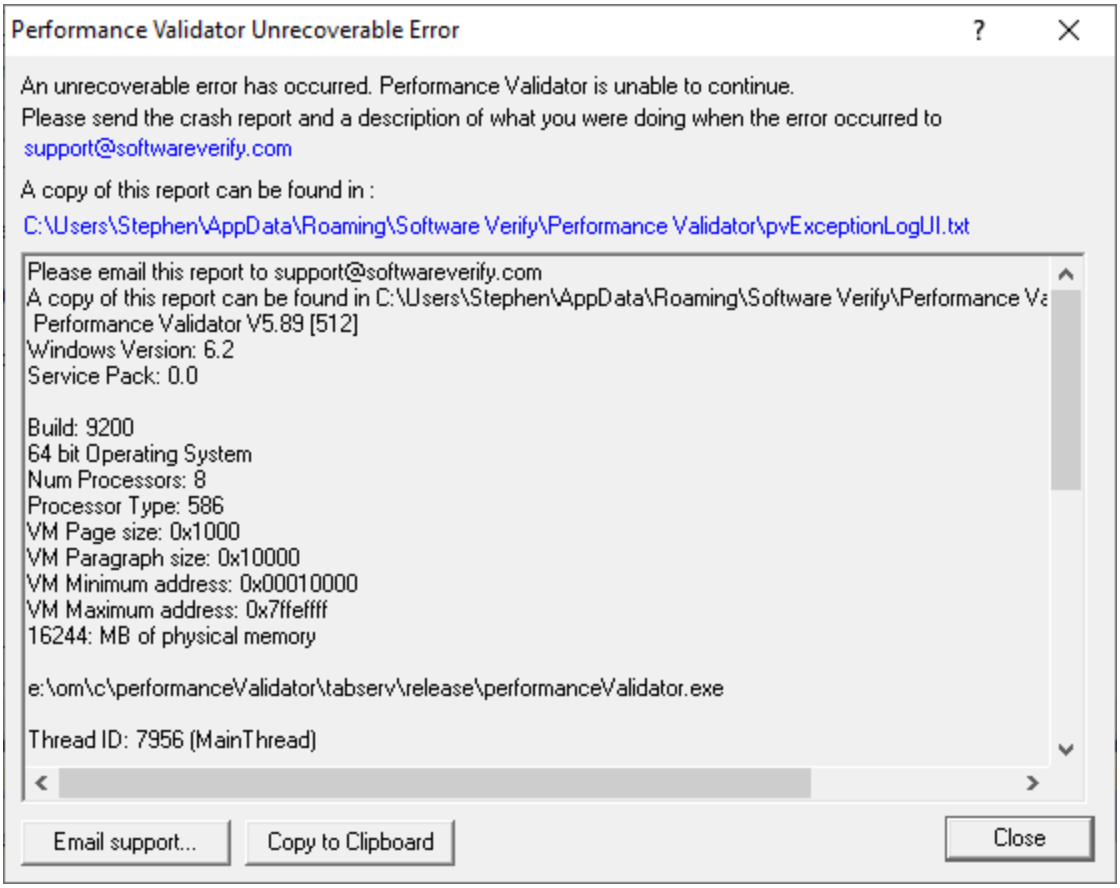
The Performance Validator Unrecoverable Error dialog is displayed when an unexpected internal error means Performance Validator cannot continue to execute.

A stack trace and register dump is shown and you can **Copy to Clipboard** so that the data can be sent to us with a description of the activities that caused the error.

We'll aim to fix any problems in as timely manner as possible.

The data shown in the dialog is also written to `c:\user\<username>\AppData\Roaming\Software Verify\Performance Validator\pvExceptionLogUI.txt` .

The picture below shows an artificial stack overflow exception report.



What is in pvExceptionLogUI.txt?

In the event of a crash in the user interface, the file `c:\user\<username>\AppData\Roaming\Software Verify\Performance Validator\pvExceptionLogUI.txt` contains information that identifies where Performance Validator was executing when it crashed.

In the event of a crash in the target process, the file `c:\user\<username>\AppData\Roaming\Software Verify\Performance Validator\pvExceptionLog.txt` contains information that identifies where the target process was executing when it crashed. This crash may have been caused by Performance Validator's instrumentation or by an error in the target application.

