x64 Workshop

Didier Stevens

Go to http://workshop-x64.DidierStevens.com

Unzip x64-workshop.zip to c:\workshop

Install:

- 010EditorWin32Installer402.exe
- nasm-2.10.05-installer.exe
- SysinternalsSuite.zip
- tdm64-gcc-4.7.1-2.exe
- tdm-gcc-4.7.1-2.exe

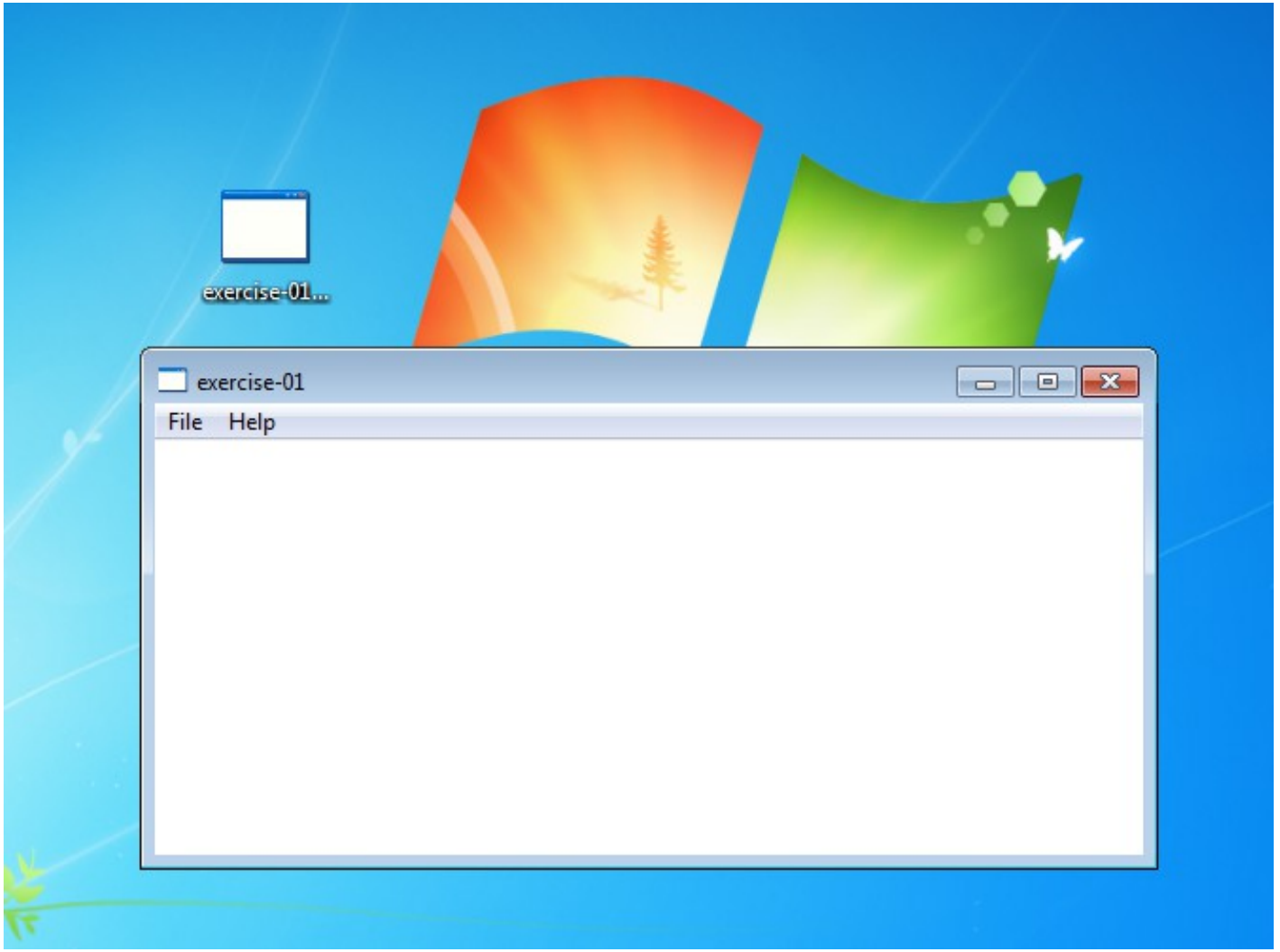
Exercise 1:

