

UEFI & EDK II Training

EDK II Debugging with Windows Lab

tianocore.org

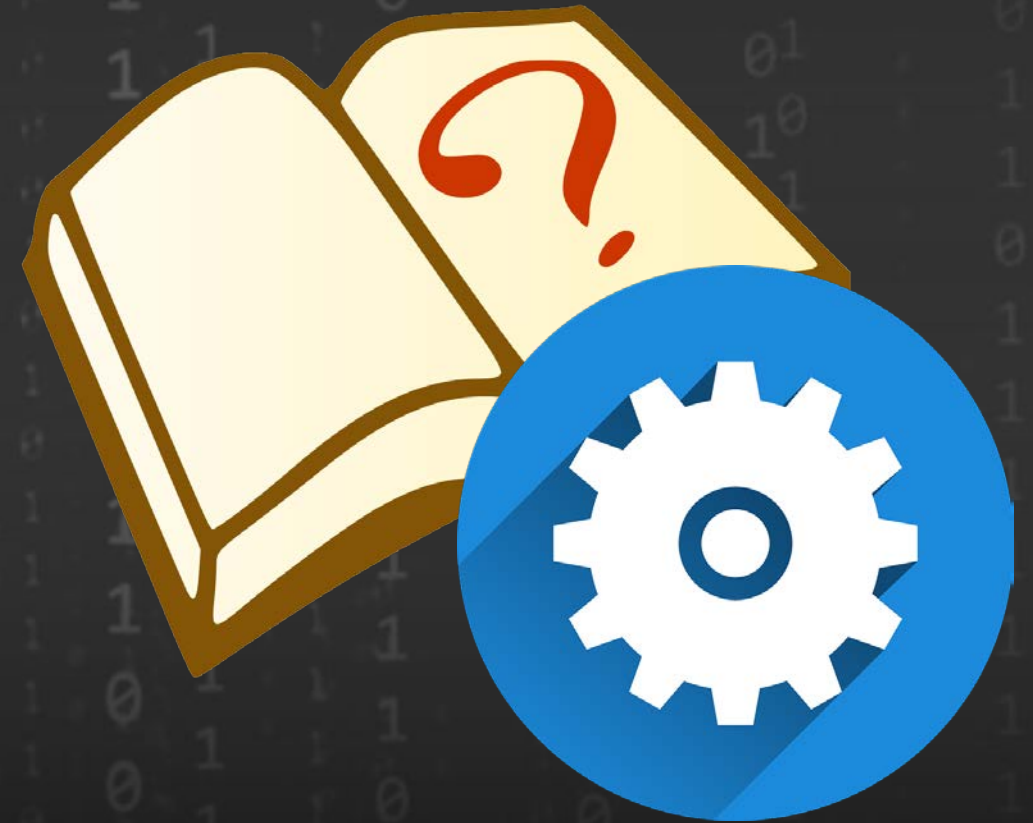
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Lesson Objective

- ✿ Using PCDs to Configure DebugLib - LAB
- ✿ Change the DebugLib instance to modify the debug output - LAB
- ✿ Debug EDK II using VS Debugger - LAB

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 to next slide if Lab Writing UEFI App Lab completed ([Lab Guide](#))

- Perform Lab Setup from previous Labs ([Lab Guide](#))
- 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>
```

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:

[LabGuide.md Slide](#) for Copy and paste