The file contains a stack trace and register dump and is the same information that is displayed in the Unrecoverable Error dialog (above) when a crash occurred.

The file contains only the data for the *most recent* exception.

10.4 Debug symbols and DbgHelp

Why does Performance Validator fail to load my symbols?

In a few cases Performance Validator will fail to load symbols for a DLL that you believe you have provided symbols for.

This topic describes the possible causes. Please read the suggested course of action for each compiler.

Microsoft Visual Studio or Developer Studio

Symbols are defined in PDB files with the same name as the .exe or .dll to which it refers.

Performance Validator uses the Microsoft supplied DbgHelp.dll to perform all symbol handling activities.

Correct PDB name and location?

To ensure that the correct PDB is found to match a DLL the following must be true:

- The DLL and PDB file have the same name, except for the extension

  For example test.pdb matches for test.dll or test.exe.

- The first matching PDB file in the PDB search path has the correct checksum

  If DbgHelp finds a PDB file with a different checksum, loading symbols will fail but the search will still stop.

Verify that there are no PDB files with the same file name that are on the PDB search path, except for the PDB file you expect to be used.

You can check the DbgHelp symbol search path to troubleshoot symbol loading failures relating to the symbol search path.

Are compiler and linker producing symbols?

If DbgHelp is still failing to load your symbols, check the following:

- Your program is **compiled** to include symbol information
- Your program is **linked** to include symbol information

  Linker options are different to the compiler options

Running correct version of DLL?

Check that you are using:

- The **most recent** version of your DLL

- The **correct build** version of your DLL

  For example release DLL with release builds, debug DLL with debug builds

Checking for correctly loaded modules

When your application is running, check the modules being loaded by the application.

In Performance Validator, you can check the modules by using the Loaded Modules dialog, or by inspecting the Diagnostics tab.

You need to be sure that your application is not loading a different DLL with the same name from a different directory that is on the search path.

Correct version of DbgHelp.dll?

Try checking the version of DbgHelp.dll used by your Visual Studio installation and the version of DbgHelp.dll distributed with Performance Validator.

If the version used by Visual Studio is higher, it's possible Microsoft changed the PDB file format, making the symbols unreadable by Performance Validator.

To fix this:

- Copy the DbgHelp.dll from Visual Studio to the Performance Validator installation directory
- Remove any DbgHelp.dll from your application directory

  When Performance Validator launches an application it copies Performance Validator's DbgHelp.dll to the directory of the executable.

  This ensure that the DbgHelp.dll used is more recent than the default `system32\dbghelp.dll` which may not get updated.

  You need to find and remove these dlls - e.g. `c:\myapplication\debug\DbgHelp.dll` etc.

If all else fails...

Sometimes symbolic information will not load for unknown reasons.

In this circumstance, after trying the above suggestions, try changing the location in which symbols are sourced.

You could also try flushing and disabling the caching of symbols.

If you still have problems, please contact us giving as much detail as possible, including what you've tried.

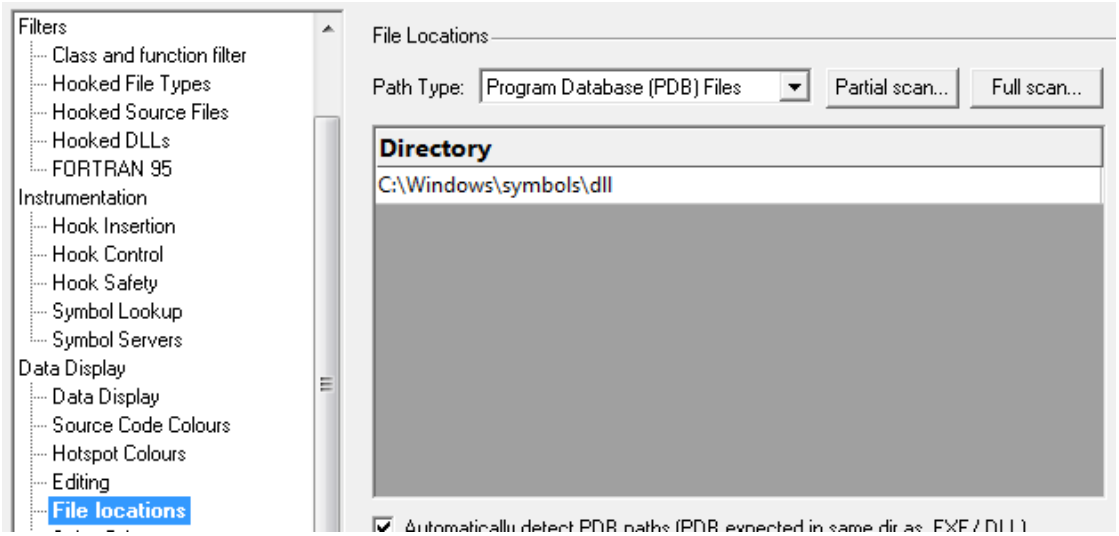
⊟ Visual Studio 2005 (8.0) and later versions