The litmus test

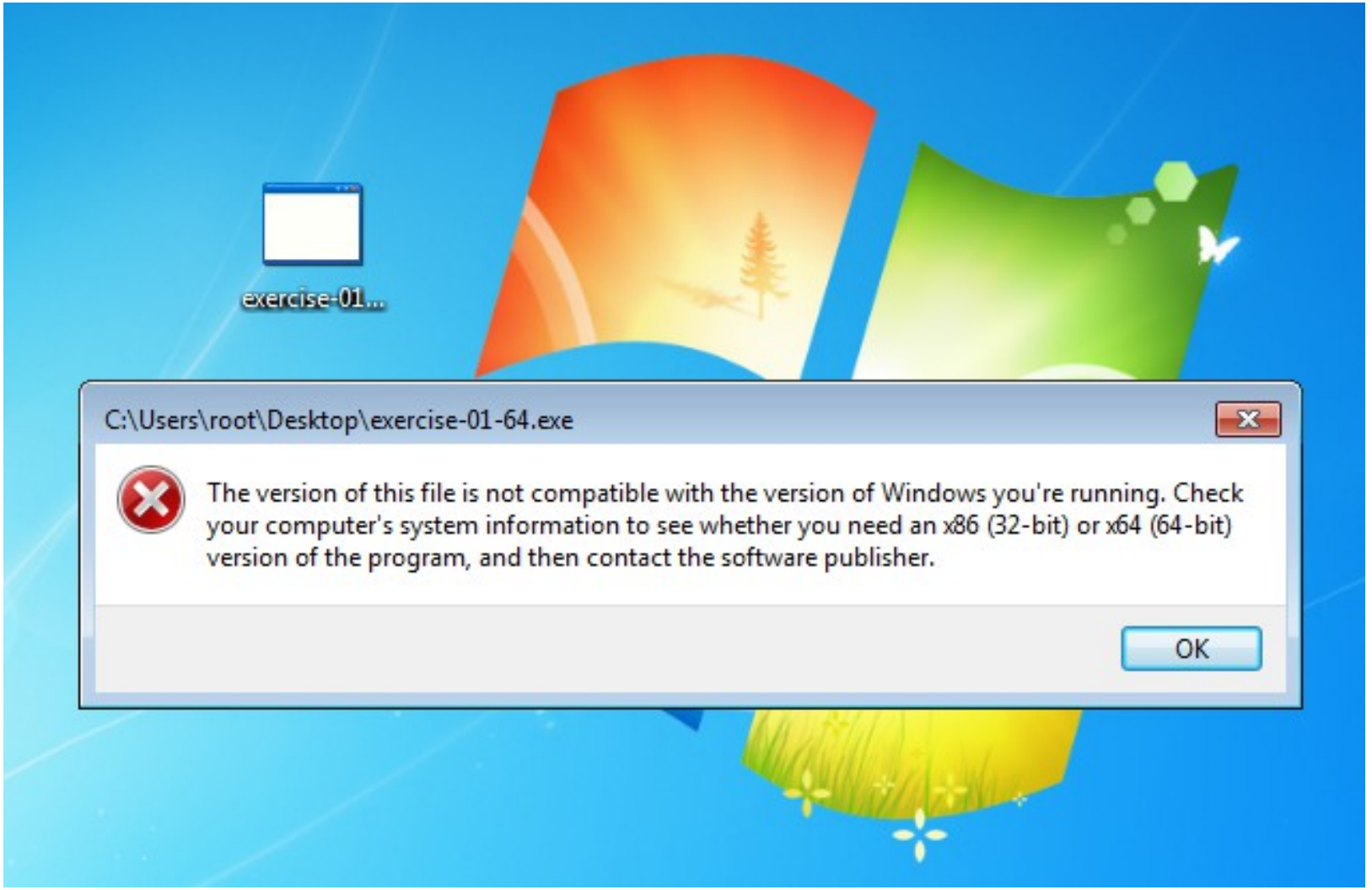
Start the following programs:

