CSec15233
Malicious Software Analysis

IDA Pro

Qasem Abu Al-Haija

IDA Pro Introduction

- The Interactive Disassembler (IDA) (Help Index).
  - https://hex-rays.com/ida-free/#download

- Extremely powerful disassembler by HexRays.

- The disassembler of choice for:
  - Malware analysts,
  - Reverse engineers, and
  - Vulnerability analysts.

IDA Pro Introduction

- Supports several PE file formats and some others.
  - Such as Executable and Linking Format (ELF).
- Disassembles an entire program and performs several tasks such as:
  - Function Discovery, Stack Analysis, Local Variable Identification,... etc.
- Alternative: radare2

IDA Pro Versions

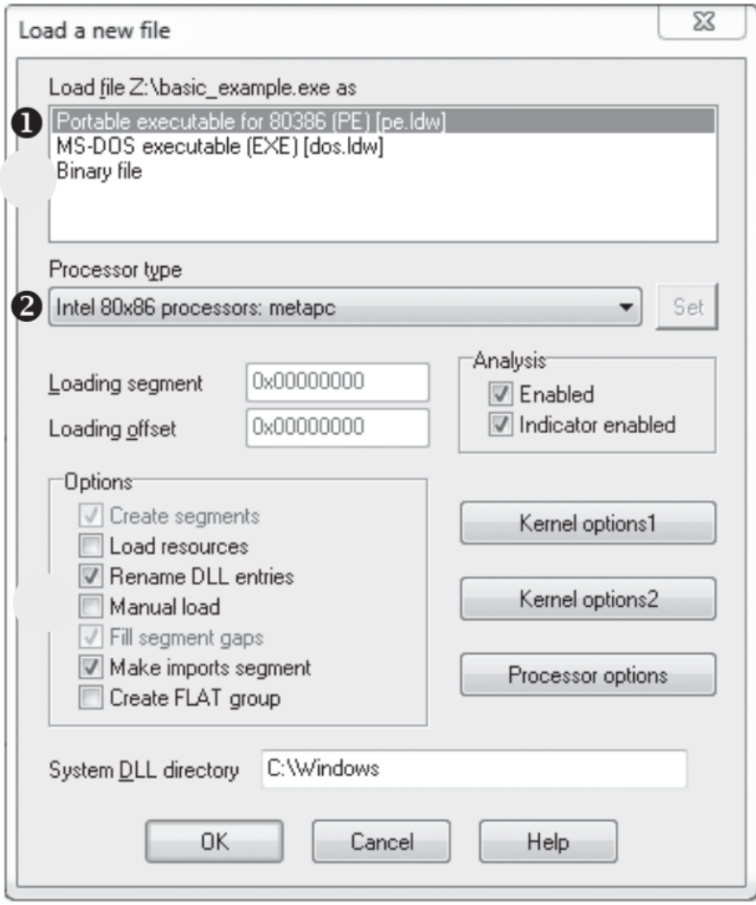
- Two versions of IDA Pro are commercially available
  - Full-featured pay version and Old free version
  - Both support x86
  - Pay version supports x64 and other processors, such as cell phone processors.
  - Both have code signatures for common library code in FLIRT
  - FLIRT: Fast Library Identification and Recognition Technology
  - This allows it to recognize and label a disassembled function, especially library code added by a compiler.

Loading an Executable

- When you load an executable on IDA Pro:

  - IDA Pro will try to recognize the file's format and processor architecture.

  - For example (Figure), the file is recognized as having the PE format ❶ with Intel x86 architecture. ❷

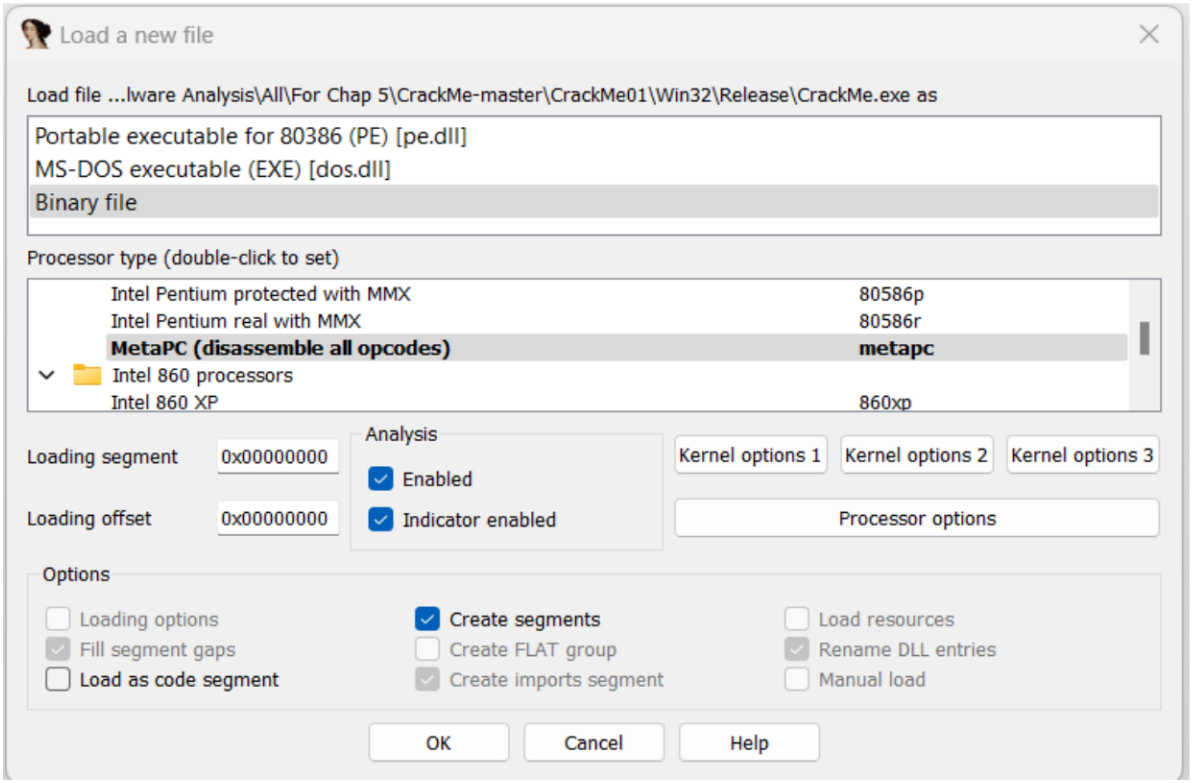


Loading an Executable

- When loading a file into IDA Pro (such as a PE file), the program maps the file into memory
  - as if the operating system loader had loaded it.

- To have IDA Pro disassemble the file as a raw binary, choose the Binary File option in the top box ❸