You may find that symbols for the `msvcr80.dll`, `msvcr80d.dll`, `mf80.dll`, `mfc80u.dll`, `mfc80d.dll` and `mfc80ud.dll` DLLs are not loaded.

The reason for this is that these symbols are stored in `c:\windows\symbols\dll` rather than with the DLLs themselves.

This is due to the Windows.NET Side-by-Side (WinSxS) DLL/assembly loading.

To resolve this, add the path **c:\windows\symbols\dll** to the list of paths for Program Database (PDB) Files on the File Locations tab:



You may need to restart Performance Validator to get valid symbols for `MFC80(u)(d).dll` if you have already recorded a session for which you did not get symbols.

Alternatively follow the instructions in the question on how to clear the symbol cache:

Metrowerks CodeWarrior for Windows V8 / V9

Metrowerks symbolic information is embedded in the .exe/.dll as CodeView information.

Please consult the documentation for CodeWarrior in order to include debug information (including filenames and line numbers) in the CodeView information.

If you still have problems, please contact us giving as much detail as possible, including what you've tried.

Salford Software Fortran 95

Salford Fortran 95 symbolic information is embedded in the .exe/.dll as COFF (Common Object File Format) information, with some proprietary extensions to Salford Software (which they have kindly shared with us).

Please consult the documentation for Salford FORTRAN95 to include debug information (including filenames and line numbers) in the COFF information.

If you still have problems, please contact us giving as much detail as possible, including what you've tried.

MingW compiler

We recommend compiling your software with `-gstabs` to create stabs debugging information.

The `-gCoff` option is also supported, but this does create a lot of unnecessary symbols, making symbol parsing slower.

Troubleshooting DbgHelp.dll

Performance Validator uses the Microsoft Debugging DLL, DbgHelp.dll, copying the correct private version to your application's directory as your program is started.

However, there are cases where your application can be started independently, and you must ensure that your application uses the correct DbgHelp.dll.

Diagnostic error messages appear on the Diagnostics tab as in the example below detailing which version of DbgHelp.dll was expected and what was actually loaded.

DbgHelp.dll version	C:\Program Files (x86)\Software Verification\C++ Performance Validator\pvExample\Debug9_0\dbghelp.dll
DbgHelp.dll version	DbgHelp.dll version loaded into target: 6.3.16.1
DbgHelp.dll version	DbgHelp.dll version expected: 6.11.1.404
DbgHelp.dll version warning	DbgHelp.dll loaded has a lower version number than the DbgHelp.dll that ships with C++ Performance Validator.
DbgHelp.dll version warning	This may cause failures when trying read debugging information (Symbols, Filenames, Line Numbers).
DbgHelp.dll version warning	DbgHelp.dll prior to 6.0 will not work properly. DbgHelp.dll 6.9 or better is preferred.
DbgHelp.dll version warning	For best results you need to ensure that C++ Performance Validator's DbgHelp.dll is found on the $PATH before the DbgHelp.dll that is being loaded.
DbgHelp.dll version warning	You can usually do this by putting the current directory ('.') at the start of your $PATH.

If you see any DbgHelp warning dialogs, or get diagnostic errors, ensure the correct DbgHelp.dll is used by:

- **Copy (don't move) DbgHelp.dll**

  from: the Performance Validator install directory

  to: the location of the application being tested (the same directory as the .exe).

