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UEFI & EDK II Training

EDK II Debugging with Windows Lab

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Lesson EDK II Debugging

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LESSON OBJECTIVE

- Define `DebugLib` and its attributes
- List the ways to debug
- Using PCDs to Configure `DebugLib` - LAB
- Change Compiler & Linker Flags for debugging
- Change the `DebugLib` instance to modify the debug output - LAB
- Debug EDK II using VS Debugger - LAB

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DEBUGGING OVERVIEW

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Debug Methods

DEBUG and ASSERT macros in EDK II code

DEBUG instead of Print functions

Software/hardware debuggers

Shell commands to test capabilities for simple debugging

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EDK II `DebugLib` Library

`Debug` and **`Assert`** macros in code

Enable/disable when compiled (`target.txt`)

Connects a Host to capture debug messages

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DEBUGGING WITH PCDS

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Using PCDs to Configure DebugLib

MdePkg Debug Library Class

```
[PcdsFixedAtBuild. PcdsPatchableInModule]
    • • •
  gEfiMdePkgTokenSpaceGuid.PcdDebugPropertyMask|0x1f
  gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0x80000040
```

PCDs Set which drivers report errors and change what messages get printed

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PcdDebugPropertyMask Values

Debugging *Features* Enabled

```
#define DEBUG_PROPERTY_DEBUG_ASSERT_ENABLED       0x01
#define DEBUG_PROPERTY_DEBUG_PRINT_ENABLED        0x02
#define DEBUG_PROPERTY_DEBUG_CODE_ENABLED         0x04
#define DEBUG_PROPERTY_CLEAR_MEMORY_ENABLED       0x08
#define DEBUG_PROPERTY_ASSERT_BREAKPOINT_ENABLED  0x10
#define DEBUG_PROPERTY_ASSERT_DEADLOOP_ENABLED    0x20
```

Default value in `OvmfPkg` is 0x2f

Default value in `EmulatorPkg` is 0x1f

Determines which debugging features are enabled

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PcdDebugPrintErrorLevel Values

Debug *Messages* Displayed

```
#define DEBUG_INIT      0x00000001  // Initialization
#define DEBUG_WARN      0x00000002  // Warnings
#define DEBUG_LOAD      0x00000004  // Load events
#define DEBUG_FS        0x00000008  // EFI File system
#define DEBUG_POOL      0x00000010  // Alloc & Free's  Pool
#define DEBUG_PAGE      0x00000020  // Alloc & Free's  Page
#define DEBUG_INFO      0x00000040  // Verbose
#define DEBUG_DISPATCH  0x00000080  // PEI/DXE Dispatchers
#define DEBUG_VARIABLE  0x00000100  // Variable
#define DEBUG_BM        0x00000400  // Boot Manager
#define DEBUG_BLKIO     0x00001000  // BlkIo Driver
#define DEBUG_NET       0x00004000  // SNP / Network Io Driver
#define DEBUG_UNDI      0x00010000  // UNDI Driver
#define DEBUG_LOADFILE  0x00020000  // Load File
#define DEBUG_EVENT     0x00080000  // Event messages
#define DEBUG_GCD       0x00100000  // Global Coherency Database changes
#define DEBUG_CACHE     0x00200000  // Memory range cache-ability changes
#define DEBUG_VERBOSE   0x00400000  // Detailed debug messages that may
                                    // significantly impact boot performance
#define DEBUG_ERROR     0x80000000  // Error
```

Determines which messages we want to print

Changing PCD Values

Change all instances of a PCD in platform DSC

```
[PcdsFixedAtBuild.IA32]
gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0x00000000
```

Change a single module’s PCD values in DSC

```
MyPath/MyModule.inf {
<PcdsFixedAtBuild>
gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0x80000000
}
```

Minimize message output and minimize size increase

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Other Debug Related Libraries

`ReportStatusCodeLib` – Progress codes

```
gEfiMdePkgTokenSpaceGuid.PcdReportStatusCodePropertyMask
```

`PostCodeLib` – Enable Post codes

```
gEfiMdePkgTokenSpaceGuid.PcdPostCodePropertyMask
```

`PerformanceLib` – Enable Measurement

```
gEfiMdePkgTokenSpaceGuid.PcdPerformanceLibraryPropertyMask
```

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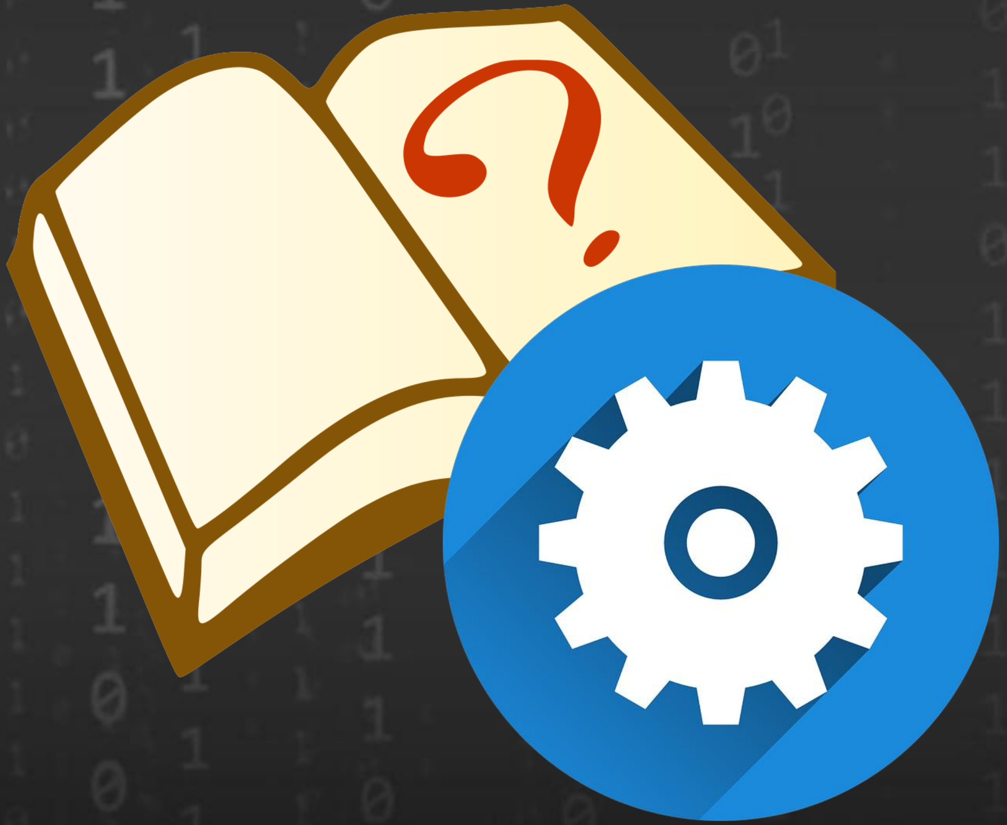
Lab 1 – Adding Debug Statements

In this lab, you’ll add debug statements to the previous lab's SampleApp UEFI Shell application



Lab 1: Catch up from previous lab

Skip if Lab Writing UEFI App Lab completed

- Perform Lab Setup from previous Labs
- Create a Directory under the workspace `C:/FW/edk2-ws/edk2` “`SampleApp`”
- Copy contents of `C:../FW/LabSampleCode/SampleAppDebug to C:/FW/edk2-ws/edk2/SampleApp`
- Open `C:/FW/edk2/EmulatorPkg/EmulatorPkg.dsc`
- Add the following to the [Components] section:

```
# Add new modules here
 SampleApp/SampleApp.inf
```

- Save and close the file `EmulatorPkg.dsc`

Lab 1: Add debug statements to SampleApp

- Open a VS Command Prompt and type: `cd C:/FW/edk2-ws` then

```
   C:/FW/edk2-ws > setenv.bat
   C:/FW/edk2-ws > cd edk2
   C:/FW/edk2-ws/edk2 > edksetup
```

- Open `C:/FW/edk2-ws/edk2/SampleApp/SampleApp.c`

- Add the following to the include statements at the top of the file after below the last "`include`" statement:

```
  #include <Library/DebugLib.h>
```

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Lab 1: Add debug statements to SampleApp

Locate the UefiMain function. Then copy and paste the following code after the "`EFI_INPUT_KEY   KEY;`" statement: and before the first `Print()` statement as shown in the screen shot below:

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```
DEBUG ((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n") );
DEBUG ((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n") );

DEBUG ((DEBUG_INIT,     " 0x%08x USING DEBUG DEBUG_INIT\n" , (UINTN)(DEBUG_INIT))  );
DEBUG ((DEBUG_WARN,     " 0x%08x USING DEBUG DEBUG_WARN\n", (UINTN)(DEBUG_WARN))  );
DEBUG ((DEBUG_LOAD,     " 0x%08x USING DEBUG DEBUG_LOAD\n", (UINTN)(DEBUG_LOAD))  );
DEBUG ((DEBUG_FS,       " 0x%08x USING DEBUG DEBUG_FS\n", (UINTN)(DEBUG_FS))  );
DEBUG ((DEBUG_POOL,     " 0x%08x USING DEBUG DEBUG_POOL\n", (UINTN)(DEBUG_POOL))  );
DEBUG ((DEBUG_PAGE,     " 0x%08x USING DEBUG DEBUG_PAGE\n", (UINTN)(DEBUG_PAGE))  );
DEBUG ((DEBUG_INFO,     " 0x%08x USING DEBUG DEBUG_INFO\n", (UINTN)(DEBUG_INFO))  );
DEBUG ((DEBUG_DISPATCH, " 0x%08x USING DEBUG DEBUG_DISPATCH\n",(UINTN)(DEBUG_DISPATCH)));
DEBUG ((DEBUG_VARIABLE, " 0x%08x USING DEBUG DEBUG_VARIABLE\n",(UINTN)(DEBUG_VARIABLE)));
DEBUG ((DEBUG_BM,       " 0x%08x USING DEBUG DEBUG_BM\n", (UINTN)(DEBUG_BM))  );
DEBUG ((DEBUG_BLKIO,    " 0x%08x USING DEBUG DEBUG_BLKIO\n", (UINTN)(DEBUG_BLKIO))  );
DEBUG ((DEBUG_NET,      " 0x%08x USING DEBUG DEBUG_NET\n", (UINTN)(DEBUG_NET))  );
DEBUG ((DEBUG_UNDI,     " 0x%08x USING DEBUG DEBUG_UNDI\n", (UINTN)(DEBUG_UNDI))  );
DEBUG ((DEBUG_LOADFILE, " 0x%08x USING DEBUG DEBUG_LOADFILE\n",(UINTN)(DEBUG_LOADFILE)));
DEBUG ((DEBUG_EVENT,    " 0x%08x USING DEBUG DEBUG_EVENT\n", (UINTN)(DEBUG_EVENT))  );
DEBUG ((DEBUG_GCD,      " 0x%08x USING DEBUG DEBUG_GCD\n", (UINTN)(DEBUG_EVENT)) );
DEBUG ((DEBUG_CACHE,    " 0x%08x USING DEBUG DEBUG_CACHE\n", (UINTN)(DEBUG_CACHE)) );
DEBUG ((DEBUG_VERBOSE,  " 0x%08x USING DEBUG DEBUG_VERBOSE\n", (UINTN)(DEBUG_VERBOSE)) );
DEBUG ((DEBUG_ERROR,    " 0x%08x USING DEBUG DEBUG_ERROR\n", (UINTN)(DEBUG_ERROR))  );
```

Lab 1: Build, Run and Test Result

At the VS Command Prompt

