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UEFI & EDK II TRAINING

UEFI SHELL LAB w/ WINDOWS EMULATION

See also Lab_Guide.md for Copy & Paste examples in labs

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Lesson Objective

- Run UEFI Shell (Windows Emulation)
- Run UEFI Shell Commands
- Run UEFI Shell Scripts

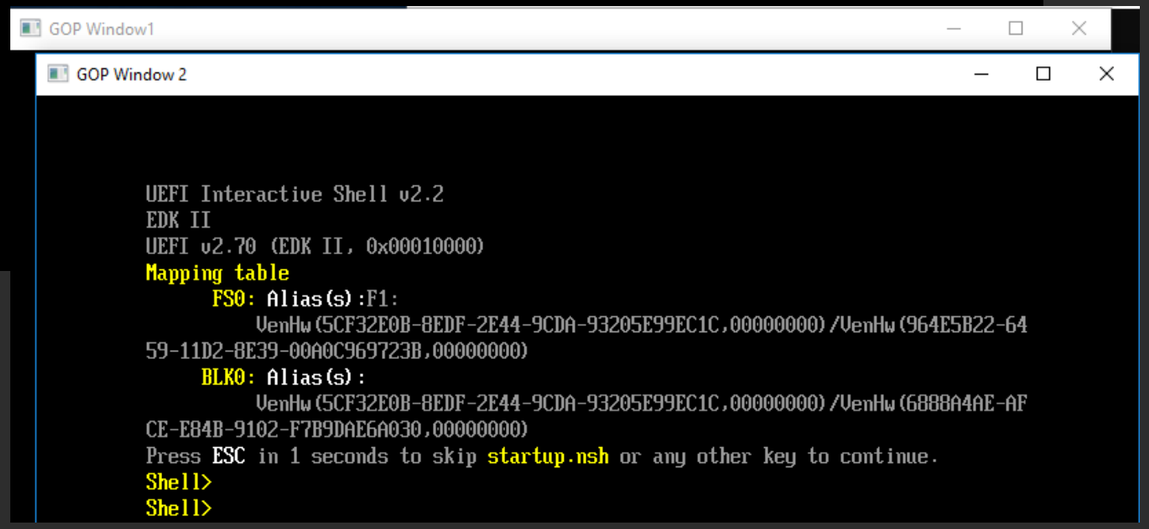
UEFI SHELL LAB WITH WIN EMULATOR

Invoke Win Emulation

First Setup for Building EDK II for EmulatorPkg, See Lab Setup

From the VS command prompt

```
CD C:\FW\edk2-ws
# set up PACKAGES_PATH
$> set WORKSPACE=%CD%
$> set PACKAGES_PATH=%WORKSPACE%\edk2;%WORKSPACE%\edk2-libc
$> cd edk2
$> edksetup Rebuild
$> Build -a X64
$> RunEmulator.bat
```



UEFI SHELL COMMANDS

Commands from the Command Line Interface

Common Shell Commands for Debugging

```
help
mm
mem
memmap
drivers
devices
devtree
dh
Load
Dmpstore
pci
stall
```

"**-b**" is the command line parameter for breaking after each page.

Shell Help

```
Shell> help -b
```

GOP Window 2

```
acpiview      - Display ACPI Table information.
alias         - Displays, creates, or deletes UEFI Shell aliases.
attrib        - Displays or modifies the attributes of files or directories.
bcfg          - Manages the boot and driver options that are stored in NVRAM.
cd            - Displays or changes the current directory.
cls           - Clears the console output and optionally changes the background
and foreground color.
comp          - Compares the contents of two files on a byte-for-byte basis.
connect       - Binds a driver to a specific device and starts the driver.
cp            - Copies one or more files or directories to another location.
date          - Displays and sets the current date for the system.
dblk          - Displays one or more blocks from a block device.
devices       - Displays the list of devices managed by UEFI drivers.
devtree       - Displays the UEFI Driver Model compliant device tree.
dh            - Displays the device handles in the UEFI environment.
disconnect    - Disconnects one or more drivers from the specified devices.
dmem          - Displays the contents of system or device memory.
dmpstore      - Manages all UEFI variables.
drivers       - Displays the UEFI driver list.
drvcfg        - Invokes the driver configuration.
drvdiag       - Invokes the Driver Diagnostics Protocol.
echo          - Controls script file command echoing or displays a message.
edit          - Provides a full screen text editor for ASCII or UCS-2 files.
eficompress   - Compresses a file using UEFI Compression Algorithm.
Press ENTER to continue or 'Q' break:_
```