  Rerun your test.

- **Try updating the versions of DbgHelp.dll** in:

  `c:\windows\system32`

  and

  `c:\windows\system32\dllcache`

Accept any Windows permission warnings if you try to do this.

Rerun your test.

If you *still* continue to have problems, please drop us a line via our support email.

How do I examine (and fix) the DbgHelp symbol search path?

It can sometimes be quite confusing to see why symbols fail to load for modules built with compilers that generate PDB files, e.g.: Microsoft, Intel.

There are typically three reasons for failure: the PDB file is...

- **missing**, for example it was not provided with the executable
- **in the wrong place**, so the debugging library can't find it
- **the wrong version**, for example from a different build

The diagnostic tab

The Diagnostic tab of Performance Validator displays lots of messages that can help diagnose many problems.

To show only DbgHelp debug information, use the message filter drop down at the top of the diagnostic tab. This lets you examine where DbgHelp.dll looks for symbols.

Examine the output to see if it's finding the PDB file you think it should, and if it rejects the contents of any PDB file it finds.

Output for alternate modules is shown in alternating colorsets, and the messages are the exact same output from the DbgHelp.dll debugging stream.

Examples of examining the diagnostics

Below we show three examples using nativeExample.exe and nativeExample.pdb from our example application.

- **Correct symbol file found**

  DbgHelp first searches in various places looking for nativeExample.pdb

DbgHelp Search Info	DBGHELP: Symbol Search Path: C:\WINDOWS\symbols\dll;C:\Program Files (x86)\Software Verify\Performance Validator x86\examples\nativeExample\Release10_0;
DbgHelp Search Info	DBGHELP: C:\WINDOWS\symbols\dll\nativeExample.pdb - file not found
DbgHelp Search Info	DBGHELP: C:\WINDOWS\symbols\dll\exe\nativeExample.pdb - file not found
DbgHelp Search Info	DBGHELP: C:\WINDOWS\symbols\dll\symbols\exe\nativeExample.pdb - file not found

  Depending on your machine, there may be other search paths included.

  Finally nativeExample.pdb is found in the same directory as the .exe file of the target program

DbgHelp Search Info	DBGHELP: nativeExample - private symbols & lines
DbgHelp Search Info	C:\Program Files (x86)\Software Verify\Performance Validator x86\examples\nativeExample\Release10_0\nativeExample.pdb

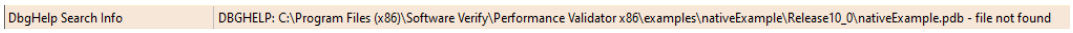
DbgHelp loads private symbols and lines, (the alternative being that DbgHelp loads public symbols).

Outcome:
Success. Symbols are loaded.

- **Missing symbol file**

  As before, DbgHelp first searches in various places looking for nativeExample.pdb

  But, nativeExample.pdb doesn't get found in the same directory as the .exe file of the target program.



  nativeExample.pdb never gets found on the search path.

  SymSrv might then look for additional locations for nativeExample.pdb, but has no luck.

  DbgHelp might find some COFF symbols in the executable, however these don't contain filename or line number information.

  Finally all options are exhausted.

  Outcome:
  Failure. The PDB file could not be found. Some default symbols are loaded but are not of much use.

  Resolution:
  Check the File Locations PDB paths to ensure that all the possible paths for PDB files are listed.

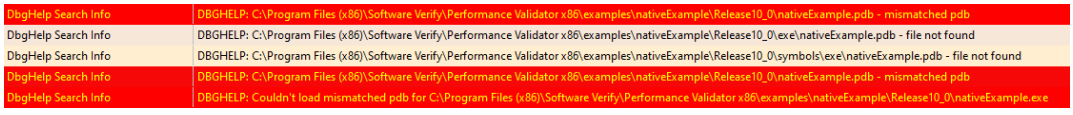
- **Incorrect symbol file**

  As before, DbgHelp first searches in various places looking for nativeExample.pdb

  This time, nativeExample.pdb *does* get found in the same directory as the .exe file of the target program.

  DbgHelp tries to load the symbols but fails - the checksum inside the PDB file does not match the module.

