FIRST EDITION – CHAPTER 19 REV 1

Kevin Thomas
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Forward

A long time ago there existed a time and space where the 6502 processor was everywhere. There was no internet, there was no cell phone and the personal computer was that of a creation of pure majesty which had a target market of a few enthusiasts.

On November 20, 1985, Microsoft introduced the Windows operating environment which was nothing more than a graphical operating shell for MS-DOS.

I will spare you the rest of the history as we know how this game played out. Today, Windows is the most used desktop and laptop OS having a 76% share followed by Apple's macOS at 16% and the remaining ChromeOS and other Linux variants.

Like it or not Windows is the major player and throughout the years I have focused on teaching Reverse Engineering in the Linux environment so that we could focus on a more thinner and efficient development and communication with the processor.

Today we begin our journey into the Win32API. This book will take you step-by-step writing very simple Win32API's in both x86 and x64 platforms in C and then reversing them both very carefully using the world's most popular Hey Rays IDA Free tool which is a stripped down version of the IDA Pro tool used in more professional Reverse Engineering environments.

Let's begin...

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Chapter 1: Hello World

We begin our journey with programming a very simple hello world program in Windows Assembly language. We will ONLY write in pure Assembly in this chapter as we will focus on development in C which almost all Windows development occurs so you have a greater understanding of how these applications are put together and THEN reversing the entire app in Assembly Language both in x86 and x64.

Let's first download Visual Studio which we will use as our integrated development environment. Select the Visual Studio 2019 Community edition at the link below. Make SURE you select all of the C++ and Windows options during the setup to ensure the build environment has all the tools necessary. When in doubt, check the box to include it during install.

https://visualstudio.microsoft.com/downloads

Once installed, let's create a new project and get started by following the below steps.

Create a new project
Empty Project
Next
Project name: 0x0001-hello_world-x86
CHECK Place solution and project in the same directory
Create

RT CLICK on the 0x0001-hello_world-x86 in Solutions Explorer
Add
New Item…
main.asm
RT CLICK 0x0001-hello_world-x86
Build Dependencies
Build Customizations
CHECK masm
OK

RT CLICK on main.asm
Properties
Configuration Properties
General
Item Type: Microsoft Macro Assembler
OK

Now let's populate our **main.asm** file with the following.

```
.686
.model flat, stdcall
.stack 4096
```

```
extrn  ExitProcess@4: proc        ;1 param  1x4
extrn  MessageBoxA@16: proc       ;4 params 4x4

.data
    msg_txt      db "Hello World", 0
    msg_caption  db "Hello World App", 0

.code
    main:
        push 0                     ;UINT uType
        lea  eax, msg_caption      ;LPCSTR lpCaption
        push eax
        lea  eax, msg_txt          ;LPCSTR lpText
        push eax
        push 0                     ;HWND hWnd
        call MessageBoxA@16

        push 0                     ;UINT uExitCode
        call ExitProcess@4
    end main
```

Congratulations! You just created your first hello world code in x86
Windows Assembly. Time for cake!

We are going to spend the majority of our time in the Win32API
documentation throughout this course.

Let's take a moment and review. To begin we designate a *.686* which
means enable the assembly of non-privileged instructions for the
Pentium Pro+ style architecture in 32-bit MASM.

(VISIT https://docs.microsoft.com/en-us/cpp/assembler/masm/dot-686?view=msvc-160)

Our first Win32API that we call is the MessageBoxA which provides a
Windows Message Box to appear. We then set up a *flat* memory model
which uses no combined segment or offset addressing. We also use the
stdcall Win32 calling convention which we push args in reverse order
onto the stack and then call the procedure. The *calle* clears the
stack after the call.

Our second Win32API that we will call is the *ExitProcess* which simply
exits the application and frees up the operation to the Windows OS.

(VISIT https://docs.microsoft.com/en-us/windows/win32/api/processthreadsapi/nf-
processthreadsapi-exitprocess)

We see that the function is a void function which returns nothing and
has one param UINT uExitCode which simply retrieves the process's
exit value.

You might have noticed a very strange *@4* after the function. This is to designate that the function has 1 param. We multiply each param by 4 to get this designation.

Our next Win32API is the *MessageBoxA* function which simply displays a modal dialog box with a title and a message.

(VISIT https://docs.microsoft.com/en-us/windows/win32/api/winuser/nf-winuser-messageboxa)

We have 4 params here so we know we will have an @16 at the end of the function.

The first param is *HWND hWnd* which is a handle to the owner of the window of the message box to be created and in our case it is *NULL* meaning the message box has no owner.

We then have the *LPCSTR lpText* which will display our text inside the message box.

We then have the *LPCSTR lpCaption* which will be the caption text on the message box.

Finally we have the UINT uType which is simply the combo of flags from the table located in the docs. In our case it will be NULL.

Remember in *stdcall* we push the params in REVERSE order onto the stack as you see in the code above.

At this point we can run our code by clicking on the green arrow next to the Local Windows Debugger.

HOORAY our hello world modal dialog box pops up.

Let's now create our x64 version of this code.

Create a new project
Empty Project
Next
Project name: 0x0001-hello_world-x64
CHECK Place solution and project in the same directory
Create

RT CLICK on the 0x0001-hello_world-x64 in Solutions Explorer
Add
New Item…
main.asm
RT CLICK 0x0001-hello_world-x64
Build Dependencies

Build Customizations
CHECK masm
OK

RT CLICK on the 0x0001-hello_world-x64 in Solutions Explorer

RT CLICK on main.asm
Properties
Configuration Properties
Linker
Advanced
Entry Point: main
OK

Select x64 to the right of Debug and the left of Local Windows Debugger menu bar

Now let's populate our **main.asm** file with the following.

```
extrn MessageBoxA: proc
extrn PostQuitMessage: proc

.data
        msg_txt         db 'Hello World', 0
        msg_caption      db 'Hello World App', 0

.code
        main proc
                sub     rsp, 20h                ;shadow stack

                mov     r9, rax                 ;UINT uType
                lea     r8, msg_caption         ;LPCSTR lpCaption
                lea     rdx, msg_txt            ;LPCSTR lpText
                xor     rcx, rcx                ;HWND hWnd
                call    MessageBoxA

                add     rsp, 20h                ;restore shadow stack

                xor     rcx, rcx                ;int nExitCode
                call    PostQuitMessage

                ret
        main endp
end
```

We also see a call to PostQuitMessage which has an int nExitCode as a param.

(VISIT https://docs.microsoft.com/en-us/windows/win32/api/winuser/nf-winuser-postquitmessage)

Congratulations! You just created your first hello world code in x64 Windows Assembly. Time for cake, again!

Let's take a moment and review. We first need to understand the x64 calling convention.

(VISIT https://docs.microsoft.com/en-us/cpp/build/x64-calling-convention?view=msvc-160)

The *Microsoft x64 calling convention, fastcall*, is what we use in x64. What we see here under the *Parameter passing* section is by default, the x64 calling convention passes the first four arguments to a function in registers. The registers used for these arguments depend on the position and type of the argument. Remaining arguments get pushed on the stack in right-to-left order. The *caller* cleans up the stack after the call.

Integer valued arguments in the leftmost four positions are passed in left-to-right order in *RCX*, *RDX*, *R8*, and *R9*, respectively. The fifth and higher arguments are passed on the stack as previously described. All integer arguments in registers are right-justified, so the callee can ignore the upper bits of the register and access only the portion of the register necessary.

Any floating-point and double-precision arguments in the first four parameters are passed in *XMM0 - XMM3*, depending on position. Floating-point values are only placed in the integer registers *RCX*, *RDX*, *R8*, and *R9* when there are varargs arguments. For details, see Varargs. Similarly, the *XMM0 - XMM3* registers are ignored when the corresponding argument is an integer or pointer type.

According to the x64 calling convention we need to provide a shadow stack for memory cells for each QWORD and the stack has to be aligned to 16 bytes for the next instruction.

The shadow space is the mandatory 32 bytes (4x8 bytes) which we must reserve for the called procedure. We provide 32 bytes on the stack before calling. This space can be left uninitialized.

In this calling convention, arguments after the 4th are pushed on the stack, which are on top of this shadow space (pushed before the 32 bytes).

We then setup and call our *MessageBoxA* Win32API again. We do not need to review the params as we have handled this earlier in our x86 example.

We then restore the shadow stack and then call *ExitProcess*.

At this point we can run our code by clicking on the green arrow next to the Local Windows Debugger.

HOORAY our hello world modal dialog box pops up.

This will be the only example where we write in all Assembly as I want to teach using the official Win32API which is natively in C however I wanted to first show you EXACTLY what is going on under the hood when it is in fact compiled.