Shell “memmap”

```
Shell> memmap
```

Displays the memory map maintained by the UEFI environment

```
RT_Data    000002B208574000-000002B208574FFF 0000000000000001 800000000000000F
BS_Data    000002B208575000-000002B20859CFFF 0000000000000028 000000000000000F
RT_Data    000002B20859D000-000002B20859FFFF 0000000000000003 800000000000000F
MMIO       000002B200580000-000002B20058BFFF 000000000000000C 8000000000000001

  Reserved  :              0 Pages (0 Bytes)
  LoaderCode:            307 Pages (1,257,472 Bytes)
  LoaderData:              0 Pages (0 Bytes)
  BS_Code   :          1,239 Pages (5,074,944 Bytes)
  BS_Data   :          5,936 Pages (24,313,856 Bytes)
  RT_Code   :             97 Pages (397,312 Bytes)
  RT_Data   :            193 Pages (790,528 Bytes)
  ACPI_Recl :              0 Pages (0 Bytes)
  ACPI_NVS  :              0 Pages (0 Bytes)
  MMIO      :             12 Pages (49,152 Bytes)
  MMIO_Port :              0 Pages (0 Bytes)
  PalCode   :              0 Pages (0 Bytes)
  Available :         24,996 Pages (102,383,616 Bytes)
  Persistent:              0 Pages (0 Bytes)
             --------------
Total Memory:            128 MB (134,217,728 Bytes)
Shell> _
```

Shell “mm”

```
Shell> mm -? -b
```

Help for “mm” command shows options for different types of memory and I/O that can be modified

GOP Window1

```
Displays or modifies MEM/MMIO/IO/PCI/PCIE address space.

MM Address [Value] [-w 1|2|4|8] [-MEM | -MMIO | -IO | -PCI | -PCIE] [-n]

  Address - Starting address in hexadecimal format.
  Value   - The value to write in hexadecimal format.
  -MEM    - Memory Address type
  -MMIO   - Memory Mapped IO Address type
  -IO     - IO Address type
  -PCI    - PCI Configuration Space Address type:
            Address format: ssssbbddffrr
              ssss - Segment
              bb   - Bus
              dd   - Device
              ff   - Function
              rr   - Register
  -PCIE   - PCIE Configuration Space Address type:
            Address format: ssssbbddffrrr
              ssss - Segment
              bb   - Bus
              dd   - Device
              ff   - Function
              rrr  - Register
  -w      - Unit size accessed in bytes:
Press ENTER to continue or 'Q' break:_
```

Shell “mm”

```
Shell> mm **
```

```
Shell> mm 2b208575000
MEM  0x000002B208575000 : 0x70 >

MEM  0x000002B208575001 : 0x68 >

MEM  0x000002B208575002 : 0x64 >

MEM  0x000002B208575003 : 0x30 >

MEM  0x000002B208575004 : 0x01 >

MEM  0x000002B208575005 : 0x00 >

MEM  0x000002B208575006 : 0x00 > q

Shell> _
```

**Pick a location from the MemMap command on Previous slide

```
BS_Data    000002B208575000-000002B20859CFFF 0000000000000028 00000
```

MM in can display / modify any location

Do **not** try in Win Emulator

```
Shell> mm 0000
```

“q” to quit

Shell “mem”

```
Shell> mem
```

Displays the contents of the system or device memory

without arguments, displays the system memory configuration.

```
  061EC170: AF AF AF AF AF AF AF AF-AF AF AF AF AF AF AF AF  *................*
  061EC180: AF AF AF AF AF AF AF AF-AF AF AF AF AF AF AF AF  *................*

Valid EFI Header at Address 00000000061EBF90
-------------------------------------------
System: Table Structure size 00000048 revision 0002001F
ConIn (000000000A3271F4) ConOut (0000000005373114) StdErr (000000000A3273A4)
Runtime Services 00000000061EBF10
Boot Services    0000000000415C40
SAL System Table 0000000000000000
ACPI Table       0000000000000000
ACPI 2.0 Table   0000000000000000
MPS Table        0000000000000000
SMBIOS Table     000000000622F000
Shell> _
```