  This might be because the symbols are for a different build of the software, or it's an incorrectly named PDB file belonging to another program.



Finally all options are exhausted.

DbgHelp Search Info	DBGHELP: nativeExample - no symbols loaded

Outcome:
Failure. A PDB file was found, but it was not the right one.

Resolutions:
Double check the PDB is the correct one for the build you are running.
When copying builds from another machine (or from a build server), make sure to copy the correct PDB as well.
Check the File Locations PDB paths to ensure that all the possible paths for PDB files are listed.
Check the order of those PDB paths in case there are multiple paths resulting in the wrong PDB being found first.

How can I create a map file with line numbers

If you don't have the ability to use .PDB files for debug information , you may be able to use .MAP files with line information.

The following is only applicable to Debug builds. Map files for Release builds can't have line number data.

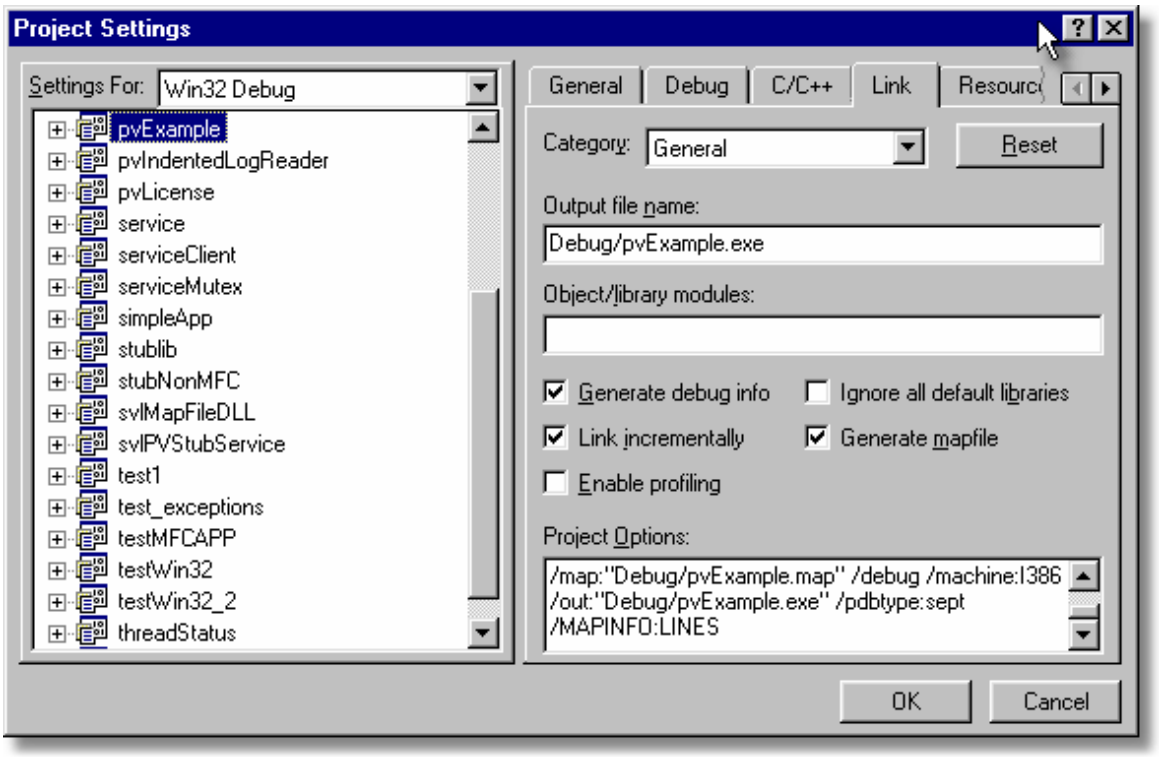
Microsoft discontinued support for including line information in .MAP files with Visual Studio 8.0 (2005). There is no easy workaround to this.

To select the `/MAPINFO:LINES` option for Visual Studio 6.0 use the following steps. If you are using Visual Studio 7.0, 7.1 (i.e .NET 2002 or 2003) the project settings user interface is slightly different, but the basic principle remains the same.

In Visual Studio:

Project Menu › **Settings...** › Select project › Shows project settings

The example image below shows project **nativeExample**.



