Didier Stevens

Saturday 20 April 2019

Extracting “Stack Strings” from Shellcode

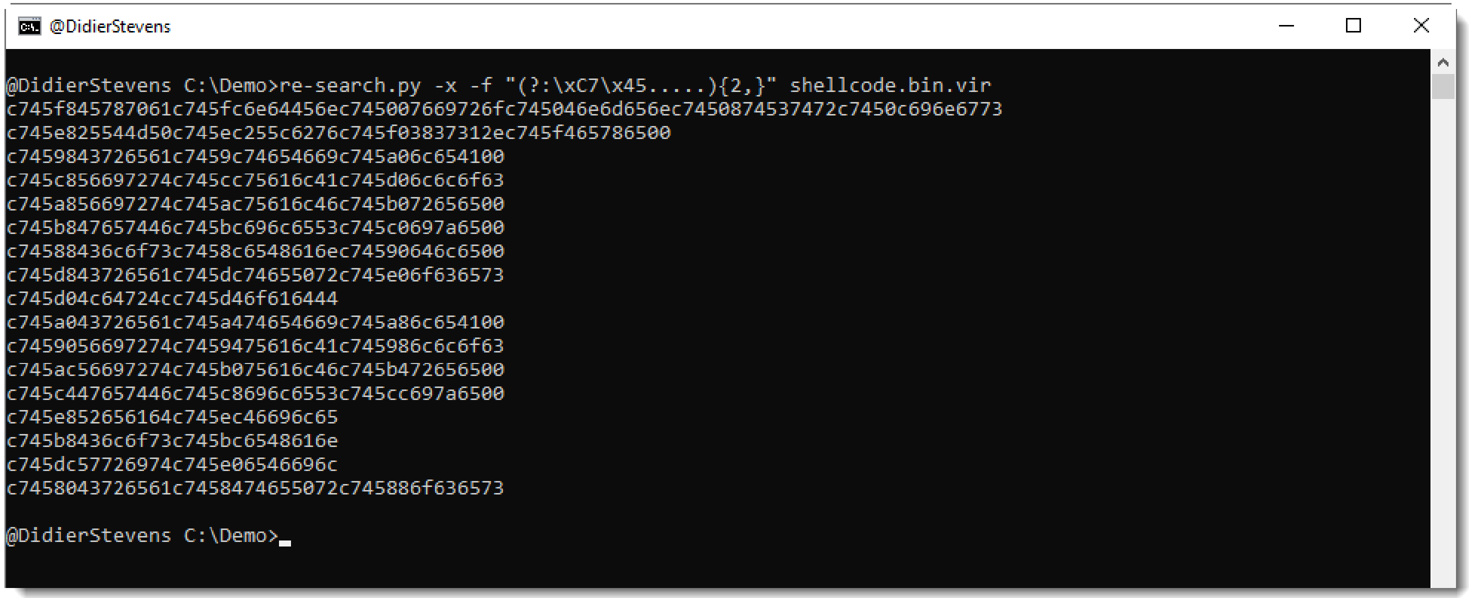
Filed under: Malware,My Software,Reverse Engineering — Didier Stevens @ 0:00

A couple of years ago, I wrote a Python script to enhance Radare2 listings: the script extract strings from stack frame instructions.

Recently, I combined my tools to achieve the same without a 32-bit disassembler: I extract the strings directly from the binary shellcode.

What I’m looking for is sequences of instructions like this: mov dword [ebp – 0x10], 0x61626364. In 32-bit code, that’s C7 45 followed by one byte (offset operand) and 4 bytes (value operand).

Or: C7 45 10 64 63 62 61. I can write a regular expression for this instruction, and use my tool re-search.py to extract it from the binary shellcode. I want at least 2 consecutive mov … instructions: {2,}.



```
@DidierStevens C:\Demo>re-search.py -x -f "(?:\xC7\x45.....){2,}" shellcode.bin.vir
c745f845787061c745fc6e64456ec745007669726fc745046e6d656ec7450874537472c7450c696e6773
c745e825544d50c745ec255c6276c745f03837312ec745f465786500
c7459843726561c7459c74654669c745a06c654100
c745c856697274c745cc75616c41c745d06c6c6f63
c745a856697274c745ac75616c46c745b072656500
c745b847657446c745bc696c6553c745c0697a6500
c74588436c6f73c7458c6548616ec74590646c6500
c745d843726561c745dc74655072c745e06f636573
c745d04c64724cc745d46f616444
c745a043726561c745a474654669c745a86c654100
c7459056697274c7459475616c41c745986c6c6f63
c745ac56697274c745b075616c46c745b472656500
c745c447657446c745c8696c6553c745cc697a6500
c745e852656164c745ec46696c65
c745b8436c6f73c745bc6548616e
c745dc57726974c745e06546696c
c7458043726561c7458474655072c745886f636573

@DidierStevens C:\Demo>
```

I’m using option -f because I want to process a binary file (re-search.py expects text files by default).