- exercise-01-32.exe
- exercise-01-64.exe

OK



Not OK


exercise-01...
C:\Users\root\Desktop\exercise-01-64.exe
The version of this file is not compatible with the version of Windows you're running. Check your computer's system information to see whether you need an x86 (32-bit) or x64 (64-bit) version of the program, and then contact the software publisher.
OK

Take a look with Process Explorer

Take a look with 010 Editor

Exercise 2:

A C program

32 gcc: gcc -o exercise-02-32.exe exercise-02.c

64 gcc: gcc -o exercise-02-64.exe exercise-02.c

exercise-02-32.exe

```
                public _main
_main           proc near               ; CODE XREF: ___mingw_CRTStartup+F8↑p

var_20          = dword ptr -20h
var_1C          = dword ptr -1Ch
var_4           = dword ptr -4

                push    ebp
                mov     ebp, esp
                and     esp, 0FFFFFFF0h
                sub     esp, 20h
                call    ___main
                mov     [esp+20h+var_4], offset aHelloWorld ; "Hello World\n"
                inc     [esp+20h+var_4]
                mov     eax, [esp+20h+var_4]
                mov     [esp+20h+var_20], eax
                call    _printf
                mov     [esp+20h+var_1C], 4
                mov     [esp+20h+var_20], offset aSizeofSzhellow ; "sizeof(szH
                call    _printf
                leave
                retn
_main           endp
```

exercise-02-64.exe

```
                public main
main            proc near               ; CODE XREF: __tmainCRTStartup+250↑p
                                        ; DATA XREF: .pdata:0000000000040A048↓o

var_8           = qword ptr -8
arg_0           = dword ptr  10h
arg_8           = qword ptr  18h

                push    rbp
                mov     rbp, rsp
                sub     rsp, 30h
                mov     [rbp+arg_0], ecx
                mov     [rbp+arg_8], rdx
                call    __main
                lea     rax, aHelloWorld ; "Hello World\n"
                mov     [rbp+var_8], rax
                add     [rbp+var_8], 1
                mov     rax, [rbp+var_8]
                mov     rcx, rax        ; char *
                call    printf
                mov     edx, 8
                lea     rcx, aSizeofSzhellow ; "sizeof(szHelloWorld) = %d\n"
                call    printf
                add     rsp, 30h
                pop     rbp
                retn
main            endp
```

Exercise 3:

A C dll

32 gcc: gcc -shared -o exercise-03-32.dll exercise-03.c

64 gcc: gcc -shared -o exercise-03-64.dll exercise-03.c

Exercise 4:

Loading and injecting a dll

32 gcc: gcc -o exercise-04-32.exe exercise-04.c

64 gcc: gcc -o exercise-04-64.exe exercise-04.c

exercise-04-32.exe exercise-03-32.dll

exercise-04-64.exe exercise-03-64.dll

exercise-04-32.exe exercise-03-64.dll

exercise-04-64.exe exercise-03-32.dll

exercise-04-32.exe exercise-03-32.dll

exercise-04-64.exe exercise-03-64.dll

~~exercise-04-32.exe exercise-03-64.dll~~

~~exercise-04-64.exe exercise-03-32.dll~~

```
//
// MessageId: ERROR_BAD_EXE_FORMAT
//
// MessageText:
//
// %1 is not a valid Win32 application.
//
#define ERROR_BAD_EXE_FORMAT             193L
```

