Slide 1

Welcome I’m Philip and I’m going to go through some of the debugging features available in Visual Studio.

Debugging is something most people don’t like doing, but we still write code that doesn’t work first time. So let’s become better at debugging and spend less time doing it.

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I’ve mentioned the previous languages I have used because in many ways people go about debugging in the same way as they did back historically in the 90s and before with COBOL.

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These are the things I am going to go through.

Visual Studio Options

We will go through some of the settings available in Visual Studio

Attributes

Attributes that help you view information when debugging

Datatips

Provide an easy way to view information about variables

Debugging Windows

Go through the windows that are available in Visual Studio under the debug menu item

Examining dumps – how to use dumps with visual studio

Symbol servers - what they are, and why you should have them

Visual Studio and links to browsers

Feature in the enterprise edition

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Visual Studio options

There are two main areas where you have options when you are debugging

Options for debugging it self and options for exceptions.

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Debugging Options

You can see the debugging option choice either via Debug> Options, or Tools>Options>Debugging.

As you can see there are a large number of options available when you are debugging. Many enable functions and what is available. I am not going to go through them all but will try to mention various ones as we go through the talk.

There will also be a link at the end to explain all the options

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Onto the exception options, - debug > windows > Exception settings

The exception options allow you to define what happens when an exception is thrown, for visual studio to pause and break you need the appropriate exception ticked. If there is an exception that you wish to only break when it is handled. you can right click on an exception and select ‘ Continue when unhandled in user code’. A column can also be added to show this – the column is called Additional Actions.

You can search for exceptions.

Slide 7 - Demo

As shown by looking for divide, the list is limited to divide by zero exception, you can further define when an exception will break using conditions for example you can specify that an exception should only break when in a specified module,

E.g Demo

Conditions line 268

Two methods the same different classes – do the same thing.

Add exception search for divide add module name = Calculator2

Run code option 4 exceptions with conditions

Show Stack dump.

Go up stack dump

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Debugging Attributes. There are 3 kinds Display, Browsable and Type Proxy.

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Debugger display allows you to define what is going to be show when looking at an object, property, or field is displayed in the debugger variable windows.

An example when looking at a list the default shows you the object type as seen

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If we add a DebuggerDisplay attribute to the class, we can specify what should be shown. I have added the name property.

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If we now look at the example the Name property is shown for each entry.

It is best to use just properties in the attribute you can use functions, but this will impact performance,

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DebuggerBrowsable allows you to define what is shown by default for a class or a property.

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Collapse shows you at the class level

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Never doesn’t show the class or property at all

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And Root Hidden, shows you the properties of the class without seeing the class level. If used with a property, then the property isn’t shown

Collapse is the default.

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DebuggerProxy

This allows you to project you class through a proxy class. The proxy class is then seen in the watch window. Raw information still available

Breakpoints set debugger proxy and untick the others

Line 204

Show PersonDebug the proxy for this is defined by the attribute

Then in the proxy class in the constructor take a parameter of the class and then define the property getters for the fields you want to display and how you want them displayed.

Demo option 15

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Debugger visualisers - When you are viewing the value of a property these allow you to see the data in a laid out format. There are a number build in, json, xml, string, html

There are also a large number in the the marketplace many free for example DataTable, there are also alternatives to the built in ones.

Or you can write one yourself.

There is a template that can be used DebuggerVisualizer or you can write a class that inherits from DialogDebuggerVisualizer and override the Show method to display the item as you want.

(poss example)

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Datatips

Allow you to see the value of a variable in the code window. You can also pin the datatip so it is always visible when you are in that area. You can also add a comment to it, this is useful as you can make notes about that variable. Datatips are exportable, and importable, which means you can share your debugging progress, or hand it over. All through the debug menu.

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The locals and autos windows show the values of variables the locals is for the method, the autos is variable used in the 2-3 lines around where you are that are in scope.