UEFI System Table Pointer

Shell “Drivers”

```
Shell> drivers -b
```

```
                T   D
D               Y C I
R               P F A
V  VERSION      E G G #D #C DRIVER NAME                          IMAGE NAME
== ======== = = = == == ==================================== ==========
47 0000000A D - -  2  - Platform Console Management Driver  ConPlatformDxe
48 0000000A D - -  2  - Platform Console Management Driver  ConPlatformDxe
49 0000000A B - -  2  2 Console Splitter Driver             ConSplitterDxe
4A 0000000A B - -  2  2 Console Splitter Driver             ConSplitterDxe
4B 0000000A ? - -  -  - Console Splitter Driver             ConSplitterDxe
4C 0000000A B - -  2  2 Console Splitter Driver             ConSplitterDxe
4D 0000000A ? - -  -  - Console Splitter Driver             ConSplitterDxe
51 0000000A D - -  2  - Graphics Console Driver             GraphicsConsoleDxe
52 0000000A B - -  1  1 Serial Terminal Driver              TerminalDxe
53 0000000A D - -  1  - Generic Disk I/O Driver             DiskIoDxe
54 0000000B ? - -  -  - Partition Driver(MBR/GPT/El Torito) PartitionDxe
57 0000000A ? - -  -  - PCI Bus Driver                      PciBusDxe
59 0000000A ? - -  -  - SCSI Bus Driver                     ScsiBus
5A 0000000A ? - -  -  - Scsi Disk Driver                    ScsiDisk
5B 0000000A B - -  1  4 Emu Bus Driver                      EmuBusDriver
5C 0000000A D - -  2  - Emulator GOP Driver                 EmuGopDxe
5D 0000000A D - -  1  - Emu Simple File System Driver       EmuSimpleFileSystem
5E 0000000A D - X  1  - Emu Block I/O Driver                EmuBlockIo
Press ENTER to continue or 'Q' break:_
```

Displays the UEFI driver list.

To get a description of teach section in the list, Use:

```
Shell>
```

Shell “Devices”

```
Shell> devices -b
```

Displays a list of devices that UEFI drivers manage.

```
Shell> devices
     T   D
     Y C I
     P F A
CTRL E G G #P #D #C  Device Name
==== = = = == == ===  ==========================================================
  1C R - -  0  1   5 VenHw(5CF32E0B-8EDF-2E44-9CDA-93205E99EC1C,00000000)
  20 R - -  0  1   1 VenHw(D3987D4B-971A-435F-8CAF-4967EB627241)/Uart(115200,8,N
,1)
  4E D - -  2  0   0 Primary Console Input Device
  4F D - -  2  0   0 Primary Console Output Device
  6F B - -  1  7   2 GOP Window 1
  70 B - -  1  7   2 GOP Window 2
  71 D - -  1  1   0 .
  72 D - X  1  2   0 disk.dmg:FW
  73 D - -  1  1   0 VenHw(5CF32E0B-8EDF-2E44-9CDA-93205E99EC1C,00000000)/VenHw(
FD5FBE54-8C35-B345-8A0F-7AC8A5FD0521,00000000)
  74 D - -  1  0   0 VT-100 Serial Console
Shell> _
```

For the Windows Emulation there is not that many devices

Shell “Devtree”

```
Shell> devtree -b
```

Displays tree of devices currently managed by UEFI drivers.

```
 Ctrl[04] MemoryMapped(0xB,0x1A3F5300000,0x1A3F531FFFF)
 Ctrl[13] MemoryMapped(0xB,0x1A3F4D80000,0x1A3F52FFFFF)
 Ctrl[1C] VenHw(5CF32E0B-8EDF-2E44-9CDA-93205E99EC1C,00000000)
   Ctrl[6F] GOP Window 1
     Ctrl[4E] Primary Console Input Device
     Ctrl[4F] Primary Console Output Device
   Ctrl[70] GOP Window 2
     Ctrl[4E] Primary Console Input Device
     Ctrl[4F] Primary Console Output Device
   Ctrl[71] .
   Ctrl[72] disk.dmg:FW
   Ctrl[73] VenHw(5CF32E0B-8EDF-2E44-9CDA-93205E99EC1C,00000000)/VenHw(FD5FBE54-
8C35-B345-8A0F-7AC8A5FD0521,00000000)
 Ctrl[20] VenHw(D3987D4B-971A-435F-8CAF-4967EB627241)/Uart(115200,8,N,1)
   Ctrl[74] VT-100 Serial Console
 Ctrl[2A] Fv(6D99E806-3D38-42C2-A095-5F4300BFD7DC)/FvFile(462CAA21-7614-4503-836
E-8AB6F4662331)/Enter Setup
 Ctrl[2B] Fv(6D99E806-3D38-42C2-A095-5F4300BFD7DC)/FvFile(EEC25BDC-67F2-4D95-B1D
5-F81B2039D11D)/BootManagerMenuApp
 Ctrl[2C] Fv(6D99E806-3D38-42C2-A095-5F4300BFD7DC)/FvFile(7C04A583-9E3E-4F1C-AD6
5-E05268D0B4D1)/Shell
 Ctrl[6D] VenHw(A04A27F4-DF00-4D42-B552-39511302113D)
 Ctrl[6E] VenHw(B3F56470-6141-4621-8F19-704E577AA9E8)
Press ENTER to continue or 'Q' break:
Shell> _
```