Calc.exe, our favorite test dummy

Start calculator 64-bit and 32-bit:

c:\windows\system32\calc.exe

c:\windows\syswow64\calc.exe

inject-dll-32.exe *4352* exercise-03-32.dll

inject-dll-64.exe *2624* exercise-03-64.dll

inject-dll-32.exe *1472* exercise-03-64.dll*

inject-dll-64.exe *1532* exercise-03-32.dll

* inspect memory

inject-dll-32.exe *4352* exercise-03-32.dll

inject-dll-64.exe *2624* exercise-03-64.dll

~~inject-dll-32.exe *1472* exercise-03-64.dll~~

inject-dll-64.exe *1532* exercise-03-32.dll 76A44BC6

```
hProcess= OpenProcess(PROCESS_ALL_ACCESS, FALSE, _tstoi(argv[1]));
if (NULL == hProcess)
{
    printf("OpenProcess error: %d\n", GetLastError());
    return -2;
}

if (argc == 3)
    fpLoadLibraryA = GetProcAddress(GetModuleHandle("kernel32.dll"), "LoadLibraryA");
else
{
    char *endPtr;

    fpLoadLibraryA = (FARPROC) strtol(argv[3], &endPtr, 16);
}
printf("fpLoadLibraryA = %p\n", fpLoadLibraryA);

lpArgument = VirtualAllocEx(hProcess, NULL, strlen(argv[2]) + 1, MEM_COMMIT | MEM_RESERVE, PAGE_READWRITE);
if (NULL == lpArgument)
{
    printf("VirtualAllocEx error: %d\n", GetLastError());
    return -3;
}
printf("lpArgument = %p\n", lpArgument);
if (!WriteProcessMemory(hProcess, lpArgument, argv[2], strlen(argv[2]) + 1, &stWritten))
{
    printf("WriteProcessMemory error: %d\n", GetLastError());
    return -4;
}

hThread = CreateRemoteThread(hProcess, NULL, 0, (LPTHREAD_START_ROUTINE)fpLoadLibraryA, lpArgument, 0, &dwThreadID);
if (NULL == hThread)
{
    printf("CreateRemoteThread error: %d\n", GetLastError());
    return -5;
}

CloseHandle(hProcess);
```

Exercise 5:

Shellcode

```
nasm -o exercise-05-32.bin exercise-05-32.asm

nasm -o exercise-05-64.bin exercise-05-64.asm
```