- **Generate mapfile** › check option to request MAP file output
- **Project Options** › add the text `/MAPINFO:LINES` to add line information to the file › **OK**

Save your project workspace and build your project.

Due to daylight saving times it is possible for a MAP file to have an embedded timestamp that is different than the DLL timestamp by an hour. In these situations Performance Validator will not recognise the MAP as valid. The solution to this problem is to rebuild the application.

10.5 Extensions, services and tools

Including stublib.h in my project doesn't compile. Why?

You may encounter problems when including `stublib.h` in order to link directly with Performance Validator.

Include path problems

Ensure that your project **C preprocessor include paths** reference both of the **stub** and **stublib** subdirectories in the installation directory of Performance Validator.

For example, if Performance Validator is installed in:

```
C:\Program Files (x86)\Software Verify\C++ Performance Validator
```

Then add the following paths for *all* configurations; Debug, Release, etc:

```
C:\Program Files (x86)\Software Verify\C++ Performance Validator\stub
C:\Program Files (x86)\Software Verify\C++ Performance Validator\stublib
```

Compiler errors

If you include `stublib.h`, your project must have included `windows.h` first, (or see below for an alternative).

If you fail to include `windows.h` then `stublib.h` will refer to some none-existent datatypes, causing compiler errors similar to the ones shown below.

Here's an example program that will not compile:

```
#include "stdafx.h"
#include "stublib.h"

int main(int argc, char* argv[])
{
   return 0;
}
```

See the compiler errors from the above code

```
--------------------Configuration: testMV_allEnum - Win32
Debug--------------------
Compiling...
testMV_allEnum.cpp
c:\program files\software verification\performance validator\stub\allenum.h(70) :
error C2146: syntax error : missing ';' before identifier 'lRequest'
c:\program files\software verification\performance validator\stub\allenum.h(70) :
error C2501: 'LONG' : missing storage-class or type specifiers
c:\program files\software verification\performance validator\stub\allenum.h(70) :
error C2501: 'lRequest' : missing storage-class or type specifiers
c:\program files\software verification\performance validator\stub\allenum.h(71) :
error C2146: syntax error : missing ';' before identifier 'reserved3'
c:\program files\software verification\performance validator\stub\allenum.h(71) :
error C2501: 'DWORD' : missing storage-class or type specifiers
c:\program files\software verification\performance validator\stub\allenum.h(71) :
error C2501: 'reserved3' : missing storage-class or type specifiers
c:\program files\software verification\performance validator\stub\allenum.h(73) :
error C2143: syntax error : missing ';' before '*'
c:\program files\software verification\performance validator\stub\allenum.h(73) :
error C2501: 'BYTE' : missing storage-class or type specifiers
c:\program files\software verification\performance validator\stub\allenum.h(74) :
error C2501: 'dde_pbData' : missing storage-class or type specifiers
```

To fix this problem simply include `windows.h` before `stublib.h`

```
#include "stdafx.h"
#include <windows.h>      // new line to fix compile errors
#include "stublib.h"

int main(int argc, char* argv[])
{
   return 0;
}
```

Can't include windows.h?

If including `windows.h` is not an option, you can just define the following types:

```
#define LONG long
#define DWORD unsigned long
#define BYTE unsigned char
#define HANDLE void *
```

What do I do if I cannot use svlMVStubService.lib?

You may find that you can't use **svlPVStubService.lib / svlPVStubService_x64.lib** because your linker doesn't understand the format of the lib file.

If that happens you can use the code below to compile the two functions that would be provided by those libraries.

