


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

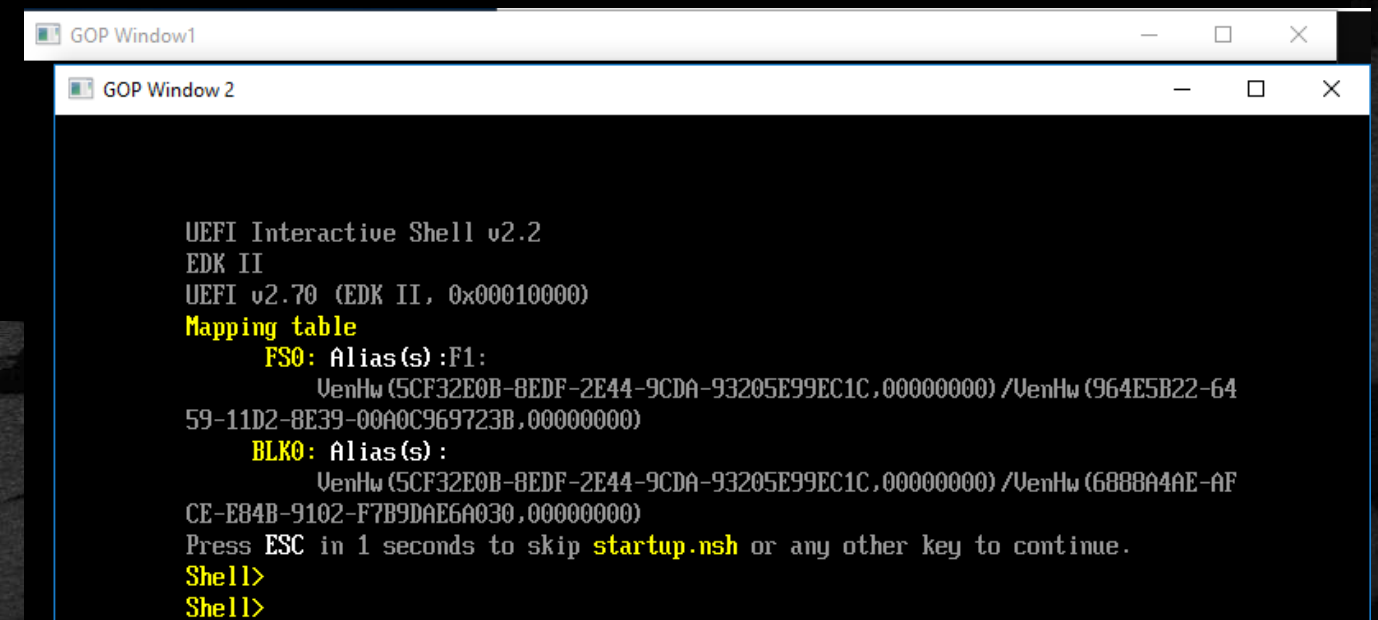
-  Run UEFI Shell (Windows Emulation)
-  Run UEFI Shell Commands
-  Run UEFI Shell Scripts