And I’m using option -x to produce hexadecimal output (to simplify further processing).

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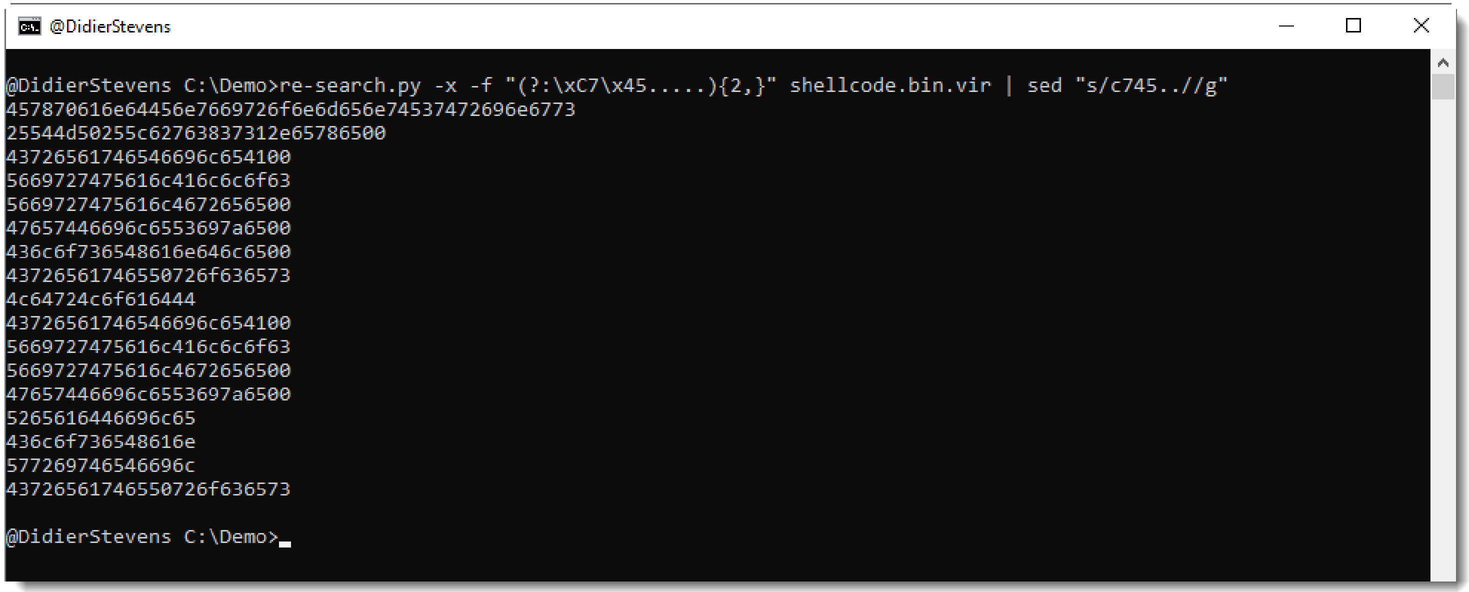
I want to get rid of the bytes for the instruction and the offset operand. I do this with sed:



```
@DidierStevens C:\Demo>re-search.py -x -f "(?:\xC7\x45.....){2,}" shellcode.bin.vir | sed "s/c745..//g"
457870616e64456e7669726f6e6d656e74537472696e6773
25544d50255c62763837312e65786500
43726561746546696c654100
5669727475616c416c6c6f63
5669727475616c4672656500
47657446696c6553697a6500
436c6f736548616e646c6500
43726561746550726f636573
4c64724c6f616444
43726561746546696c654100
5669727475616c416c6c6f63
5669727475616c4672656500
47657446696c6553697a6500
5265616446696c65
436c6f736548616e
577269746546696c
43726561746550726f636573

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```
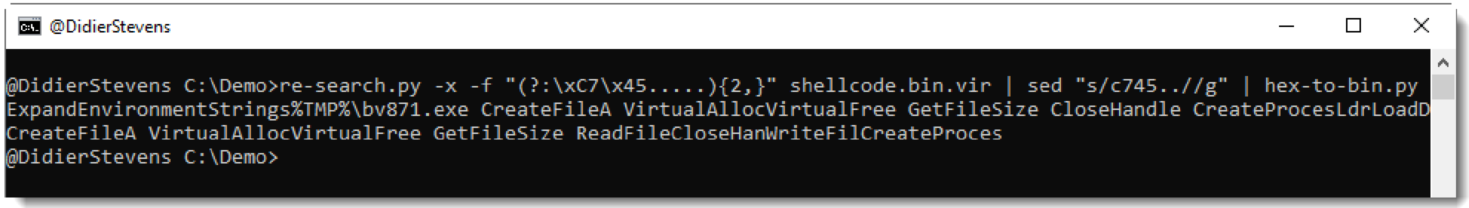

I could convert this back to text with my tool hex-to-bin.py:



```
@DidierStevens C:\Demo>re-search.py -x -f "(?:\xC7\x45.....){2,}" shellcode.bin.vir | sed "s/c745..//g" | hex-to-bin.py
ExpandEnvironmentStrings%TMP%\bv871.exe CreateFileA VirtualAllocVirtualFree GetFileSize CloseHandle CreateProcesLdrLoadD
CreateFileA VirtualAllocVirtualFree GetFileSize ReadFileCloseHanWriteFilCreateProces
@DidierStevens C:\Demo>
```

But that’s not ideal, because now all characters are merged into a single line.

My tool python-per-line.py gives a better result by processing this hexadecimal input line per line:

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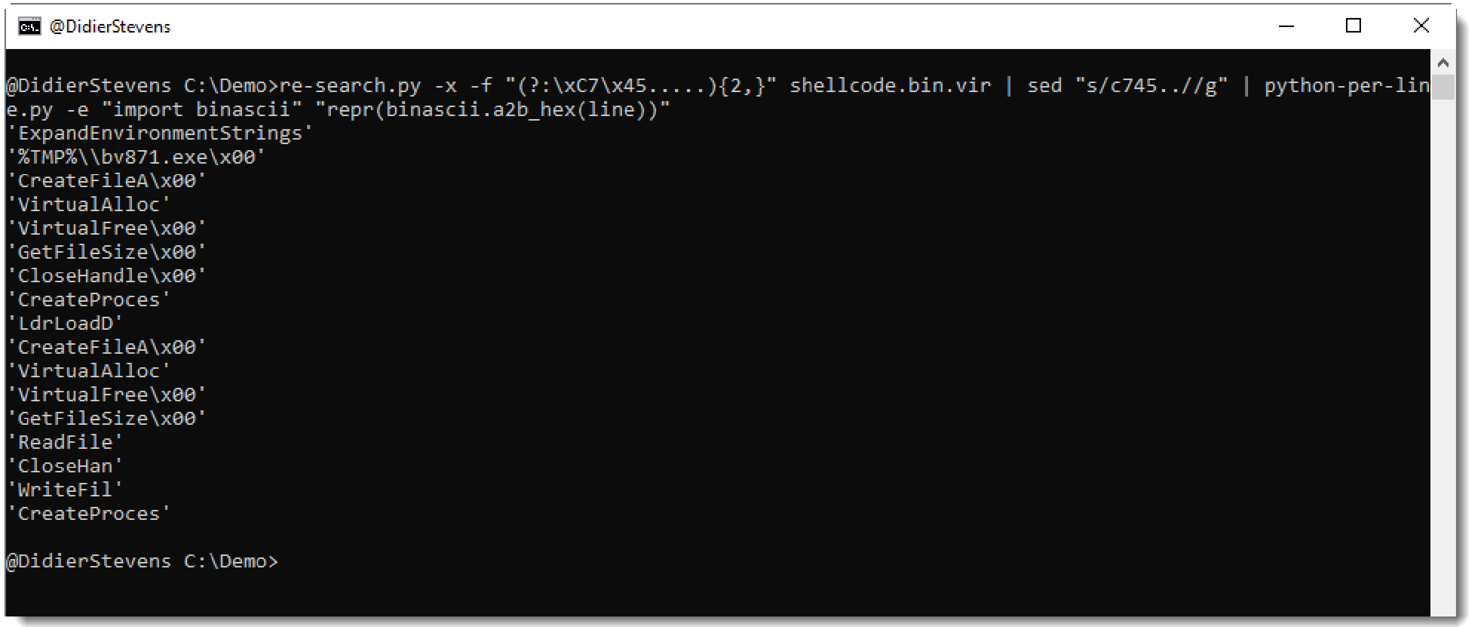

```
@DidierStevens C:\Demo>re-search.py -x -f "(?:\xC7\x45.....){2,}" shellcode.bin.vir | sed "s/c745..//g" | python-per-line.py -e "import binascii" "repr(binascii.a2b_hex(line))"
'ExpandEnvironmentStrings'
'%TMP%\\bv871.exe\x00'
'CreateFileA\x00'
'VirtualAlloc'
'VirtualFree\x00'
'GetFileSize\x00'
'CloseHandle\x00'
'CreateProces'
'LdrLoadD'
'CreateFileA\x00'
'VirtualAlloc'
'VirtualFree\x00'
'GetFileSize\x00'
'ReadFile'
'CloseHan'
'WriteFil'
'CreateProces'