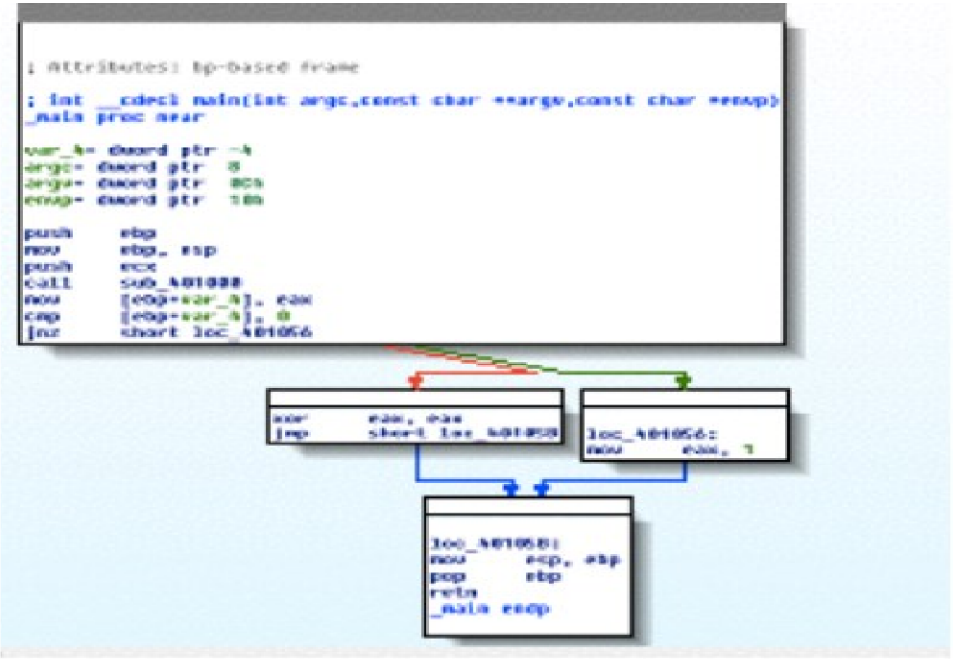
❸



IDA Pro - Interface

- Graph and Text Mode

- Spacebar Switches mode

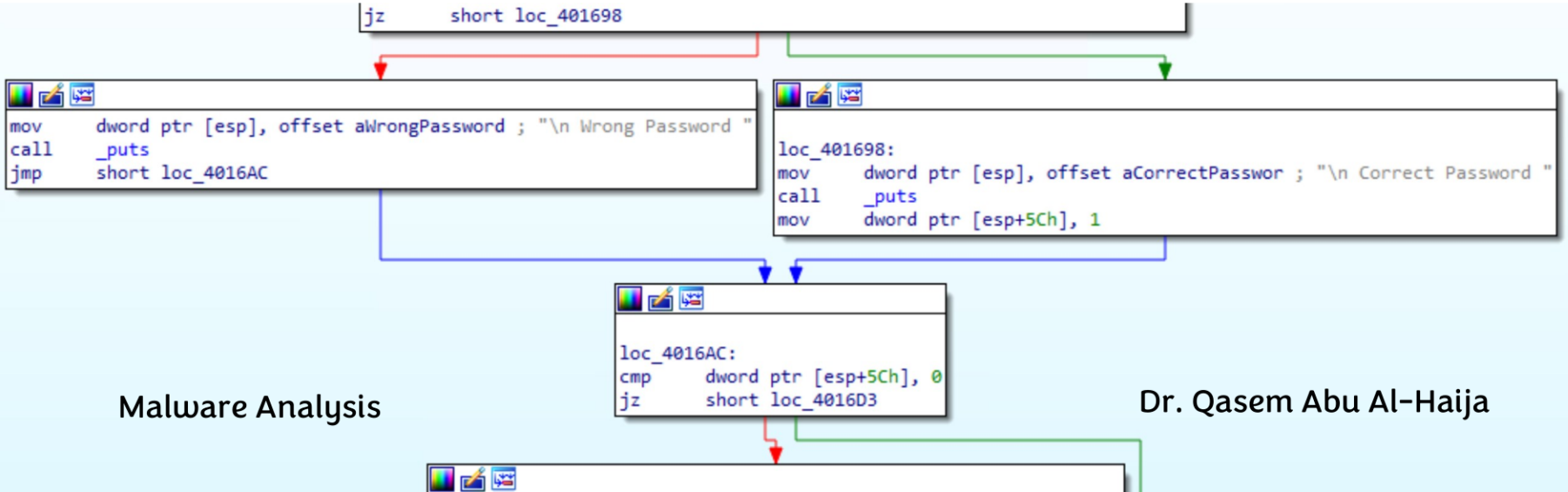


IDA View-A

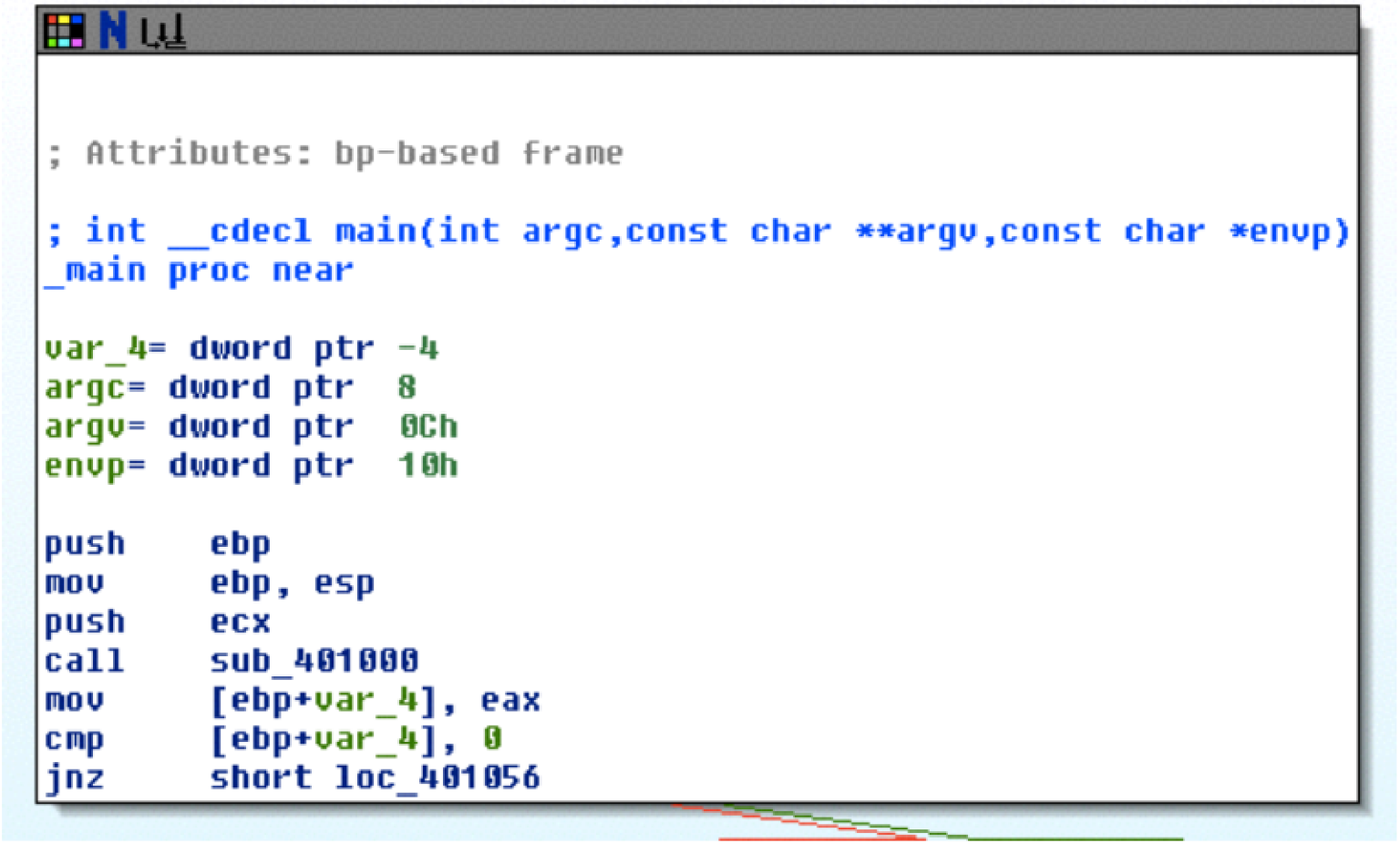
```
.text:00401040
.text:00401040 ; Attributes: bp-based frame
.text:00401040
.text:00401040 ; int __cdecl main(int argc,const char **argv,const char *envp)
.text:00401040 _main            proc near               ; CODE XREF: start+AF↓p
.text:00401040
.text:00401040 var_4            = dword ptr -4
.text:00401040 argc             = dword ptr  8
.text:00401040 argv             = dword ptr  0Ch
.text:00401040 envp             = dword ptr  10h
.text:00401040
.text:00401040                  push    ebp
.text:00401041                  mov     ebp, esp
.text:00401043                  push    ecx
```

Graph Mode Interface

- Provides a control flow graph to help you understand how the program works
- In graph mode, IDA Pro excludes certain information, such as line numbers and operation codes (i.e., binary code)
  - To change these options, select **Options->General**, and then select **Line prefixes** and set the **Number of Opcode Bytes** to **6**.