Chapter 2: Debugging Hello World x86

Today we debug our Hello World x86 version within Ida Free. We first need to download Ida Free which is the free version of the most popular Ida Pro tool.

https://hex-rays.com/ida-free/#download

Once installed let's copy our **0x0001-hello_world-x86.exe**, which is inside the **Debug** folder within **0x0001-hello_world-x86** folder to a new folder called **0x0001-hello_world-x86-debug**.

After loading Ida Free, click Go Work on your own and drag-and-drop the **0x0001-hello_world-x86.exe** into it.

When the *Load a new file* modal pops up click *OK*.

When *The input file was linked with debug information* modal pops up select *Yes* as we will use the symbols in our reversing as we learn the Win32API.

Immediately it shows the disassembly and drops us into the *_main* function.

```
public _main
_main proc near

argc= dword ptr  4
argv= dword ptr  8
envp= dword ptr  0Ch

push    0                 ; uType
lea     eax, msg_caption
push    eax               ; lpCaption
lea     eax, msg_txt
push    eax               ; lpText
push    0                 ; hWnd
call    _MessageBoxA@16 ; MessageBoxA(x,x,x,x)
push    0                 ; uExitCode
call    _ExitProcess@4  ; ExitProcess(x)
_main endp
```

Here we see a clean disassembly of our source as we wrote it in Assembly.

Let's first examine what is inside *msg_caption* so the first step is to double-click on the *msg_caption* text which will take us into the *.data* section of the code.

```
.data:0040400C ; CHAR msg_caption
.data:0040400C msg_caption    db 48h              ; DATA XREF: _main+2↑o
.data:0040400D aElloWorldApp   db 'ello World App',0
```

In the *msg_text* we also notice a strange *db 48h* at offset *4000* and
another at offset 4001 of *db `ello World`,0*.

The first *48h* is ascii. Let's load up an ascii table and do some
simple investigation.

https://www.asciitable.com

Here we see *0x48* or *48h* as *H*. This makes sense as our *msg_caption*
begins with a capital *H*.

We are currently in the *IDA View-A* tab. Let's click on the *48h* value
and the click on the *Hex View-1* tab to the right of *IDA View-A*.

```
00404000   48 65 6C 6C 6F 20 57 6F  72 6C 64 00 48 65 6C 6C   Hello·World.Hell
00404010   6F 20 57 6F 72 6C 64 20  41 70 70 00 00 00 00 00   o·World·App.....
```

Here we see our string represented in hex ascii. If we refer back to
our table we can easily see how everything matches up. These
letters, each representing a byte in the *.data* section are in fact
the letters that will display in our *msg_caption*.

If we click back on the IDA View-A tab we can follow the same
procedure and as the above images indicate we can see our *msg_txt*
section as well following the same pattern.

Let's his the esc button and go back to our _main function.

Let's click on the first *push 0* instruction and hit f2 to set a
breakpoint. You will notice a red box highlight that line.

```
public _main
_main proc near

argc= dword ptr  4
argv= dword ptr  8
envp= dword ptr  0Ch

push    0                ; uType
lea     eax, msg_caption
push    eax              ; lpCaption
lea     eax, msg_txt
push    eax              ; lpText
push    0                ; hWnd
call    _MessageBoxA@16  ; MessageBoxA(x,x,x,x)
push    0                ; uExitCode
call    _ExitProcess@4   ; ExitProcess(x)
_main endp
```
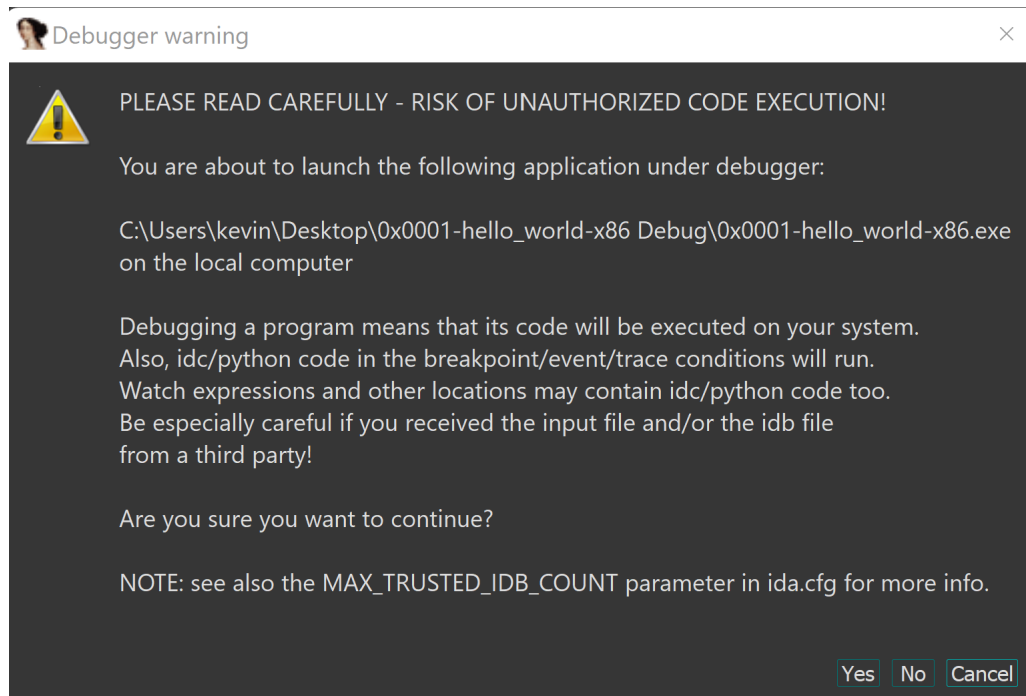
When we click on the green *play* button next to *Local Windows Debugger* it will then begin the debugging session.

We immediately see a warning message as we are going to run the code dynamically however we wrote it so we can then click *Yes* at the bottom right.
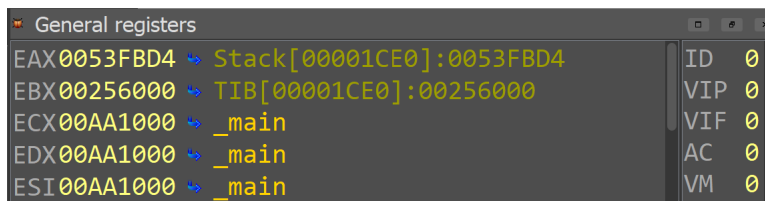

We see it load up our source code window which is quite handy as we can see that it broke on the *push 0* instruction.

Let's ignore this window for now and click on the *IDA View-EIP* window to the left.
Here we see a number of different windows. We see our *Code* window.

There is a *General registers* window.

This is only a partial view of the registers as you have to scroll bars to work with. On the right hand side you see the values of the *eflags* register as it displays each bit.

The next window is the *Modules* window which shows the application and all of the respective .dll libs it is using. Like the registers window you will need to scroll.
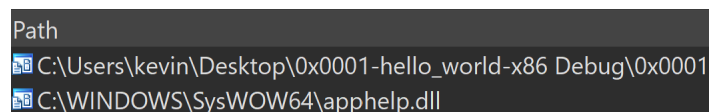
We have our *Threads* window.

We then have our *Stack view* window which the top of the stack is highlighted in blue. Like all of the others it is scrollable.
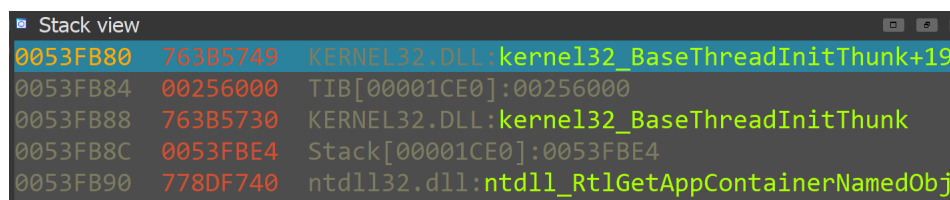
We have our *Hex View-1* window where if you type g within the window you can seek to that given memory address within the hex.
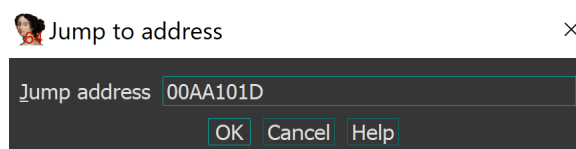
Let's jump to *00aa101d* and look at the *Hex View-1*.

```
Hex View-1
00AA1000  6A 00 8D 05 0C 40 AA 00   50 8D 05 00 40 AA 00 50  j....@ª.P...@ª.P
00AA1010  6A 00 E8 14 00 00 00 6A   00 E8 07 00 00 00 CC CC  j.è....j.è....ÌÌ
00AA1020  CC CC CC CC CC FF 25 00   50 AA 00 FF 25 30 50 AA  ÌÌÌÌÌÿ%.Pª.ÿ%0Pª
00AA1030  00 CC CC CC CC CC CC CC   CC CC CC CC CC CC CC CC  .ÌÌÌÌÌÌÌÌÌÌÌÌÌÌÌ
00AA1040  CC CC CC CC CC CC CC CC   CC CC CC CC CC CC CC CC  ÌÌÌÌÌÌÌÌÌÌÌÌÌÌÌÌ
```