@DidierStevens C:\Demo>
```

Remark that I also use function repr to escape unprintable characters like 00.

This output provides a good overview of all API functions called by this shellcode.

If you take a close look, you'll notice that the last strings are incomplete: that's because they are missing one or two characters, and these are put on the stack with another mov instruction for single or double bytes. I can accommodate my regular expression to take these instructions into account:

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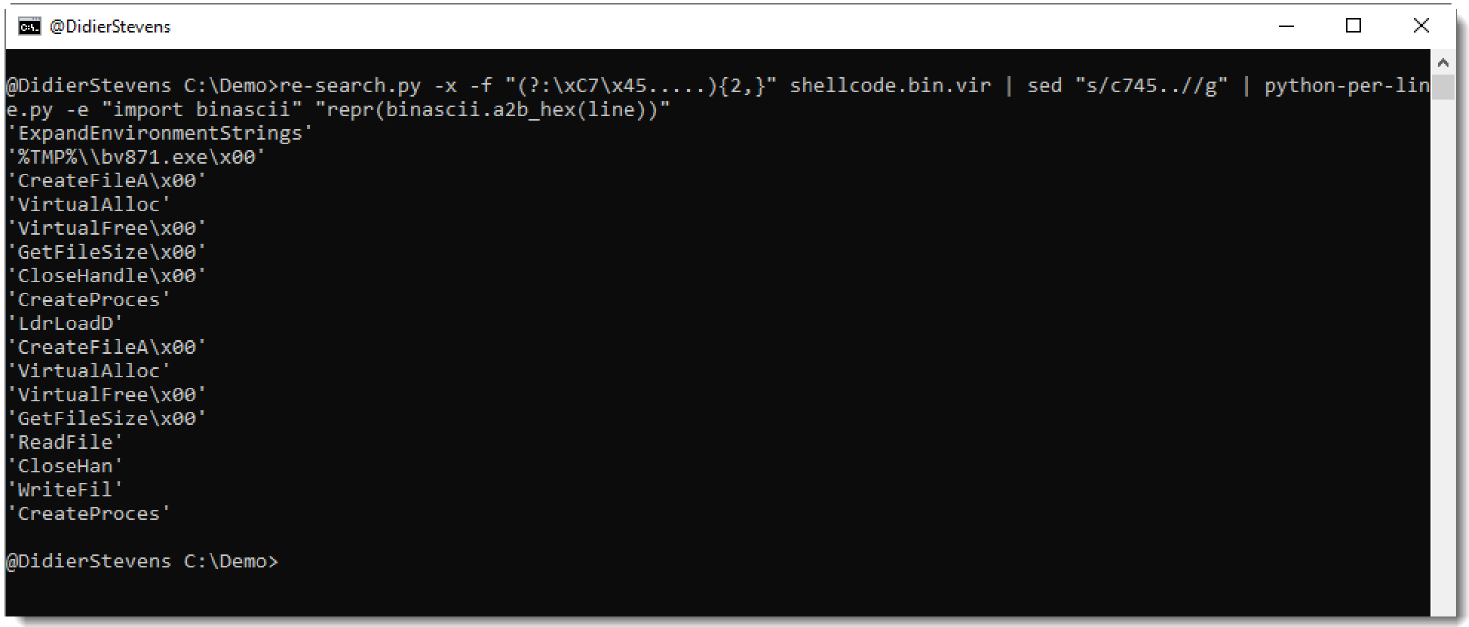

```
@DidierStevens C:\Demo>re-search.py -x -f "(?:\xC7\x45.....){2,}" shellcode.bin.vir | sed "s/c745..//g" | python-per-line.py -e "import binascii" "repr(binascii.a2b_hex(line))"
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'%TMP%\\bv871.exe\x00'
'CreateFileA\x00'
'VirtualAlloc'
'VirtualFree\x00'
'GetFileSize\x00'
'CloseHandle\x00'
'CreateProces'
'LdrLoadD'
'CreateFileA\x00'
'VirtualAlloc'
'VirtualFree\x00'
'GetFileSize\x00'
'ReadFile'
'CloseHan'
'WriteFil'
'CreateProces'

@DidierStevens C:\Demo>
```

This is the complete command:

```
re-search.py -x -f "(?:\xC7\x45.....){2,}(?:(?:\xC6\x45..)|(?:\x66\xC7\x45...))?" shellcode.bin.vir | sed "s/66c745..//g" | sed "s/c[67]45..//g" | python-per-line.py -e "import binascii" "repr(binascii.a2b_hex(line))"
```

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