Default Graph Mode Display



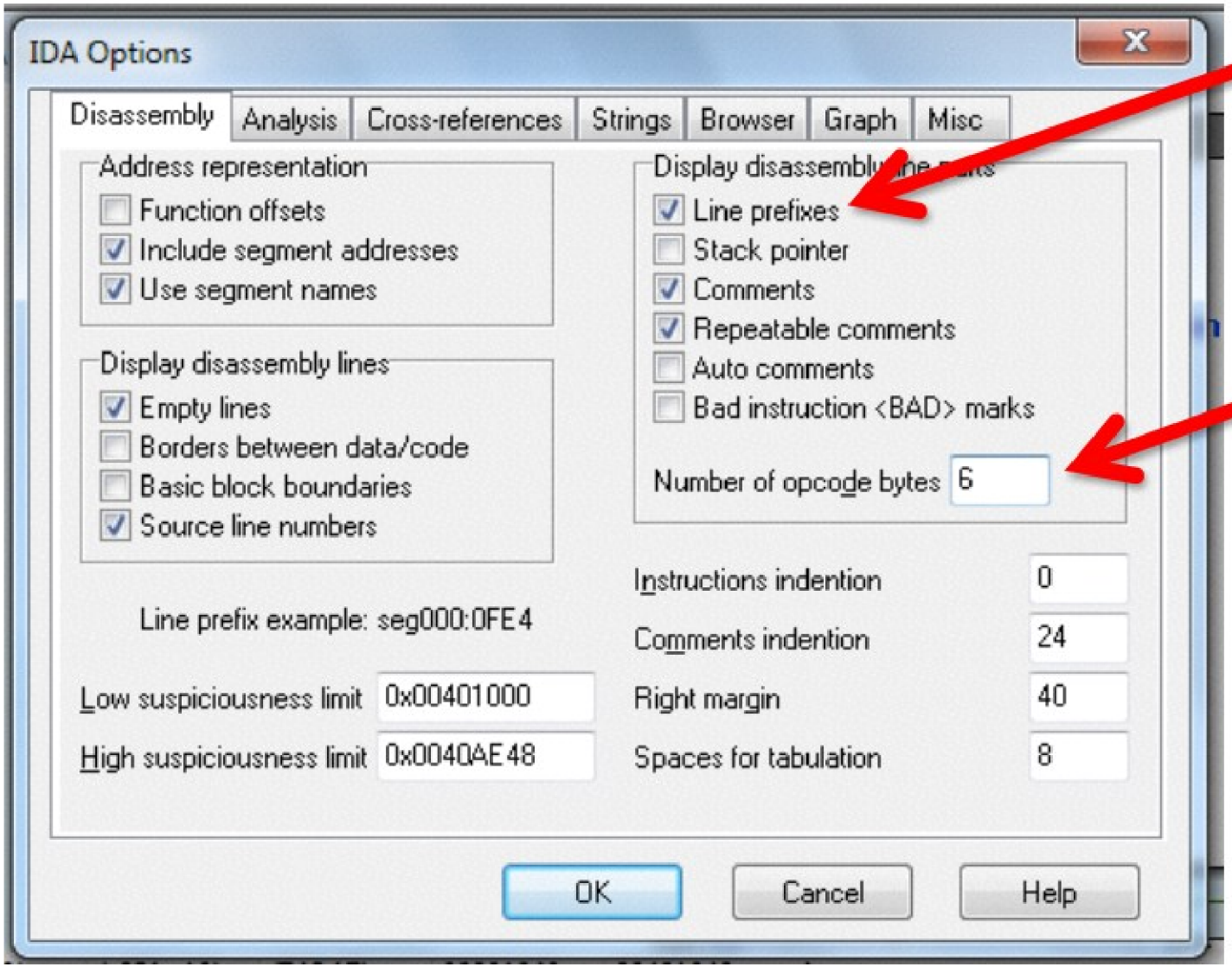
```
; Attributes: bp-based frame

; int __cdecl main(int argc,const char **argv,const char *envp)
_main proc near

var_4= dword ptr -4
argc= dword ptr  8
argv= dword ptr  0Ch
envp= dword ptr  10h

push    ebp
mov     ebp, esp
push    ecx
call    sub_401000
mov     [ebp+var_4], eax
cmp     [ebp+var_4], 0
jnz     short loc_401056
```

Options, General



Better Graph Mode Display

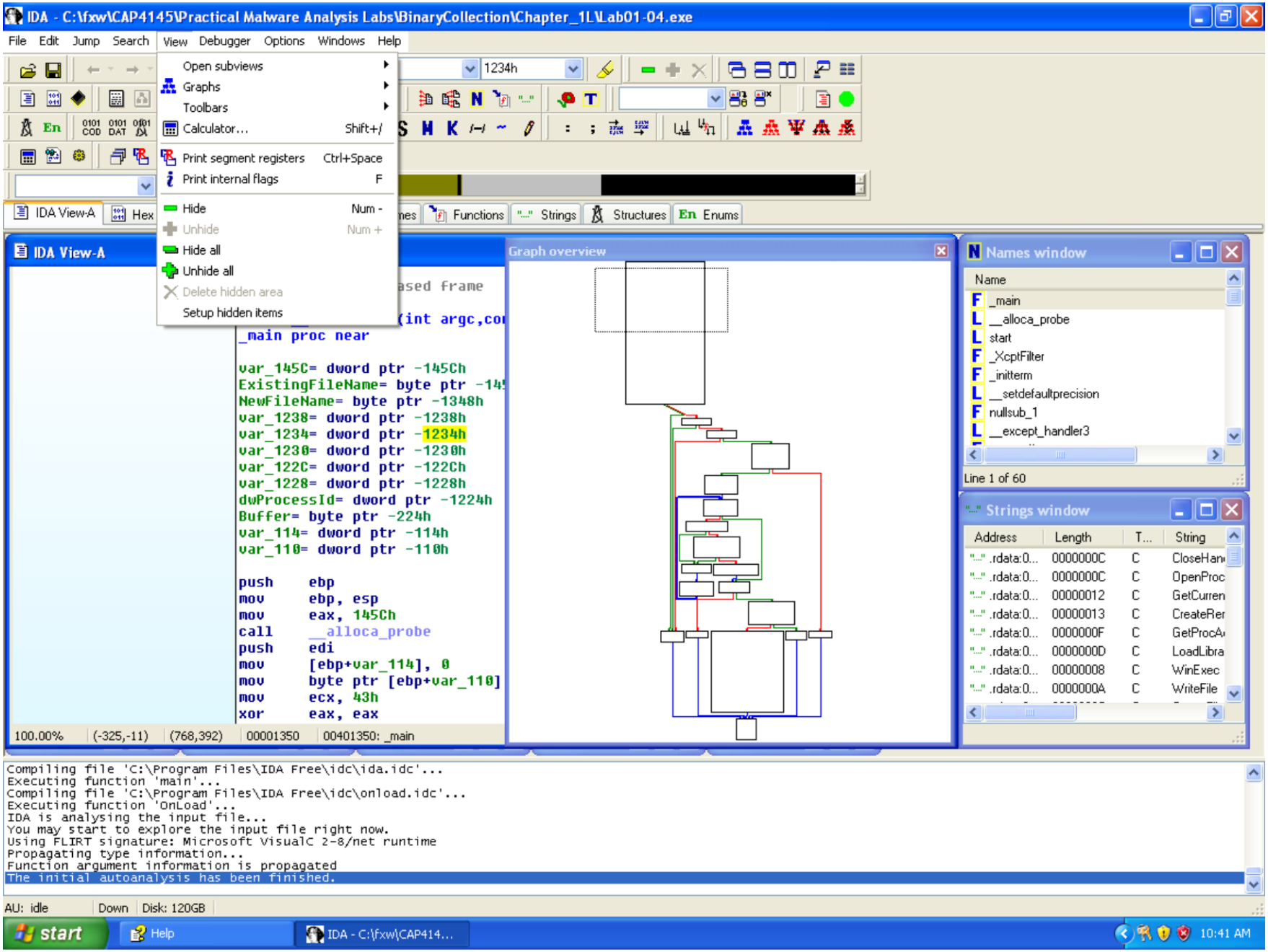
```
00401040
00401040
00401040                        ; Attributes: bp-based frame
00401040
00401040                        ; int __cdecl main(int argc,const char **argv,const char *envp)
00401040                        _main proc near
00401040
00401040                        var_4= dword ptr -4
00401040                        argc= dword ptr  8
00401040                        argv= dword ptr  0Ch
00401040                        envp= dword ptr  10h
00401040
00401040 55                     push    ebp
00401041 8B EC                  mov     ebp, esp
00401043 51                     push    ecx
00401044 E8 B7 FF FF FF         call    sub_401000
00401049 89 45 FC               mov     [ebp+var_4], eax
0040104C 83 7D FC 00            cmp     [ebp+var_4], 0
00401050 75 04                  jnz     short loc_401056
```