Finally we have our *Output* window.

```
Output
75F10000: loaded C:\WINDOWS\SysWOW64\IMM32.DLL
PDBSRC: loading symbols for 'C:\Users\kevin\Desktop\0x0001-hello_world-x86 Debug\0x0001-hello_world-x86.exe'...
PDB: using PDBIDA provider
PDB: loading C:\Users\kevin\Documents\Hacking-Windows\0x0001-hello_world-x86\Debug\0x0001-hello_world-x86.pdb
PDB: There is no type information
PDB: There is no IPI stream
IDC
AU:   idle   Down Disk: 41GB
```

Let's step through the code. Let's enable the debugger menu.

View – Toolbars – Debugger commands

Let's click on the first blue icon with the two arrows to single-step. Let's single-step twice.

We are now about to execute the first *push eax* instruction. We see *msg_caption* moved into *eax*. Before we step take note of the *Stack view* window as well.

```
.text:00AA1000 argv= dword ptr  8
.text:00AA1000 envp= dword ptr  0Ch
.text:00AA1000
.text:00AA1000 push    0                ; uType
.text:00AA1002 lea     eax, msg_caption
.text:00AA1008 push    eax              ; lpCaption
.text:00AA1009 lea     eax, msg_txt
.text:00AA100F push    eax              ; lpText
.text:00AA1010 push    0                ; hWnd
.text:00AA1012 call    _MessageBoxA@16  ; MessageBoxA(x,x,x,x)
.text:00AA1017 push    0                ; uExitCode
.text:00AA1019 call    _ExitProcess@4   ; ExitProcess(x)
.text:00AA1019 _main endp
```

```
General registers
EAX 00AA400C ↳ .data:msg_caption
EBX 004D6000 ↳ TIB[00005CC8]:004D6000
ECX 00AA1000 ↳ _main
EDX 00AA1000 ↳ _main
ESI 00AA1000 ↳ _main
```

Now let's step again. Let's now examine the stack.

```
Stack view                                                    ▫ ▪
006FFDC8   00AA400C    .data:msg_caption
006FFDCC   00000000
006FFDD0   763B5749    KERNEL32.DLL:kernel32_BaseThreadInitThunk
006FFDD4   004D6000    TIB[00005CC8]:004D6000
```

We see the msg_caption moved to the top of the stack as it was just pushed from eax.

Take immediate note of the value in esp as that is the top of the stack.

```
General registers
EBX 004D6000 ↪ TIB[00005CC8]:004D6000
ECX 00AA1000 ↪ _main
EDX 00AA1000 ↪ _main
ESI 00AA1000 ↪ _main
EDI 00AA1000 ↪ _main
EBP 006FFDDC ↪ Stack[00005CC8]:006FFDDC
ESP 006FFDC8 ↪ Stack[00005CC8]:006FFDC8
```

Let's step and stop right before the call.

```
.text:00AA1000 public _main
.text:00AA1000 _main proc near
.text:00AA1000
.text:00AA1000 argc= dword ptr  4
.text:00AA1000 argv= dword ptr  8
.text:00AA1000 envp= dword ptr  0Ch
.text:00AA1000
.text:00AA1000 push    0                  ; uType
.text:00AA1002 lea     eax, msg_caption
.text:00AA1008 push    eax                ; lpCaption
.text:00AA1009 lea     eax, msg_txt
.text:00AA100F push    eax                ; lpText
.text:00AA1010 push    0                  ; hWnd
.text:00AA1012 call    _MessageBoxA@16    ; MessageBoxA(x,x,x,x)
.text:00AA1017 push    0                  ; uExitCode
.text:00AA1019 call    _ExitProcess@4     ; ExitProcess(x)
.text:00AA1019 _main endp
```

At this point take careful note on the Stack view.

```
Stack view                                                    ▫ ▣ ×
006FFDC0   00000000
006FFDC4   00AA4000    .data:msg_txt
006FFDC8   00AA400C    .data:msg_caption
006FFDCC   00000000
```

It is CRITICAL that you take SPECIAL CARE to review the *Code* window above and compare it to the *Stack view* window.

Notice that the top of the stack, in this case *0x006ffdc0* holds the value of *0* which was the LAST, most recent value pushed to the stack.

Remember that the STACK GROWS DOWN in memory. The value of *ebp* which is the stack base pointer is HIGHER in memory as compared to *esp*. Please write this down.

As we push more items onto the stack *esp* will continue to grow DOWNWARD in memory and therefore the gap between *ebp* and *esp* grows larger as *esp* is growing downward toward the heap until either call occurs which will collapse the stack frame (*ebp* to *esp*) OR a pop operation will pop the value in *esp* into whatever you are popping it into and therefore moving esp UPWARD in memory.

At the +4 offset we see *msg_txt* which was the 2nd to the last thing pushed onto the stack.

At the +8 offset we see *msg_caption* was the 3rd to the last thing pushed onto the stack.

Finally at +12 or +0xc we see *0* which was the 4th to the last thing pushed onto the stack.

We can step over the call to _MessageBoxA@16 and it will load our modal window.

We can then step over the call to _ExitProcess@4 and it will terminate our binary.

If you single-step it will take you through the internal Win32API functions if you wanted to get a greater appreciation of what exactly is happening when these functions are in fact called.

When we continue execution we will see our program run and we now have a complete idea of how this simple programs works as we did a complete dynamic reversing analysis on this binary.

Chapter 3: Hacking Hello World x86

Today we hack our Hello World x86 version within Ida Free. Let's fire up our session in Ida Free and begin.

We start with our *_main* proc.

```
public _main
_main proc near

argc= dword ptr  4
argv= dword ptr  8
envp= dword ptr  0Ch

push    0                ; uType
lea     eax, msg_caption
push    eax              ; lpCaption
lea     eax, msg_txt
push    eax              ; lpText
push    0                ; hWnd
call    _MessageBoxA@16  ; MessageBoxA(x,x,x,x)
push    0                ; uExitCode
call    _ExitProcess@4   ; ExitProcess(x)
_main endp
```

Double-click on *msg_caption*.

```
; CHAR msg_txt
msg_txt         db 48h                   ; DATA XREF: _main+9↑o
aElloWorld      db 'ello World',0
; CHAR msg_caption
msg_caption     db 48h                   ; DATA XREF: _main+2↑o
aElloWorldApp   db 'ello World App',0
                align 1000h
_data           ends
```
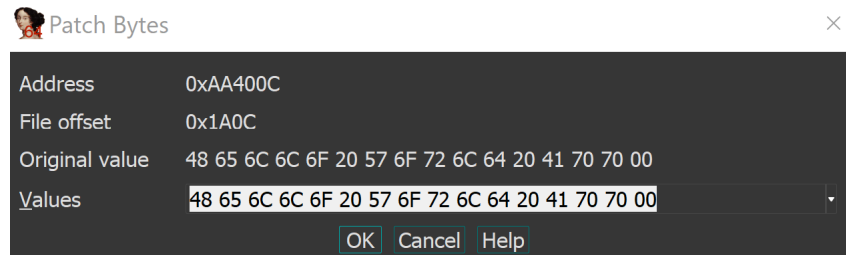
Click on the *Hex View-1* tab.

```
00AA4000   48 65 6C 6C 6F 20 57 6F   72 6C 64 00 48 65 6C 6C   Hello·World.Hell
00AA4010   6F 20 57 6F 72 6C 64 20   41 70 70 00 00 00 00 00   o·World·App.....
```

We noticed in the last chapter that *0x48* begins the string as we know in the ascii table that *0x48* is in fact *'H'*.

https://www.asciitable.com

Click *Edit – Patch program – Change byte …*

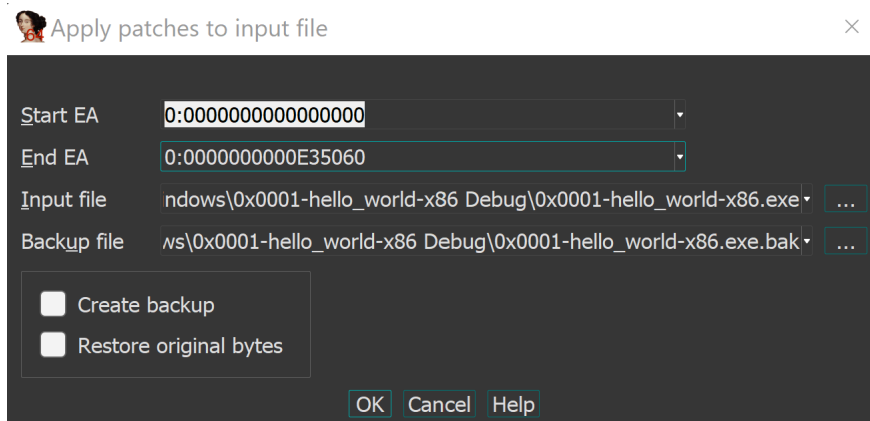48 65 6C 6C 6F 20 57 6F 72 6C 64 20 41 70 70 00

Let's change the caption to 'Hacky World'.