inject-shellcode-32.exe *1532* exercise-05-32.bin

inject-shellcode-64.exe *1472* exercise-05-64.bin

inject-shellcode-32.exe *3396* exercise-05-64.bin

inject-shellcode-64.exe *4188* exercise-05-32.bin

inject-shellcode-32.exe *1532* exercise-05-32.bin

inject-shellcode-64.exe *1472* exercise-05-64.bin

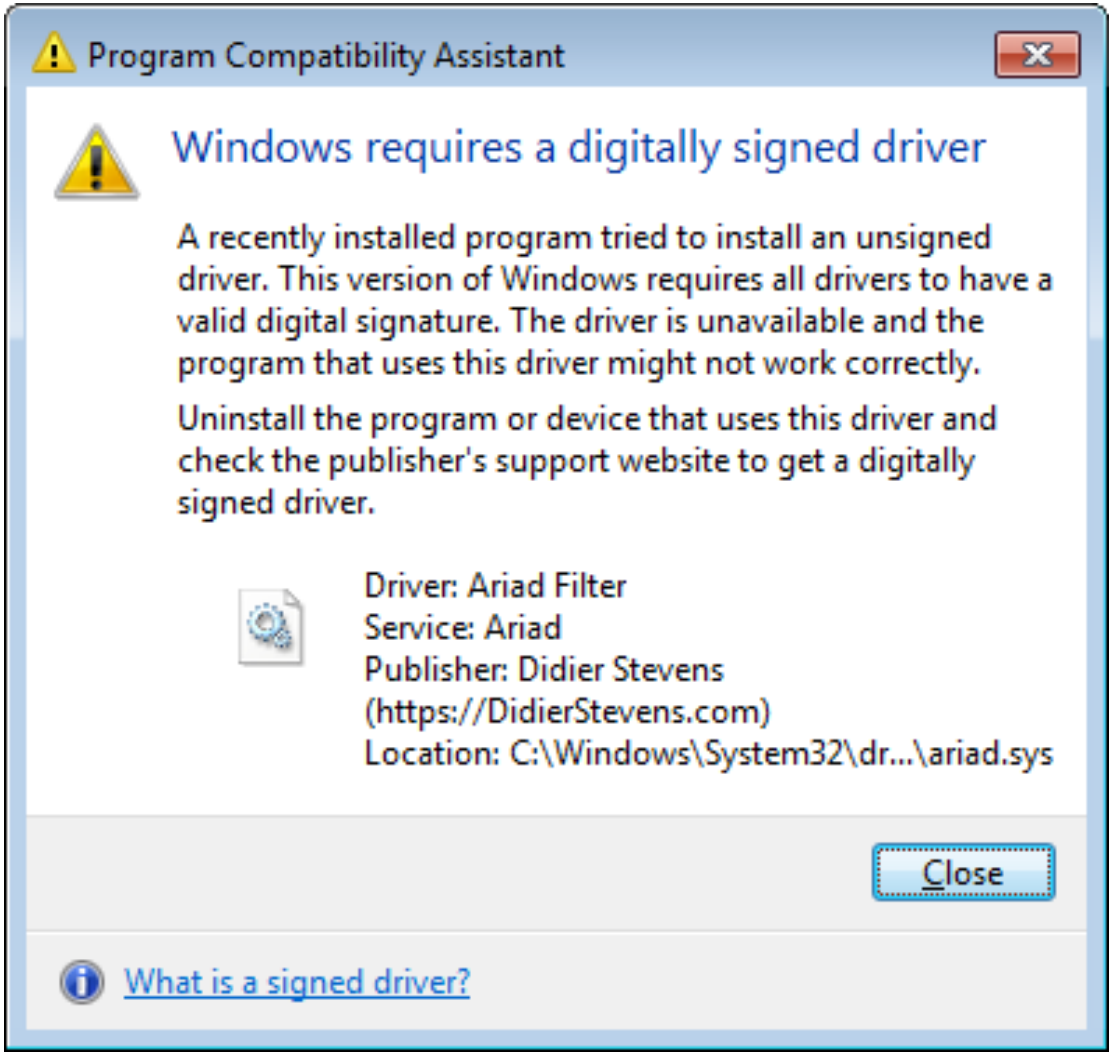
~~inject-shellcode-32.exe *3396* exercise-05-64.bin~~

inject-shellcode-64.exe *4188* exercise-05-32.bin

```
}
hProcess= OpenProcess(PROCESS_ALL_ACCESS, FALSE, _tstoi(argv[1]));
if (NULL == hProcess)
{
    printf("OpenProcess error: %d\n", GetLastError());
    return -3;
}

lpArgument = VirtualAllocEx(hProcess, NULL, sizeof(abBuffer), MEM_COMMIT | MEM_RESERVE, PAGE_EXECUTE_READWRITE);
if (NULL == lpArgument)
{
    printf("VirtualAllocEx error: %d\n", GetLastError());
    return -4;
}
printf("lpArgument = %p\n", lpArgument);
if (!WriteProcessMemory(hProcess, lpArgument, abBuffer, sizeof(abBuffer), &stWritten))
{
    printf("WriteProcessMemory error: %d\n", GetLastError());
    return -5;
}

hThread = CreateRemoteThread(hProcess, NULL, 0, (LPTHREAD_START_ROUTINE)lpArgument, 0, 0, &dwThreadID);
if (NULL == hThread)
{
    printf("CreateRemoteThread error: %d\n", GetLastError());
    return -6;
}

CloseHandle(hProcess);
```