```
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

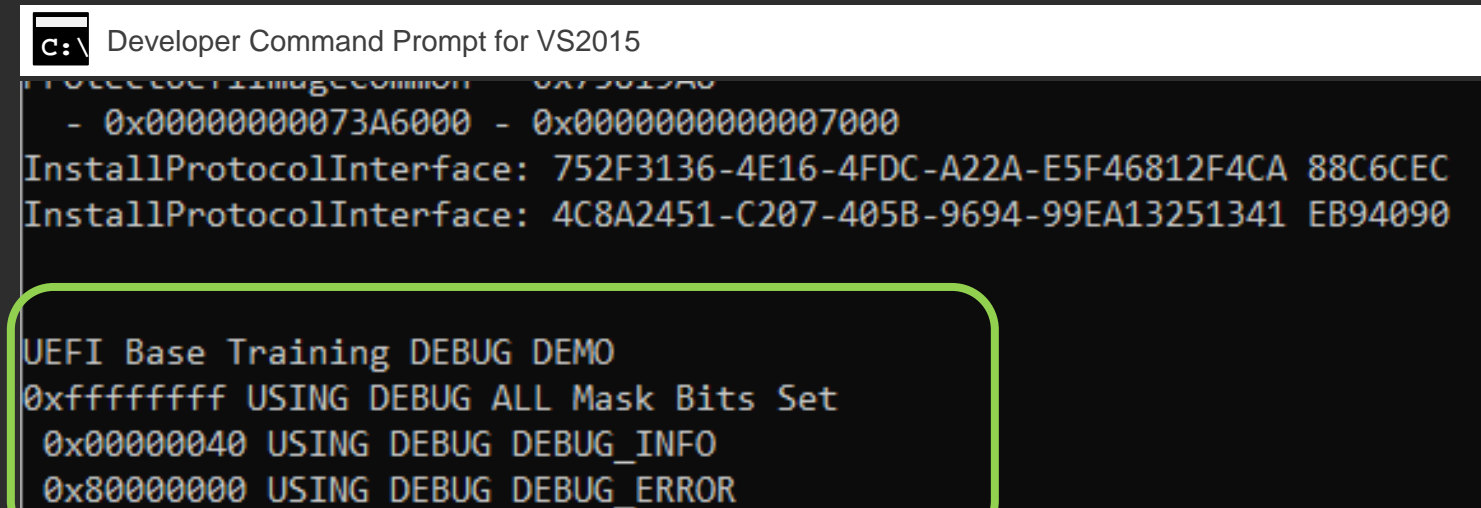
```
Shell> SampleApp
```

Check the VS Debug output

Exit

```
Shell> Reset
```

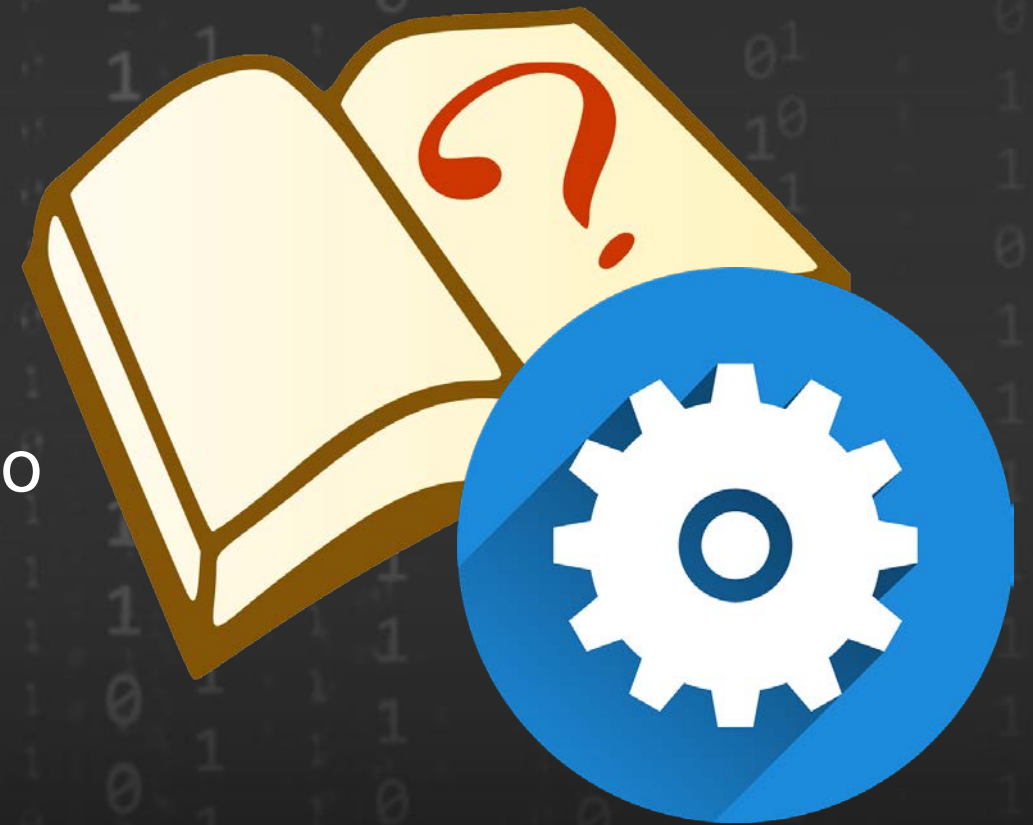
Visual Studio command prompt window output



```
c:\> Developer Command Prompt for VS2015  
UEFI Base Training DEBUG DEMO  
0xffffffff USING DEBUG ALL Mask Bits Set  
0x00000040 USING DEBUG DEBUG_INFO  
0x80000000 USING DEBUG DEBUG_ERROR
```