Graph Mode: Notes

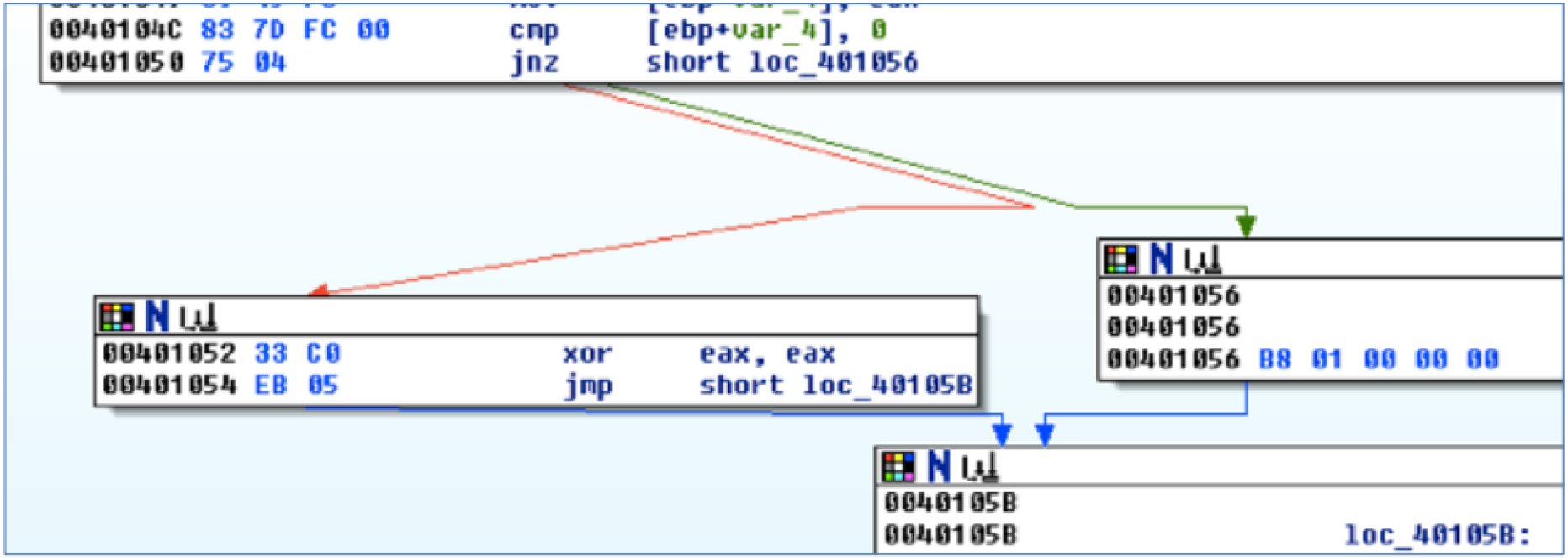
- The color and direction of the arrows help show the program's flow during analysis.

- The arrow's color tells you whether the path is based on a particular decision having been made:
  - red if a conditional jump is not taken,
  - green if the jump is taken, and
  - blue for an unconditional jump.

- The arrow direction shows the program's flow;
  - upward arrows typically denote a loop situation.

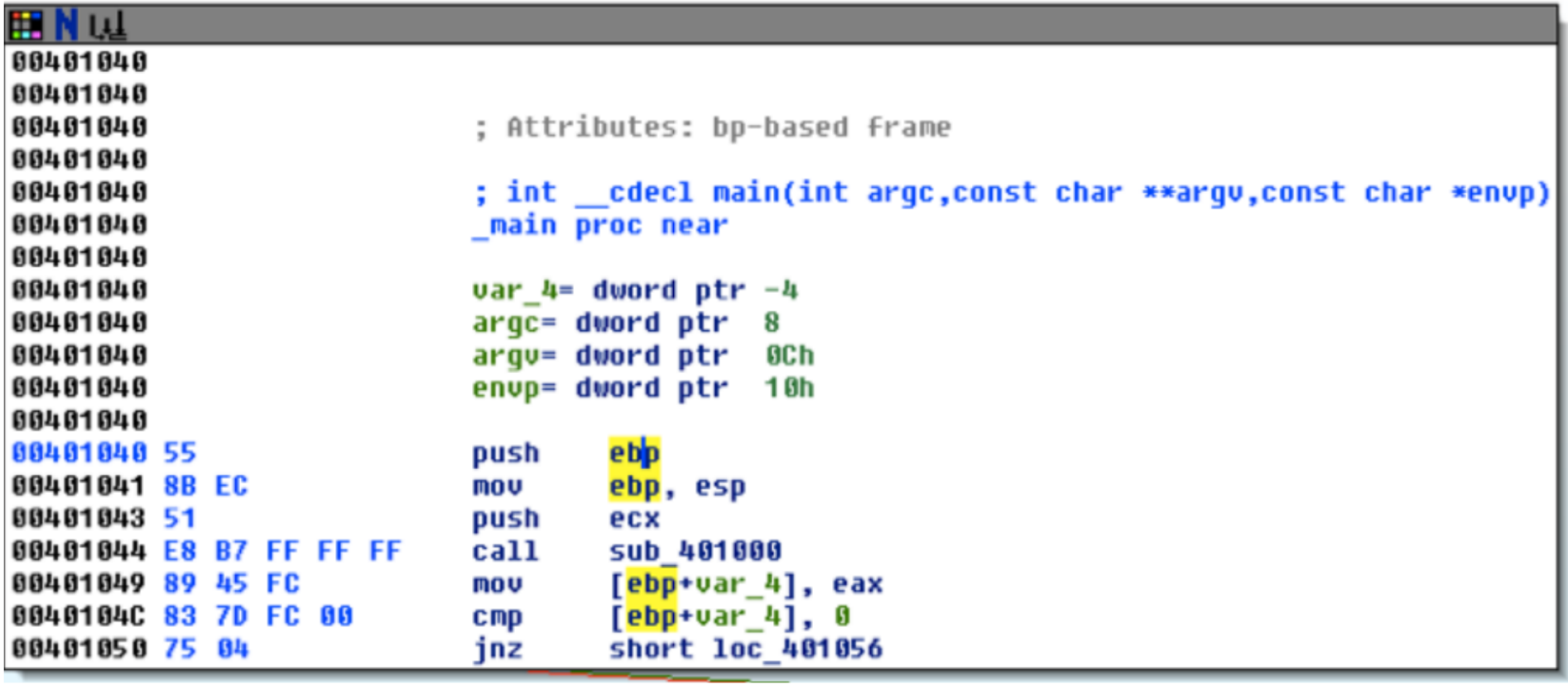

IDA - C:\fxw\CAP4145\Practical Malware Analysis Labs\BinaryCollection\Chapter_1L\Lab01-04.exe
File Edit Jump Search View Debugger Options Windows Help
Open subviews
Graphs
Toolbars
Calculator... Shift+/
Print segment registers Ctrl+Space
Print internal flags F
Hide Num -
Unhide Num +
Hide all
Unhide all
Delete hidden area
Setup hidden items
IDA View-A
Graph overview
Names window
Strings window
_main proc near
var_145C= dword ptr -145Ch
ExistingFileName= byte ptr -14
NewFileName= byte ptr -1348h
var_1238= dword ptr -1238h
var_1234= dword ptr -1234h
var_1230= dword ptr -1230h
var_122C= dword ptr -122Ch
var_1228= dword ptr -1228h
dwProcessId= dword ptr -1224h
Buffer= byte ptr -224h
var_114= dword ptr -114h
var_110= dword ptr -110h
push ebp
mov ebp, esp
mov eax, 145Ch
call __alloca_probe
push edi
mov [ebp+var_114], 0
mov byte ptr [ebp+var_110]
mov ecx, 43h
xor eax, eax
Compiling file 'C:\Program Files\IDA Free\idc\ida.idc'...
Executing function 'main'...
Compiling file 'C:\Program Files\IDA Free\idc\onload.idc'...
Executing function 'OnLoad'...
IDA is analysing the input file...
You may start to explore the input file right now.
Using FLIRT signature: Microsoft VisualC 2-8/net runtime
Propagating type information...
Function argument information is propagated
The initial autoanalysis has been finished.
start
Help
IDA - C:\fxw\CAP414...
10:41 AM