UEFI SHELL LAB WITH WIN EMULATOR

Invoke Win Emulation

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 Interactive Shell v2.2
EDK II
UEFI v2.70 (EDK II, 0x00010000)
Mapping table
FS0: Alias(s) :F1:
    VenHw (5CF32E0B-BEDF-2E44-9CDA-93205E99EC1C,00000000) /VenHw (964E5B22-64
59-11D2-8E39-00A0C969723B,00000000)
BLK0: Alias(s) :
    VenHw (5CF32E0B-BEDF-2E44-9CDA-93205E99EC1C,00000000) /VenHw (6888A4AE-AF
CE-E84B-9102-F7B9DAE6A030,00000000)
Press ESC in 1 seconds to skip startup.nsh or any other key to continue.
Shell>
Shell>
```

UEFI SHELL COMMANDS

Commands from the Command Line Interface

Common Shell Commands for Debugging

help

mm

mem

memmap

drivers

devices

devtree

dh

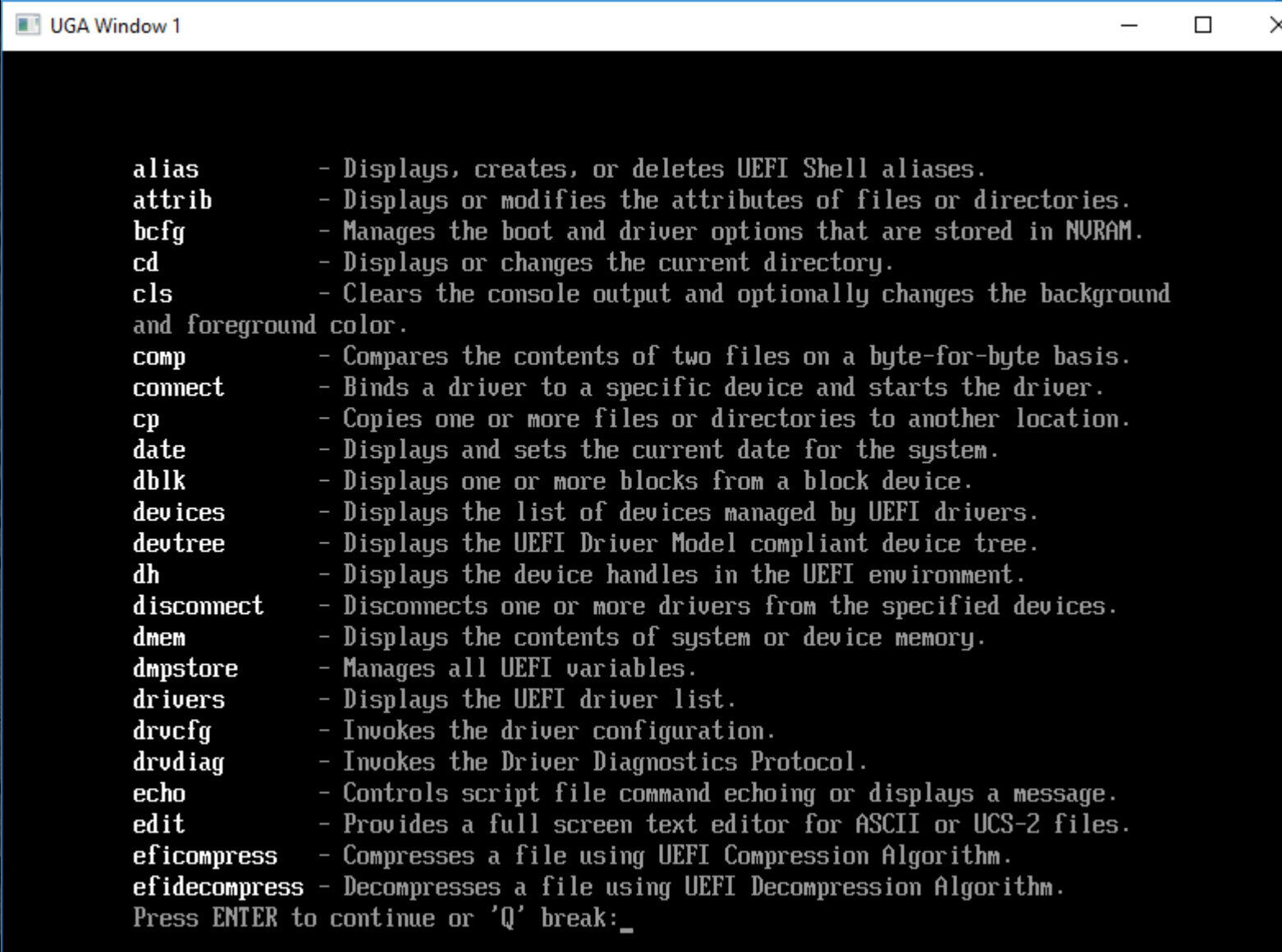
Load

dmpstore

stall

“-b” is the command line parameter for breaking after each page.


```
Shell> help -b
```



```
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.
efidecompress - Decompresses a file using UEFI Decompression Algorithm.
Press ENTER to continue or 'Q' break: _
```



```
Shell> memmap
```

Displays the memory map maintained by the UEFI environment

```
RT_Data  000002B208574000-000002B208574FFF 00000000000000001 8000000000000000F
BS_Data  000002B208575000-000002B20859CFFF 00000000000000028 0000000000000000F
RT_Data  000002B20859D000-000002B20859FFFF 00000000000000003 8000000000000000F
MMIO     000002B200580000-000002B20058BFFF 0000000000000000C 80000000000000001
```

```
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 -? -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: ssssbddffrr

ssss - Segment

bb - Bus

dd - Device

ff - Function

rr - Register

-PCIE - PCIE Configuration Space Address type:

Address format: ssssbddffrrr

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 **
```

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

```
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> _
```

```
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
```

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
```

Displays the UEFI driver list.

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

```
Shell> drivers -?
```

```

D      T      D
R      Y C I
U      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:

```



```
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,000000000)
 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,000000000) /VenHw (
FD5FBE54-8C35-B345-8A0F-7AC8A5FD0521,000000000)
 74 D - - 1 0 0 VT-100 Serial Console
Shell> _
```

For the Windows Emulation there is not that many devices


```
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-7ACBA5FD0521,00000000)
  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)) FirmwareVolumeBlock
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 (ReportStatusCodeRouterRuntimeDxe)
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(..0x1A3F4D80000,0x1A3F52FFFFFF)) FirmwareVolumeBlock
Press ENTER to continue or 'Q' break: _
```

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


```
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 *.....l>..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 *....U.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> stall 10000000
```