Lab 2 – Changing PCD Value

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



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

[LabGuide.md Slide](#) for Copy and paste

Lab 2: Build, Run and Test Result

At the VS Command Prompt

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

Run the application from the shell

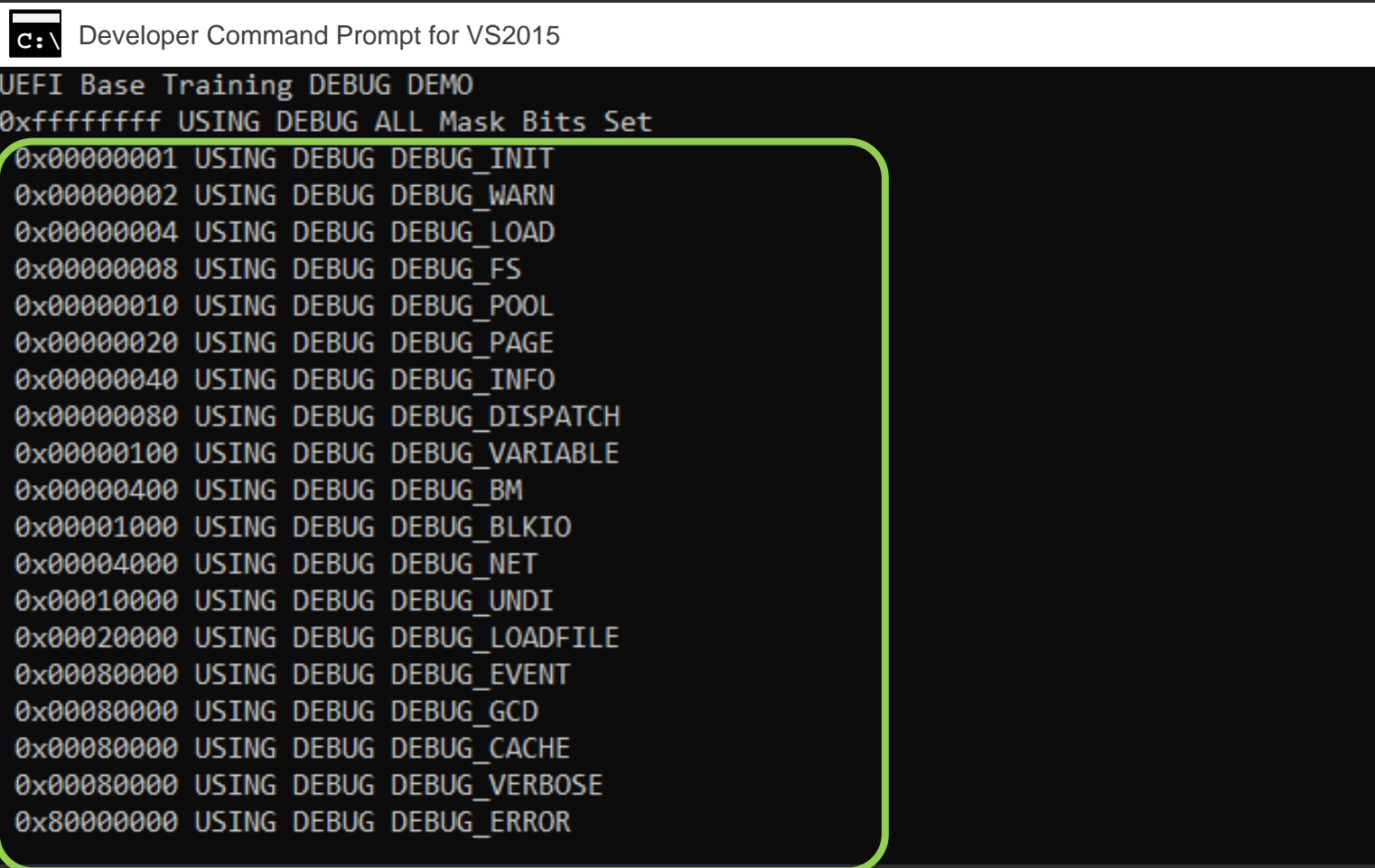
```
Shell> SampleApp
```

Check the VS Debug output

Exit

```
Shell> Reset
```

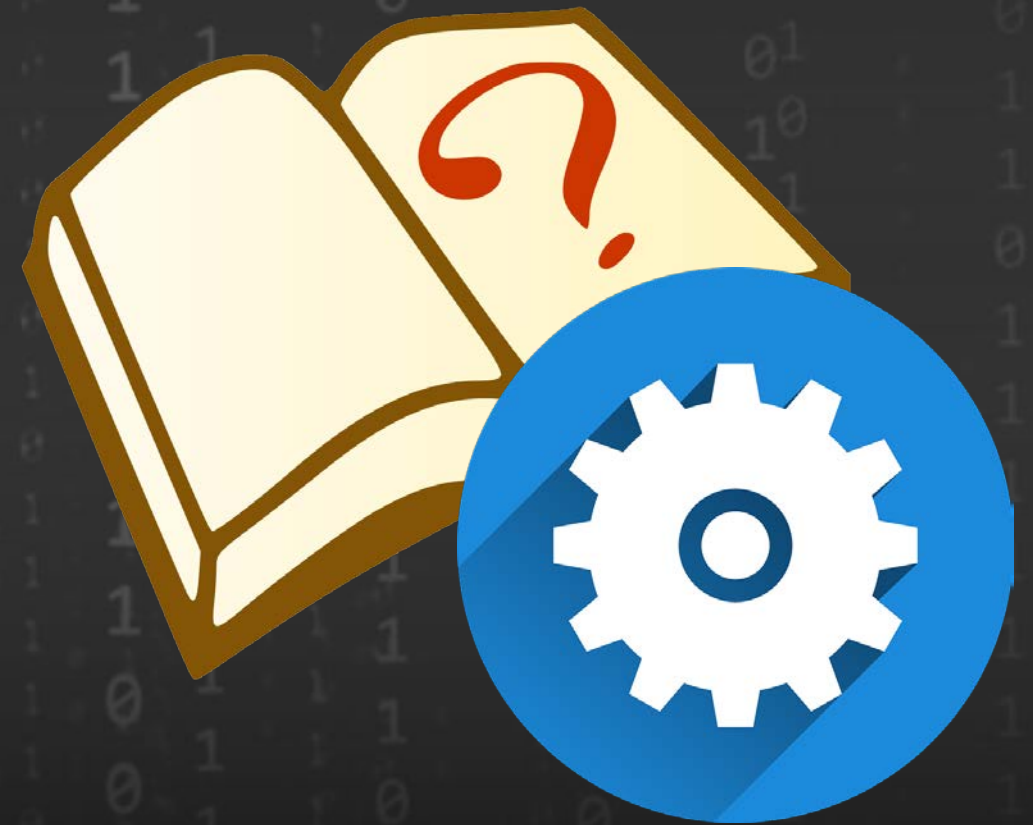
Visual Studio command prompt window output



```
C:\> Developer Command Prompt for VS2015  
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
```

Lab 3 – Library Instances for Debugging

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



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

[LabGuide.md Slide](#) for Copy and paste

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
```

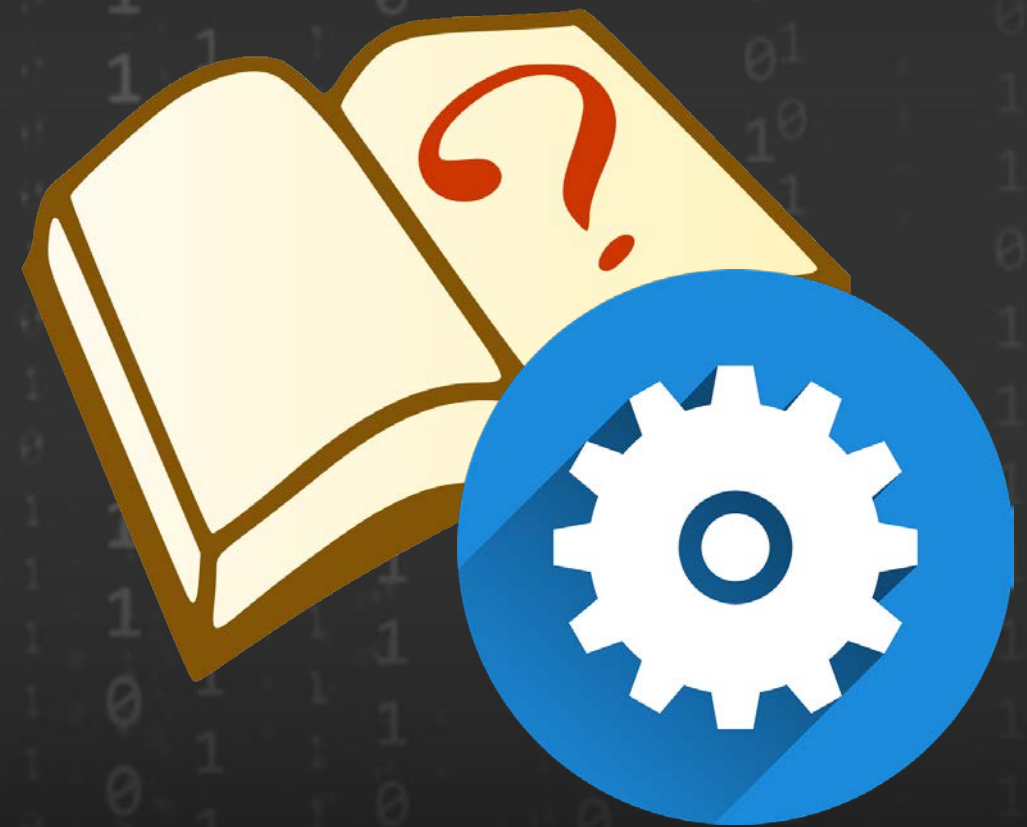
```
UEFI Base Training DEBUG DEMO  
0xffffffff USING DEBUG ALL Mask Bits Set  
0x00000040 USING DEBUG DEBUG_INFO  
0x80000000 USING DEBUG DEBUG_ERROR  
System Table: 0xB7A7C018
```