48 61 63 6B 79 20 57 6F 72 6C 64 20 41 70 70 00

Click OK.

Click *Edit – Patch program – Apply patches to input file…*
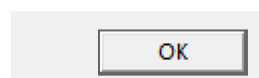
Click OK.

Click the green play button. We notice two warning windows which we can ignore stating that the binary has changed.

We broke on our first break point. Let's hit the play button again.

Hooray! Time for cake! We saw that we were able to successfully hack our *msg_caption* correctly.

You could also take it a step further and hack the actual *msg_txt* if you so chose.

This is the first of many small hacks. The purpose of this book it to take SMALL steps. Take very careful analysis on exactly what is happening at the assembly level and understanding have to have absolute control over the process.

Chapter 4: Debugging Hello World x64

Today we debug our Hello World x64 version within Ida Free.

Let's copy our **0x0001-hello_world-x64.exe**, which is inside the **Debug** folder within **0x0001-hello_world-x64** folder to a new folder called **0x0001-hello_world-x64-debug**.

After loading Ida Free, click Go Work on your own and drag-and-drop the **0x0001-hello_world-x64.exe** into it.

When the *Load a new file* modal pops up click *OK*.

When *The input file was linked with debug information* modal pops up select *Yes* as we will use the symbols in our reversing as we learn the Win32API.

Immediately it shows the disassembly and drops us into the *main* function.

```
main proc near
sub     rsp, 20h
mov     r9, rax         ; uType
lea     r8, msg_caption ; lpCaption
lea     rdx, msg_txt    ; lpText
xor     rcx, rcx        ; hWnd
call    MessageBoxA_0
add     rsp, 20h
xor     rcx, rcx        ; nExitCode
call    PostQuitMessage_0
retn
main endp
```

Take note and re-read Chapter 2. Unlike x86 where we push params to the stack we are moving the params into *rcx*, *rdx*, *r8*, *r9*. This is how x64 handles their function calls at the Assembly level.

Let's first examine what is inside *msg_caption* so the first step is to double-click on the *msg_caption* text which will take us into the *.data* section of the code.

```
.data:000000014000400C ; CHAR msg_caption
.data:000000014000400C msg_caption     db 48h                    ; DATA XREF: main+7↑o
.data:000000014000400D aElloWorldApp   db 'ello World App',0
```

In the *msg_text* we also notice a strange *db 48h* at offset *4000* and another at offset 4001 of *db `ello World`,0*.

The first *48h* is ascii. Let's load up an ascii table and do some simple investigation.

https://www.asciitable.com

Here we see *0x48* or *48h* as *H*. This makes sense as our *msg_caption* begins with a capital *H*.

We are currently in the *IDA View-A* tab. Let's click on the *48h* value and the click on the *Hex View-1* tab to the right of *IDA View-A*.

```
0000000140004000  48 65 6C 6C 6F 20 57 6F  72 6C 64 00 48 65 6C 6C   Hello·World.Hell
0000000140004010  6F 20 57 6F 72 6C 64 20  41 70 70 00 00 00 00 00   o·World·App.....
```

Here we see our string represented in hex ascii. If we refer back to our table we can easily see how everything matches up. These letters, each representing a byte in the *.data* section are in fact the letters that will display in our *msg_caption*.

If we click back on the IDA View-A tab we can follow the same procedure and as the above images indicate we can see our *msg_txt* section as well following the same pattern.

Let's his the esc button and go back to our main function.

Let's click on the *mov r9, rax* instruction and hit f2 to set a breakpoint. You will notice a red box highlight that line.

```
main proc near
sub     rsp, 20h
mov     r9, rax          ; uType
lea     r8, msg_caption ; lpCaption
lea     rdx, msg_txt     ; lpText
xor     rcx, rcx         ; hWnd
call    MessageBoxA_0
add     rsp, 20h
xor     rcx, rcx         ; nExitCode
call    PostQuitMessage_0
retn
main endp
```

When we click on the green *play* button next to *Local Windows Debugger* it will then begin the debugging session.

We immediately see a warning message as we are going to run the code dynamically however we wrote it so we can then click *Yes* at the bottom right.
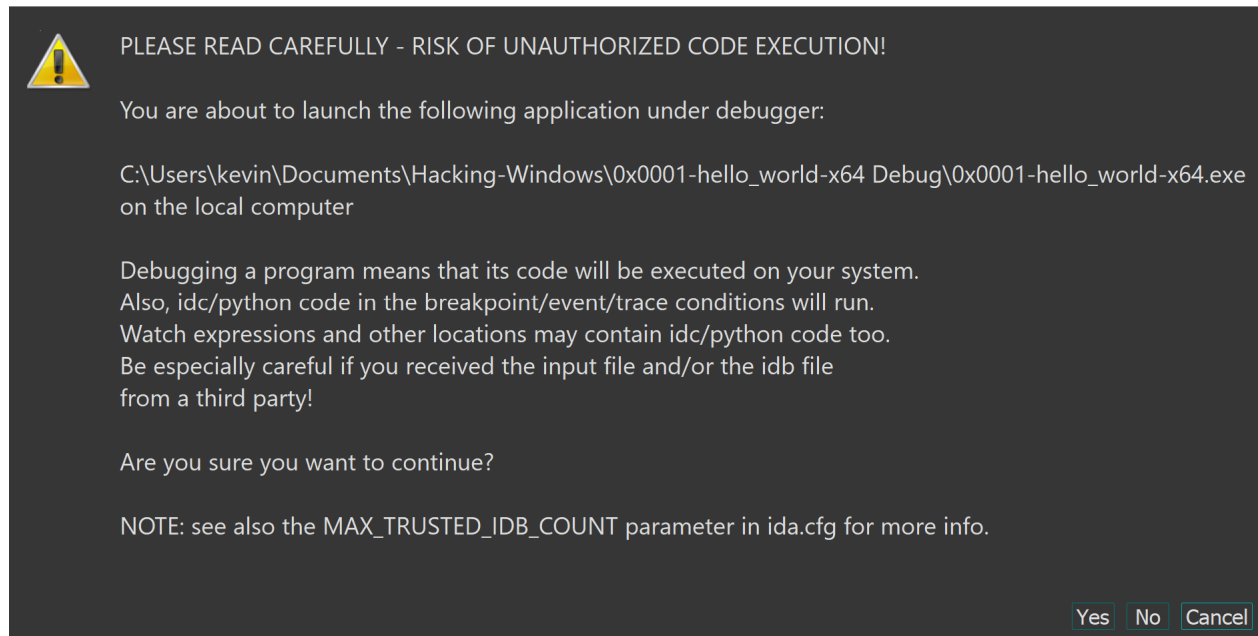
We see it load up our source code window. As with the x86 version as
we wrote this in Assembly we can ignore and click on the *IDA View-RIP*
tab.

Enable debugger menu.

View – Toolbars – Debugger commands

Let's click on the first blue icon with the two arrows to single-
step. Let's single-step once.

We see the value of *rax* moved into *r9* which holds the value of *start*.
This is the fourth param in reverse order.

This is likely a compiler optimization as we did not code this in
Assembly.

We then load the effective address of *msg_caption* into *r8* the third
param in reverse order after we step again.

We then load the effective address of *msg_txt* into *rdx* the second
param in reverse order after we step again.

`RDX`**00007FF688F24000** ↳ `.data:msg_txt`

We then zero out or *xor rcx, rcx* to put a *0* in *rcx*.