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The call stack, this shows the nesting of methods in classes of where you are at the moment, if you click on one of the levels the locals’ window changes with it. You can add and remove data from the window by right clicking, same examples shown on the slide. This saves adding to the watch window. Various information can be added to the display by right clicking such as line numbers, parameter types, values and names.

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The watch window allows you to view a variable, and for classes/structures expand and see the properties. When stepping into a method a variable might become out of scope and not have a value, you can still see the value, if you right click the variable before it goes out of scope and select make object id, it gets given an id, $1 the example in the slide. $1 then is visible when the variable is out of scope. It may also carry on showing a variable once the variable has died until it is garbage collected. This is useful when reference types are passed into methods. You can see if the reference variable has changed.

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Multi thread and parallel processing can be a problem when debugging.

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The thread window

This shows you what threads you have in your program. You can mark threads by flagging them, you can also search for particular threads using the search window, show different details by selecting what columns to show, and freeze and thaw threads. This is very useful when you are stepping through code and it is jumping from one thread to another.

If you have a number of threads in your application, you can come to this windows - select all the threads right click and freeze and then select the thread you are interested in and thaw that one, and then F10 will take you on that threads path.

Naming threads can help identify thread, this can be in the threads window by using rename, or programmable. The caveat here is that this may not work if you are using tasks or thread pool threads as threads can only be named once.

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The debug toolbar allows you to see where threads are clicking the far right icon. This will show in the column on the left of the source - where breakpoints are shown, using the thread icon to shown where each thread is. By hovering on this icon using can see the thread id.

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There is another toolbar debug location, if this is not visible can be displayed via the toolbar menu option. This toolbar allows you to switch processes/ threads and also select an item in the relevant call stack

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There are windows to help with debugging parallel code as well. If we use the code on the slide as an example, just a simple loop that counts to 10 for each person.

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We can use the parallel stack window to view the call stack for each of the parallel loops, here we can freeze or flag threads as well as select the call stack we want.

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Also in the example there are 4 versions of i and name one for each person, using the parallel watch window we can see the value of each in thread, the variables are list horizontally.

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Breakpoints

The bread and butter of a lot of debugging,

There are a number of different ways to use breakpoints.

Breakpoints can be labelled which is a way of commenting them. As with datatips, breakpoints and can be exported and imported. This is helpful when trying different scenarios or pair debugging.

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Data breakpoints, in many of the older languages you could set a breakpoint on a variable when it changed value. That was done by watching a memory location, this is won’t work wilth .net and managed code. However we can set a breakpoint on the set method for a property, so maybe instead of fields use private properties and set breakpoints on the set.

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With Condition breakpoints you can get the breakpoint to only fire in certain conditions. E.g with this code when i =5;

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If we set at breakpoint at the line we wish to break at and right click and select condition and now you can set the condition e.g i == 5; Now the breakpoint will only cause the code to break when i = 5. However this is expensive in time, as the code actually stops every time the breakpoint is hit, visual studio then does the comparison and then continues if the comparison is false. If the breakpoint is likely to be hit a lot, this can be a problem. You can just put a normal if statement around the breakpoint. Though you have to remember to take it out before going live. Which of course is forgotten

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So if you do put an extra condition is and check that the debugger is attached.

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Hit count = you can also have the breakpoint triggered when it is hit for the nth time. This is helpful when you have a method or line of code that throws an exception but not every time, it may be on the 1500th time or even unknown time.

If the number is unknown set the hit count very high, run the code.

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When the exception is thrown - look at the breakpoint window and this will tell you what the hit count current is. Now change the hit count condition to that number and re run, now you will break just before the exception.

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Filter - for use in multi threaded applications

This allows you to specify that a breakpoint will only be triggered for a specific thread – options MachineName, ProcessId, ProcessName, ThreadId, and ThreadName. For this to work you need Enable breakpoint filters set in the debugging options

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These can be combined, note conditions always go before hit counts with filters last

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You can also carry out actions on a breakpoint, right click and select actions, here you can display information to the console window. With these you can have the program carry on after the action or stop like a normal breakpoint. As well as display information also process code –

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Like set the value of a variable, in the slide I have set I = 2 or call methods on a class. Note the accessibility of a method does not apply here, you can call private methods!