```
Press any Key to continue :
```

EmulatorPkg

Lab 4: Null Instance of DebugLib

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



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

[LabGuide.md Slide](#) for Copy and paste

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

```
c:\ Developer Command Prompt for VS2015  
Loading driver at 0x0000618A000 EntryPoint=0x000001C1090 SampleApp.efi  
InstallProtocolInterface: BC62157E-3E33-4FEC-9920-2D3B36D750DF 62AF410  
ProtectUefiImageCommon - 0x62AF128  
- 0x0000000000618A000 - 0x00000000000006000  
InstallProtocolInterface: 752F3136-4E16-4FDC-A22A-E5F46812F4CA 7534CEC
```

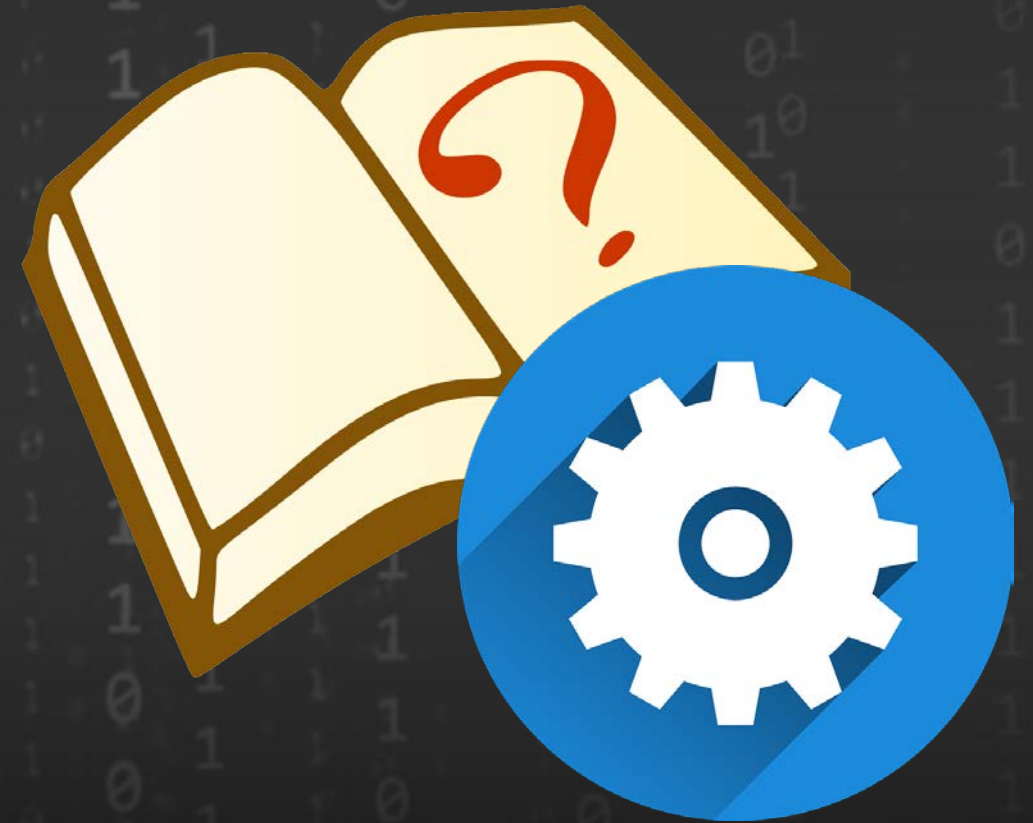
Console window – NO DEBUG

```
Shell> sampleapp  
System Table: 0x074CF010  
  
Press any Key to continue :  
  
Enter text. Include a dot ('.') in a sentence then <Enter> to ex
```

Lab 5: Debugging EDK II with VS Debugger

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

First make sure you have “Just-in-Time” Debugging enabled in the Visual Studio Application [Link](#)



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);
```

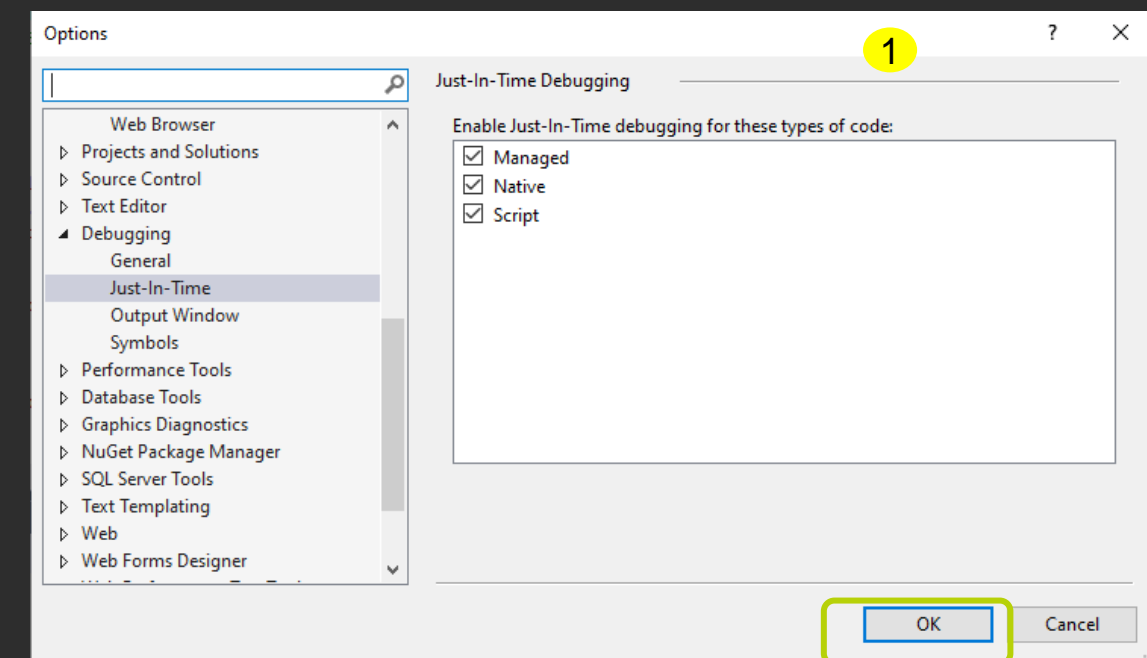
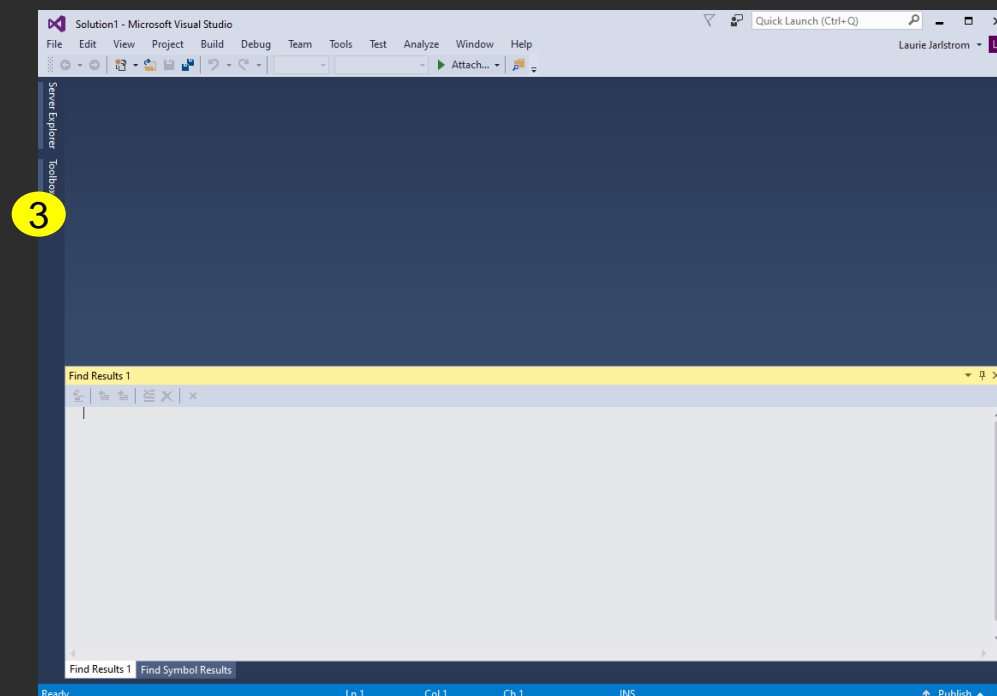
```
EFI_STATUS Status;  
Status = EFI_NO_RESPONSE; // or any EFI Error  
  
DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));  
DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));  
  
ASSERT_EFI_ERROR(Status);
```