```
$> Build
$> RunEmulator.bat
```

Run the application from the shell

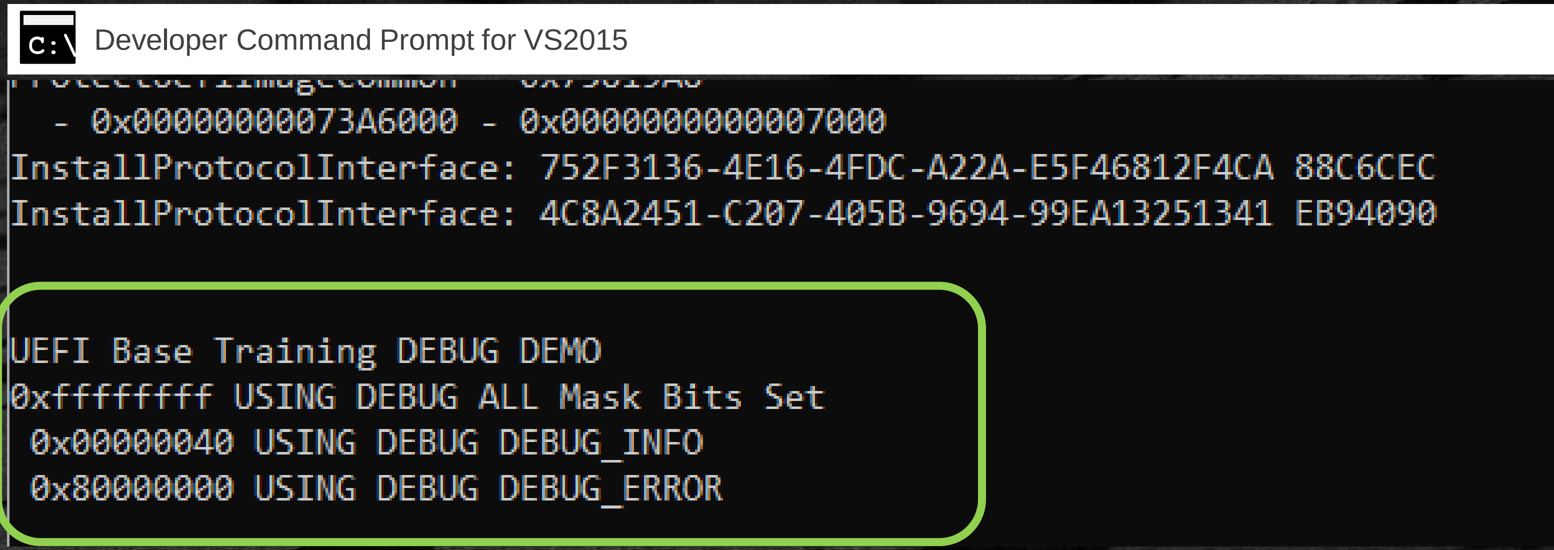
```
Shell> SampleApp
```

Check the VS Debug output

Exit

```
Shell> Reset
```

Visual Studio command prompt window output



```
  - 0x00000000073A6000 - 0x0000000000007000
InstallProtocolInterface: 752F3136-4E16-4FDC-A22A-E5F46812F4CA 88C6CEC
InstallProtocolInterface: 4C8A2451-C207-405B-9694-99EA13251341 EB94090


UEFI Base Training DEBUG DEMO
0xffffffff USING DEBUG ALL Mask Bits Set
 0x00000040 USING DEBUG DEBUG_INFO
 0x80000000 USING DEBUG DEBUG_ERROR
```

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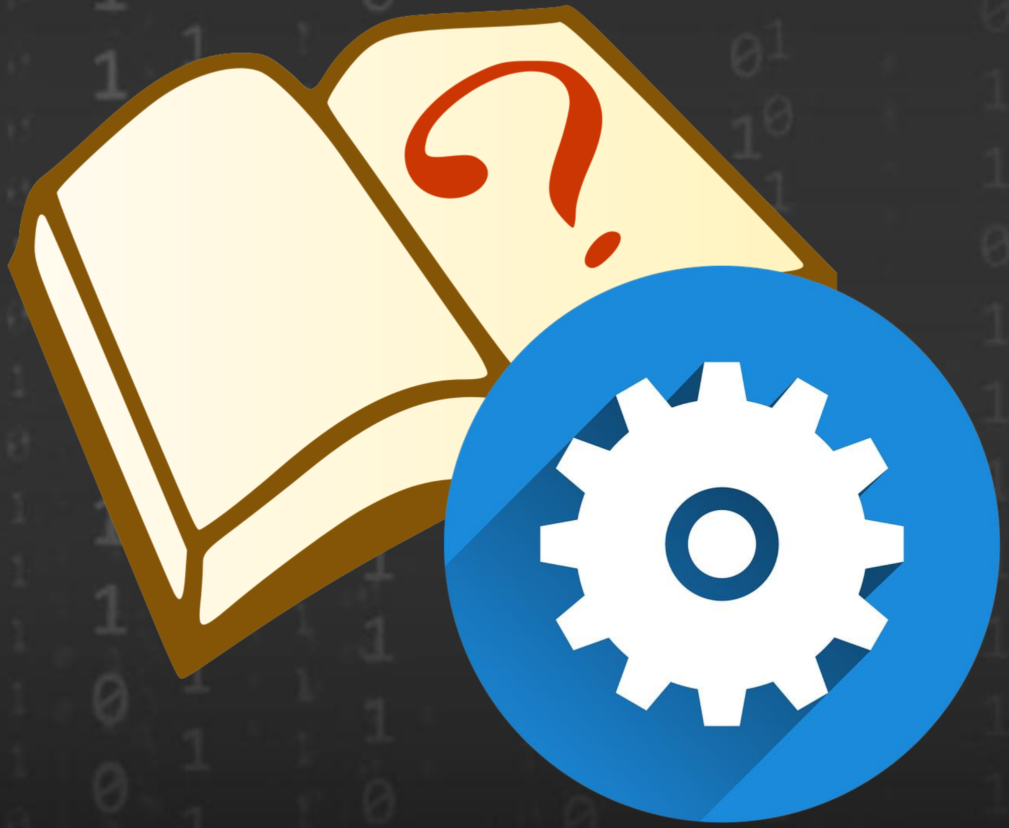
Lab 2 – Changing PCD Value

In this lab, you'll learn how to use PCD values to change debugging capabilities.



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Lab 2: Change PCDs for SampleApp

Open `C:/FW/edk2-ws/edk2/EmulatorPkg/EmulatorPkg.dsc`
Replace `SampleApp/SampleApp.inf` with the following:

```
SampleApp/SampleApp.inf {
   <PcdsFixedAtBuild>
    gEfiMdePkgTokenSpaceGuid.PcdDebugPropertyMask|0xff
    gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0xffffffff
 }
```

Save and **close** `EmulatorPkg.dsc`

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Lab 1: Build, Run and Test Result

At the VS Command Prompt