Stalls the operation for a specified number of microseconds

```
Shell> stall 100000000  
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:

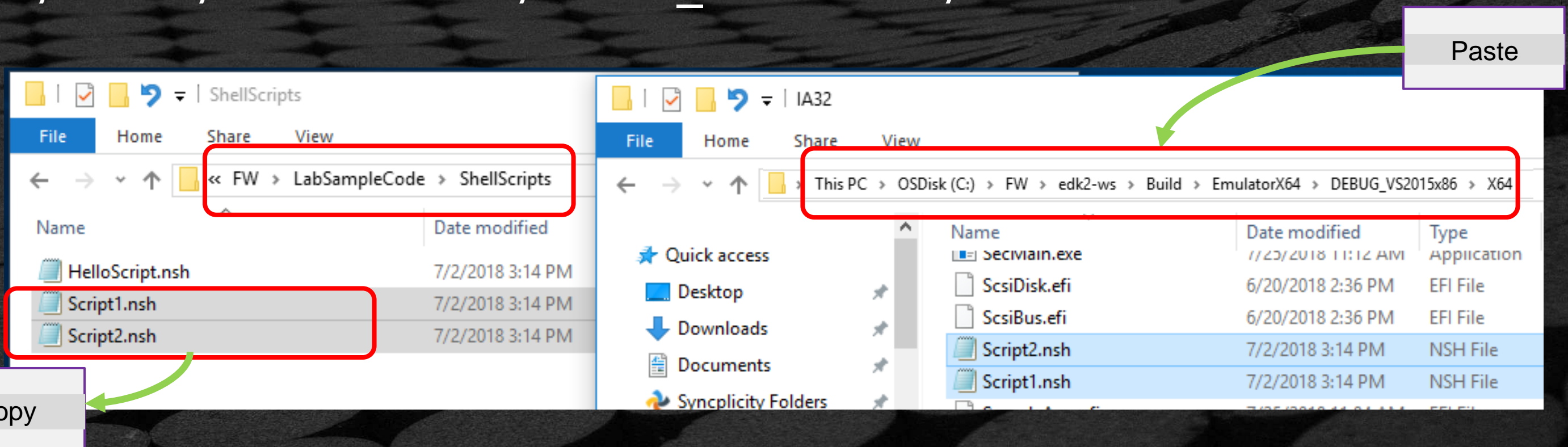
```
FS0:\> helloscript.nsh  
FS0:\> echo Hello World  
Hello World  
FS0:\> _
```

Close the Win emulation, type: "reset"

```
FS0:\> reset
```


UEFI Shell Nested Scripts

Copy the Scripts from the /FW/LabSampleCode/ShellScripts to the runtime directory C:/FW/edk2-ws/Build/EmulatorX64/DEBUG_VS2015x86/X64



The image shows two Windows File Explorer windows side-by-side. The left window is titled 'ShellScripts' and shows the path 'FW > LabSampleCode > ShellScripts'. It contains a table of files:

Name	Date modified
HelloScript.nsh	7/2/2018 3:14 PM
Script1.nsh	7/2/2018 3:14 PM
Script2.nsh	7/2/2018 3:14 PM

The right window is titled 'IA32' and shows the path 'This PC > OSDisk (C:) > FW > edk2-ws > Build > EmulatorX64 > DEBUG_VS2015x86 > X64'. It contains a table of files:

Name	Date modified	Type
SecMain.exe	1/23/2018 11:12 AM	Application
ScsiDisk.efi	6/20/2018 2:36 PM	EFI File
ScsiBus.efi	6/20/2018 2:36 PM	EFI File
Script2.nsh	7/2/2018 3:14 PM	NSH File
Script1.nsh	7/2/2018 3:14 PM	NSH File

Green arrows indicate the flow of the process: one arrow points from the 'Script1.nsh' and 'Script2.nsh' files in the source window to a 'Copy' button, and another arrow points from the 'Script2.nsh' and 'Script1.nsh' files in the destination window to a 'Paste' button.

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

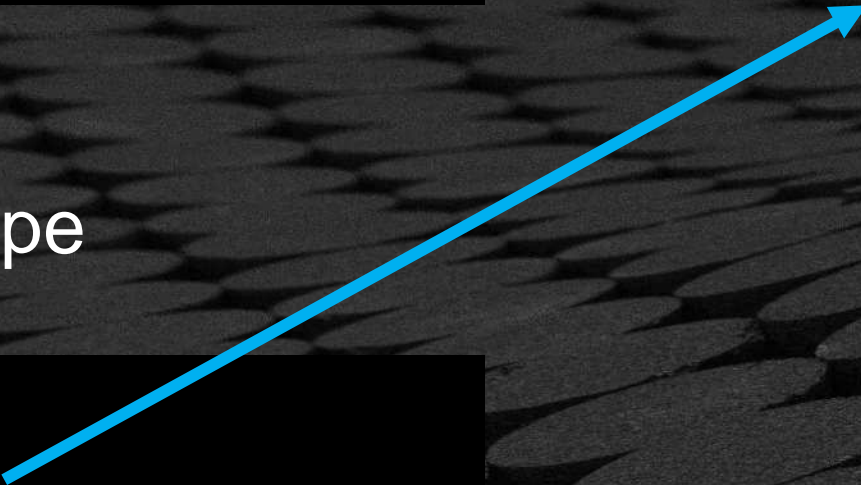
```
# Show nested scripts
time > Mytime.log
for %a run (3 1 -1)
    echo %a counting down
endfor
```


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
```



```
U 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

Press “F2”

Enter

Press “F3” to exit

Type



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

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

Questions?





ACKNOWLEDGEMENTS

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