Save SampleApp.c

[LabGuide.md Slide](#) for Copy and paste

First Enable Visual Studio Debugging

1. First make sure you have “Just-in-Time” Debugging enabled in the Visual Studio Application [Link](#) (note: need to open as Admin)
2. Use the Regedt32 to add the “Auto” key: [Link](#)
3. Next Open the Visual Studio Application



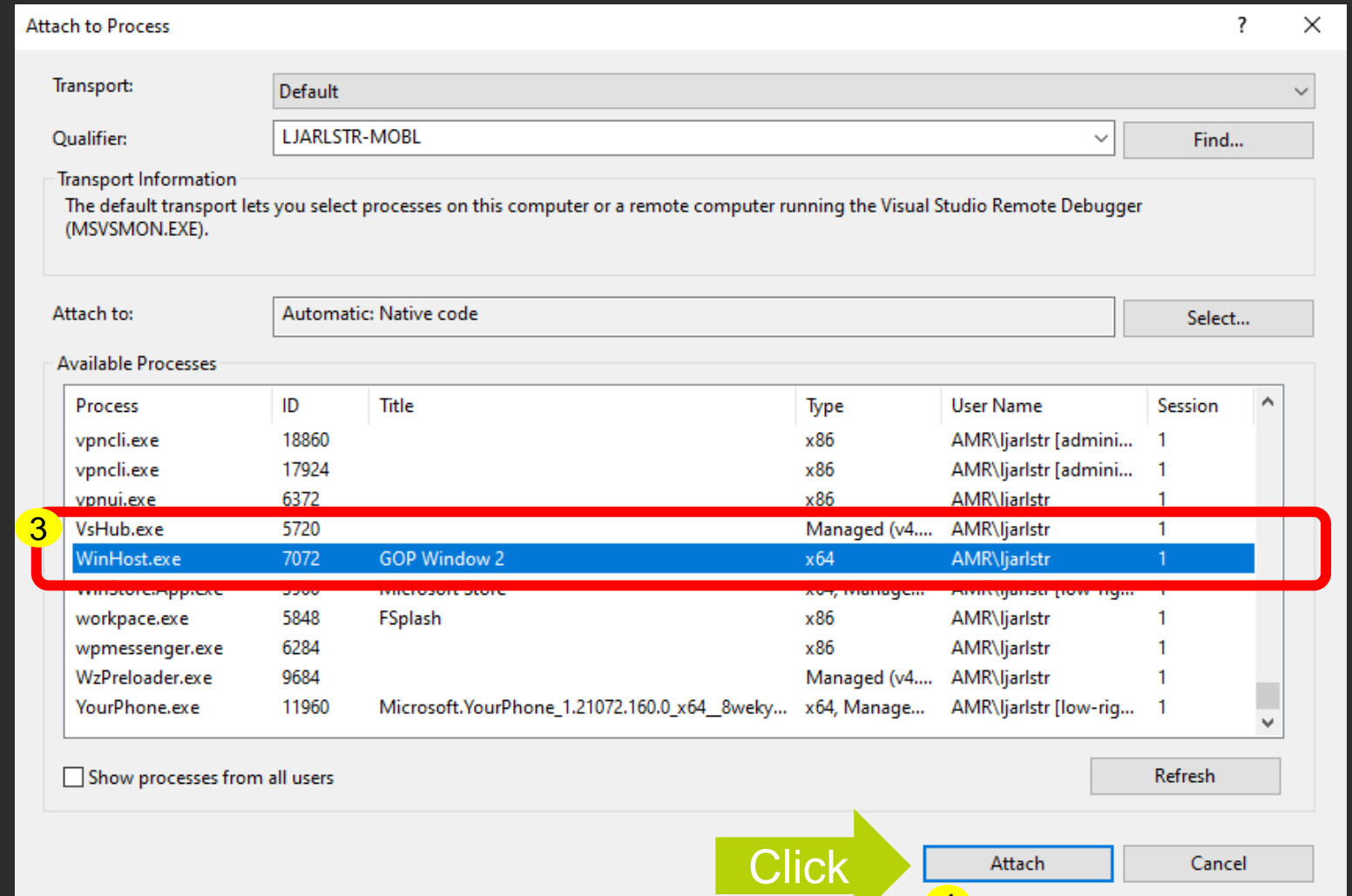
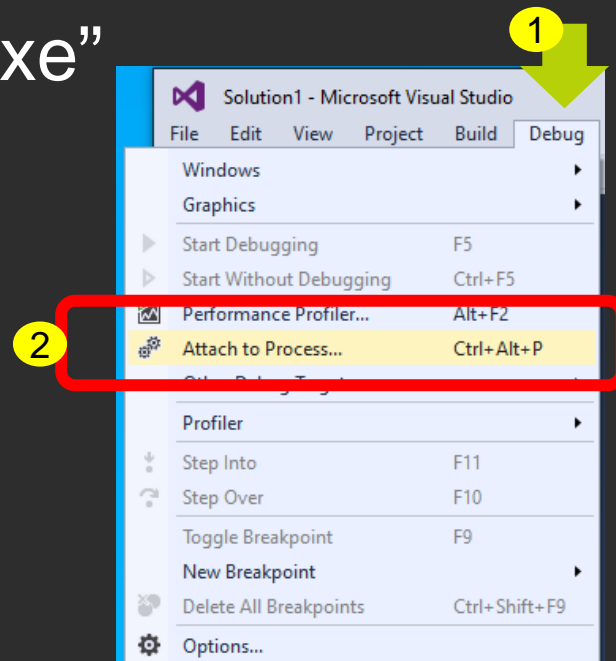
Lab 5: Debug with VS - ASSERT