```
$> Build
$> RunEmulator.bat
```

Run the application from the shell

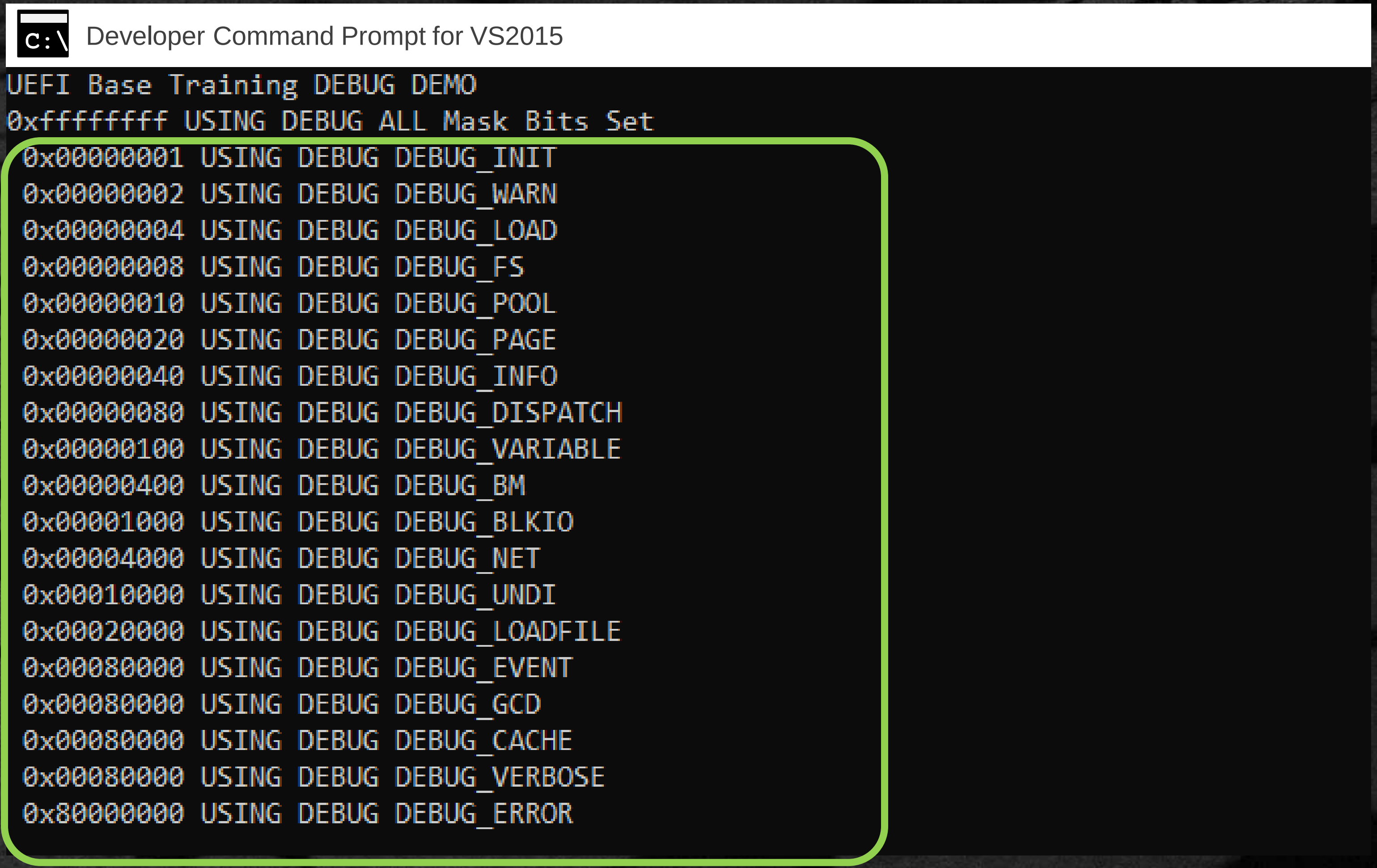
```
Shell> SampleApp
```

Check the VS Debug output

Exit

```
Shell> Reset
```

Visual Studio command prompt window output



```
UEFI Base Training DEBUG DEMO
0xffffffff USING DEBUG ALL Mask Bits Set
 0x00000001 USING DEBUG DEBUG_INIT
 0x00000002 USING DEBUG DEBUG_WARN
 0x00000004 USING DEBUG DEBUG_LOAD
 0x00000008 USING DEBUG DEBUG_FS
 0x00000010 USING DEBUG DEBUG_POOL
 0x00000020 USING DEBUG DEBUG_PAGE
 0x00000040 USING DEBUG DEBUG_INFO
 0x00000080 USING DEBUG DEBUG_DISPATCH
 0x00000100 USING DEBUG DEBUG_VARIABLE
 0x00000400 USING DEBUG DEBUG_BM
 0x00001000 USING DEBUG DEBUG_BLKIO
 0x00004000 USING DEBUG DEBUG_NET
 0x00010000 USING DEBUG DEBUG_UNDI
 0x00020000 USING DEBUG DEBUG_LOADFILE
 0x00080000 USING DEBUG DEBUG_EVENT
 0x00080000 USING DEBUG DEBUG_GCD
 0x00080000 USING DEBUG DEBUG_CACHE
 0x00080000 USING DEBUG DEBUG_VERBOSE
 0x80000000 USING DEBUG DEBUG_ERROR
```

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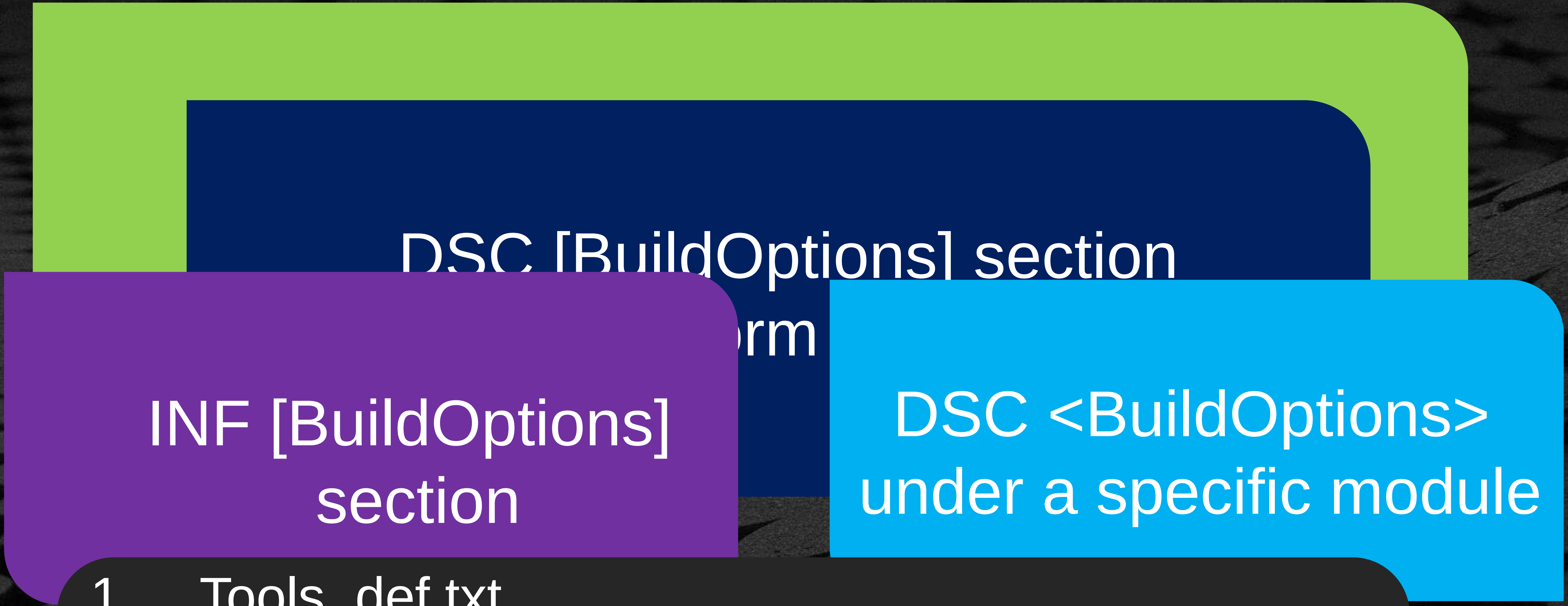
CHANGING FLAGS

Changing Compiler & Linker Flags

Precedence for Debug Flags Hierarchy


DSC [BuildOptions] section
rm
INF [BuildOptions] section
DSC <BuildOptions> under a specific module

1. Tools_def.txt
2. DSC [BuildOptions] section (platform scope)
3. INF [BuildOptions] section (module scope)
4. DSC <BuildOptions> under a specific module

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Compiler / Linker Flags

Example from Microsoft* compiler to turn off optimization

"/O2" to "/O1" requires "/Od /O1" flags

Change common flags in platform DSC

```
[BuildOptions]
     DEBUG_*_IA32_CC_FLAGS = /Od /Oy-
```

Change a single module's flags in DSC

```
MyPath/MyModule.inf {
<BuildOptions>
   DEBUG_*_IA32_CC_FLAGS = /Od /Oy-
}
```

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DebugLib USAGE

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The DebugLib Class

Interface

MdePkg\Include\Library\DebugLib.h

Macros

(where PCDs are checked)

```
    ASSERT (Expression)
    DEBUG (Expression)
    ASSERT_EFI_ERROR (StatusParameter)
    ASSERT_PROTOCOL_ALREADY_INSTALLED(…)
```

Advanced Macros

```
    DEBUG_CODE (Expression)
    DEBUG_CODE_BEGIN() & DEBUG_CODE_END()
    DEBUG_CLEAR_MEMORY(…)
```

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Implementation

DebugLib Instances (1)

BaseDebugLibSerialPort

- Instance of DebugLib
- Uses SerialPortLib class to send debug output to serial port
- Default for many platforms: BaseDebugLibNull
- OVMF uses it with Switch DEBUG_ON_SERIAL_PORT

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Implementation

DebugLib Instances (2)

UefiDebugLibConOut   UefiDebugLibStdErr

- Instances of DebugLib (for apps and drivers)
- Send all debug output to console/debug console

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Implementation

DebugLib Instances (3)

PeiDxeDebugLibReportStatusCode

- Sends ASCII String specified by Description Value to the `ReportStatusCode()`
- May also use the `SerialPortLib` class to send debug output to serial port
- `BaseDebugLibNull` - Resolves references

Default for most platforms

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Changing Library Instances

Change common library instances in the platform DSC by module type

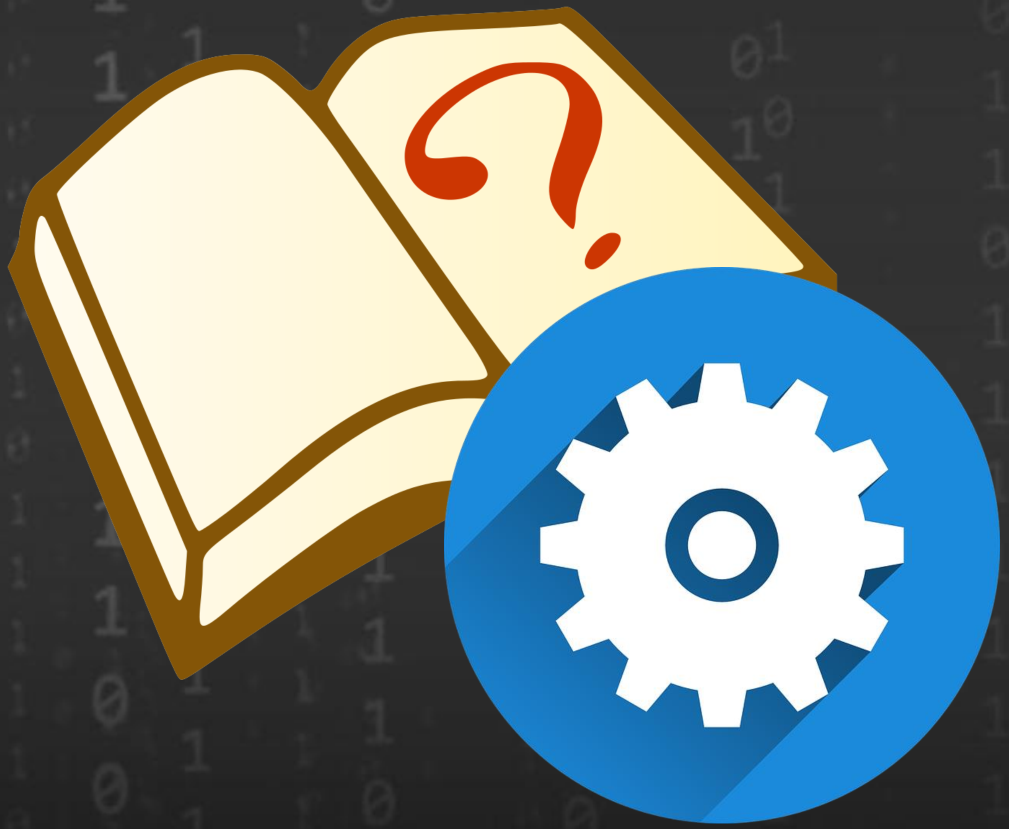
```
[LibraryClasses.common.IA32]
DebugLib|MdePkg/Library/BaseDebugLibNull/BaseDebugLibNull.inf
```

Change a single module's library instance in the platform DSC