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Sometimes you know a method is going to be used but you don’t know which instance is, e.g. you may have an interface implemented by several classes. You can set a breakpoint by the function name, in the breakpoints window, click on new and you can add a function breakpoint. When you start debugging you will notice that a plus sign appears next to it in the breakpoint window, which you can expand and see a breakpoint for each function. You can then disable/remove individual ones. You can add action and conditions as previously mentioned to these.

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Not going to go into depth here, but there are windows that allow you to see memory, the disassembly (you can set breakpoints in the disassembly), and the registers. All available via debug>windows.

For these options to be available you need the **Enable address-level debugging**: option selected.

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If you using WPF or UWP. There are the live visual tree and the live property explorer.

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The visual tree allows to to look into the controls on the screen and the property tree shows the properties of the controls.

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Dumps.

These can be opened by visual studio - just open file and select the dump.

When you open a dump, you will see the following amongst other information. I’ll just show what it looks like with managed code

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Your see the code with the value of properties of classes, so if a program hangs - see if you can get a dump.

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Symbol servers.

The symbol server keeps record of the pdb files giving details of symbols required for debugging. Having a symbol server allows the system to access code from for any version that has a pdb file on the server. Microsoft have 30- 40 thousand versions of windows running somewhere at Redmond and they can access the code for any one of these versions. Each build produces new pdb files, if you wish to debug a build you need the right pdb files. Using the Microsoft symbol server you can even debug through the .net framework (you will need enable .net framework source stepping in the options switched, also other components that you don’t have the code for , . They are also useful for things that relate to production debugging like dumps. Symbol servers are set under debugging options > symbols. To create your own Symbol server you will need to publish the symbols when you make your code available, e.g publish to nuget. With Azure devops this is an available task.

If the source is on a remote server you will need source server support ticked

With nuget packages there is now soucelink which builds into the pdb metadata to remap to files on github, gitlab or AzureDevops.You will need SourceLink ticked in the debug options.

And for all third party dlls you will need just my code unticked.

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There are a few tools that can help with debugging the front end. You can now debug javascript from within visual studio, But also browser link lets you run you website in a number of browsers and then change css, html and see it reflected in all browsers. This is started by using the drop down for choosing which browser, selecting browse with, select the browsers you want and clicking browse.

Browse sync - you may need to install from the marketplace. Allows when using multiple browsers to keep them in sync regarding the page and data entered.

Inspector allows you to click on a field and be taken to the line of code in visual studio. This is another marketplace add in

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The features in the enterprise edition

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The code map. This shows the structure of your code, you can have it built up as you debug or choose the class /method and add the references to it. You can also then click on one of the boxes and the editor will go to that segment of code, this can be very useful when debugging, for example re visit the method that was called before the one that is currently being run.

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Intellitrace . This allows historical debugging, meaning you can go over the same scenario over and over again without having to rerun the code. First you have to turn it on and you have a choice of what you want to record. Obviously the more you want to record the larger the file, but you don’t want to miss the bit that you want to know.

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You then have to specify the events you want recorded, again the more recorded the larger the files.

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This is the type of output you see and you can click on the events to see where they occurred.

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You can also record a session from your live production machine, and copy the produced file to your develop machine and open it there.

And you will see something like the slide

Clicking the exception will take you to the code

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You can jump up and down the call stack if you wish, step backwards in the code. And also do it numerous times

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Here are some links that I got information from and that you might find useful

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And here are some other debugging tools that I haven’t spoken about.

Though remote debugging is similar to normal debugging, just make sure no one else is using the remote server application, as they will hit your breakpoints etc. The hardest part is finding the process id out from the process you wish to attach to. (Mike Warren)

Immediate and attributes

Live Debugging is IT’s version of phone a friend, and allows you to debug in your choice of tool visual studio, code on a mac or windows

The last two windbg and SOS just blow my mind.

Any questions

Breakpoints window and immediate window nse