Arrow Color Example



Highlighting

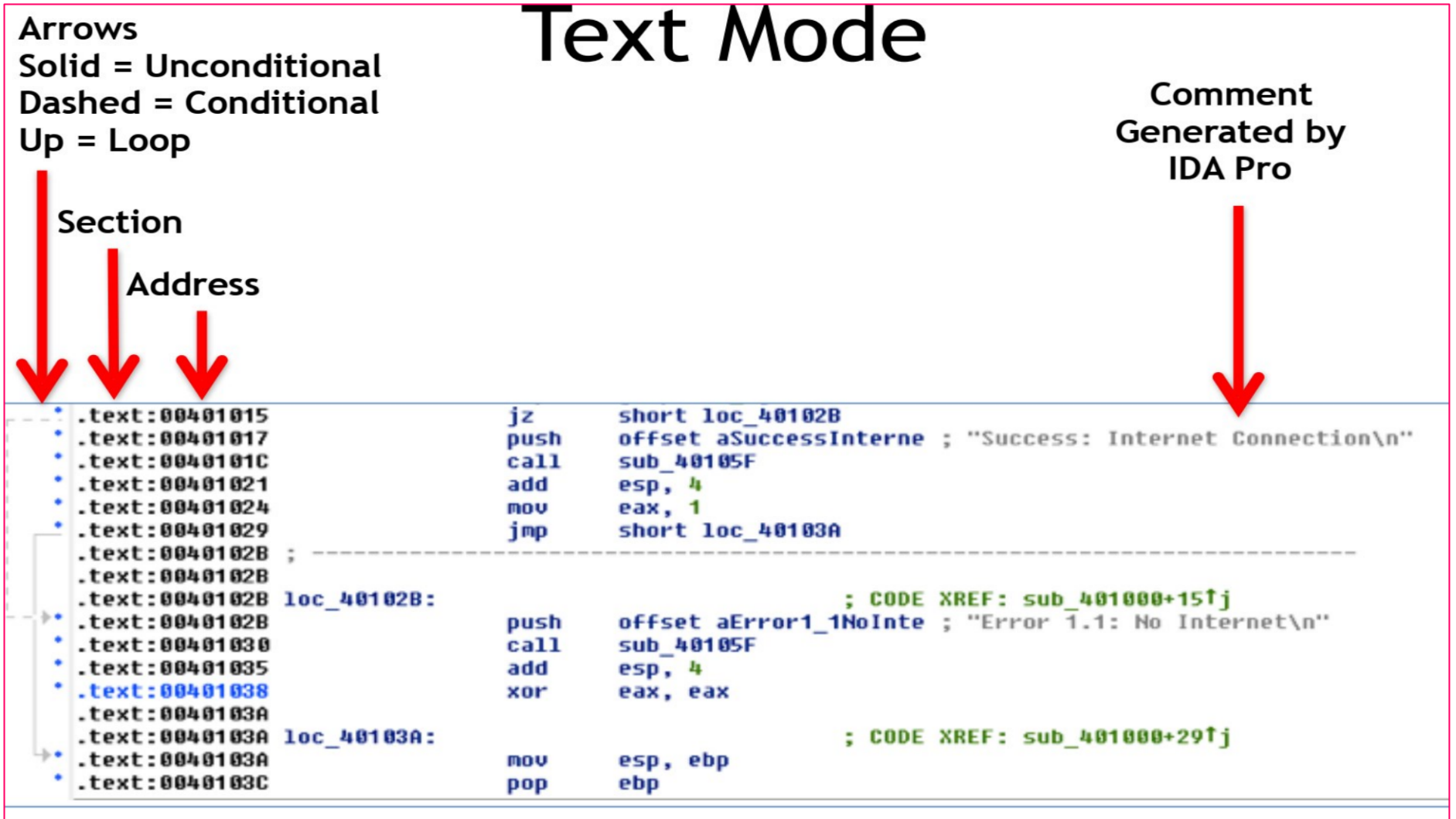
- Highlighting text in graph mode highlights every instance of that text



```
00401040
00401040
00401040                        ; Attributes: bp-based frame
00401040
00401040                        ; int __cdecl main(int argc,const char **argv,const char *envp)
00401040                        _main proc near
00401040
00401040                        var_4= dword ptr -4
00401040                        argc= dword ptr  8
00401040                        argv= dword ptr  0Ch
00401040                        envp= dword ptr  10h
00401040
00401040 55                     push    ebp
00401041 8B EC                  mov     ebp, esp
00401043 51                     push    ecx
00401044 E8 B7 FF FF FF         call    sub_401000
00401049 89 45 FC               mov     [ebp+var_4], eax
0040104C 83 7D FC 00            cmp     [ebp+var_4], 0
00401050 75 04                  jnz     short loc_401056
```

Text Mode Interface

- **Text Mode** – the traditional view
  - Use it to view data regions of a binary

