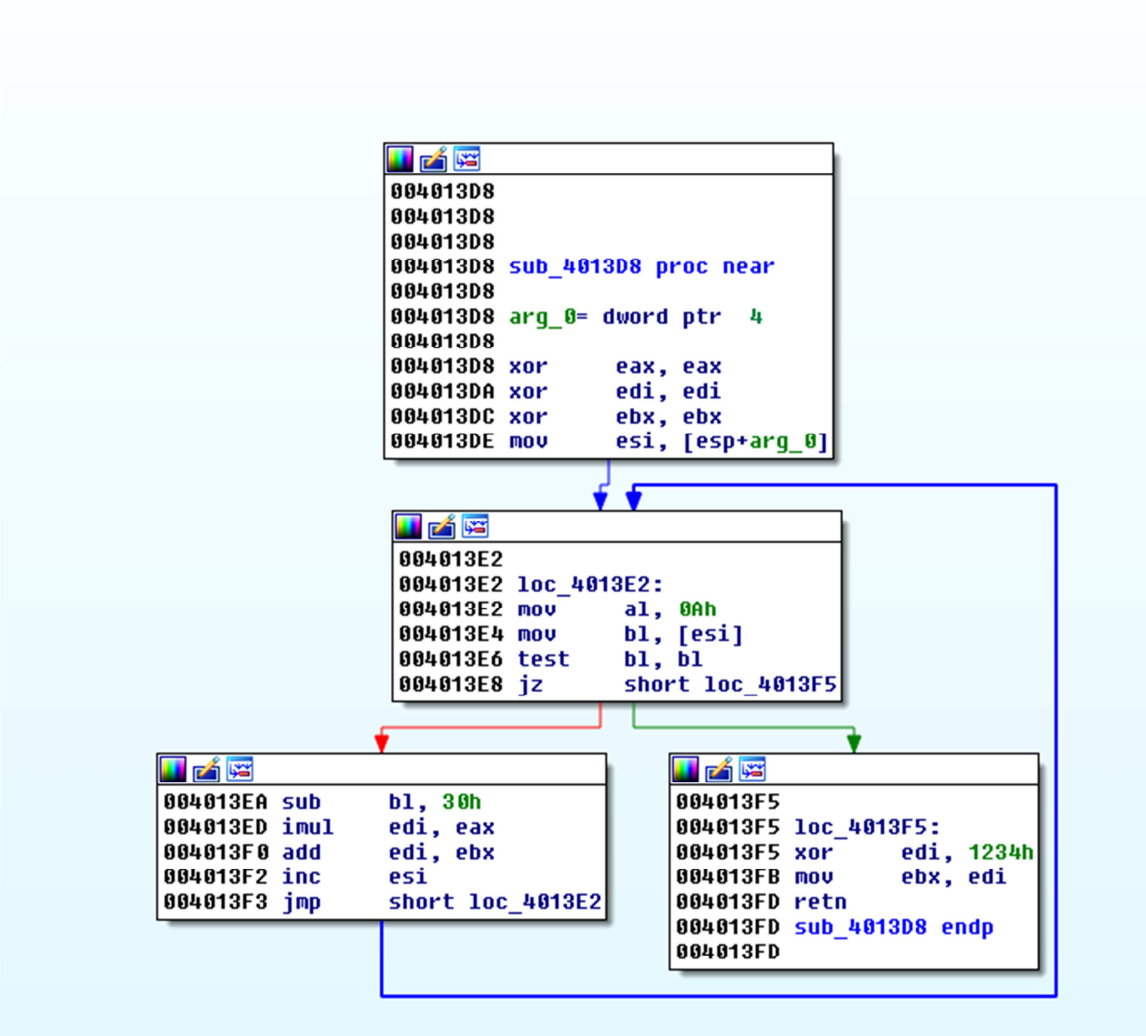
PART 4

Let's continue practicing the data transfer instructions in IDA.

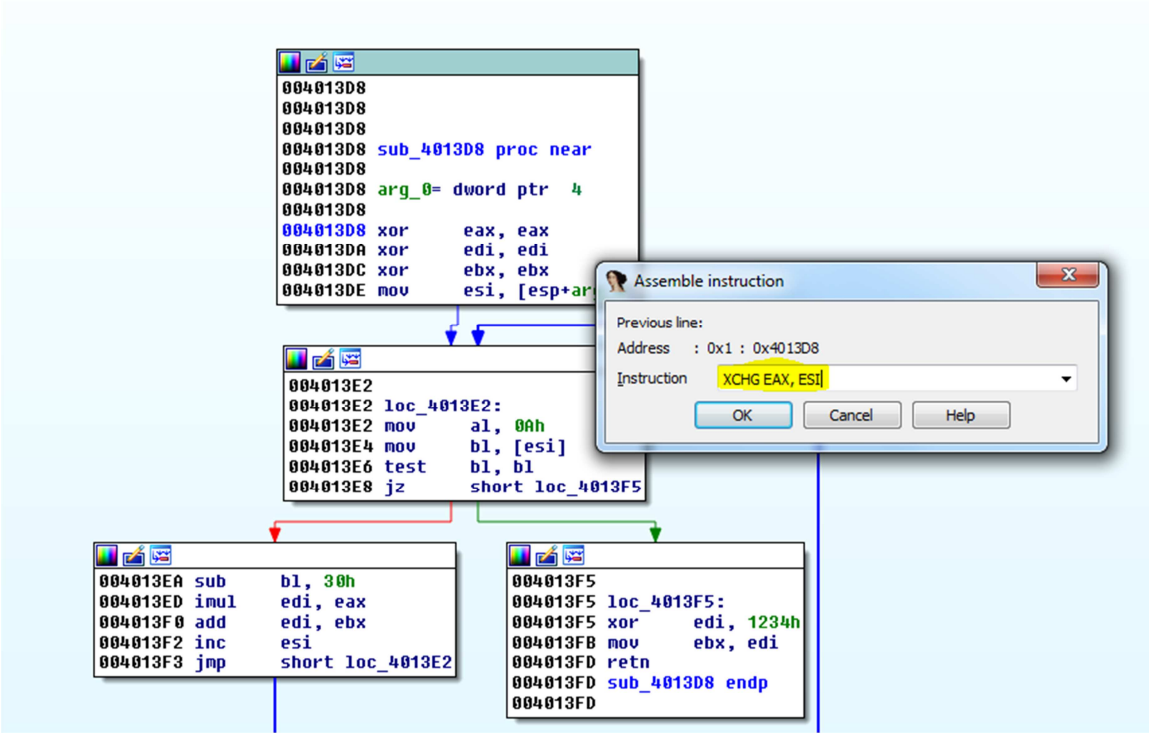
XCHG A, B

Interchange the value of A with the value of B. Let's see some example.