`RCX`**0000000000000000** ↳

Finally we call *MessageBoxA_0* and display our caption and message.

Hello World App   ×

Hello World

Retry   Cancel
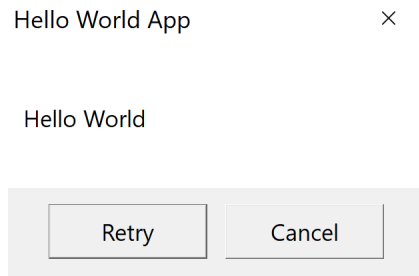
We then called *PostQuitMessage_0* and exit the program.

Chapter 5: Hacking Hello World x64

Today we hack our Hello World x64 version within Ida Free. Let's fire up our session in Ida Free and begin.

We start with our *main* proc.

```
main proc near
sub     rsp, 20h
mov     r9, rax            ; uType
lea     r8, msg_caption ; lpCaption
lea     rdx, msg_txt    ; lpText
xor     rcx, rcx           ; hWnd
call    MessageBoxA_0
add     rsp, 20h
xor     rcx, rcx           ; nExitCode
call    PostQuitMessage_0
retn
main endp
```
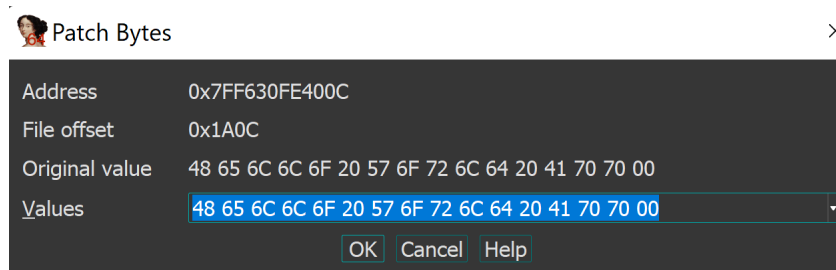
Double-click on *msg_caption*.

```
; CHAR msg_txt
msg_txt         db 48h                ; DATA XREF: main+E↑o
aElloWorld      db 'ello World',0
; CHAR msg_caption
msg_caption     db 48h                ; DATA XREF: main+7↑o
aElloWorldApp   db 'ello World App',0
                align 1000h
_data           ends
```

Click on the Hex View-1 tab.

```
07FF630FE4000  48 65 6C 6C 6F 20 57 6F  72 6C 64 00 48 65 6C 6C   Hello·World.Hell
07FF630FE4010  6F 20 57 6F 72 6C 64 20  41 70 70 00 00 00 00 00   o·World·App.....
```

We know from our prior chapters that *0x48* is *'H'* and the other bytes are the additional letters.

Click *Edit – Patch program – Change byte …*

Patch Bytes

Address	0x7FF630FE400C
File offset	0x1A0C
Original value	48 65 6C 6C 6F 20 57 6F 72 6C 64 20 41 70 70 00
Values	48 65 6C 6C 6F 20 57 6F 72 6C 64 20 41 70 70 00

OK   Cancel   Help

```
48 65 6C 6C 6F 20 57 6F 72 6C 64 20 41 70 70 00
```

Let's change the caption to 'Hacky World'.

```
48 61 63 6B 79 20 57 6F 72 6C 64 20 41 70 70 00
```

Click OK.

Click *Edit – Patch program – Apply patches to input file…*

Click OK.
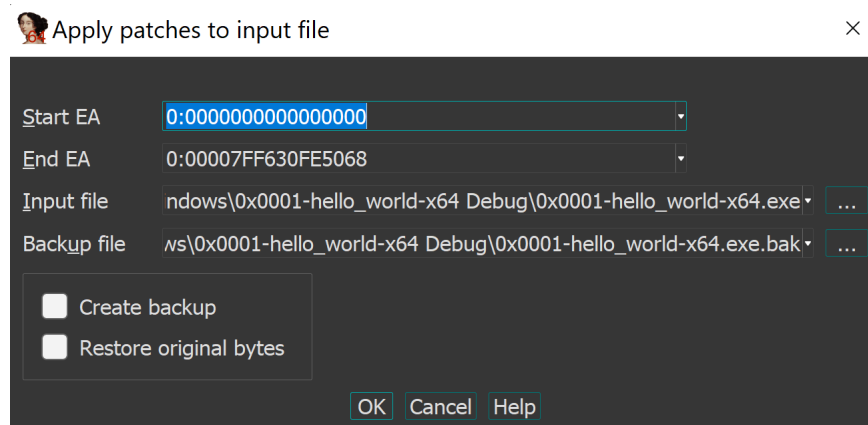
Click the green play button. We notice two warning windows which we can ignore stating that the binary has changed.

We broke on our first break point. Let's hit the play button again.
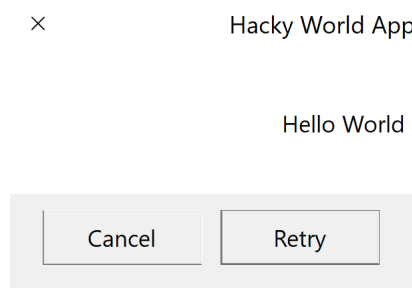
Hooray! As in the previous hacking chapter you can further hack anything you wish. We are doing nothing more than taking small bite-sized building blocks so you have a full understanding of the Win32API.

Chapter 6: Directories

We continue with a simple app that handles Windows directory manipulation by creating and removing a directory.

Let's create a new project

Create a new project
Empty Project
Next
Project name: 0x0006-directories
CHECK Place solution and project in the same directory
Create

RT CLICK on the 0x0006-directories in Solutions Explorer
Add
New Item…
main.c
OK

Now let's populate our **main.c** file with the following.

```c
#include <stdio.h>
#include <Windows.h>

int main(void)
{
    BOOL bDir;

    bDir = CreateDirectory(
        L"C:\\mydir",
        NULL
    );
    if (bDir == FALSE)
    {
        printf("CreateDirectory failed & error no %ul\n", GetLastError());
    }
    else
    {
        printf("CreateDirectory Success!\n");
    }

    bDir = RemoveDirectory(
        L"C:\\mydir"
    );
    if (bDir == FALSE)
    {
        printf("RemoveDirectory failed & error no %ul\n", GetLastError());
    }
    else
    {
        printf("RemoveDirectory Success!\n");
    }
```

```
    return 0;
}
```

Let's review the *CreateDirectoryW* API below.

(VISIT https://docs.microsoft.com/en-us/windows/win32/api/fileapi/nf-fileapi-createdirectoryw)

REMEMBER if you hover over *CreateDirectory* it expands to *CreateDirectoryW* in Visual Studio. This mean *CreateDirectory* is an alias for *CreateDirectoryW*.

We see we have two params which are *lpPathName* which is the path of the directory to be created and *lpSecurityAttributes* which is a pointer to a SECURITY_ATTRIBUTES structure. In our case we are just using *NULL*.

The return value is non-zero if the function succeeds otherwise it will return the code *ERROR_ALREADY_EXISTS* or *ERROR_PATH_NOT_FOUND*.

Let's review the RemoveDirectoryW API below.

(VISIT https://docs.microsoft.com/en-us/windows/win32/api/fileapi/nf-fileapi-removedirectoryw)

We see we have one param *lpPathName* which is the path of the directory to be created.

The return value is non-zero if the function succeeds otherwise it will return *0* and any relevant error information inside *GetLastError*.

When we run the program it shows the following output.

```
CreateDirectory Success!
RemoveDirectory Success!

C:\Users\kevin\Documents\Hacking-Windows\0x0006-directories\0x0006-directories\Debug\0x0006-directories.exe (process 10204) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
```

In our next chapter we will debug this program in x86.

Chapter 7: Debugging Directories x86

We are going to debug the 32-bit version of our Directories program.

Since we have created a few projects together I assume you know what you are doing in IDA at this point. If this process is unfamiliar to you please re-read the prior chapters.

In the IDA View-A text view we first see our *CreateDirectoryW* function.

```
.text:00621887          push    0               ; lpSecurityAttributes
.text:00621889          push    offset PathName ; "C:\\mydir"
.text:0062188E          call    ds:__imp__CreateDirectoryW@8 ; CreateDirectoryW(x,x)
```

In our last chapter we reviewed the API in C. Here we first push the *lpSecurityAttributes* param to the stack followed by the *PathName* param and then we call the function.

Let's set a breakpoint directly after the call and run the Local Windows debugger.

NOTICE we see that our **mydir** folder has been created.

Let's stop execution and delete our breakpoint.