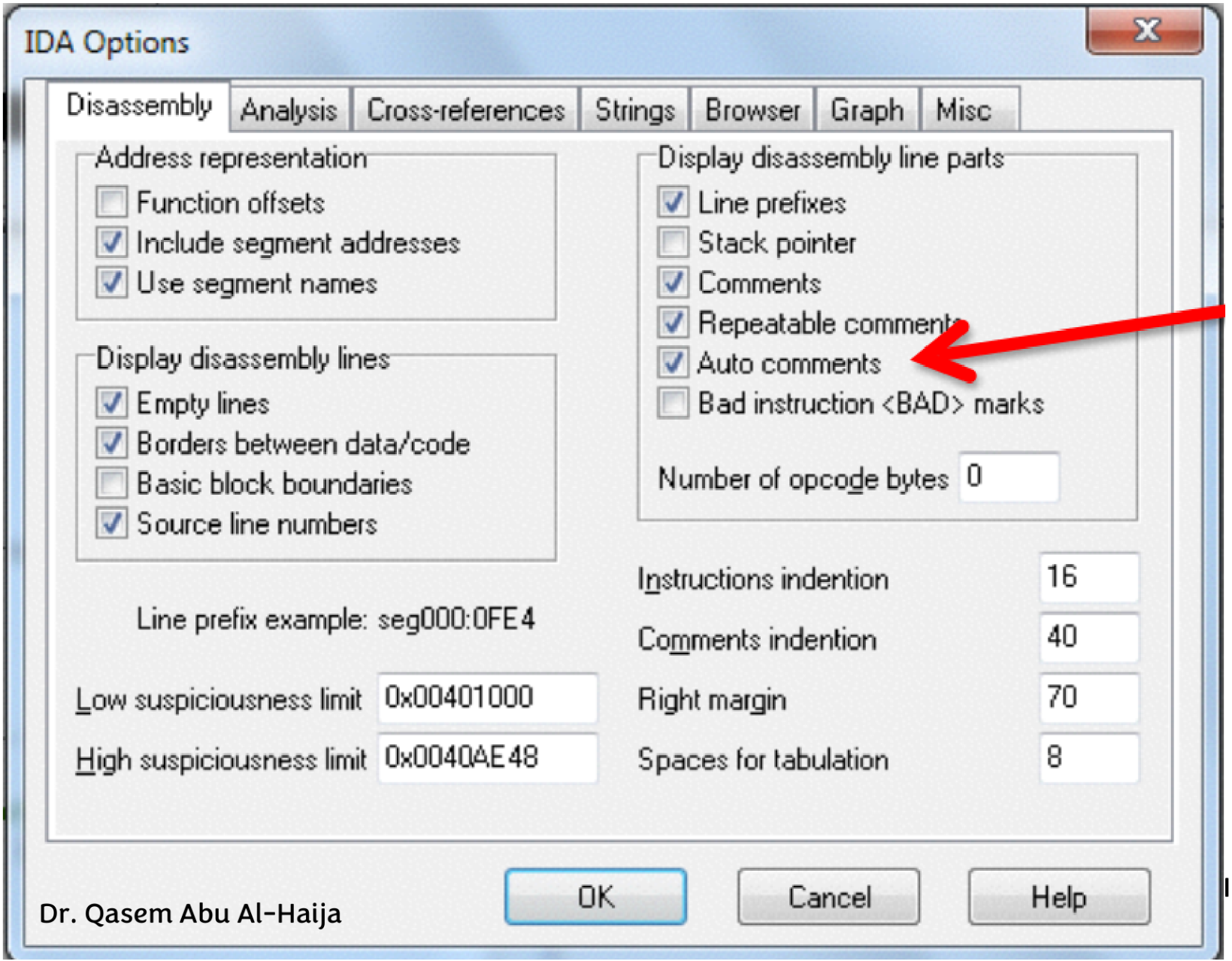


Text Mode: Notes

- The left portion of the text-mode display is known as the arrows window and shows the program's *nonlinear flow*.
  - Solid lines mark unconditional jumps
  - Dashed lines mark conditional jumps
  - Arrows facing up indicate a loop

- A comment (beginning with a semicolon) that IDA Pro automatically added

Options, General



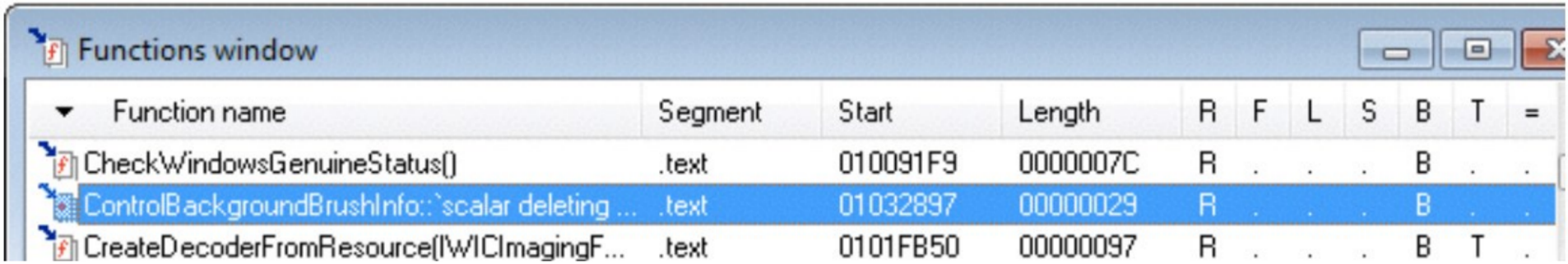
Adds Comments to Each Instruction

```
.text:00401015                  jz      short loc_40102B ; Jump if Zero (ZF=1)
.text:00401017                  push    offset aSuccessInterne ; "Success: Internet Connection\n"
.text:0040101C                  call    sub_40105F      ; Call Procedure
.text:00401021                  add     esp, 4          ; Add
.text:00401024                  mov     eax, 1
.text:00401029                  jmp     short loc_40103A ; Jump
.text:0040102B ; ---------------------------------------------------------------------------
.text:0040102B
.text:0040102B loc_40102B:                              ; CODE XREF: sub_401000+15↑j
.text:0040102B                  push    offset aError1_1NoInte ; "Error 1.1: No Internet\n"
.text:00401030                  call    sub_40105F      ; Call Procedure
.text:00401035                  add     esp, 4          ; Add
.text:00401038                  xor     eax, eax        ; Logical Exclusive OR
.text:0040103A
.text:0040103A loc_40103A:                              ; CODE XREF: sub_401000+29↑j
.text:0040103A                  mov     esp, ebp
.text:0040103C                  pop     ebp
```

Useful Windows for Analysis

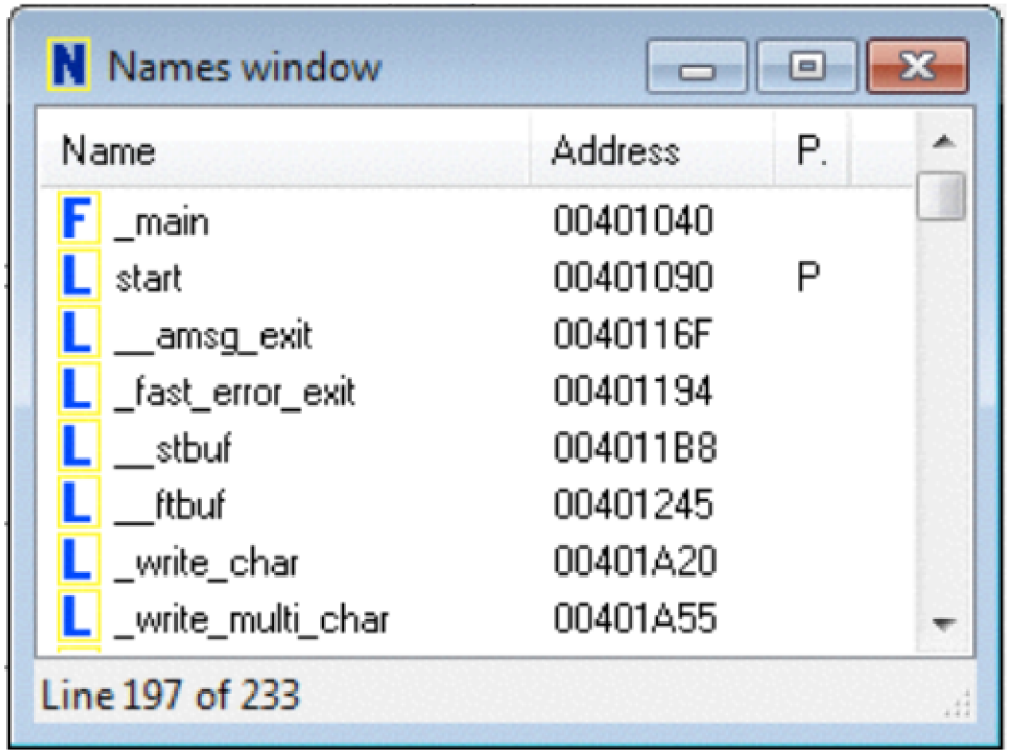
Functions window

- Shows every function, its length, and flags.
- The most useful flag is L: indicates library functions.
  - The L flag can save you time during analysis because you can identify and skip these compiler-generated functions.
- Sortable: Large functions usually more important