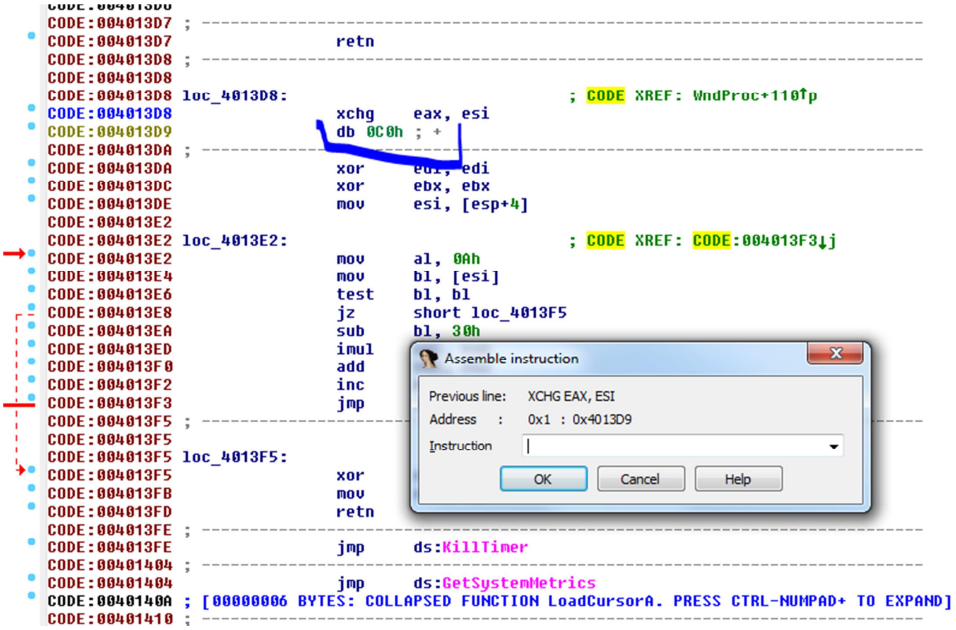


As there is no XCHG in VEVIEWER. I load Cruehead's CRACKME.exe and I will change the instruction in 0x4013D8.

I place the cursor on that line and go to Menu EDIT-PATCH PROGRAM-ASSEMBLE



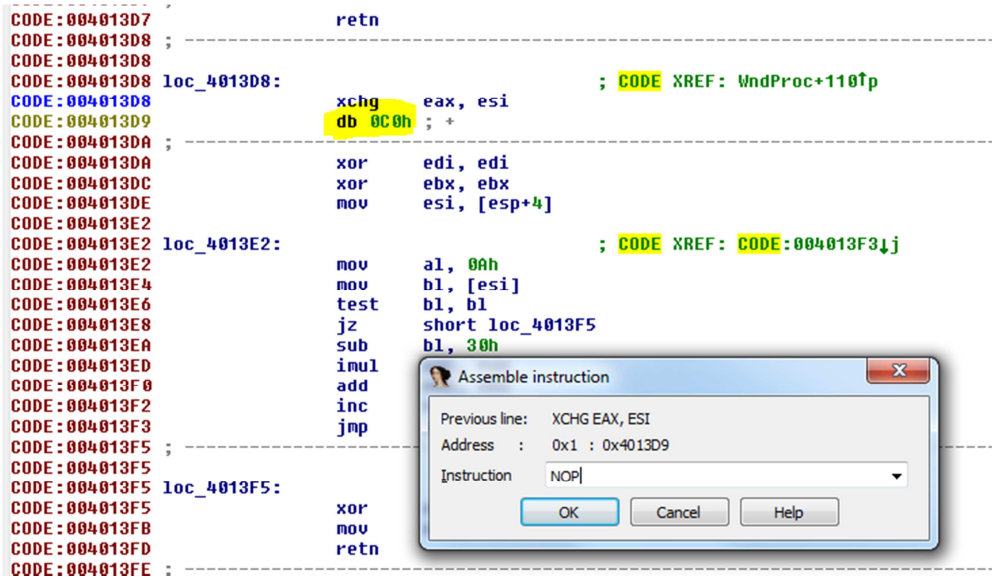
The function broke down.



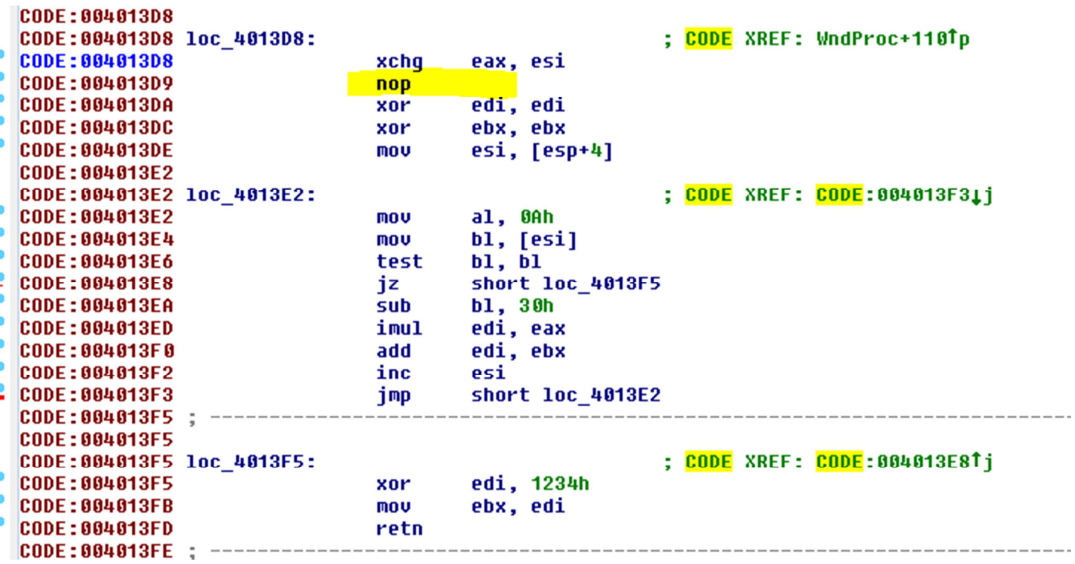
Because we have already seen that if there is no a known instruction, that zone is shown as data.