```
MyPath/MyModule.inf {
<LibraryClasses>
DebugLib|MdePkg/Library/BaseDebugLibSerialPort.inf
}
```

Lab 2 – Library Instances for Debugging

In this lab, you'll learn how to add specific debug library instances.



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Lab 3: Using Library Instances for Debugging

Open `C:/FW/edk2-ws/edk2/EmulatorPkg/EmulatorPkg.dsc`
Replace `SampleApp/SampleApp.inf { . . .}` with the following:

```
SampleApp/SampleApp.inf {
   <LibraryClasses>
    DebugLib|MdePkg/Library/UefiDebugLibConOut/UefiDebugLibConOut.inf
 }
```

Save and **close** `EmulatorPkgPkg.dsc`

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Lab 3: Build, Run and Test Result

At the VS Command Prompt

```
$> Build
$> RunEmulator.bat
```

Run the application from the shell

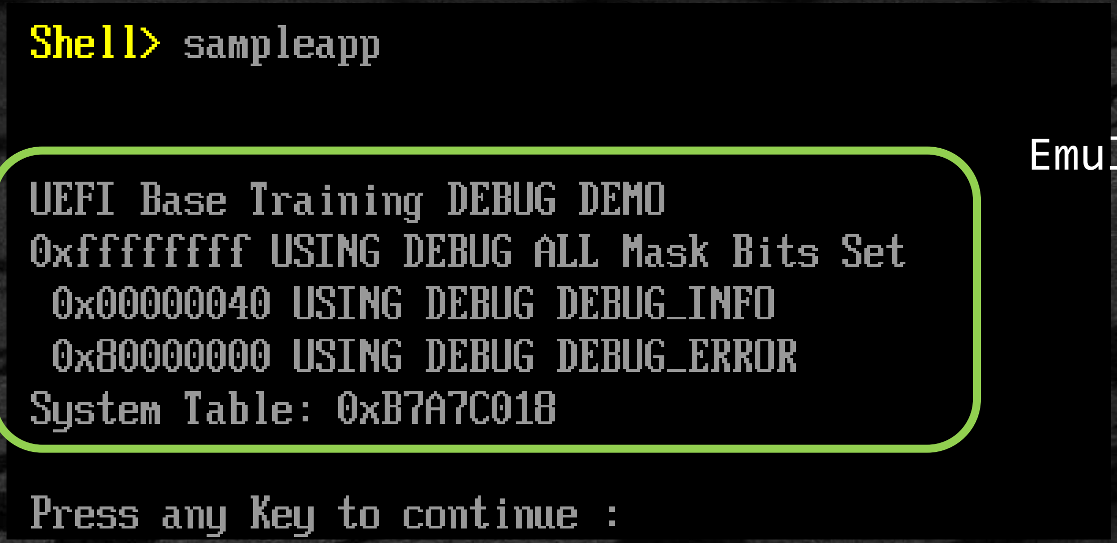
```
Shell> SampleApp
```

See that the output from the Debug statements now goes to the console

Exit

```
Shell> Reset
```

Debug output to console



```
Shell> sampleapp

UEFI Base Training DEBUG DEMO
0xffffffff USING DEBUG ALL Mask Bits Set
 0x00000040 USING DEBUG DEBUG_INFO
 0x80000000 USING DEBUG DEBUG_ERROR
System Table: 0xB7A7C018

Press any Key to continue :
```

EmulatorPkg

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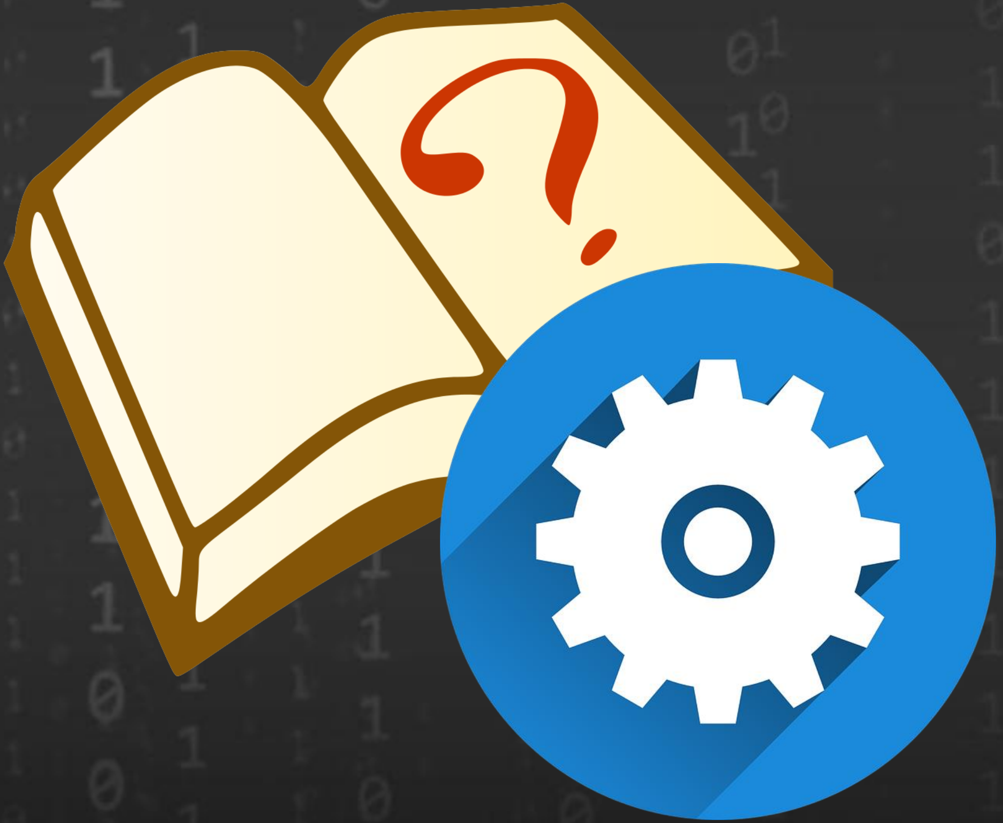
Lab 4: Null Instance of `DebugLib`

In this lab, you'll change the `DebugLib` to the Null instance.



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Lab 4: Using Null Library Instances

Open `C:/FW/edk2-ws/edk2/EmulatorPkg/EmulatorPkg.dsc`
Replace `SampleApp/SampleApp.inf { . . .}` with the following:

```
SampleApp/SampleApp.inf {
   <LibraryClasses>
   DebugLib|MdePkg/Library/BaseDebugLibNull/BaseDebugLibNull.inf
}
```

Save and **close** `EmulatorPkg.dsc`

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Lab 4: Build, Run and Test Result

At the VS Command Prompt