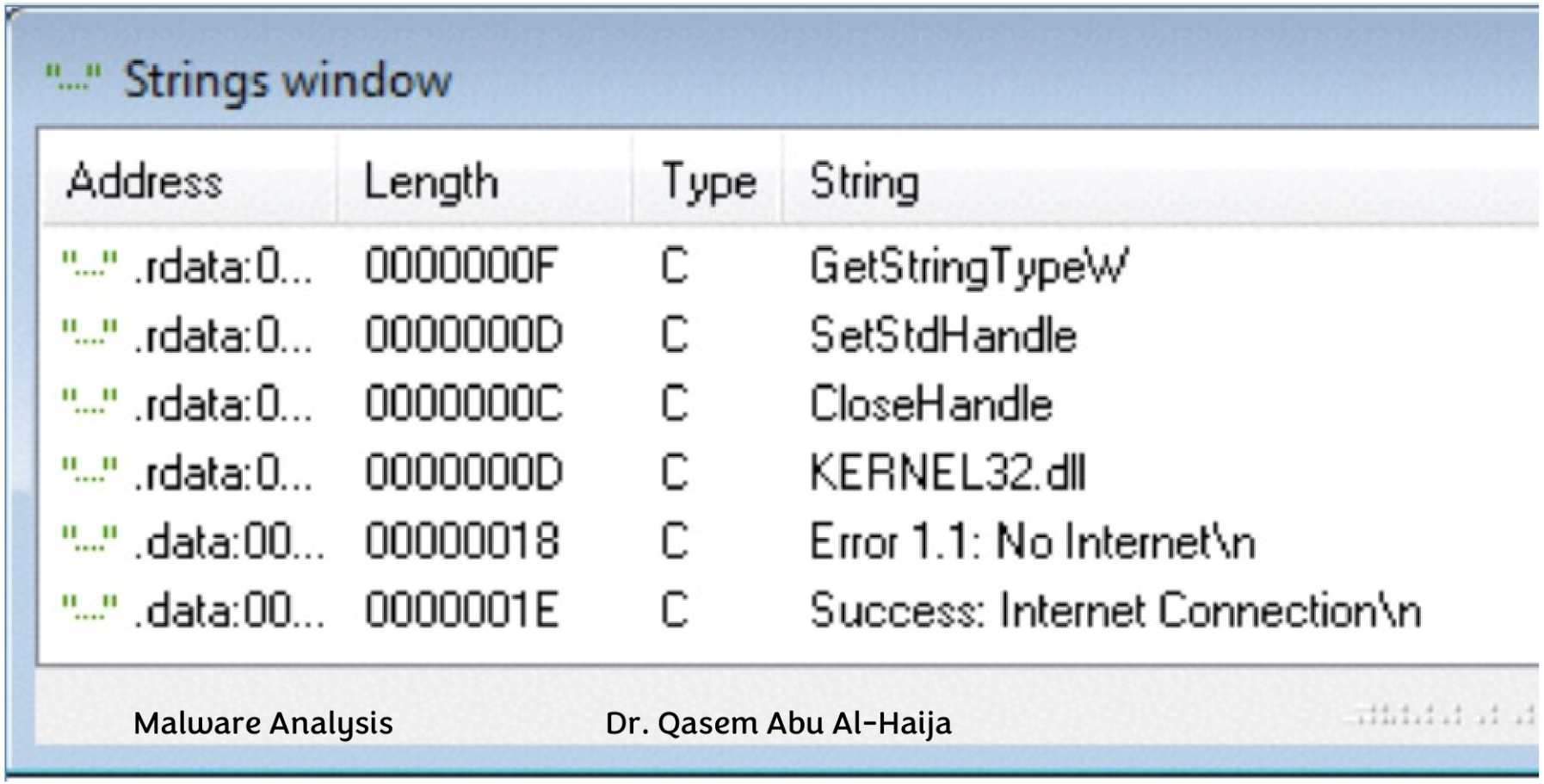
Names window

- Lists every address with a name, including:
  - Functions, named code, named data, and strings.



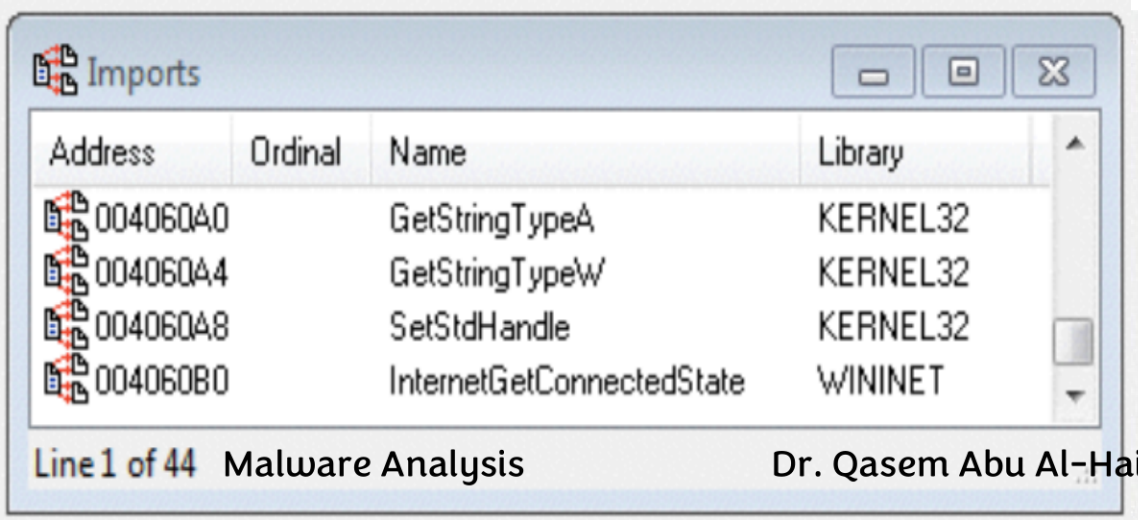
Strings window

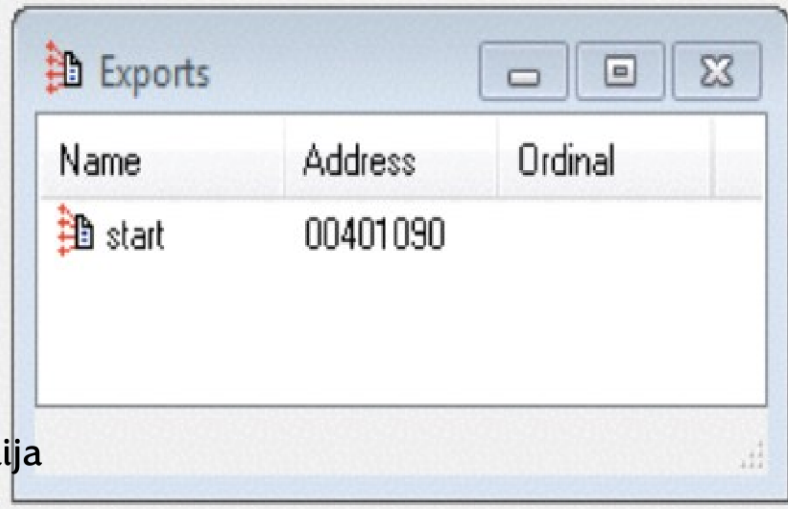
- Shows all strings.
  - Default: shows only ASCII strings longer than five characters.
  - You can change this: by right-clicking in Strings window ➔ Setup.



Imports & Exports

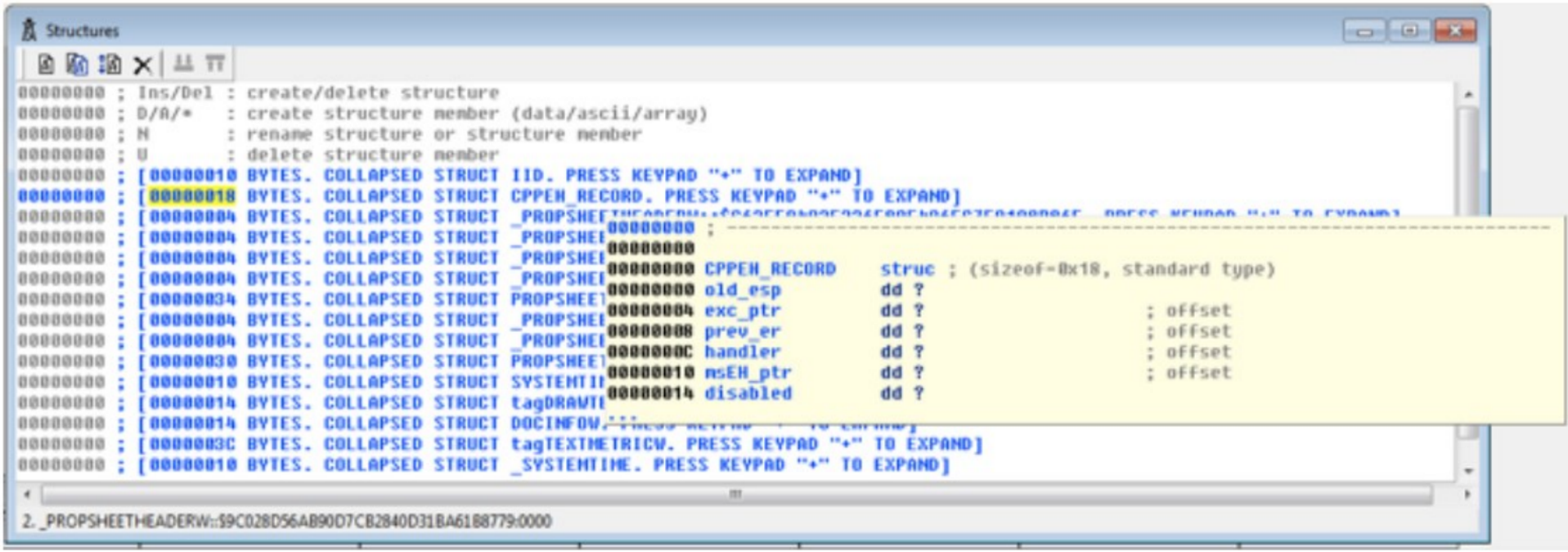
- **Imports window**
  - Lists all imports for a file.
  - This window is useful when you're analyzing EXE.
- **Exports window**
  - Lists all the exported functions for a file.
  - This window is useful when you're analyzing DLLs.