In this case, it is just 1 byte. As there are no references in any part of the program, there is no info on the right side of the address. Then, the data type that is **db**. Just 1 byte and its value is **0xC0** here.

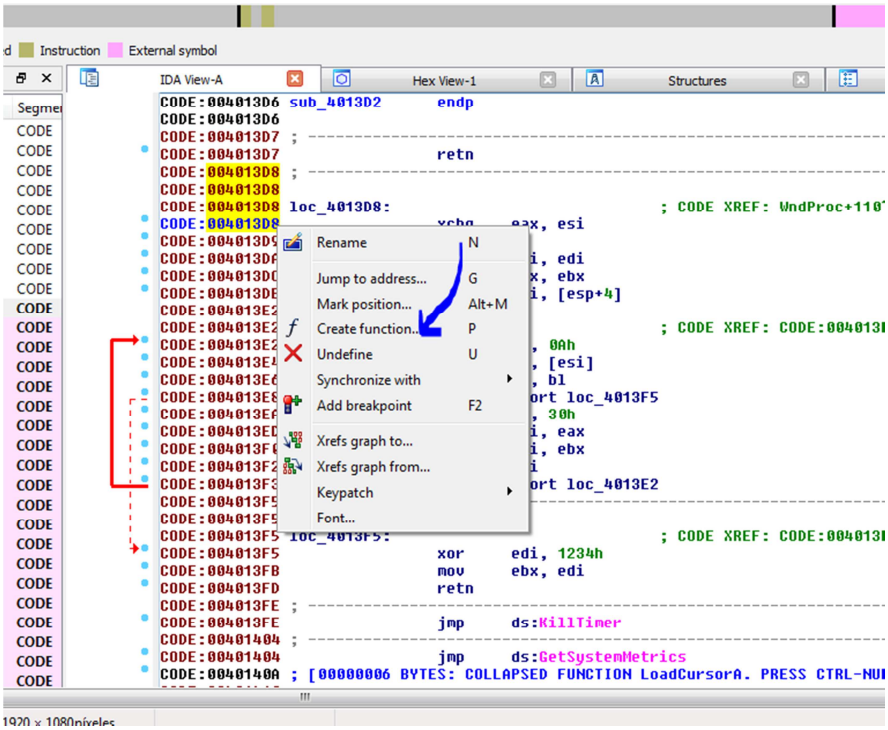
If we write the NOP instruction, that means NO OPERATION or a filling instruction that does nothing, to replace that **0xC0**.



There's the NOP.



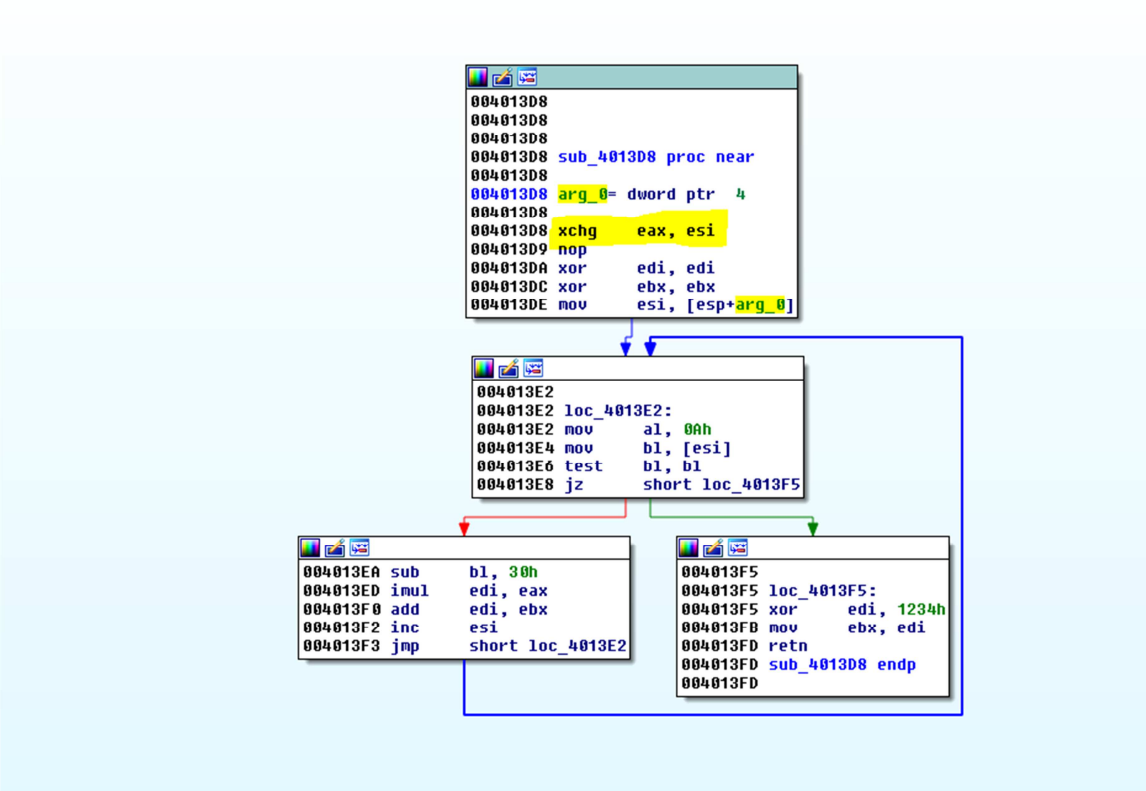
Everything’s nice, but the function broke down. If there are unknown parts like code in the middle, it won’t create it, but now that the code is OK, we right click on where it was the start of the function 0x4013D8 and there we select CREATE FUNCTION.