We then see our RemoveDirectoryW function.

```
.text:006218D2          push    offset PathName ; "C:\\mydir"
.text:006218D7          call    ds:__imp__RemoveDirectoryW@4 ; RemoveDirectoryW(x)
```

Here we see the first param of *PathName* and then the call.

Let's set a breakpoint directly after the call and run the Local Windows debugger.

NOTICE we see that our **mydir** folder has been deleted.

Let's stop execution and delete our breakpoint.

The flow of this series now that we have a basic familiarity with IDA will be a simple reversing of the binary such that we continue to reinforce how each Windows API looks like in both 32-bit and 64-bit Assembly as this will help us get a firm grasp on what is going on under the hood with any Windows binary.

I won't often keep repeating myself however I wanted to at this stage have a small retrospective.

There are TONS of good reversing resources out there however my aim is to take SMALL Win32 API's and reverse them step-by-step so that in the real world when you are dealing with obfuscated Windows binaries which might have dynamic resolution based on a complicated hash you will recognize patters that you may not have without going through these exercises.

Taking time and getting your hands dirty on these small but digestible exercises will help you master the domain!

In our next chapter we will hack this program in x86.

Chapter 8: Hacking Directories x86

We are going to hack the 32-bit version of our Directories program.
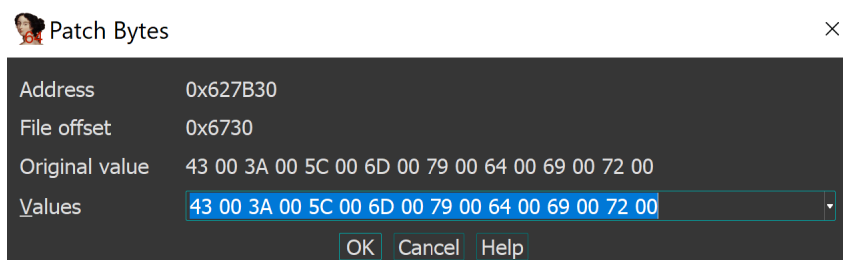
In this chapter we will hack the directory name this will continue to build our experience on custom hacking binaries.

```
.text:00621889                      push    offset PathName ; "C:\\mydir"
```

Here we see the *PathName* of *"C:\\mydir"*. Double-click to get to the .rdata section.

```
.rdata:00627B30                     text "UTF-16LE", 'C:\mydir',0
```

Click *Edit – Patch program – Change byte …*

Patch Bytes

Address	0x627B30
File offset	0x6730
Original value	43 00 3A 00 5C 00 6D 00 79 00 64 00 69 00 72 00
Values	43 00 3A 00 5C 00 6D 00 79 00 64 00 69 00 72 00

OK Cancel Help

43 00 3A 00 5C 00 6D 00 79 00 64 00 69 00 72 00

Let's change the path to 'hacky'.

43 00 3A 00 5C 00 68 00 61 00 63 00 6b 00 79 00

Click OK.

Click *Edit – Patch program – Apply patches to input file…*

Click OK.

Let's set a breakpoint on the next instruction after the call to *printf* indicating the *CreateDirectory Success!* Message.

```
.text:003B18C3                      push    offset aCreatedirector_0 ; "CreateDirectory Success!\n"
.text:003B18C8                      call    j__printf
.text:003B18CD                      add     esp, 4
```

Click the green play button. We see the terminal indicating our
CreateDirectory has been called successfully.
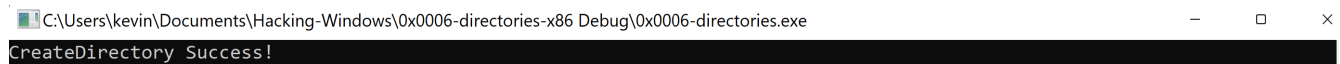
Let's look at the root of our hard drive.
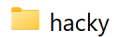
📁 hacky   11/5/2021 4:21 AM   File folder

Hooray! We have hacked our simple program and altered the creation
of the directory name.

As I have said before these are small bite-sized lessons that help
you to code, debug and hack in addition to researching each of the
Win32API functions so we have a mastery of the process.

In our next chapter we will debug this program in x64.

Chapter 9: Debugging Directories x64

We are going to debug the 64-bit version of our Directories program.

Since we have created a few projects together I assume you know what you are doing in IDA at this point. If this process is unfamiliar to you please re-read the prior chapters.

In the IDA View-A text view we first see our *CreateDirectoryW* function.

```
.text:000000014001187B                    xor     edx, edx        ; lpSecurityAttributes
.text:000000014001187D                    lea     rcx, PathName   ; "C:\\mydir"
.text:0000000140011884                    call    cs:__imp_CreateDirectoryW
```

Here we are simply putting the security attribute into *edx*, which is *0* and then we load the effective address of PathName into *rcx* and call our function.

Let's set a breakpoint directly after the call and run the Local Windows debugger.

NOTICE we see that our **mydir** folder has been created.

Let's stop execution and delete our breakpoint.

We then see our RemoveDirectoryW function.

```
.text:00007FF75AE618B5                    lea     rcx, PathName   ; "C:\\mydir"
.text:00007FF75AE618BC                    call    cs:__imp_RemoveDirectoryW
```

Here we see the first param of *PathName* and then the call.

Let's set a breakpoint directly after the call and run the Local Windows debugger.

NOTICE we see that our **mydir** folder has been deleted.

Let's stop execution and delete our breakpoint.

Bingo! Another debug victory!

In our next chapter we will hack this program in x64.

Chapter 10: Hacking Directories x64

We are going to debug the 64-bit version of our Directories program.
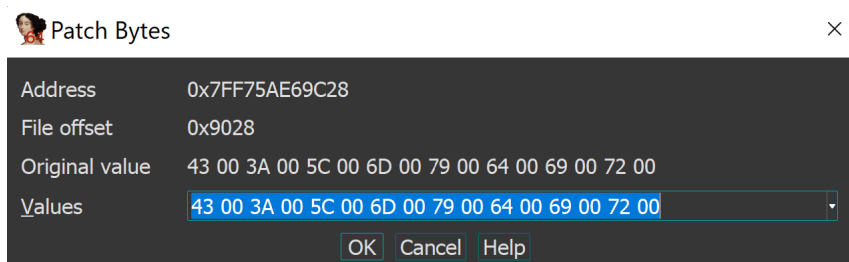
In this chapter we will hack the directory name in an x64 environment.

```
·5AE6187D                    lea     rcx, PathName   ; "C:\\mydir"
```

Here we see the *PathName* of *"C:\\mydir"*. Double-click to get to the .rdata section.

```
·75AE69C28                           text "UTF-16LE", 'C:\mydir',0
```

Click *Edit – Patch program – Change byte …*

43 00 3A 00 5C 00 6D 00 79 00 64 00 69 00 72 00

Let's change the path to 'hacky'.

43 00 3A 00 5C 00 68 00 61 00 63 00 6b 00 79 00
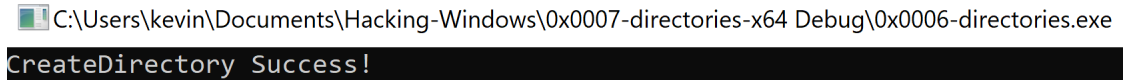
Click OK.

Click *Edit – Patch program – Apply patches to input file…*

Click OK.

Let's set a breakpoint on the next instruction after the call to *printf* indicating the *CreateDirectory Success!* Message.

```
·5AE618A9                    lea     rcx, aCreatedirector_0 ; "CreateDirectory Success!\n"
·5AE618B0                    call    j_printf
 5AE618B5
 5AE618B5 loc_7FF75AE618B5:                      ; CODE XREF: main+47↑j
·5AE618B5                    lea     rcx, PathName   ; "C:\\hacky"
```

Click the green play button. We see the terminal indicating our *CreateDirectory* has been called successfully.

```
CreateDirectory Success!
```

Let's look at the root of our hard drive.

📁 hacky   12/17/2021 3:50 AM   File folder

Hooray! We have hacked our simple program and altered the creation of the directory name.

In our next chapter we discuss CopyFile.

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Chapter 11: CopyFile

We continue with a simple app that handles the Windows CopyFile API which simply copies the contents of one file into a new file.

Let's create a new project

Create a new project
Empty Project
Next
Project name: 0x000b-copyfile
CHECK Place solution and project in the same directory
Create

RT CLICK on the 0x000b-copyfile in Solutions Explorer
Add
New Item…
main.c
OK

Now let's populate our **main.c** file with the following.

```c
#include <stdio.h>
#include <Windows.h>

int main(void)
{
      BOOL bFile;

      bFile = CopyFile(
            L"C:\\temp\\test1.txt",
            L"C:\\temp\\test2.txt",
            TRUE
      );
      if (bFile == FALSE)
      {
            printf("CopyFile failed & error no %ul\n", GetLastError());
      }
      else
      {
            printf("CopyFile Success!\n");
      }

      return 0;
}
```

Let's review the *CopyFileW API* below.