See the header file

```
#ifndef _SVL_PVSTUB_SERVICE_H
#define _SVL_PVSTUB_SERVICE_H
```

```
#include "svlServiceError.h"

// IMPORTANT.
// If you use svlPVStub_LoadPerformanceValidator() to load svlPerformanceValidatorS
// application, you must also use svlPVStub_UnloadPerformanceValidator() to unload
// your application being closed down. Failure to do so will almost certainly resul
// It does not matter how the application is closed down, you must ensure that you
// svlPVStub_UnloadPerformanceValidator() to unload the DLL if you have loaded it.
//
// The DLL prepares itself in different ways and shuts itself down differently depe
// it is:-
// a) Directly linked to the application for use with the API or injected with Perf
//    When the DLL is used in this manner to DLL expects to oversee and manage the
//    shutdown.
// b) Loaded by using svlPVStub_LoadPerformanceValidator().
//    When the DLL is used in this manner to DLL expects to be removed prior to app
//    and the behaviour of the DLL is undefined once you enter the program shutdown
//
//     This difference in behaviour is intentional and is done to allow the use of
//     services.

#ifdef __cplusplus
extern "C" {
#endif

SVL_SERVICE_ERROR svlPVStub_LoadPerformanceValidator(serviceCallback_FUNC callback,
                                                     void                *userPara

SVL_SERVICE_ERROR svlPVStub_UnloadPerformanceValidator();

#ifdef __cplusplus
}
#endif

#endif
```

See the implementation file

```
#include "svlPVStubService.h"

#include <windows.h>
#include <tchar.h>

//-NAME-----------------------------------
//.DESCRIPTION.........................
//.PARAMETERS..........................
//.RETURN.CODES........................
//-----------------------------------------

static HMODULE   hModule = NULL;

//-NAME-----------------------------------
//.DESCRIPTION.........................
//.PARAMETERS..........................
//.RETURN.CODES........................
//-----------------------------------------

typedef void (*ENABLE_STUB_SYMBOL_FUNC)();

SVL_SERVICE_ERROR svlPVStub_LoadPerformanceValidator(serviceCallback_FUNC callback,
                                                     void                *userPara
{
   SVL_SERVICE_ERROR   errCode = SVL_OK;

   if (hModule == NULL)
   {
      hModule = LoadLibraryW(L"svlPerformanceValidatorStub.dll");     // change thi
      if (hModule != NULL)
      {
         // DLL loaded, set the service callback function

         SETCALLBACK_FUNC   setCallbackFunc;

         setCallbackFunc = (SETCALLBACK_FUNC)GetProcAddress(hModule, "apiSetService
         if (setCallbackFunc != NULL)
         {
            (*setCallbackFunc)(callback, userParam);
         }

         // now start the profiler

         PROC *p;

         p = GetProcAddress(hModule, "startProfiler");
         if (p != NULL)
             (*p)();
```

```
            // we don't need to turn on provision of symbols by the stub for Performan
        }
        else
        {
            errCode = SVL_LOAD_FAILED;
        }
    }
    else
    {
        errCode = SVL_ALREADY_LOADED;
    }

    return errCode;
}

//-NAME-----------------------------------
//.DESCRIPTION.........................
//.PARAMETERS.........................
//.RETURN.CODES.......................
//---------------------------------------

typedef void (*UNLOAD_FUNC)();
typedef HANDLE (*GET_STUB_HEAP_FUNC)();

SVL_SERVICE_ERROR svlPVStub_UnloadPerformanceValidator()
{
    SVL_SERVICE_ERROR   errCode = SVL_OK;

    if (hModule != NULL)
    {
        // get the stub heap before we shut down the DLL

        HANDLE          hStubHeap = NULL;
        GET_STUB_HEAP_FUNC   getHeapFunc;

        getHeapFunc = (GET_STUB_HEAP_FUNC)GetProcAddress(hModule, "apiGetInternalMVst
        if (getHeapFunc != NULL)
        {
            hStubHeap = (*getHeapFunc)();
        }

        // get the unload stub function

        UNLOAD_FUNC   unloadFunc;

        unloadFunc = (UNLOAD_FUNC)GetProcAddress(hModule, "apiShutdownPerformanceVali
        if (unloadFunc != NULL)
        {
            (*unloadFunc)();

            // get the function

            HMODULE   hModule;
```

```
            hModule = GetModuleHandleW(L"svlPerformanceValidatorStub.dll");
            if (hModule != NULL)
            {
               // unload the stub

               FreeLibrary(hModule);

               // destroy the stub's heap (which was still in use whilst FreeLibrary()

               if (hStubHeap != NULL)
                  HeapDestroy(hStubHeap);
               else
               {
                  if (errCode == SVL_OK)
                     errCode = SVL_FAIL_TO_CLEANUP_INTERNAL_HEAP;
               }
            }
            else
            {
               errCode = SVL_FAIL_MODULE_HANDLE;
            }
         }
         else
         {
            errCode = SVL_FAIL_UNLOAD;
         }

         hModule = NULL;
      }
      else
         errCode = SVL_NOT_LOADED;

     return errCode;
   }
```

10.6 System and environment

How do I create a Power User on Windows XP?