And it changes the prefix **loc**_ that means “common instruction” for the prefix **sub**_ that means “start of a subroutine or function.”

```
CODE:004013D8 ; ---------- S U B R O U T I N E ----------
CODE:004013D8
CODE:004013D8
CODE:004013D8 sub_4013D8      proc near               ; CODE XREF: WndProc+110↑p
CODE:004013D8
CODE:004013D8 arg_0           = dword ptr  4
CODE:004013D8
CODE:004013D8                 xchg    eax, esi
CODE:004013D9                 nop
CODE:004013DA                 xor     edi, edi
CODE:004013DC                 xor     ebx, ebx
CODE:004013DE                 mov     esi, [esp+arg_0]
CODE:004013E2
CODE:004013E2 loc_4013E2:                             ; CODE XREF: sub_4013D8+1B↓j
CODE:004013E2                 mov     al, 0Ah
CODE:004013E4                 mov     bl, [esi]
CODE:004013E6                 test    bl, bl
CODE:004013E8                 jz      short loc_4013F5
CODE:004013EA                 sub     bl, 30h
CODE:004013ED                 imul    edi, eax
CODE:004013F0                 add     edi, ebx
CODE:004013F2                 inc     esi
CODE:004013F3                 jmp     short loc_4013E2
CODE:004013F5 ; ---------------------------------------------------------------------------
CODE:004013F5
CODE:004013F5 loc_4013F5:                             ; CODE XREF: sub_4013D8+10↑j
CODE:004013F5                 xor     edi, 1234h
CODE:004013FB                 mov     ebx, edi
CODE:004013FD                 retn
CODE:004013FD sub_4013D8      endp
CODE:004013FD
CODE:004013FE ; ---------------------------------------------------------------------------
CODE:004013FE                 jmp     ds:KillTimer
CODE:00401404 ; ---------------------------------------------------------------------------
CODE:00401404                 jmp     ds:GetSystemMetrics
CODE:00401400 ; [00000006 BYTES: COLLAPSED FUNCTION LoadCursorA. PRESS CTRL-NUMPAD+ TO EXPAND]
CODE:00401410 ; ---------------------------------------------------------------------------
CODE:00401410                 jmp     ds:LoadAcceleratorsA
CODE:00401416 ; [00000006 BYTES: COLLAPSED FUNCTION MessageBeep. PRESS CTRL-NUMPAD+ TO EXPAND]
CODE:0040141C ; ---------------------------------------------------------------------------
CODE:0040141C                 jmp     ds:GetWindowRect
CODE:00401422 ; ---------------------------------------------------------------------------
CODE:00401422                 jmp     ds:LoadStringA
CODE:00401428 ; [00000006 BYTES: COLLAPSED FUNCTION LoadIconA. PRESS CTRL-NUMPAD+ TO EXPAND]
CODE:0040142E ; ---------------------------------------------------------------------------
```

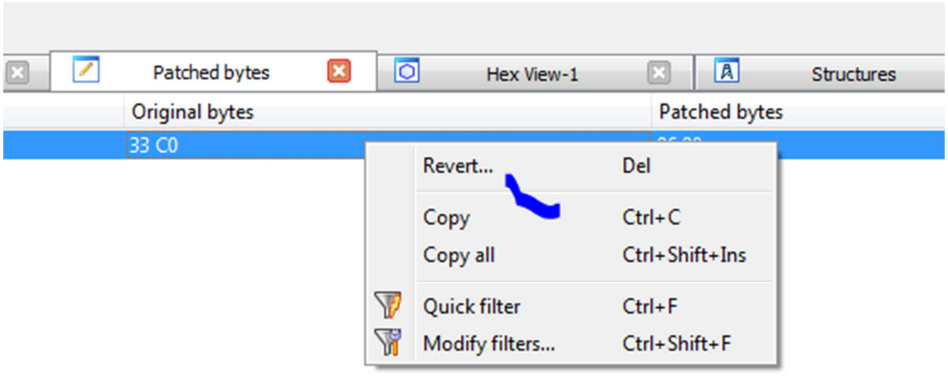
Now that it is a function, if it is not in graphic mode, we press the space bar.



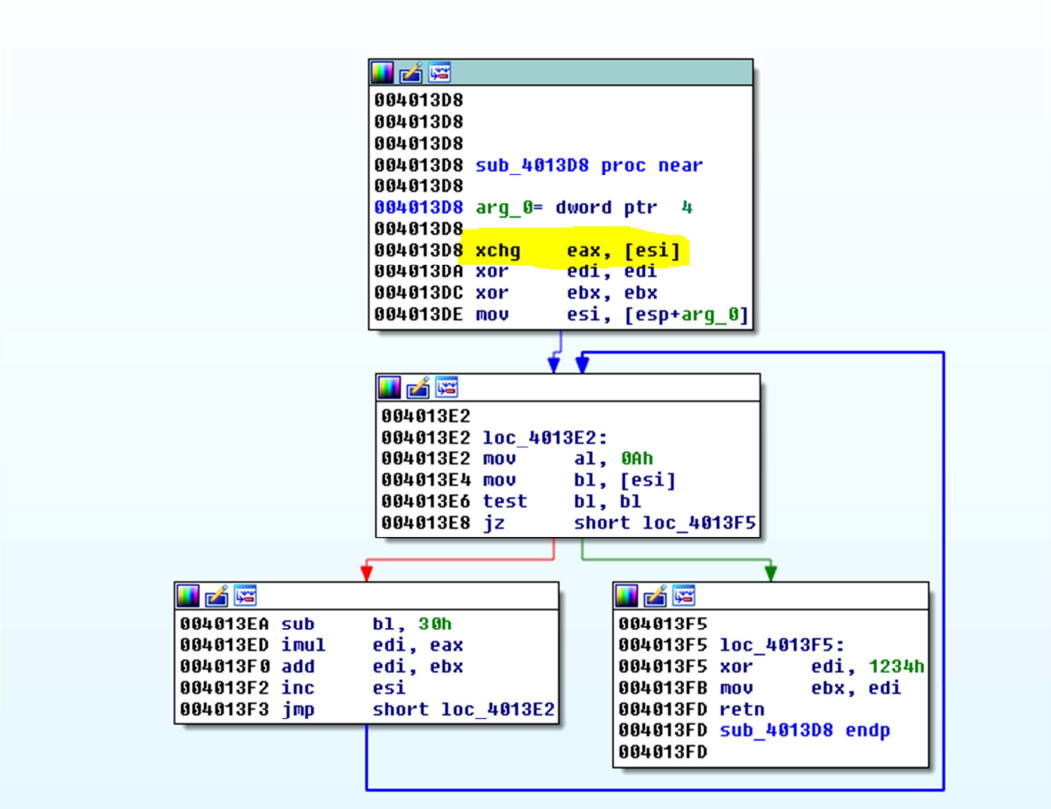
It looks better now and with our XCHG there.