```
$> Build
$> RunEmulator.bat
```

Run the application from the shell

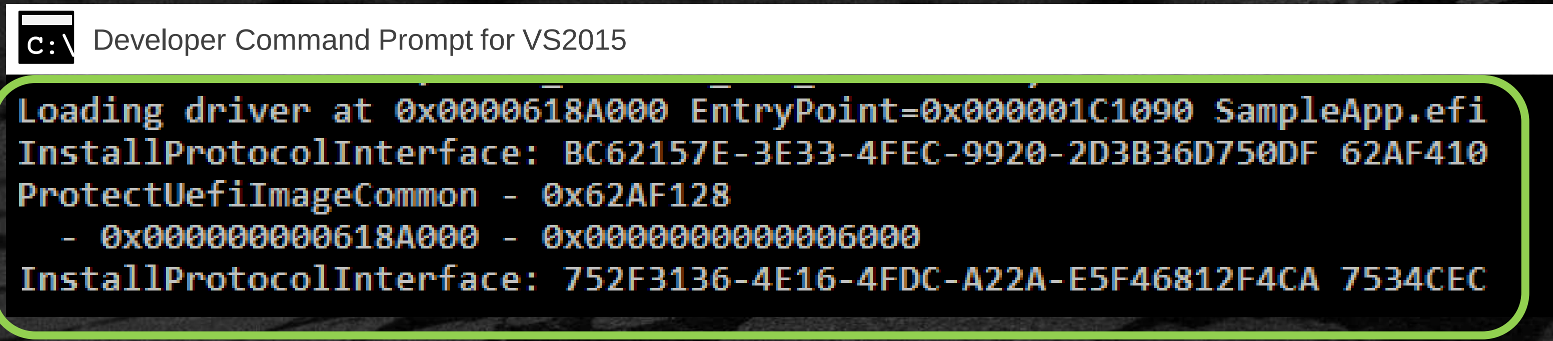
```
Shell> SampleApp
```

Check – now **NO** Debug output

Exit

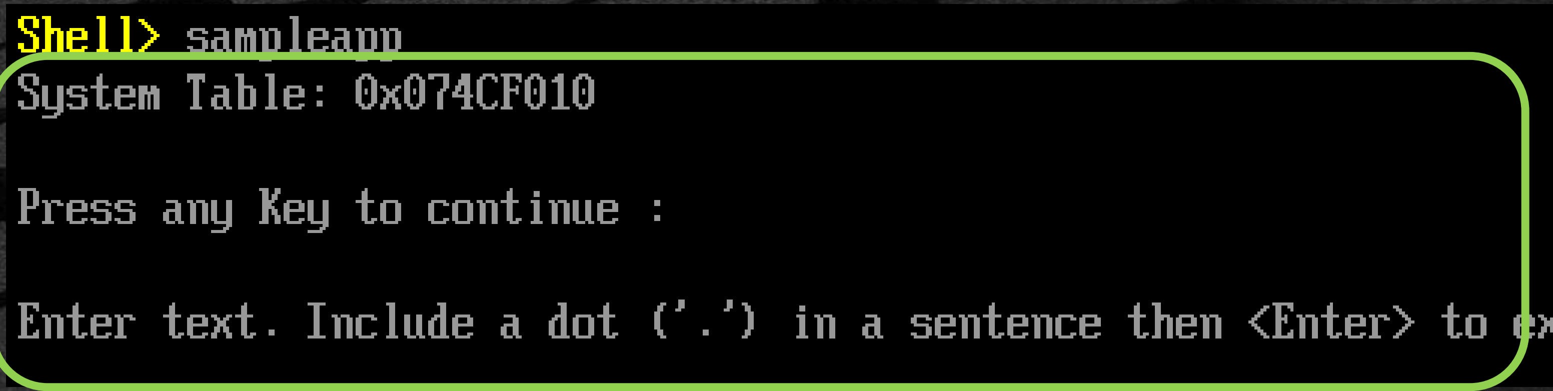
```
Shell> Reset
```

Visual Studio command prompt window output – NO DEBUG


Developer Command Prompt for VS2015

```
Loading driver at 0x0000618A000 EntryPoint=0x000001C1090 SampleApp.efi
InstallProtocolInterface: BC62157E-3E33-4FEC-9920-2D3B36D750DF 62AF410
ProtectUefiImageCommon - 0x62AF128
  - 0x000000000618A000 - 0x0000000000006000
InstallProtocolInterface: 752F3136-4E16-4FDC-A22A-E5F46812F4CA 7534CEC
```

Console window – NO DEBUG



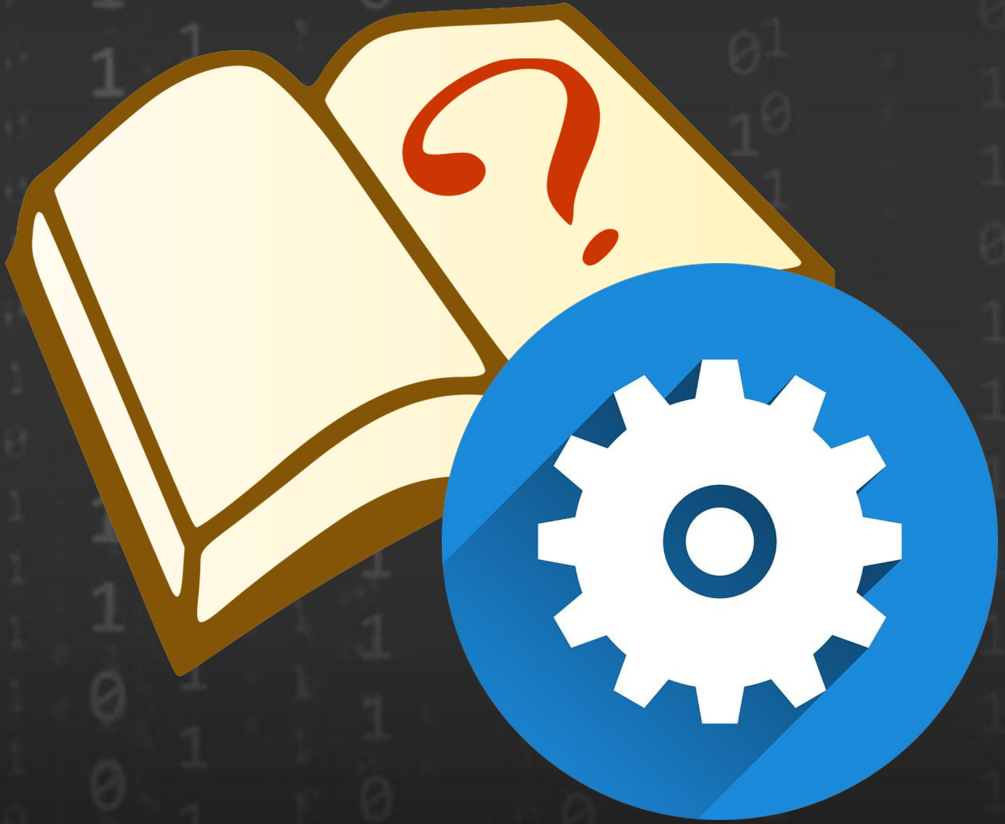
```
Shell> sampleapp
System Table: 0x074CF010

Press any Key to continue :

Enter text. Include a dot ('.') in a sentence then <Enter> to e
```

Lab 5: Debugging EDK II with VS Debugger

In this lab, you'll learn how setup the VS to debug the EDK II emulation



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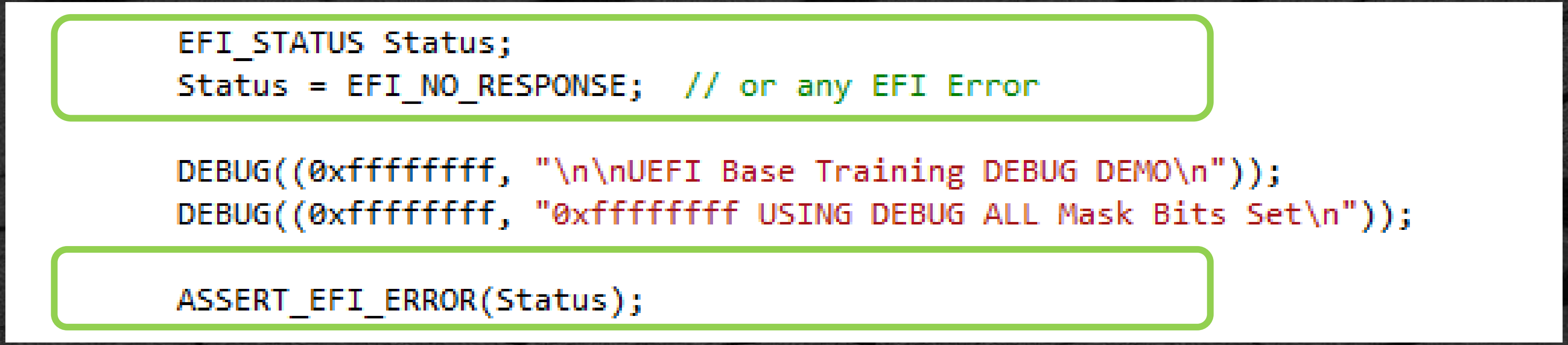
Lab 5: Debug with VS

Edit the SampleApp.c and add an "`ASSERT_EFI_ERROR`" :
Add the following:

```
      EFI_STATUS      Status;
      Status = EFI_NO_RESPONSE;
               . . .
       ASSERT_EFI_ERROR(Status);
```



```
      EFI_STATUS Status;
      Status = EFI_NO_RESPONSE;   // or any EFI Error

      DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));
      DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));

      ASSERT_EFI_ERROR(Status);
```

Save SampleApp.c

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Lab 5: Debug with VS - ASSERT

At the VS Command Prompt

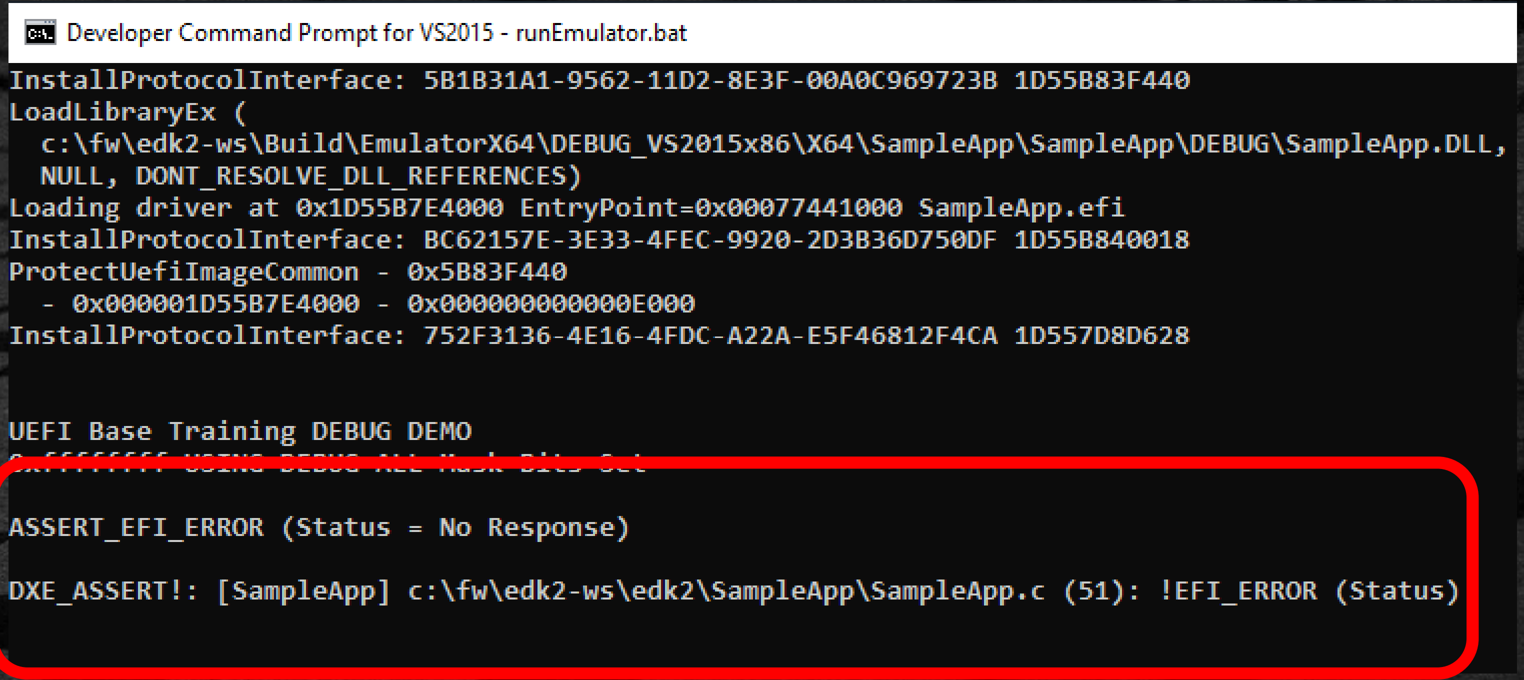
```
$> Build
$> RunEmulator.bat
```

Run the application from the shell