At the VS Command Prompt

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

Inside the Visual Studio app, Enable the Winhost.exe for Debugging

1. Select "Debug"
2. "Attach to Process"
3. Find "WinHost.exe"
4. Click "Attach"



Lab 5: Debug with VS - ASSERT

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

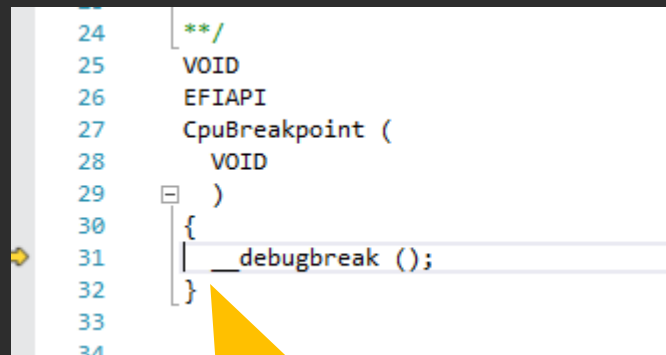
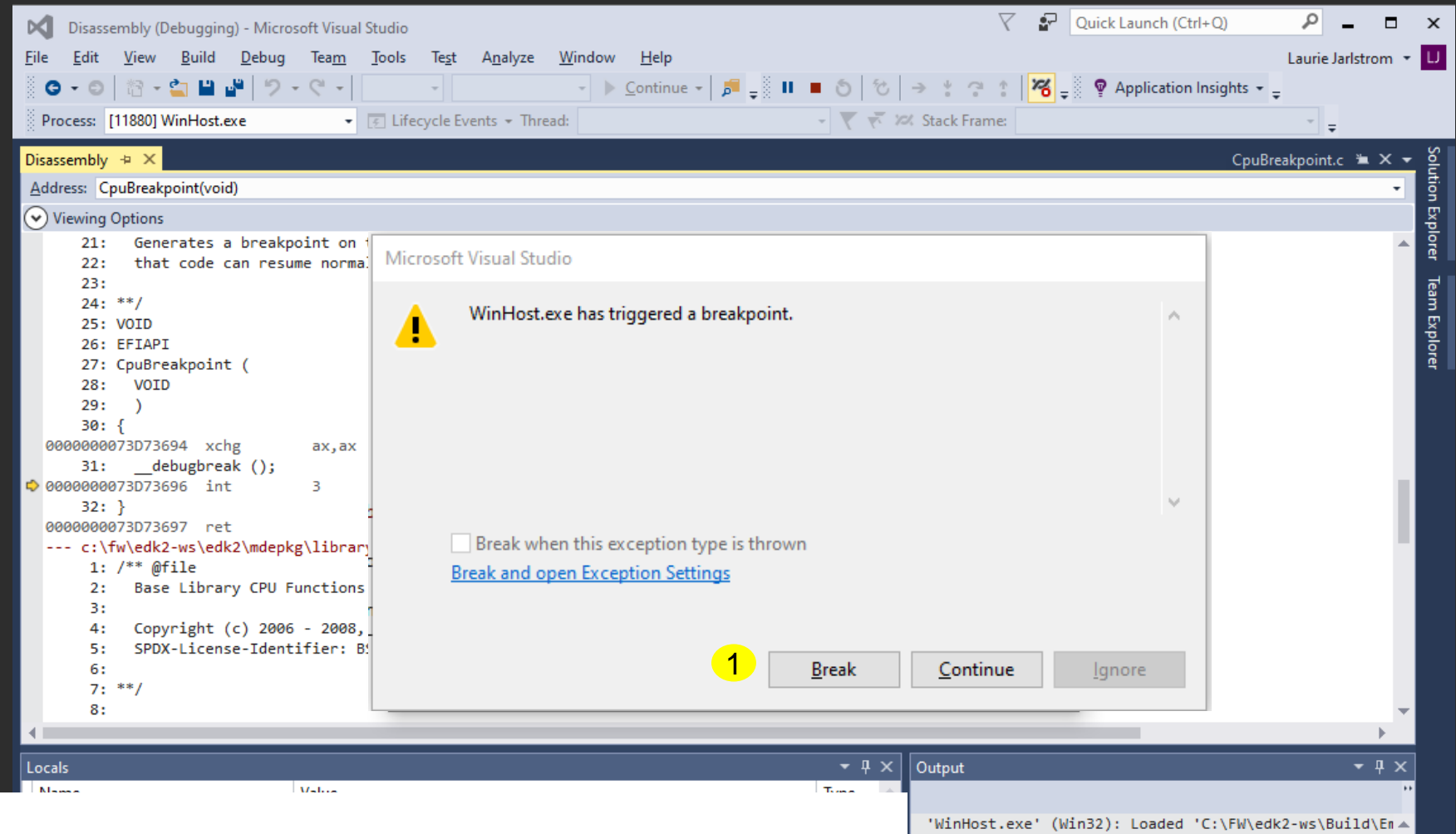
ASSERT_EFI_ERROR (Status = No Response)
DXE_ASSERT!: [SampleApp] c:\fw\edk2-ws\edk2\SampleApp\SampleApp.c (51): !EFI_ERROR (Status)
```

Lab 5: Debug with VS - ASSERT

Windows* VS Debugger

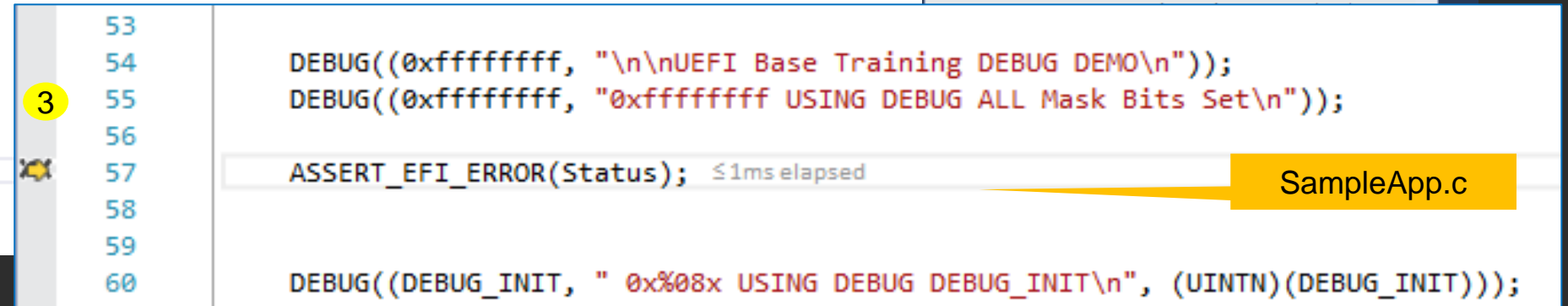
1. Select "Break"
2. "F10" about 2 times
3. SampleApp.c can be debugged

"F5" to continue
"Shift F5" to Stop
debugging



2

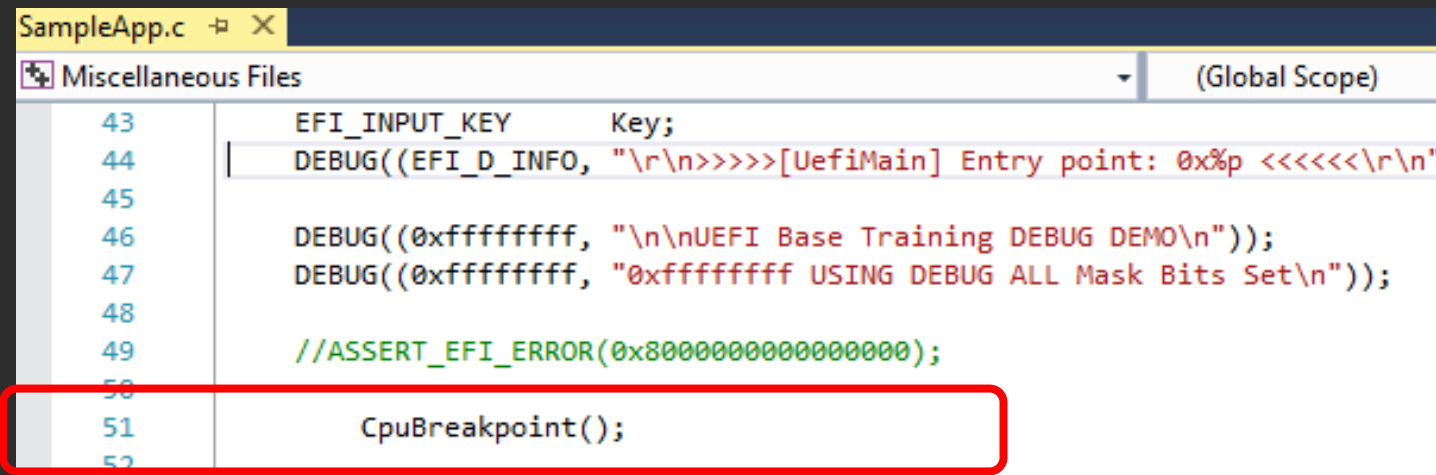
"F10" - Step over 2-3 times



Lab 5: Debug with VS - CpuBreakpoint

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

CpuBreakpoint();