Shell Handle Database - “Dh”

```
Shell> dh -b
```

Dump Handle - Displays the device handles associated with UEFI drivers

```
Shell> dh -b
Handle dump
01: LoadedImage(DxeCore)
02: Decompress
03: FirmwareVolume2 DevicePath(..3D38-42C2-A095-5F4300BFD7DC)) FirmwareVolumeBlo
ck
04: DevicePath(..0x1A3F5300000,0x1A3F531FFFF)) FirmwareVolumeBlock
05: FC1BCDB0-7D31-49AA-936A-A4600D9DD083 EE4E5898-3914-4259-9D6E-DC7BD79403CF
06: ImageDevicePath(..87AB-47F9-A3FE-D50B76D89541)) LoadedImage(PcdDxe)
07: GetPcdInfo GetPcdInfoProtocol Pcd Pcd
08: ImageDevicePath(..A563-4561-B858-D8476F9DEFC4)) LoadedImage(Metronome)
09: MetronomeArch
0A: ImageDevicePath(..A7EB-4730-8C8E-CC466A9ECC3C)) LoadedImage(ReportStatusCode
RouterRuntimeDxe)
0B: SmartCardReader RscHandler
0C: ImageDevicePath(..8985-11DB-8429-0040D02B1835)) LoadedImage(RealTimeClock)
0D: RealTimeClockArch
0E: ImageDevicePath(..37AD-8743-BCF2-DF1A8FF12FAB)) LoadedImage(EmuReset)
0F: ResetArch
10: ImageDevicePath(..43B7-4784-95B1-F4226CB40CEE)) LoadedImage(RuntimeDxe)
11: RuntimeArch
12: ImageDevicePath(..96E8-2A4C-95F4-85248F989753)) LoadedImage(FwBlockService)

13: FirmwareVolume2 DevicePath(..0x1A3F4D80000,0x1A3F52FFFFF)) FirmwareVolumeBlP
ress ENTER to continue or 'Q' break:_
```

Also try dh -d
with handle number
to get more information
on that handle.

Shell “Load”

```
Shell> load -?
```

Loads a UEFI driver into memory

```
Shell> load -? -b
Loads a UEFI driver into memory.

LOAD [-nc] file [file...]

  -nc  - Loads the driver, but does not connect the driver.
  File - Specifies a file that contains the image of the UEFI driver (wildcards
are
         permitted).

NOTES:
  1. This command loads a driver into memory. It can load multiple files at
     one time. The file name supports wildcards.
  2. If the -nc flag is not specified, this command attempts to connect the
     driver to a proper device. It might also cause previously loaded drivers
     to be connected to their corresponding devices.
  3. Use the 'UNLOAD' command to unload a driver.

EXAMPLES:
  * To load a driver:
```