```
Shell> SampleApp
```

Assert in VS Command Prompt

Visual Studio command prompt window output



Developer Command Prompt for VS2015 - runEmulator.bat

```
InstallProtocolInterface: 5B1B31A1-9562-11D2-8E3F-00A0C969723B 1D55B83F440
LoadLibraryEx (
  c:\fw\edk2-ws\Build\EmulatorX64\DEBUG_VS2015x86\X64\SampleApp\SampleApp\DEBUG\SampleApp.DLL,
  NULL, DONT_RESOLVE_DLL_REFERENCES)
Loading driver at 0x1D55B7E4000 EntryPoint=0x00077441000 SampleApp.efi
InstallProtocolInterface: BC62157E-3E33-4FEC-9920-2D3B36D750DF 1D55B840018
ProtectUefiImageCommon - 0x5B83F440
  - 0x000001D55B7E4000 - 0x000000000000E000
InstallProtocolInterface: 752F3136-4E16-4FDC-A22A-E5F46812F4CA 1D557D8D628


UEFI Base Training DEBUG DEMO
0xffffffff USING DEBUG ALL Mask Bits Set

ASSERT_EFI_ERROR (Status = No Response)

DXE_ASSERT!: [SampleApp] c:\fw\edk2-ws\edk2\SampleApp\SampleApp.c (51): !EFI_ERROR (Status)
```

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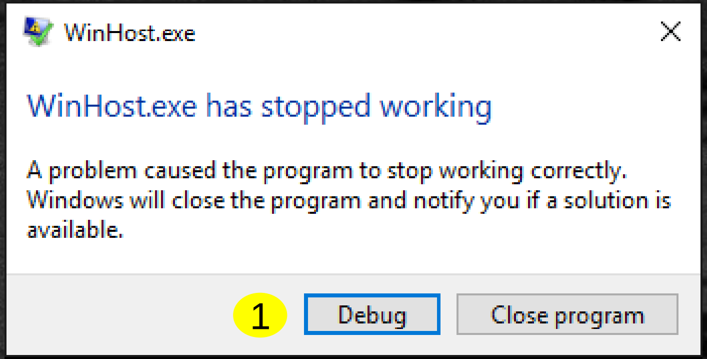
Lab 5: Debug with VS - ASSERT

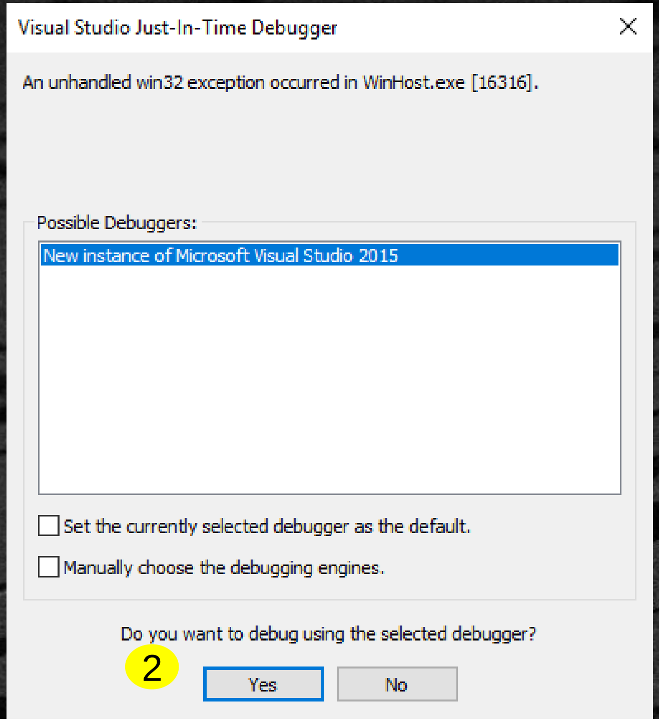
Windows* VS Debugger Will Pop UP



WinHost.exe

WinHost.exe has stopped working

A problem caused the program to stop working correctly. Windows will close the program and notify you if a solution is available.



Visual Studio Just-In-Time Debugger

An unhandled win32 exception occurred in WinHost.exe [16316].

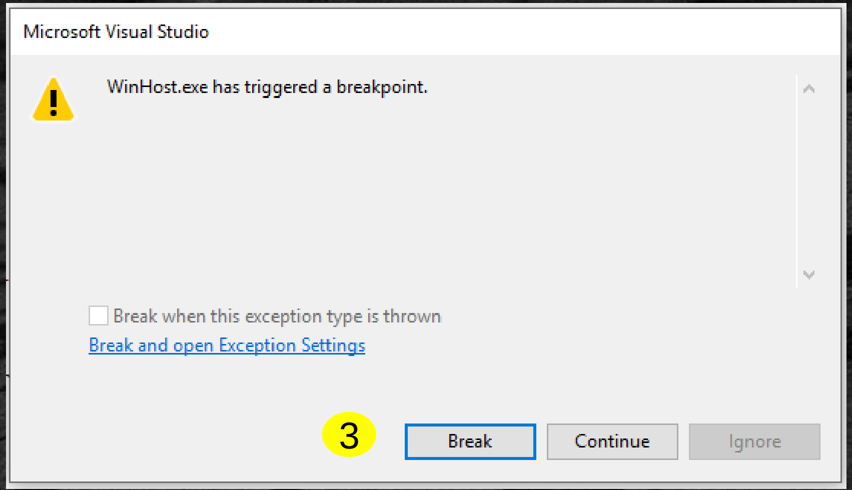
Possible Debuggers:

New instance of Microsoft Visual Studio 2015

☐ Set the currently selected debugger as the default.

☐ Manually choose the debugging engines.

Do you want to debug using the selected debugger?

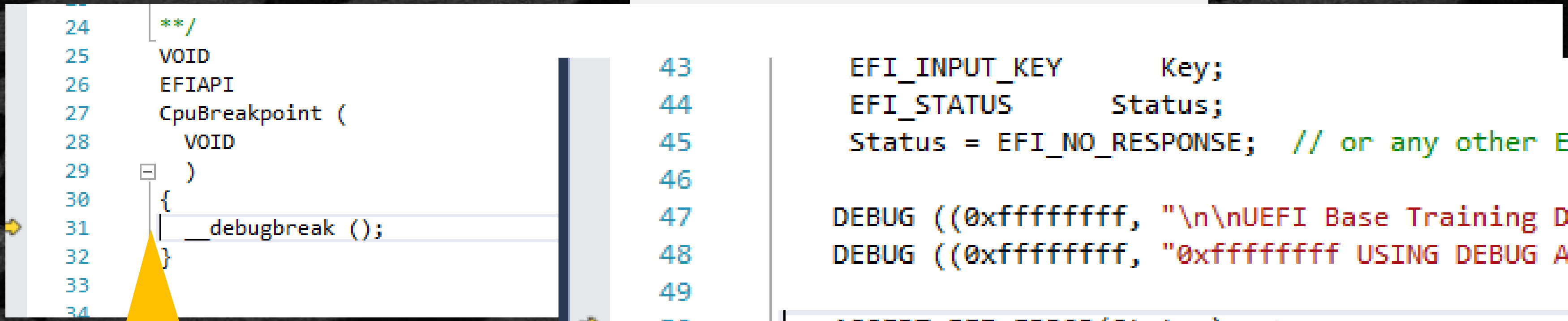


Microsoft Visual Studio

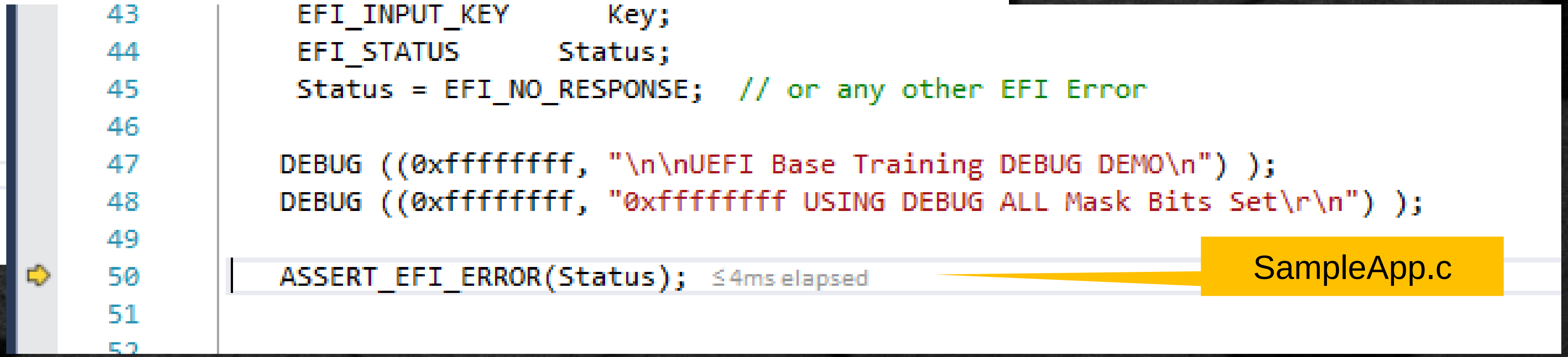
WinHost.exe has triggered a breakpoint.

☐ Break when this exception type is thrown

Break and open Exception Settings