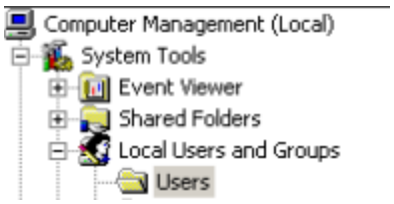
Windows 2000 and Windows XP Pro allow Power User accounts that stop short of full Administrator permissions.

To make an existing user (say **Test User**) a Power User do the following:

- **Start Menu** › **Right click** on **My Computer** › **Manage**

The Computer Management window appears

- On the left, expand **System Tools** › **Local Users and Groups** › **Users**



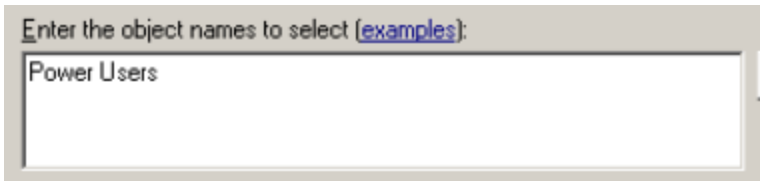
- On the right, select and **Right click** on **'Test User'** › **Properties**

  The User Properties dialog appears

- Select the **Member Of** tab › **Add...**

  The Select Groups dialog appears

- In the bottom box, **type** `Power Users` › **OK**



- In the user properties dialog select **Users** › **Remove** › **OK**
- Close **Computer Management**

Your **Test User** is now a member of the Power Users group - and probably not really a 'Test' User any more!

What file extensions does Performance Validator use?

Most configuration data is stored in the registry, but some information is file-based such as settings, session, hook and filter data.

Performance Validator uses the following extensions:

Sessions, Settings, Filters, Hooks and Performance

- **pvm** Session files for 32 or 64 bit Performance Validator
- **pvm_x64**
- **pvs** Settings for 32 or 64 bit
- **pvm_x64**
- **pvx** Hooked DLLs
- **pvxc** Class and function filters
- **pvxfl** File locations
- **pvxft** Source file filters

Session Export

- **html** HTML export files
- **xml** XML export files

Program Launch, Extensions

- **dll** Extension DLLs
- **exe** Program files

Part

11 Installing Floating Licensing

How to install floating licences

Floating licences float globally. Your team members in an office on the other side of the world can share a floating licence with you.

If you have floating licences install the software on all machines in your business unit that wish to use the software.

For an overview of how floating licences work, please read this.

Floating licence server

The floating licence server is managed by Software Verify.

No server to setup, no licences to misconfigure. All the things that are bad about floating licences, we've removed all that.

If you need to acquire a licences or release a licence, see the Floating Licences tab.

Floating licence help

If you have problems with the floating licences please contact support@softwareverify.com

If you need to purchase additional floating licences for a new floating licence please visit https://www.softwareverify.com/purchasing/.

If you need to purchase additional floating licences to add to an existing floating licence please contact sales@softwareverify.com.

Part XII

12 Copyright notices

12.1 Udis86

This software uses the library svlUdis86.dll and svlUdis86_x64.dll. These libraries are modified binary versions of the open source disassembler udis86.

udis86 was hosted at http://udis86.sourceforge.net/
udis86 is currently hosted at https://github.com/vmt/udis86 although the current distribution (at the time of writing) appears to be missing some files required to compile.

The 1.7.0 version of the udis source code contains this copyright notice: Copyright (c) 2005, 2006, Vivek Mohan
The 1.7.2 version of the udis source code contains this copyright notice: Copyright (c) 2002-2009 Vivek Thampi

These copyright notices appear to conflict and the latter copyright notice completely ignores the claims set forth in the 1.7.0 copyright notice.

In accordance with the license terms in the 1.7.2 software we include this binary license.

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```

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