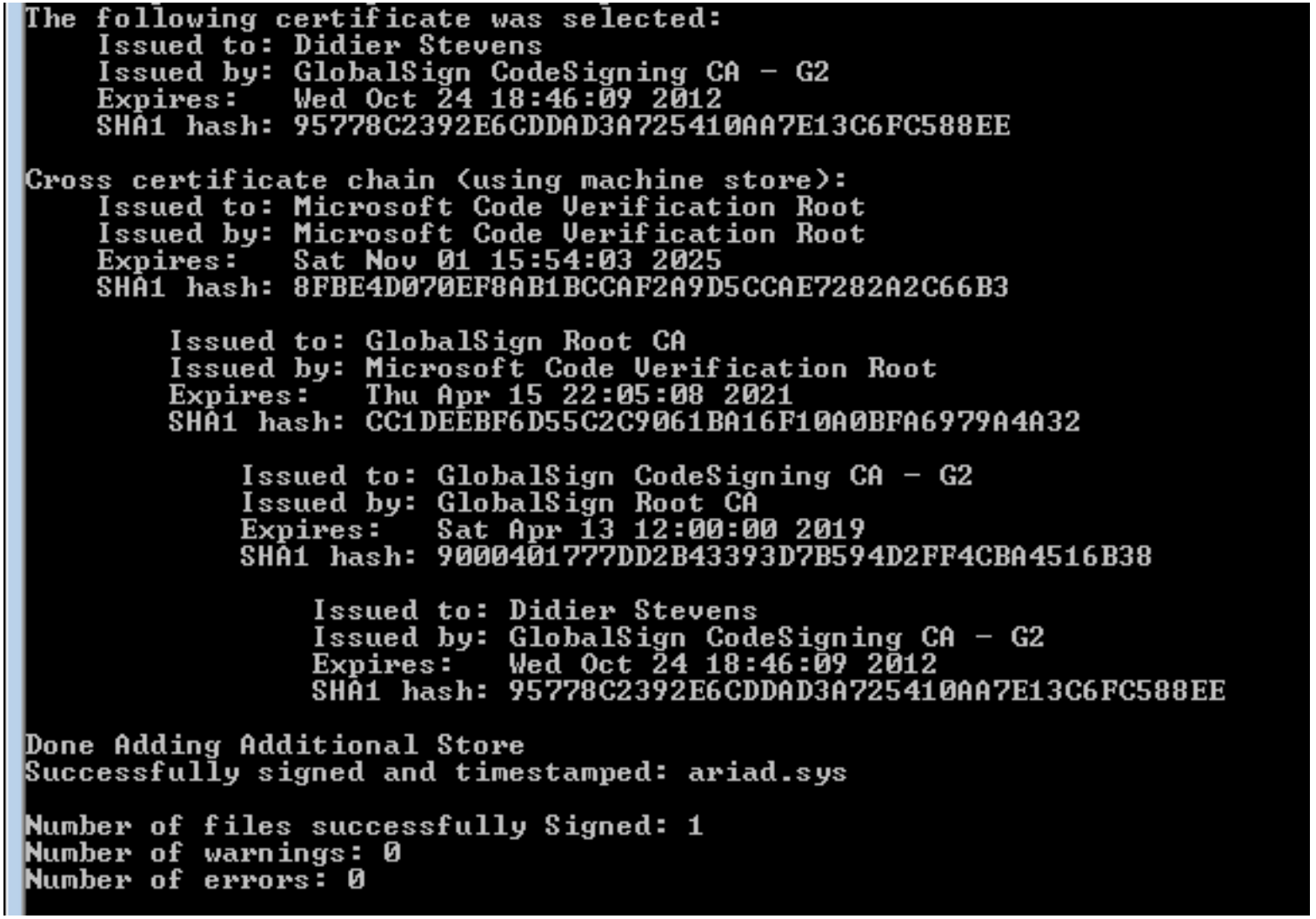
Exercise 6:

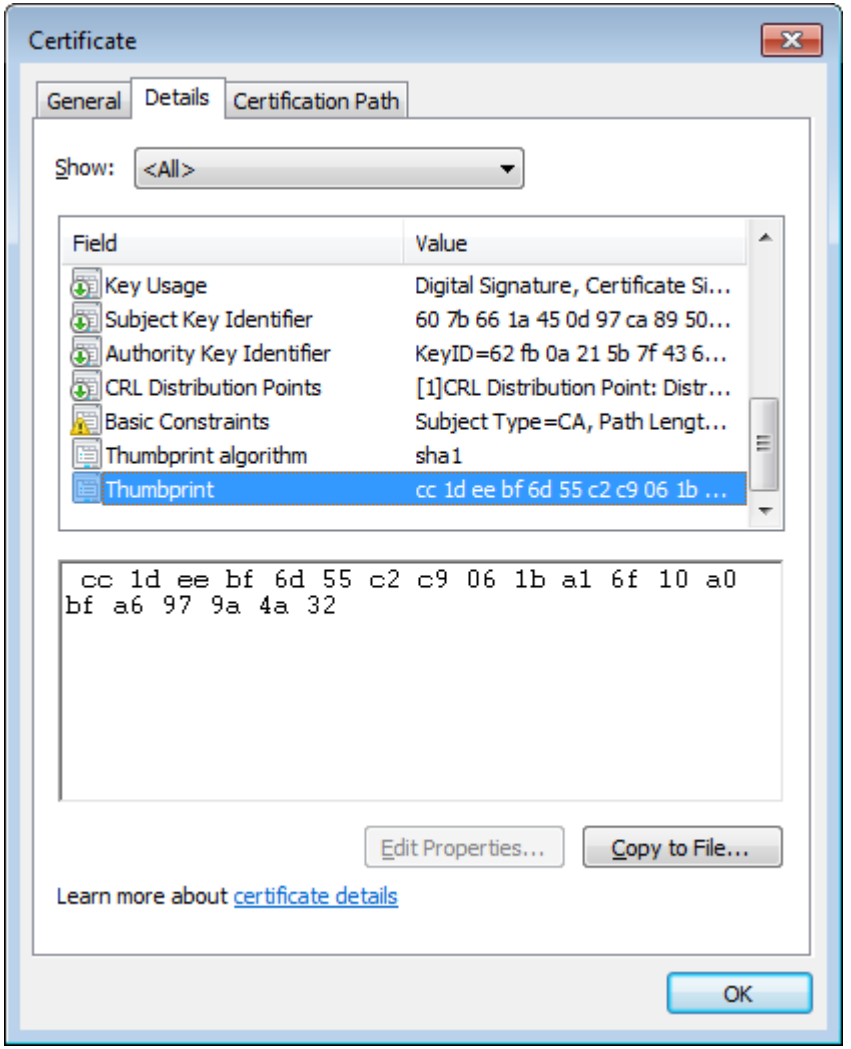
Drivers:
Kernel Mode Code Signing


Program Compatibility Assistant
Windows requires a digitally signed driver
A recently installed program tried to install an unsigned driver. This version of Windows requires all drivers to have a valid digital signature. The driver is unavailable and the program that uses this driver might not work correctly.
Uninstall the program or device that uses this driver and check the publisher's support website to get a digitally signed driver.
Driver: Ariad Filter
Service: Ariad
Publisher: Didier Stevens
(https://DidierStevens.com)
Location: C:\Windows\System32\dr...\ariad.sys
Close
What is a signed driver?

```
signtool.exe sign
/v
/sha1 95778C2392E6CDDAD3A725410AA7E13C6FC588EE
/t http://timestamp.verisign.com/scripts/timestamp.dll
ariad.sys

signtool.exe sign
/v
/ph /ac GSRCA.crt
/sha1 95778C2392E6CDDAD3A725410AA7E13C6FC588EE
/t http://timestamp.verisign.com/scripts/timestamp.dll
ariad.sys
```