```
**/
VOID
EFIAPI
CpuBreakpoint (
  VOID
  )
{
  __debugbreak ();
}
```

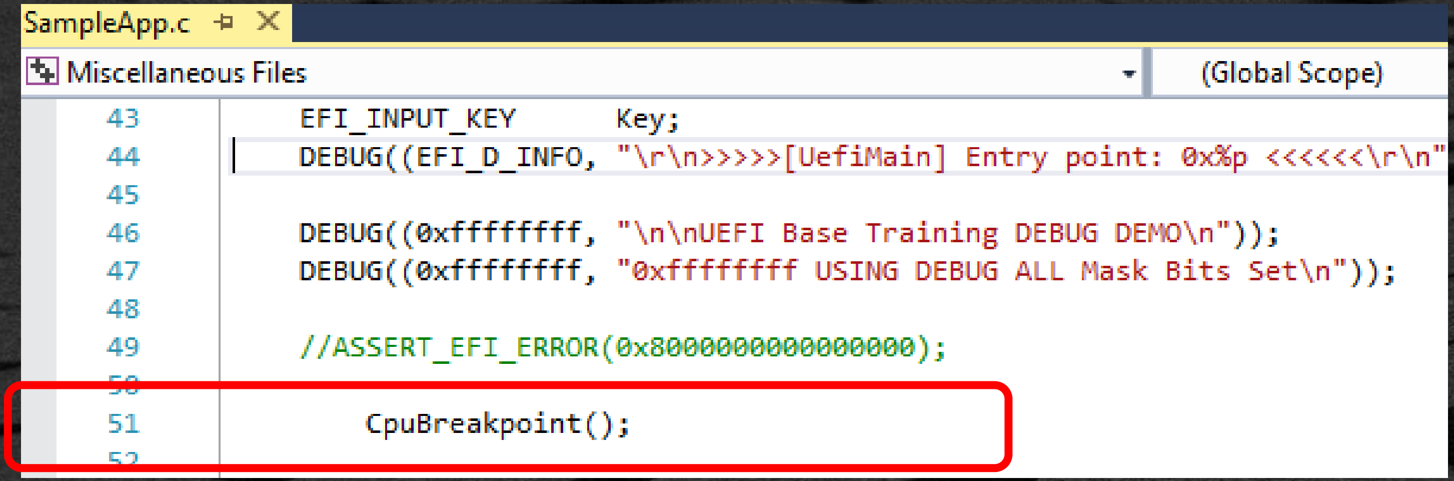


```
    EFI_INPUT_KEY       Key;
    EFI_STATUS        Status;
    Status = EFI_NO_RESPONSE;  // or any other EFI Error

  DEBUG ((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n") );
  DEBUG ((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\r\n") );

  ASSERT_EFI_ERROR(Status);  ≤4ms elapsed
```

Lab 5: Debug with VS - CpuBreakpoint

Edit the `SampleApp.c` and add "`CpuBreakpoint();`" Statement and comment out the "`ASSERT`":

```
CpuBreakpoint();
```


SampleApp.c
Miscellaneous Files (Global Scope)

```
    EFI_INPUT_KEY       Key;
    DEBUG((EFI_D_INFO, "\r\n>>>>>[UefiMain] Entry point: 0x%p <<<<<\r\n"

    DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));
    DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));

    //ASSERT_EFI_ERROR(0x8000000000000000);

        CpuBreakpoint();
```

Save `SampleApp.c`

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Lab 5: Debug with VS

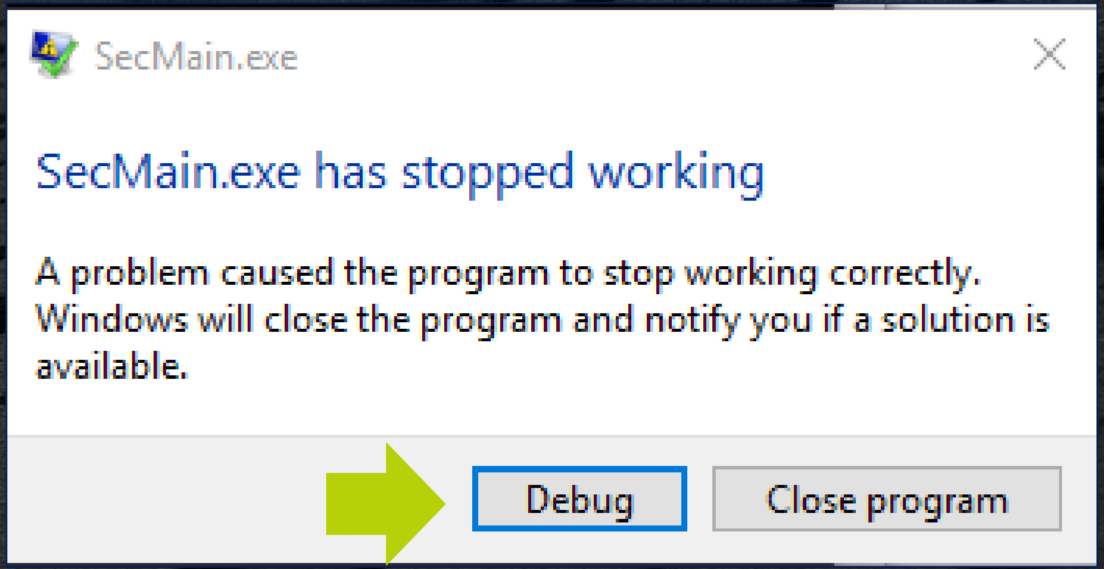
At the VS Command Prompt

```
$> Build
$> RunEmulator.bat
```

Run the application from the shell

```
Shell> SampleApp
```

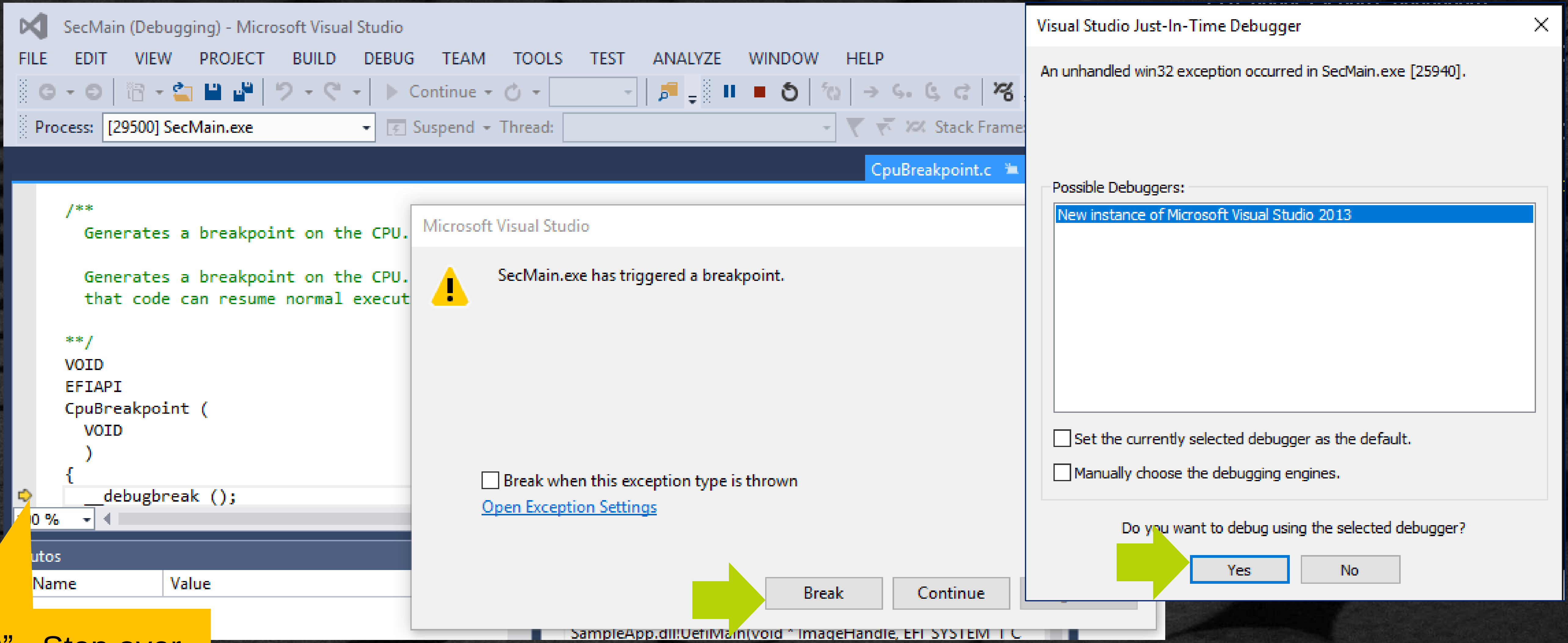
VS option go to VS Debugger


SecMain.exe

SecMain.exe has stopped working

A problem caused the program to stop working correctly. Windows will close the program and notify you if a solution is available.

Invoke Windows Visual Studio Debugger



SecMain (Debugging) - Microsoft Visual Studio

FILE EDIT VIEW PROJECT BUILD DEBUG TEAM TOOLS TEST ANALYZE WINDOW HELP
Continue
Process: [29500] SecMain.exe
Suspend Thread:
Stack Frame
CpuBreakpoint.c

```
/**
  Generates a breakpoint on the CPU.