We saw that if EAX equals 12345678 and ESI equals 55 when executing the XCHG the register EAX equals 55 and ESI equals 12345678 in this example.

As a comment, we see that in the PATCH menu there is an item called PATCHED BYTES that shows the changes and it can be reverted to the original ones.



XCHG can also interchange values between a register and the content of a register that points to a memory position.



In this case, the ESI value and it will search for the content in that memory position and it will interchange it for the EAX value that will be saved in that memory position if it has write permission.

If EAX equals 55 and ESI equals 0x10000, it will check what there is in that memory position and if it is writable, it will save there the 55 and it will read the value that was there and it will put it in EAX.

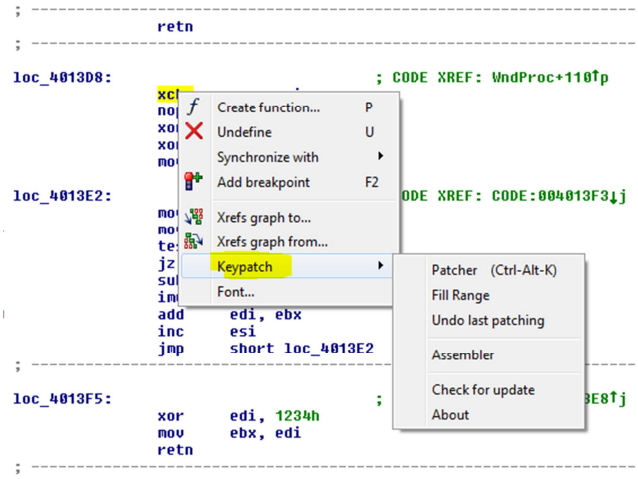
What happens if we do the same thing but instead of using a register we use a numerical memory position as we did in the MOV?

As the ASSEMBLE command doesn't work completely for all instructions, we should change the bytes there in the menu where it says PATCH BYTES, but it is better to download a plugin like the keystone that let us write all the instruction in an easy way.

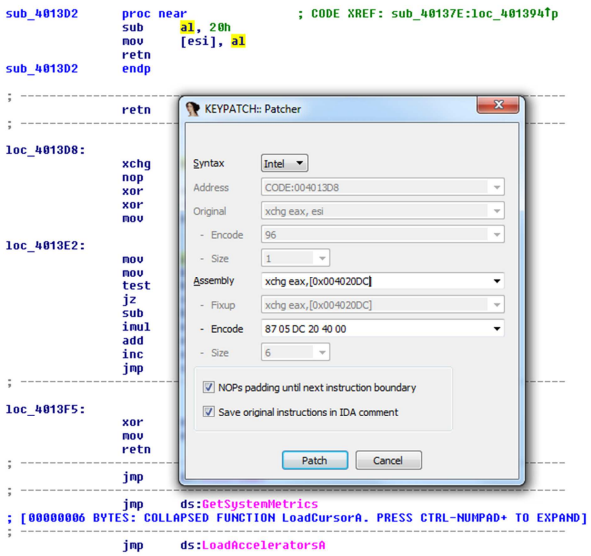
https://github.com/keystone-engine/keypatch

https://drive.google.com/file/d/0B13TW0I0f8O2eU1VdUJzVjdYTWs/view?usp=sharing

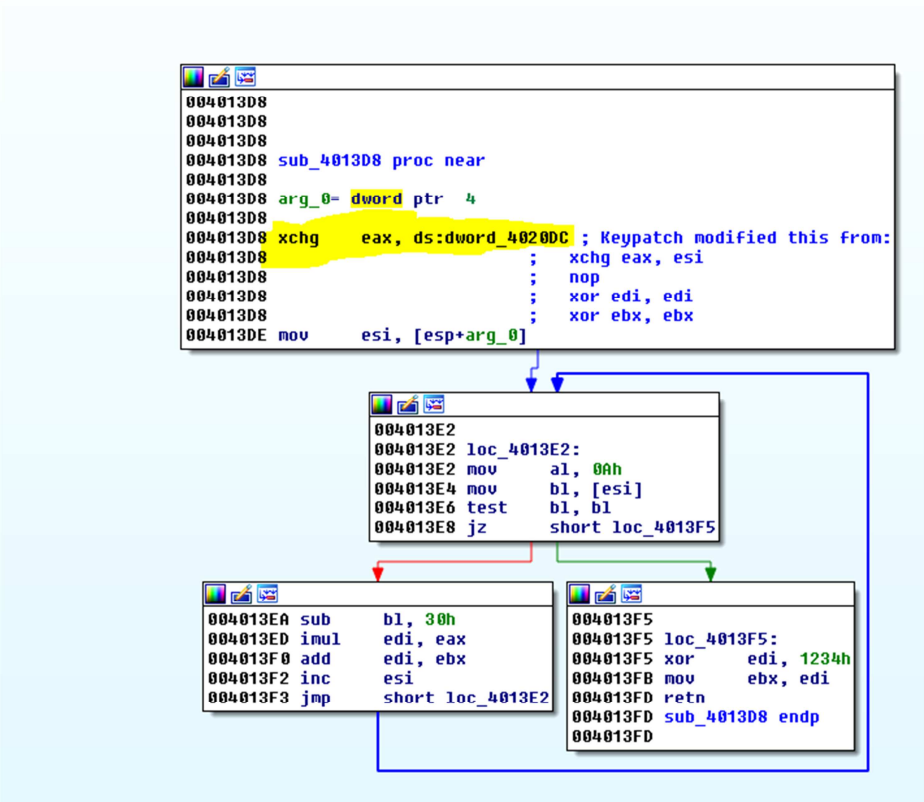
In the second link is the keypatch.py file that we must copy in the IDA plugin folder and the keystone-0.9.1-python-win32.msi setup we have to install.