The following certificate was selected:
Issued to: Didier Stevens
Issued by: GlobalSign CodeSigning CA - G2
Expires: Wed Oct 24 18:46:09 2012
SHA1 hash: 95778C2392E6CDDAD3A725410AA7E13C6FC588EE
Done Adding Additional Store
Successfully signed and timestamped: ariad.sys
Number of files successfully Signed: 1
Number of warnings: 0
Number of errors: 0


The following certificate was selected:
Issued to: Didier Stevens
Issued by: GlobalSign CodeSigning CA - G2
Expires: Wed Oct 24 18:46:09 2012
SHA1 hash: 95778C2392E6CDDAD3A725410AA7E13C6FC588EE
Cross certificate chain (using machine store):
Issued to: Microsoft Code Verification Root
Issued by: Microsoft Code Verification Root
Expires: Sat Nov 01 15:54:03 2025
SHA1 hash: 8FBE4D070EF8AB1BCCAF2A9D5CCAE7282A2C66B3
Issued to: GlobalSign Root CA
Issued by: Microsoft Code Verification Root
Expires: Thu Apr 15 22:05:08 2021
SHA1 hash: CC1DEEBF6D55C2C9061BA16F10A0BFA6979A4A32
Issued to: GlobalSign CodeSigning CA - G2
Issued by: GlobalSign Root CA
Expires: Sat Apr 13 12:00:00 2019
SHA1 hash: 9000401777DD2B43393D7B594D2FF4CBA4516B38
Issued to: Didier Stevens
Issued by: GlobalSign CodeSigning CA - G2
Expires: Wed Oct 24 18:46:09 2012
SHA1 hash: 95778C2392E6CDDAD3A725410AA7E13C6FC588EE
Done Adding Additional Store
Successfully signed and timestamped: ariad.sys
Number of files successfully Signed: 1
Number of warnings: 0
Number of errors: 0


Certificate
General
Details
Certification Path
Show:
<All>
Field
Value
Key Usage
Digital Signature, Certificate Si...
Subject Key Identifier
60 7b 66 1a 45 0d 97 ca 89 50...
Authority Key Identifier
KeyID=62 fb 0a 21 5b 7f 43 6...
CRL Distribution Points
[1]CRL Distribution Point: Distr...
Basic Constraints
Subject Type=CA, Path Lengt...
Thumbprint algorithm
sha1
Thumbprint
cc 1d ee bf 6d 55 c2 c9 06 1b ...
cc 1d ee bf 6d 55 c2 c9 06 1b a1 6f 10 a0
bf a6 97 9a 4a 32
Edit Properties...
Copy to File...
Learn more about certificate details
OK

signtool verify /kp ariad-signed.sys
Successfully verified: ariad-signed.sys

signtool verify /pa ariad-simple-signed.sys
Successfully verified: ariad-simple-signed.sys

Exercise 7:

WoW64

gcc -o exercise-07.exe exercise-07.c

Wow64DisableWow64FsRedirection

C:\Windows\System32
C:\Windows\SysWOW64

HKEY_LOCAL_MACHINE\SOFTWARE\
Microsoft\Windows
NT\CurrentVersion\Windows\AppInit_DLLs

HKEY_LOCAL_MACHINE\SOFTWARE\
Wow6432Node\
Microsoft\Windows
NT\CurrentVersion\Windows\AppInit_DLLs

Exercise 8:

VBA 64-bit

http://DidierStevensLabs.com

Windows x64 The Essentials videos: €25
PDF Analysis workshop videos: €25
White Hat Shellcode workshop videos: €25
Bundle of 3 workshops: €60