```
SampleApp.c  X
Miscellaneous Files  (Global Scope)
43     EFI_INPUT_KEY    Key;
44     DEBUG((EFI_D_INFO, "\r\n>>>>>[UefiMain] Entry point: 0x%p <<<<<\r\n"
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
```

Save SampleApp.c

[LabGuide.md Slide](#) for Copy and paste

Lab 5: Debug with VS

At the VS Command Prompt

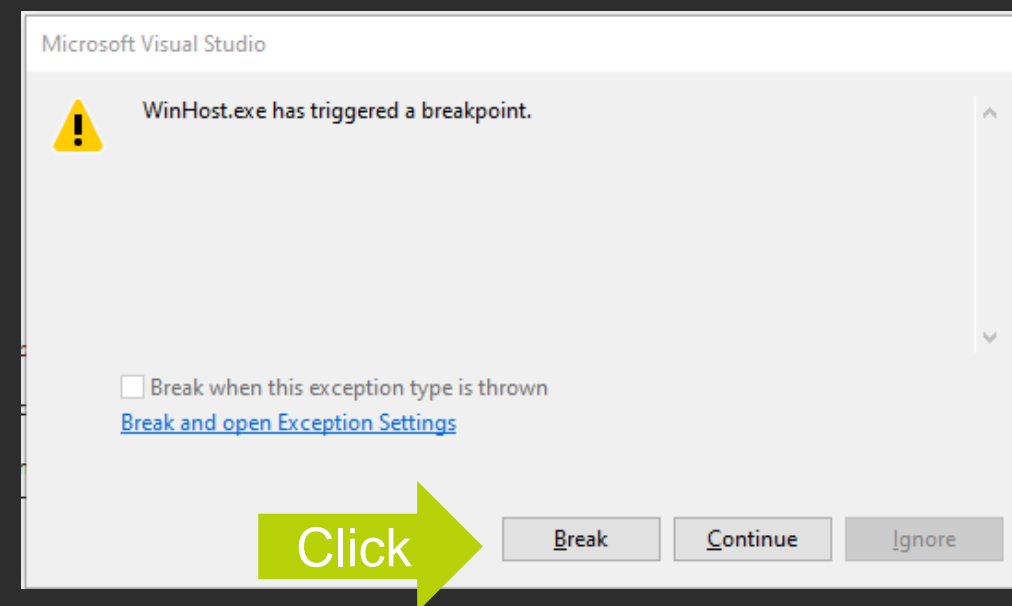
```
$> Build  
$> RunEmulator.bat
```

Inside the Visual Studio App, Enable the Winhost.exe for Debugging.
“Cnt-Alt-p” then select “Winhost.exe”

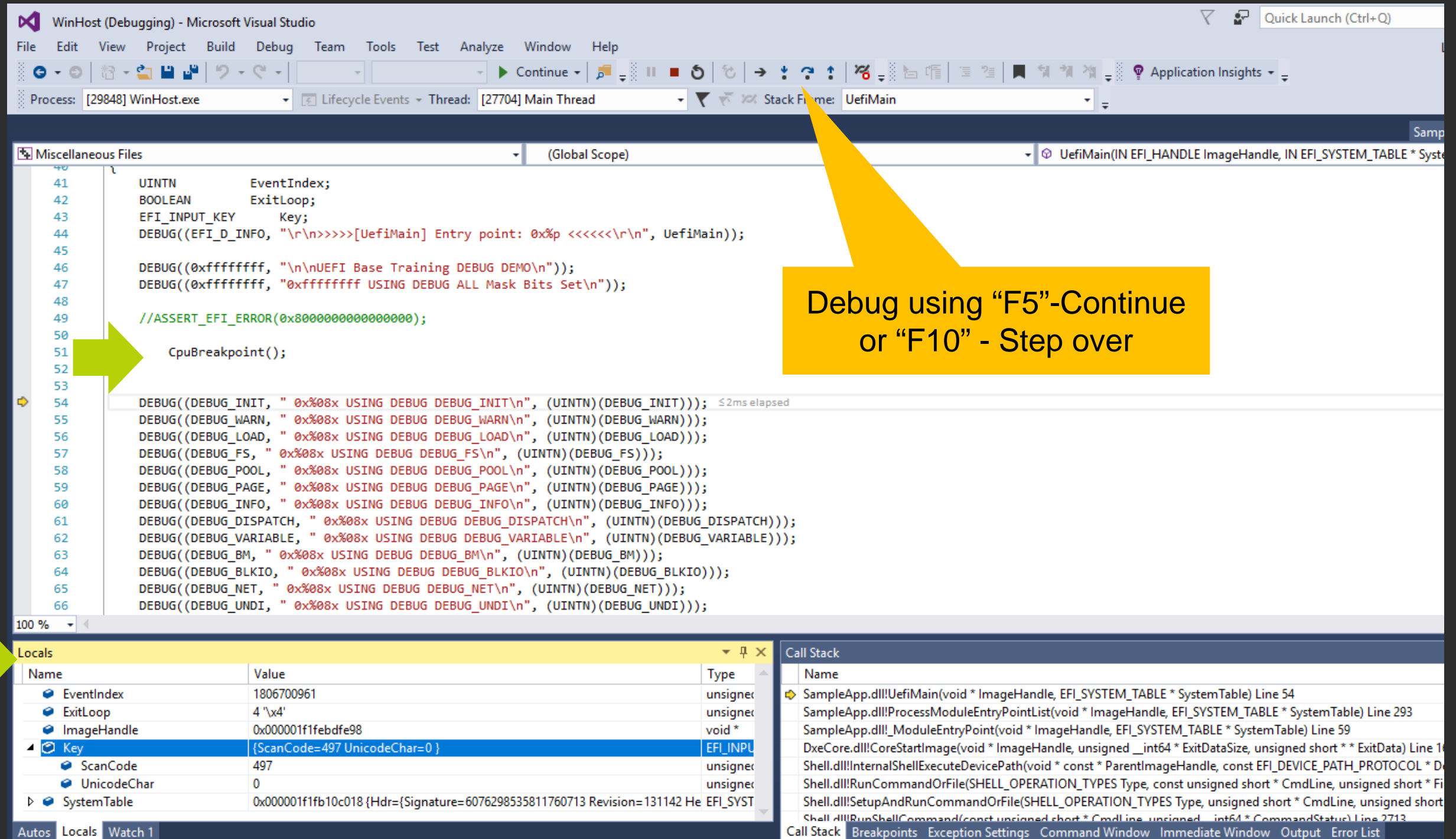
Run the application from the shell