  Generates a breakpoint on the CPU.
  that code can resume normal execut

**/
VOID
EFIAPI
CpuBreakpoint (
  VOID
  )
{
  __debugbreak ();
```

Microsoft Visual Studio

SecMain.exe has triggered a breakpoint.

☐ Break when this exception type is thrown

Open Exception Settings

SampleApp.dll!UefiMain(void * ImageHandle, EFI_SYSTEM_T C

Visual Studio Just-In-Time Debugger

An unhandled win32 exception occurred in SecMain.exe [25940].

Possible Debuggers:

New instance of Microsoft Visual Studio 2013

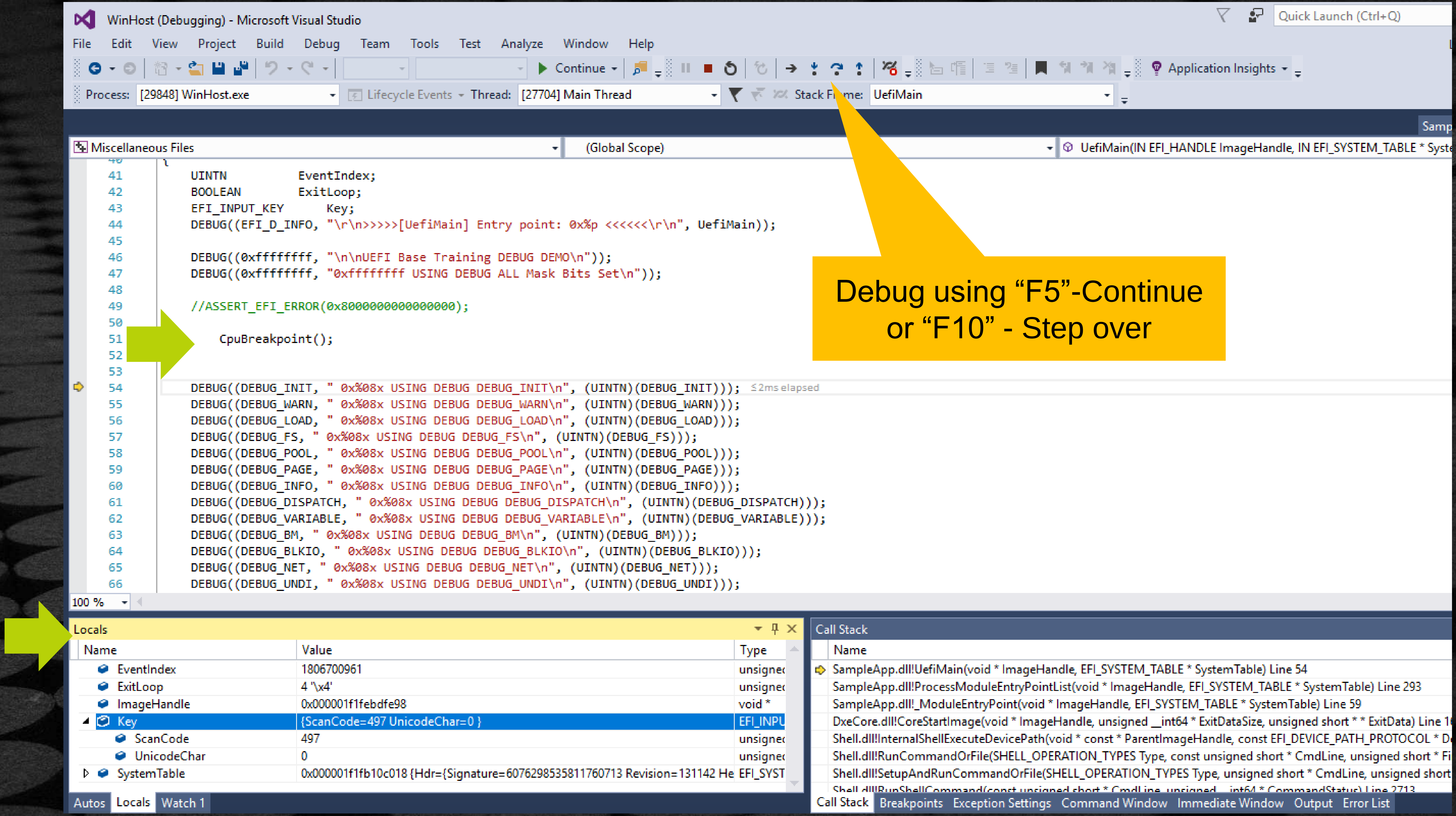
☐ Set the currently selected debugger as the default.

☐ Manually choose the debugging engines.

Do you want to debug using the selected debugger?

“F10” - Step over

Invoke Windows Visual Studio Debugger


WinHost (Debugging) - Microsoft Visual Studio
Quick Launch (Ctrl+Q)
File Edit View Project Build Debug Team Tools Test Analyze Window Help
Continue
Application Insights
Lifecycle Events
Samp
Miscellaneous Files
(Global Scope)
100 %

Process: [29848] WinHost.exe   Thread: [27704] Main Thread   Stack Frame: UefiMain

UefiMain(IN EFI_HANDLE ImageHandle, IN EFI_SYSTEM_TABLE * Syste

```
41      UINTN          EventIndex;
42      BOOLEAN        ExitLoop;
43      EFI_INPUT_KEY      Key;
44      DEBUG((EFI_D_INFO, "\r\n>>>>>[UefiMain] Entry point: 0x%p <<<<<\r\n", UefiMain));
45
46      DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));
47      DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));
48
49      //ASSERT_EFI_ERROR(0x8000000000000000);
50
51          CpuBreakpoint();
52
53
54      DEBUG((DEBUG_INIT, " 0x%08x USING DEBUG DEBUG_INIT\n", (UINTN)(DEBUG_INIT)));  ≤2ms elapsed
55      DEBUG((DEBUG_WARN, " 0x%08x USING DEBUG DEBUG_WARN\n", (UINTN)(DEBUG_WARN)));
56      DEBUG((DEBUG_LOAD, " 0x%08x USING DEBUG DEBUG_LOAD\n", (UINTN)(DEBUG_LOAD)));
57      DEBUG((DEBUG_FS, " 0x%08x USING DEBUG DEBUG_FS\n", (UINTN)(DEBUG_FS)));
58      DEBUG((DEBUG_POOL, " 0x%08x USING DEBUG DEBUG_POOL\n", (UINTN)(DEBUG_POOL)));
59      DEBUG((DEBUG_PAGE, " 0x%08x USING DEBUG DEBUG_PAGE\n", (UINTN)(DEBUG_PAGE)));
60      DEBUG((DEBUG_INFO, " 0x%08x USING DEBUG DEBUG_INFO\n", (UINTN)(DEBUG_INFO)));
61      DEBUG((DEBUG_DISPATCH, " 0x%08x USING DEBUG DEBUG_DISPATCH\n", (UINTN)(DEBUG_DISPATCH)));
62      DEBUG((DEBUG_VARIABLE, " 0x%08x USING DEBUG DEBUG_VARIABLE\n", (UINTN)(DEBUG_VARIABLE)));
63      DEBUG((DEBUG_BM, " 0x%08x USING DEBUG DEBUG_BM\n", (UINTN)(DEBUG_BM)));
64      DEBUG((DEBUG_BLKIO, " 0x%08x USING DEBUG DEBUG_BLKIO\n", (UINTN)(DEBUG_BLKIO)));
65      DEBUG((DEBUG_NET, " 0x%08x USING DEBUG DEBUG_NET\n", (UINTN)(DEBUG_NET)));
66      DEBUG((DEBUG_UNDI, " 0x%08x USING DEBUG DEBUG_UNDI\n", (UINTN)(DEBUG_UNDI)));
```

Debug using "F5"-Continue or "F10" - Step over

Locals

Name	Value	Type
EventIndex	1806700961	unsignec
ExitLoop	4 '\x4'	unsignec
ImageHandle	0x000001f1febdfe98	void *
◢ Key	{ScanCode=497 UnicodeChar=0 }	EFI_INPU
ScanCode	497	unsignec
UnicodeChar	0	unsignec
▷ SystemTable	0x000001f1fb10c018 {Hdr={Signature=6076298535811760713 Revision=131142 He	EFI_SYST

Autos Locals Watch 1

Call Stack

```
Name
SampleApp.dll!UefiMain(void * ImageHandle, EFI_SYSTEM_TABLE * SystemTable) Line 54
SampleApp.dll!ProcessModuleEntryPointList(void * ImageHandle, EFI_SYSTEM_TABLE * SystemTable) Line 293
SampleApp.dll!_ModuleEntryPoint(void * ImageHandle, EFI_SYSTEM_TABLE * SystemTable) Line 59
DxeCore.dll!CoreStartImage(void * ImageHandle, unsigned __int64 * ExitDataSize, unsigned short * * ExitData) Line 1
Shell.dll!InternalShellExecuteDevicePath(void * const * ParentImageHandle, const EFI_DEVICE_PATH_PROTOCOL * D
Shell.dll!RunCommandOrFile(SHELL_OPERATION_TYPES Type, const unsigned short * CmdLine, unsigned short * Fi
Shell.dll!SetupAndRunCommandOrFile(SHELL_OPERATION_TYPES Type, unsigned short * CmdLine, unsigned short
Shell.dll!RunShellCommand(const unsigned short * CmdLine, unsigned __int64 * CommandStatus) Line 2713
```

Call Stack Breakpoints Exception Settings Command Window Immediate Window Output Error List

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SUMMARY

- Define `DebugLib` and its attributes
- List the ways to debug
- Using PCDs to Configure `DebugLib` - LAB
- Change Compiler & Linker Flags for debugging
- Change the `DebugLib` instance to modify the debug output - LAB
- Debug EDK II using VS Debugger - LAB

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Questions?

Return to Main Training Page

Return to Training Table of contents for next presentation link

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BACK UP

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ISSUE:

Debugging in Emulatior with Windows 7 and Visual Studio does not work?

Symptom: With Windows 7 a **`CpuBreakpoint()`** or **`ASSERT`** just exits with an error from the "Build Run" command.

Link to fix this issue:
https://github.com/tianocore/tianocore.github.io/wiki/NT32#Debugging_in_Nt32_Emulation_with_Windows_7_and_Visual_Studio_does_not_work

1. Run the RegEdt32
2. Navigate to the HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Microsoft\Windows NT\CurrentVersion\AeDebug
3. Add a string value entry called "Auto" with a value of "1"

Windows 10 Visual Studio does not seem to have this issue