Shell “dmpstore”

```
Shell> dmpstore –all -b
```

Display the contents of the NVRAM variables

```
Shell> dmpstore -all -b
Variable NV+RT+BS 'EB704011-1402-11D3-8E77-00A0C969723B:MTC' DataSize = 0x04
  00000000: 03 00 00 00                                      *....*
Variable NV+RT+BS 'EFIGlobalVariable:BootOrder' DataSize = 0x0C
  00000000: 05 00 01 00 02 00 03 00-04 00 00 00              *............*
Variable NV+RT+BS 'EFIGlobalVariable:Boot0005' DataSize = 0x68
  00000000: 01 00 00 00 3C 00 55 00-45 00 46 00 49 00 20 00  *....<.U.E.F.I. .*
  00000010: 53 00 68 00 65 00 6C 00-6C 00 00 00 04 07 14 00  *S.h.e.l.l.......*
  00000020: 06 E8 99 6D 38 3D C2 42-A0 95 5F 43 00 BF D7 DC  *...m8=.B.._C....*
  00000030: 04 06 14 00 83 A5 04 7C-3E 9E 1C 4F AD 65 E0 52  *.......|>..O.e.R*
  00000040: 68 D0 B4 D1 04 04 10 00-53 00 68 00 65 00 6C 00  *h.......S.h.e.l.*
  00000050: 6C 00 00 00 7F FF 04 00-4E AC 08 81 11 9F 59 4D  *l.......N.....YM*
  00000060: 85 0E E2 1A 52 2C 59 B2-                         *....R,Y.*
Variable NV+RT+BS 'EFIGlobalVariable:Boot0004' DataSize = 0x9C
  00000000: 01 00 00 00 56 00 55 00-45 00 46 00 49 00 20 00  *....V.U.E.F.I. .*
  00000010: 42 00 6F 00 6F 00 74 00-4D 00 61 00 6E 00 61 00  *B.o.o.t.M.a.n.a.*
  00000020: 67 00 65 00 72 00 4D 00-65 00 6E 00 75 00 41 00  *g.e.r.M.e.n.u.A.*P
ress ENTER to continue or 'Q' break:_
```

Shell “pci”

```
Shell> pci -? -b
```

Display the help for the PCI command

```
Shell> pci -? -b
Displays PCI device list or PCI function configuration space and PCIe extended
configuration space.

PCI [Bus Dev [Func] [-s Seg] [-i [-ec ID]]]

  -s   - Specifies optional segment number (hexadecimal number).
  -i   - Displays interpreted information.
  -ec  - Displays detailed interpretation of specified PCIe extended capability
         ID (hexadecimal number).
  Bus  - Specifies a bus number (hexadecimal number).
  Dev  - Specifies a device number (hexadecimal number).
  Func - Specifies a function number (hexadecimal number).

NOTES:
  1. This command displays a list of all the PCI devices found in the system. It

     also displays the configuration space of a PCI device according to the
     specified bus (Bus), device (Dev), and function (Func) addresses. If the
     function address is not specified, it defaults to 0.
  2. The -i option displays verbose information for the specified PCI
     device. The PCI configuration space for the device is displayed with
     a detailed interpretation.
  3. If no parameters are specified, all PCI devices are listed.
Press ENTER to continue or 'Q' break:_
```

Shell “Stall”

```
Shell> stall 10000000
```

Stalls the operation for a specified number of microseconds

```
Shell> stall 10000000
Shell> _
```

UEFI SHELL SCRIPTS

Use Scripting with UEFI Shell

UEFI Shell Scripts

The UEFI Shell can execute commands from a file, which is called a batch script file (**.nsh** files).

Benefits: These files allow users to simplify routine or repetitive tasks.

- Perform basic flow control.
- Allow branching and looping in a script.
- Allow users to control input and output and call other batch programs (known as script nesting).

Writing UEFI Shell Scripts

At the shell prompt

```
Shell> fs0:
FS0:\> edit HelloScript.nsh
```

Type : `echo Hello World`

```
UEFI EDIT helloscript.nsh                    UNICODE
echo Hello World
```

Press “F2”
Enter
Press “F3” to exit

Help Menu - Shell

```
Help

Control Key   Function Key   Command
-----------   ------------   -----------------
Ctrl-G        F1             Go To Line
Ctrl-S        F2             Save File
Ctrl-Q        F3             Exit
Ctrl-F        F4             Search
Ctrl-R        F5             Search/Replace
Ctrl-K        F6             Cut Line
Ctrl-U        F7             Paste Line
Ctrl-O        F8             Open File
Ctrl-T        F9             File Type

Use Ctrl-W to exit this help
```

Hello World Script

In the shell, **type** HelloScript for the following result:

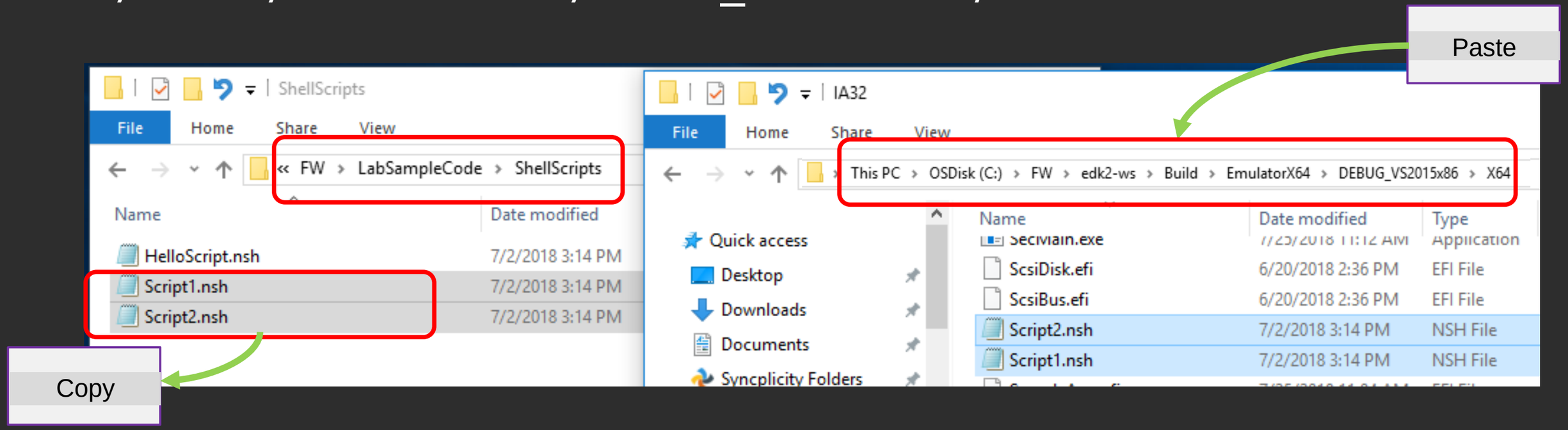
```
FS0:\> helloscript.nsh
FS0:\> echo Hello World
Hello World
FS0:\> _
```

Close the Win emulation, type: "`reset`"

```
FS0:\>
```

UEFI Shell Nested Scripts

Copy the Scripts from the `/FW/LabSampleCode/ShellScripts` to the runtime directory `C:/FW/edk2-ws/Build/EmulatorX64/DEBUG_VS201nx86/X64`



UEFI Shell Script Example

Script1.nsh

```
# Simple UEFI Shell script file
echo -off
script2.nsh
if exist %cwd%Mytime.log then
     type Mytime.log
endif
echo "%HThank you.” “%VByeBye:) %N“
```

Script2.nsh

```
# Show nested scripts
time > Mytime.log
for %a run (3 1 -1)
    echo %a counting down
endfor
```

Run UEFI Shell Scripts

From the VS command Prompt

```
C:\FW\edk2> RunEmulator.bat
```

At the Shell prompt Type

```
Shell> fs0:
FS0:\> Script1

FS0:\> Edit Script1.nsh
```

```
          0 Dir(s)
FS0:\> Script1
FS0:\> script2.nsh
FS0:\> time > Mytime.log
FS0:\> for %a run (3 1 -1)
FS0:\>     echo %a counting down
3 counting down
FS0:\> endfor
FS0:\> for %a run (3 1 -1)
FS0:\>     echo %a counting down
2 counting down
FS0:\> endfor
FS0:\> for %a run (3 1 -1)
FS0:\>     echo %a counting down
1 counting down
FS0:\> endfor
FS0:\> for %a run (3 1 -1)
FS0:\> if exist %cwd%Mytime.log then
FS0:\>      type Mytime.log
20:08:54 (UTC 00:00)

FS0:\> endif
FS0:\> echo "Thank you. ByeBye:) "
Thank you. ByeBye:)
FS0:\> _
```

Run UEFI Shell Scripts

Remove the “#” on the first line

```
UEFI EDIT Script1.nsh
echo  -off
script2.nsh
if exist %cwd%Mytime.log then
     type Mytime.log
endif
echo "%HThank you. %VByeBye:) %N"
```

Press “F2”

Enter

Press “F3” to exit

Type

```
FS0:\> Script1
```

```
FS0:\> Script1
FS0:\> echo  -off
3 counting down
2 counting down
1 counting down
20:19:52 (UTC 00:00)

Thank you. ByeBye:)
FS0:\> _
```

Summary

- Run UEFI Shell (Windows Emulation)
- Run UEFI Shell Commands
- Run UEFI Shell Scripts

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Questions?

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