```
Shell> SampleApp
```

VS Debugger pop up, select “Break”
Press “F10” until SampleApp.c shows



Invoke Windows Visual Studio Debugger



WinHost (Debugging) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

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

Miscellaneous Files (Global Scope) UefiMain(IN EFI_HANDLE ImageHandle, IN EFI_SYSTEM_TABLE * SystemTable)

```

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)));
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)));

```

100 %

Locals

| Name | Value | Type |
|-------------|--|------------------|
| EventIndex | 1806700961 | unsigned int |
| ExitLoop | 4 '\x4' | unsigned char |
| ImageHandle | 0x000001f1febdfe98 | void * |
| Key | {ScanCode=497 UnicodeChar=0} | EFI_INPUT_KEY |
| ScanCode | 497 | unsigned short |
| UnicodeChar | 0 | unsigned char |
| SystemTable | 0x000001f1fb10c018 {Hdr={Signature=6076298535811760713 Revision=131142 He EFI_SYST | EFI_SYSTEM_TABLE |

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 14 |
| Shell.dll!InternalShellExecuteDevicePath(void * const * ParentImageHandle, const EFI_DEVICE_PATH_PROTOCOL * DevicePath) Line 14 |
| Shell.dll!RunCommandOrFile(SHELL_OPERATION_TYPES Type, const unsigned short * CmdLine, unsigned short * File) Line 14 |
| Shell.dll!SetupAndRunCommandOrFile(SHELL_OPERATION_TYPES Type, unsigned short * CmdLine, unsigned short * File) Line 14 |
| Shell.dll!RunShellCommand(const unsigned short * CmdLine, unsigned __int64 * CommandStatus) Line 2713 |

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

Summary

- ✿ Using PCDs to Configure DebugLib - LAB
- ✿ Change the DebugLib instance to modify the debug output - LAB
- ✿ Debug EDK II using VS Debugger - LAB

Questions?



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BACK UP

Debugging in Emulator with Windows 7/10 64Bit and Visual Studio does not work?

Symptom: With Windows 7/10 64bit 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"