If we select PATCHER, we see that if we write the instruction in the easiest way and with brackets, it will write it and transform it into IDA syntax.



And here is the result…



As in the MOV when it shows the prefix dword_ without OFFSET before it means that it interchanges the content of 0x4020DC for the EAX value.

STACK BASED TRANSFER SPECIFIC INSTRUCTIONS

WHAT IS THE STACK?

A stack is a memory section in which the access mode is FILO that means **First In, Last Out**. It permits to save and recover data.

.For the data handling, there are two basic operations: **PUSH** that places an object on the stack and its inverse operation **POP** the takes out the last pushed element.

At each moment, it only has access to the top of the stack or the last pushed object.

The **POP** operation gets this element that is popped from the stack permitting the access to the one that was below (pushed previously) that comes to be the last pushed object.

In the CRACKME.EXE, we see examples of both instructions.

```
0040101D mov     ds:WndClass.style, 4003h
00401027 mov     ds:WndClass.lpfnWndProc, offset WndProc
00401031 mov     ds:WndClass.cbClsExtra, 0
0040103B mov     ds:WndClass.cbWndExtra, 0
00401045 mov     eax, ds:hInstance
0040104A mov     ds:WndClass.hInstance, eax
0040104F push    64h             ; lpIconName
00401051 push    eax             ; hInstance
00401052 call    LoadIconA
00401057 mov     ds:WndClass.hIcon, eax
0040105C push    7F00h           ; lpCursorName
00401061 push    0               ; hInstance
00401063 call    LoadCursorA
00401068 mov     ds:WndClass.hCursor, eax
0040106D mov     ds:WndClass.hbrBackground, 5
00401077 mov     ds:WndClass.lpszMenuName, offset aMenu ; "MENU"
00401081 mov     ds:WndClass.lpszClassName, offset ClassName ; "No need to di:
0040108B push    offset WndClass ; lpWndClass
00401090 call    RegisterClassA
00401095 push    0               ; lpParam
00401097 push    ds:hInstance    ; hInstance
0040109D push    0               ; hMenu
0040109F push    0               ; hWndParent
004010A1 push    8000h           ; nHeight
004010A6 push    8000h           ; nWidth
004010AB push    6Eh             ; Y
004010AD push    0B4h            ; X
004010B2 push    0CF0000h        ; dwStyle
004010B7 push    offset WindowName ; "CrackMe v1.0"
004010BC push    offset ClassName ; "No need to disasm the code!"
004010C1 push    0               ; dwExStyle
004010C3 call    CreateWindowExA
004010C8 mov     ds:hWnd, eax
004010CD push    1               ; nCmdShow
004010CF push    ds:hWnd         ; hWnd
004010D5 call    ShowWindow
004010DA push    ds:hWnd         ; hWnd
004010E0 call    UpdateWindow
004010E5 push    1               ; bErase
004010E7 push    0               ; lpRect
004010E9 push    dword ptr [ebp+8] ; hWnd
004010EC call    InvalidateRect
```

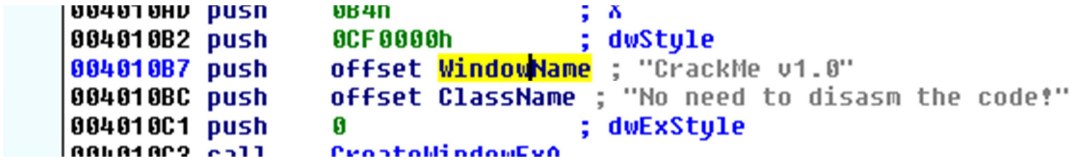
Commonly, in 32 bits, the **PUSH** is used to send function arguments to the stack before calling it with a CALL. In the picture above, we see that example in 0x40104F.

PUSH 64 places the dword 64 on the top of the stack, then **PUSH EAX** places the **EAX** value on the dword **64** saving it and so the **EAX** value will be the top of the stack now.

ESP → EAX value

→ 0x64

There, we see different PUSH types. We can push constants, but we can also push memory addresses as in this case.

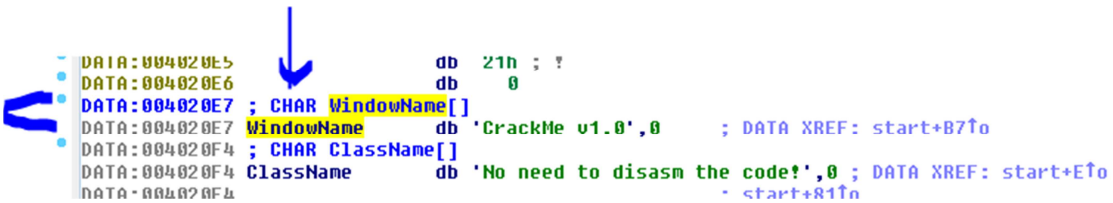


We see the word OFFSET before the TAG that belongs to a string. There, it would push the address whose content is a string or character array.

If we double click on the tag that represents the string name WindowName.

In C source code, an array of characters could be this way:

char mystring[] = "Hello";



Here, it uses two lines for the variable description.

char WindowName[] is there because it detect from the api CreateWindow that receives the argument that must be an LPCTSTR that is a char[] and that argument is a string called WindowName.