(VISIT https://docs.microsoft.com/en-us/windows/win32/api/winbase/nf-winbase-copyfilew)

Here we see we have 3 parameters. The first, *lpExistingFileName*, is simply the existing file we want to copy. The second, *lpNewFileName*, is the name of the new file to which we will create and copy the contents of the original file to. The third, *bFailIfExists*, is the flag to indicate if the new file already exists and if it does fail the operation if TRUE.

The return value is non-zero if the function succeeds otherwise it will return 0 and any relevant error information inside *GetLastError*.

We need to manually create the file **test1.txt** within C:\temp so you can use Notepad to do so now. Simply create the file and put any contents you like inside.

When we run the program it shows the following input.

```
CopyFile Success!

C:\Users\kevin\Documents\Hacking-Windows\0x000b-copyfile\0x000b-copyfile\Debug\0x000b-
copyfile.exe (process 22464) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging-
>Automatically close the console when debugging stops.
Press any key to close this window . . .
```

In our next chapter we will debug this program in x86.

Chapter 12: Debugging CopyFile x86

We are going to debug the 32-bit version of our CopyFile program.

In the IDA View-A text view we first see our *CopyFileW* function.

```
.text:00411877                 push    1               ; bFailIfExists
.text:00411879                 push    offset NewFileName ; "C:\\temp\\test2.txt"
.text:0041187E                 push    offset ExistingFileName ; "C:\\temp\\test1.txt"
.text:00411883                 call    ds:__imp__CopyFileW@12 ; CopyFileW(x,x,x)
```

Here we are simply pushing the *bFailIfExists* onto the stack followed
by the *lpNewFileName* and finally the *lpExistingFileName*.

BEFORE we run make sure we delete the file **test2.txt** within C:\temp
so we can proceed as if this was being run the first time.

Let's set a breakpoint directly after the call and run the Local
Windows debugger.

NOTICE we see that **test2.text** was created.

This was a very simple debug as I have to take the time again to
clearly state that our objective is to take SMALL steps so you can
not get overwhelmed and have a full appreciation for what is going on
at every step of these very popular Win32API calls.

In our next chapter we will hack this program in x86.

Chapter 13: Hacking CopyFile x86

We are going to hack the 32-bit version of our CopyFile program.

In this chapter we will hack the directory name this will continue to build our experience on custom hacking binaries.

```
•.text:00AA1879                    push    offset NewFileName ; "C:\\temp\\test2.txt"
```

Here we see the *PathName* of *"C:\\temp\\test2.txt"*. Double-click to get to the .rdata section.

```
•.rdata:00AA7B30                    text "UTF-16LE", 'C:\temp\test2.txt',0
```

Select the Hex View-1 tab. Click on the *32*.

```
00AA7B30  43 00 3A 00 5C 00 74 00  65 00 6D 00 70 00 5C 00   C.:.\.t.e.m.p.\.
00AA7B40  74 00 65 00 73 00 74 00  32 00 2E 00 74 00 78 00   t.e.s.t.2...t.x.
00AA7B50  74 00 00 00 00 00 00 00  00 00 00 00 43 00 3A 00   t..........C.:.
00AA7B60  5C 00 74 00 65 00 6D 00  70 00 5C 00 74 00 65 00   \.t.e.m.p.\.t.e.
00AA7B70  73 00 74 00 31 00 2E 00  74 00 78 00 74 00 00 00   s.t.1...t.x.t...
00AA7B80  00 00 00 00 00 00 00 00  43 6F 70 79 46 69 6C 65   ........CopyFile
00AA7B90  20 66 61 69 6C 65 64 20  26 20 65 72 72 6F 72 20   ·failed·&·error·
00AA7BA0  6E 6F 20 25 75 6C 0A 00  00 00 00 00 00 00 00 00   no·%ul..........
00AA7BB0  43 6F 70 79 46 69 6C 65  20 53 75 63 63 65 73 73   CopyFile·Success
```

Click *Edit – Patch program – Change byte …*

Patch Bytes   ×

Address	0xAA7B48
File offset	0x6748
Original value	32 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00
Values	32 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00

OK Cancel Help

32 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00

Let's change the file to 'test3'.

33 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00

Click OK.

Click *Edit – Patch program – Apply patches to input file…*

Click OK.

Back in the IDA View0A tab, let's set a breakpoint on the next instruction after the call to *CopyFileW*.

```
.text:00AA1877                push    1               ; bFailIfExists
.text:00AA1879                push    offset NewFileName ; "C:\\temp\\test3.txt"
.text:00AA187E                push    offset ExistingFileName ; "C:\\temp\\test1.txt"
.text:00AA1883                call    ds:__imp__CopyFileW@12 ; CopyFileW(x,x,x)
.text:00AA1889                cmp     esi, esp
```

Let's look at the root of our hard drive.

📄 test3	9/27/2021 7:26 AM	Text Document	0 KB

Hooray! We have hacked our simple program and altered the new file name.

In our next chapter we will debug this program in x64.

Chapter 14: Debugging CopyFile x64

We are going to debug the 64-bit version of our CopyFile program.

In the IDA View-A text view we first see our *CopyFileW* function.

```
.text:000000014001187B          mov     r8d, 1              ; bFailIfExists
.text:0000000140011881          lea     rdx, NewFileName ; "C:\\temp\\test2.txt"
.text:0000000140011888          lea     rcx, ExistingFileName ; "C:\\temp\\test1.txt"
.text:000000014001188F          call    cs:__imp_CopyFileW
```

Here we are simply putting the value of *bFailIfExists* into *r8d* followed by the *NewFileName* into *rdx* and finally the *ExistingFileName* into *rcx*.

BEFORE we run make sure we delete the file **test2.txt** within C:\temp so we can proceed as if this was being run the first time.

Let's set a breakpoint directly after the call and run the Local Windows debugger.

NOTICE we see that **test2.text** was created.

This was a very simple debug as I have to take the time again to clearly state that our objective is to take SMALL steps so you can not get overwhelmed and have a full appreciation for what is going on at every step of these very popular Win32API calls.

In our next chapter we will hack this program in x64.

Chapter 15: Hacking CopyFile x64

We are going to hack the 64-bit version of our CopyFile program.

In this chapter we will hack the directory name this will continue to build our experience on custom hacking binaries.

```
.text:00007FF79C8C1881                    lea     rdx, NewFileName ; "C:\\temp\\test2.txt"
```
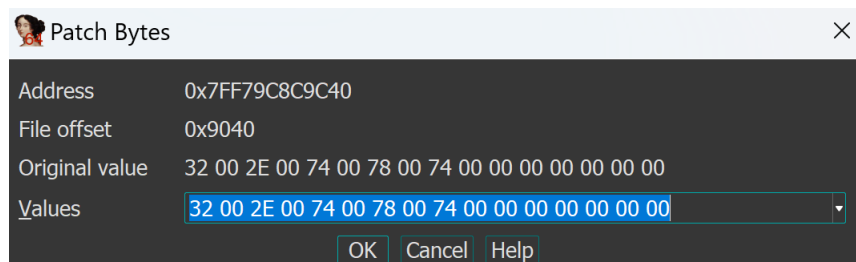
Here we see the *PathName* of *"C:\\temp\\test2.txt"*. Double-click to get to the .rdata section.

```
.rdata:00007FF79C8C9C28                    text "UTF-16LE", 'C:\temp\test2.txt',0
```

Select the Hex View-1 tab. Click on the *32*.

```
00007FF79C8C9C20   00 00 00 00 00 00 00 00   43 00 3A 00 5C 00 74 00   ........C.:.\.t.
00007FF79C8C9C30   65 00 6D 00 70 00 5C 00   74 00 65 00 73 00 74 00   e.m.p.\.t.e.s.t.
00007FF79C8C9C40   32 00 2E 00 74 00 78 00   74 00 00 00 00 00 00 00   2...t.x.t.......
00007FF79C8C9C50   00 00 00 00 00 00 00 00   43 00 3A 00 5C 00 74 00   ........C.:.\.t.
00007FF79C8C9C60   65 00 6D 00 70 00 5C 00   74 00 65 00 73 00 74 00   e.m.p.\.t.e.s.t.
00007FF79C8C9C70   31 00 2E 00 74 00 78 00   74 00 00 00 00 00 00 00   1...t.x.t.......
00007FF79C8C9C80   00 00 00 00 00 00 00 00   43 6F 70 79 46 69 6C 65   ........CopyFile
00007FF79C8C9C90   20 66 61 69 6C 65 64 20   26 20 65 72 72 6F 72 20   ·failed·&·error·
00007FF79C8C9CA0   6E 6F 20 25 75 6C 0A 00   00 00 00 00 00 00 00 00   no·%ul.........
00007FF79C8C9CB0   43 6F 70 79 46 69 6C 65   20 53 75 63 63 65 73 73   CopyFile·Success
```

Click *Edit – Patch program – Change byte …*

Patch Bytes		×
Address	0x7FF79C8C9C40	
File offset	0x9040	
Original value	32 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00	
Values	32 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00	
	OK Cancel Help	

32 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00

Let's change the file to 'test3'.