CreateWindow function

Creates an overlapped, pop-up, or child window. It specifies the window class, wind
The function also specifies the window's parent or owner, if any, and the window's r

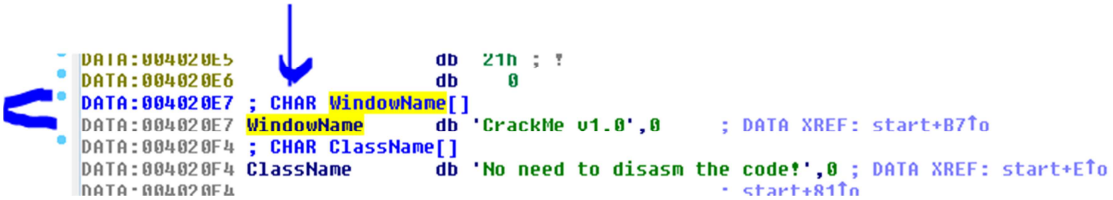
To use extended window styles in addition to the styles supported by **CreateWindo**

Syntax

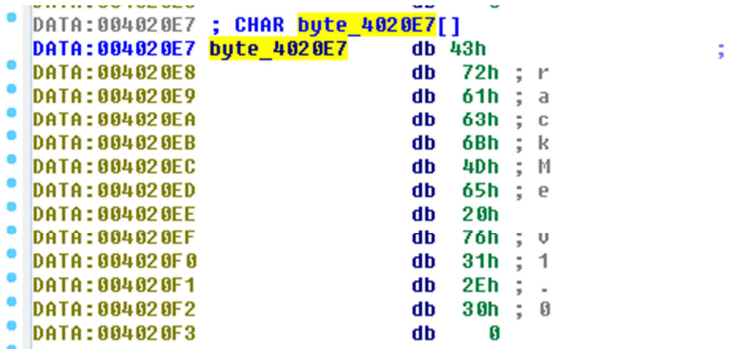
C++

```
HWND WINAPI CreateWindow(
  _In_opt_ LPCTSTR   lpClassName,
  _In_opt_ LPCTSTR   lpWindowName,
  _In_     DWORD     dwStyle,
  _In_     int       x,
  _In_     int       y,
  _In_     int       nWidth,
  _In_     int       nHeight,
  _In_opt_ HWND      hWndParent,
  _In_opt_ HMENU     hMenu,
  _In_opt_ HINSTANCE hInstance,
  _In_opt_ LPVOID    lpParam
);
```

Anyways, it is an array of characters or bytes and IDA adds it a little more info that it gets from the api. After 0x4020E7, the next address in the disassembly is 0x4020F4. There are some consecutive bytes that belong to the string characters of “Crackme v1.0” and the 0 that delimits the final of the string.

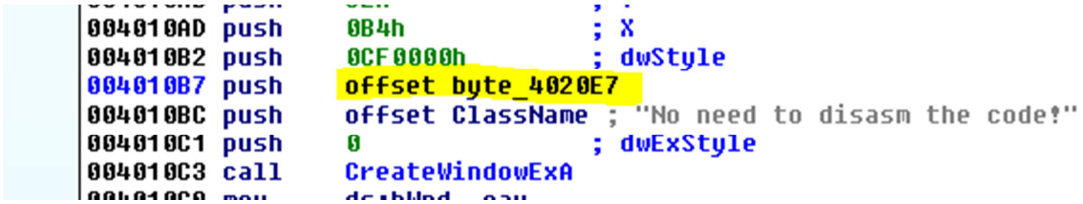


If we press D to change the data type on WindowName, we can make it stop detecting it as a character array and stay as **db** o byte.



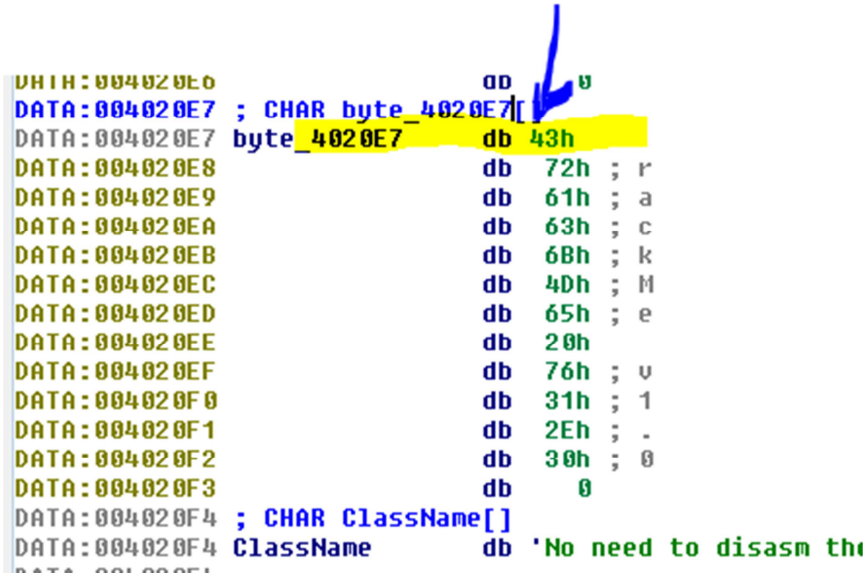
They are the same bytes that belong to the string Crackme v1.0…

The original instruction that it changed is in the reference, obviously, the word offset before keeps **0x4020E7** as a pushable value, but now that the content stopped being a character array and it is a byte now, the instruction changed to…



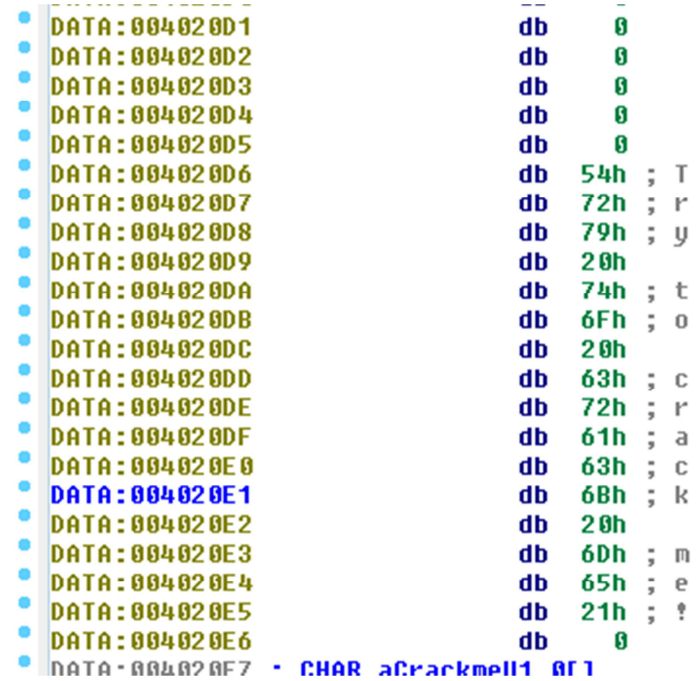
push offset byte_4020e7

Because when it looks for the content of 0x4020E7 to tell us what it is, there is a **db**, that is to say, a variable changed by us into just a byte.



Pressing **A** that is an ASCII string it shows it as before.

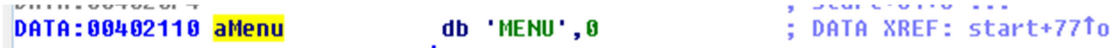
We do the same if when we work we see any string as separated bytes.



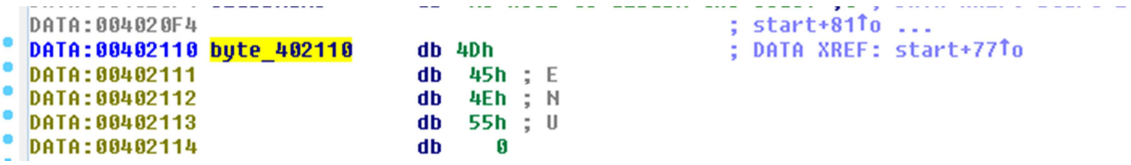
We go to the start of it and press A and it will look better.

In this case, there is a string that is not defined in two lines as the previous one and it doesn't say it is a CHAR[], but it is just defined with a tag that starts with the letter **a** for being an ASCII string. In the previous case, it showed extra info because it detected that it was an api argument or system function and it told it that argument should be a **char[]** and that's why it add it there, but a normal string will look like this last one.

There, we see other string.

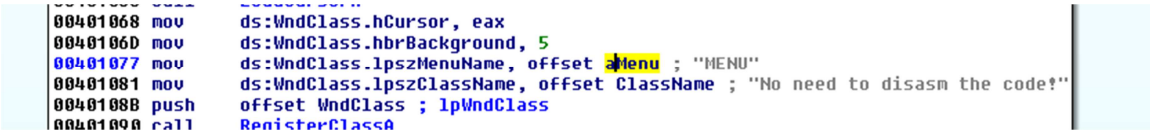


In 0x402110, the first byte of it can be separated pressing D in **aMenu.**



If we press A, we revert the changes.

If I press X to look for the reference and I see where it uses that string…

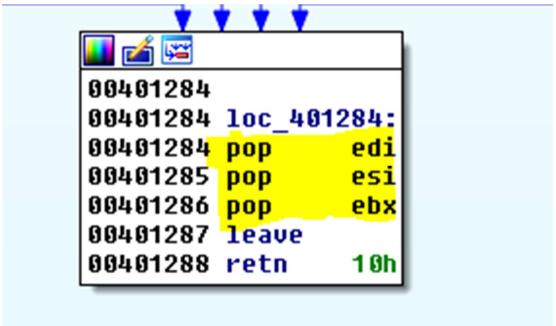


We realize that it saves the address 0x402110 because it adds OFFSET before it.

Normally, when adding arguments to functions, we'll always see the **PUSH offset xxxxx** because the idea is adding the address where the string is if it did not have the word offset, we would push the content of the address 0x402110 that is the bytes 55 4E 45 4D of the same string and the api's don't work like that. They always receive the pointer or address to the start or where the string starts.

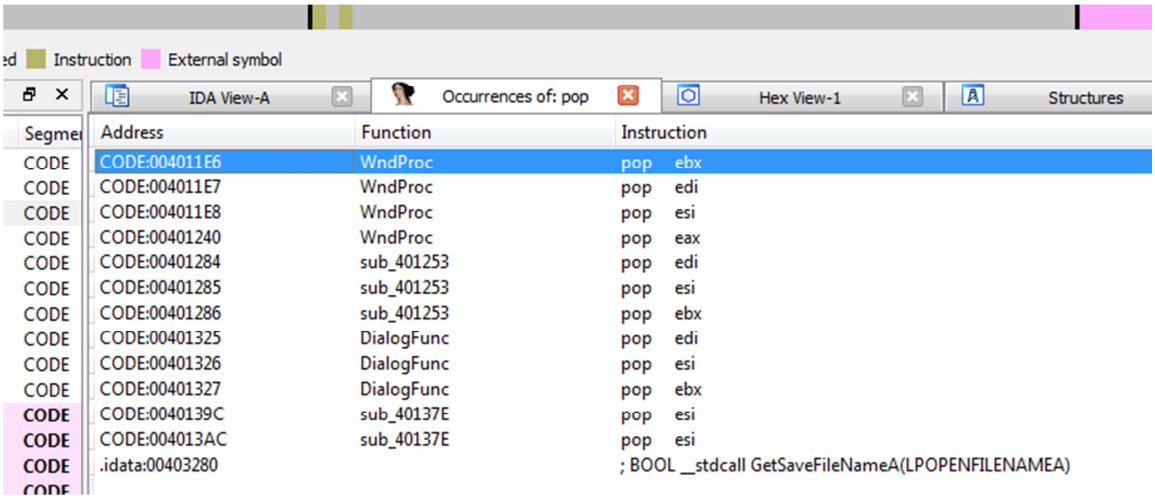
In the above instruction, we see the prefix DS:TAG that indicates it is going to save it in a memory address of the data section (DS=DATA). When we see structures, we will study that case. Now, the important thing is that it saves the address of the string start in the DATA section.

POP



It is the operation that reads the top of the stack and moves it to the destination register, in this case, POP EDI will read the first value or top of the stack and it will copy in EDI and then it will point ESP to the value that was below and it will become the top of the stack.

If we search as text the word POP, we see that there are no many variants in spite of that there is the possibility of POPPING to a memory address instead of a register, this option is not that used.



We will continue with more instructions in part 5 to be able to study the LOADER function.

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Translated by: @IvinsonCLS