33 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00

Click OK.

Click *Edit – Patch program – Apply patches to input file…*

Click OK.

Back in the IDA View0A tab, let's set a breakpoint on the next instruction after the call to *CopyFileW*.

```
.text:00007FF79C8C187B                     mov     r8d, 1              ; bFailIfExists
.text:00007FF79C8C1881                     lea     rdx, NewFileName ; "C:\\temp\\test3.txt"
.text:00007FF79C8C1888                     lea     rcx, ExistingFileName ; "C:\\temp\\test1.txt"
.text:00007FF79C8C188F                     call    cs:__imp_CopyFileW
.text:00007FF79C8C1895                     mov     [rbp+0F0h+var_EC], eax
```

Let's look at the root of our hard drive.

📄 test3	9/27/2021 7:26 AM	Text Document	0 KB

Hooray! We have hacked our simple program and altered the new file name.

In our next chapter we discuss MoveFile.

Chapter 16: MoveFile

We continue with a simple app that handles the Windows MoveFile API which simply moves (renames) one file.

Let's create a new project

Create a new project
Empty Project
Next
Project name: 0x0010-movefile
CHECK Place solution and project in the same directory
Create

RT CLICK on the 0x0010-movefile in Solutions Explorer
Add
New Item…
main.c
OK

Now let's populate our **main.c** file with the following.

```c
#include <stdio.h>
#include <Windows.h>

int main(void)
{
        BOOL bFile;

        bFile = MoveFile(
                L"C:\\temp\\test1.txt",
                L"C:\\temp\\test2.txt"
        );
        if (bFile == FALSE)
        {
                printf("MoveFile failed and error no %ul\n", GetLastError());
        }
        else
        {
                printf("MoveFile Success!");
        }
}
```

Let's review the *MoveFileW* API below.

(VISIT https://docs.microsoft.com/en-us/windows/win32/api/winbase/nf-winbase-movefilew)

Here we see we have 2 parameters. The first, *lpExistingFileName*, is simply the existing file we want to copy. The second, *lpNewFileName*, is the name of the new file to which we will move the contents of the

original file to.

The return value is non-zero if the function succeeds otherwise it will return 0 and any relevant error information inside *GetLastError*.

We need to manually create the file **test1.txt** within [C:\temp](C:\temp) so you can use Notepad to do so now. Simply create the file and put any contents you like inside.

When we run the program it shows the following input.

```
MoveFile Success!

C:\Users\kevin\Documents\Hacking-Windows\0x0010-movefile\Debug\0x0010-movefile.exe (process
10480) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging-
>Automatically close the console when debugging stops.
Press any key to close this window . . .
```

In our next chapter we will debug this program in x86.

Chapter 17: Debugging MoveFile x86

We are going to debug the 32-bit version of our MoveFile program.

Since we have created a few projects together I assume you know what you are doing in IDA at this point. If this process is unfamiliar to you please re-read the prior chapters.

In the IDA View-A text view we first see a *_KERNEL32_NULL_THUNK_DATA* function.

```
.text:00411887                 push    offset NewFileName ; "C:\\temp\\test2.txt"
.text:0041188C                 push    offset ExistingFileName ; "C:\\temp\\test1.txt"
.text:00411891                 call    ds:_KERNEL32_NULL_THUNK_DATA
```

Wait! What?

Let's double-click and do more inspection.

```
.idata:0041B064 ; BOOL (__stdcall *KERNEL32_NULL_THUNK_DATA)(LPCWSTR lpExistingFileName, LPCWSTR lpNewFileName)
.idata:0041B064                 extrn _KERNEL32_NULL_THUNK_DATA:dword
.idata:0041B064                                 ; CODE XREF: _main+31↑p
.idata:0041B064                                 ; DATA XREF: MoveFileW(x,x)↑r ...
```

Here we do see this is actually calling MoveFileW as expected.

In our last chapter we reviewed the API in C. Here we first push the *lpNewFileName* param to the stack followed by the *lpExistingFileName* param and then we call the function.

Let's set a breakpoint directly after the call and run the Local Windows debugger.

NOTICE we see that our **test2.txt** file has been created.

In our next chapter we will hack this program in x86.

Chapter 18: Hacking MoveFile x86

We are going to hack the 32-bit version of our MoveFile program.

In this chapter we will hack the file name this will continue to build our experience on custom hacking binaries.

```
.text:00A21887                    push    offset NewFileName ; "C:\\temp\\test2.txt"
```
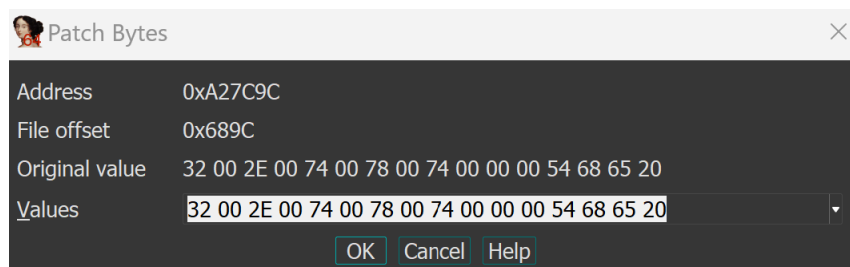
Here we see the *PathName* of *"C:\\temp\\test2.txt"*. Double-click to get to the .rdata section.

```
.rdata:00A27C84                    text "UTF-16LE", 'C:\temp\test2.txt',0
```

Select the Hex View-1 tab. Click on the *32*.

```
00A27C80  64 2E 00 00 43 00 3A 00  5C 00 74 00 65 00 6D 00  d...C.:.\.t.e.m.
00A27C90  70 00 5C 00 74 00 65 00  73 00 74 00 32 00 2E 00  p.\.t.e.s.t.2...
00A27CA0  74 00 78 00 74 00 00 00  54 68 65 20 76 61 6C 75  t.x.t...The·valu
```

Click *Edit – Patch program – Change byte …*

32 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00

Let's change the file to 'test3'.

33 00 2E 00 74 00 78 00 74 00 00 00 00 00 00 00

Click OK.

Click *Edit – Patch program – Apply patches to input file…*

Click OK.

Back in the IDA View0A tab, let's set a breakpoint on the next instruction after the call to *_KERNEL32_NULL_THUNK_DATA*.

```
.text:00A21887                 push    offset NewFileName ; "C:\\temp\\test3.txt"
.text:00A2188C                 push    offset ExistingFileName ; "C:\\temp\\test1.txt"
.text:00A21891                 call    ds:_KERNEL32_NULL_THUNK_DATA
.text:00A21897                 cmp     esi, esp
```

Let's look at the root of our hard drive.

📄 test3   9/27/2021 7:26 AM   Text Document   0 KB

Hooray! We have hacked our simple program and altered the new file name.

In our next chapter we will debug this program in x64.

Chapter 19: Debugging MoveFile x64

We are going to debug the 64-bit version of our MoveFile program.

In the IDA View-A text view we first see our *MoveFileW* function.

```
.text:000000014001187B                         lea     rdx, NewFileName ; "C:\\temp\\test2.txt"
.text:0000000140011882                         lea     rcx, ExistingFileName ; "C:\\temp\\test1.txt"
.text:0000000140011889                         call    cs:__imp_MoveFileW
```

Here we are simply putting the value of *NewFileName* into *rdx* and the *ExistingFileName* into *rcx*.

BEFORE we run make sure we rename the file **test2.txt** to **test1.txt** within C:\temp so we can proceed as if this was being run the first time.

Let's set a breakpoint directly after the call and run the Local Windows debugger.

NOTICE we see that **test2.txt** was the final renamed file.

This was a very simple debug as I have to take the time again to clearly state that our objective is to take SMALL steps so you can not get overwhelmed and have a full appreciation for what is going on at every step of these very popular Win32API calls.

In our next chapter we will hack this program in x64.