Structures window

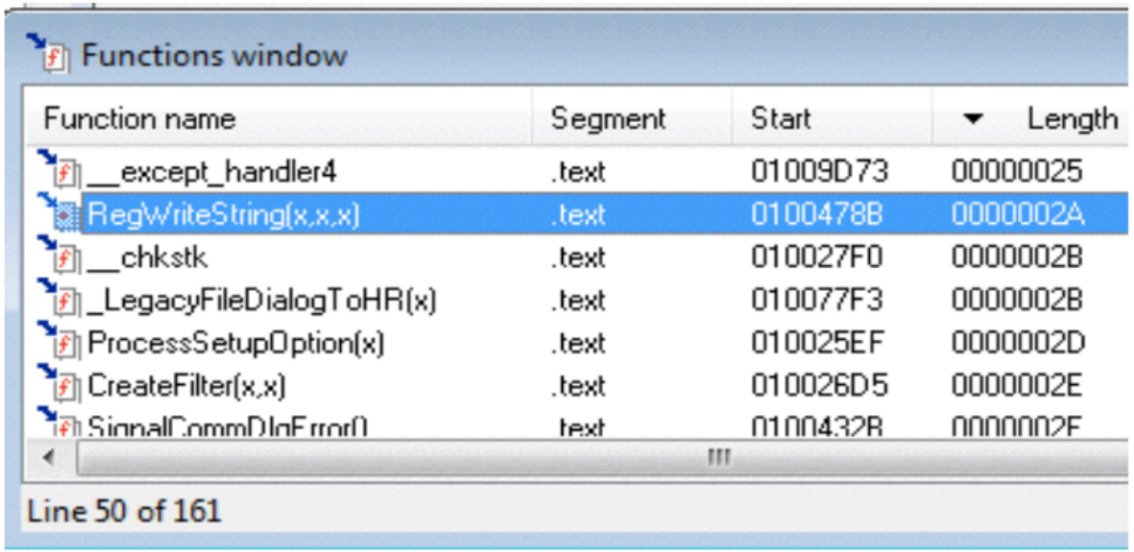
- Lists the layout of all active data structures.
  - Hover to see a yellow pop-up window



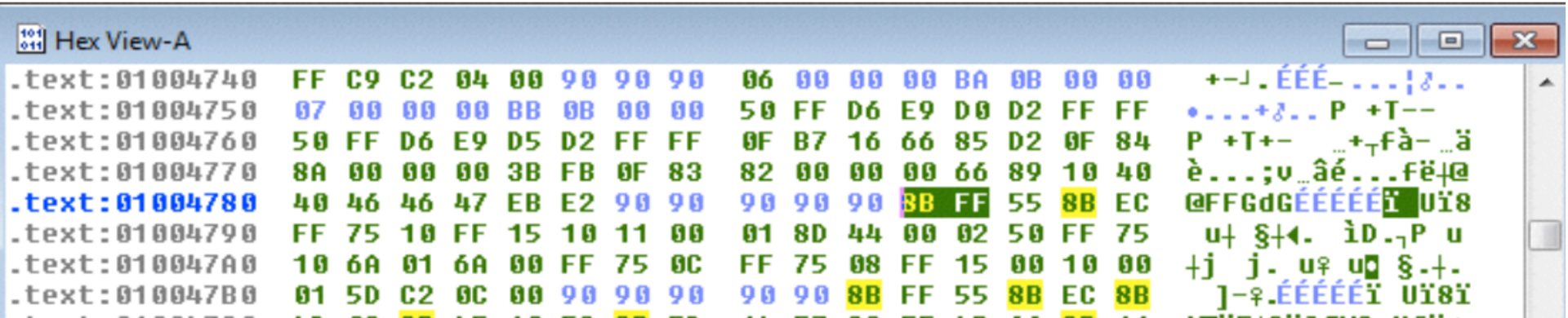
Cross-References and Links

Cross-Reference

- Double-click function
- Jump to code in other views

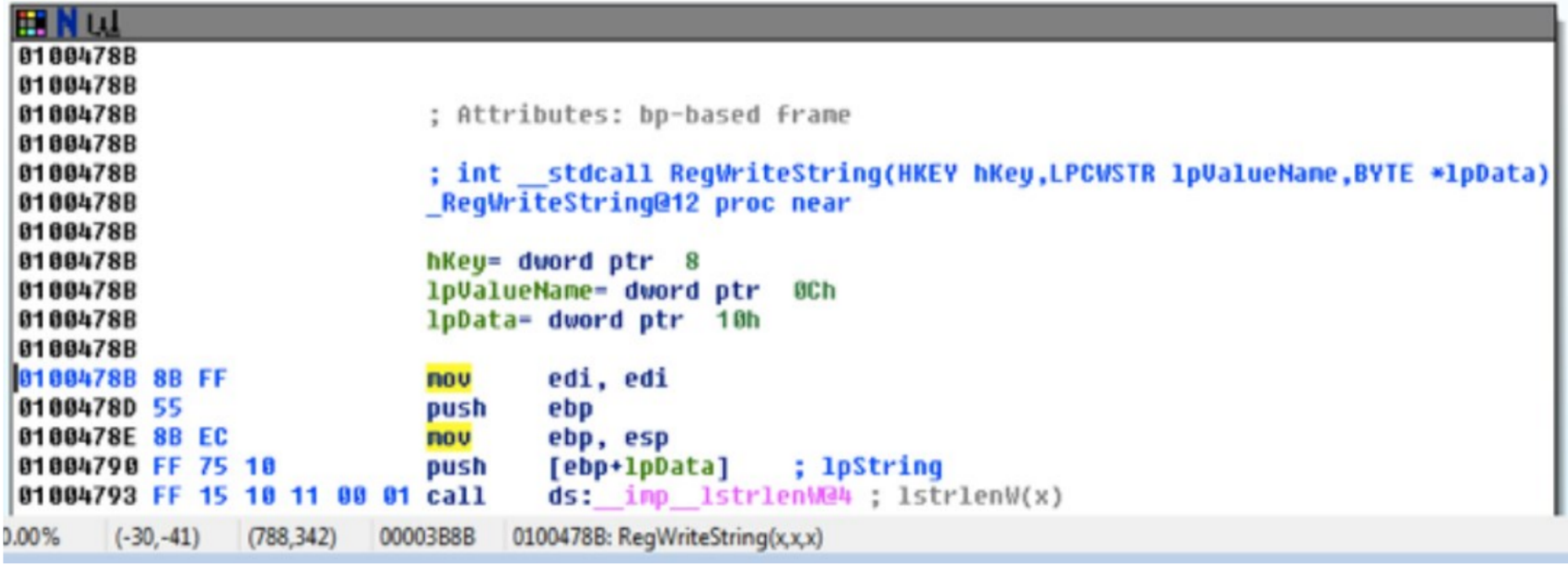


Links are function names, locations, and offsets.
Clicking a link and pressing [x] (key *x*) allows you to see everywhere that link is referenced and jump around



Function Call

- Parameters pushed onto the stack
- CALL to start the function



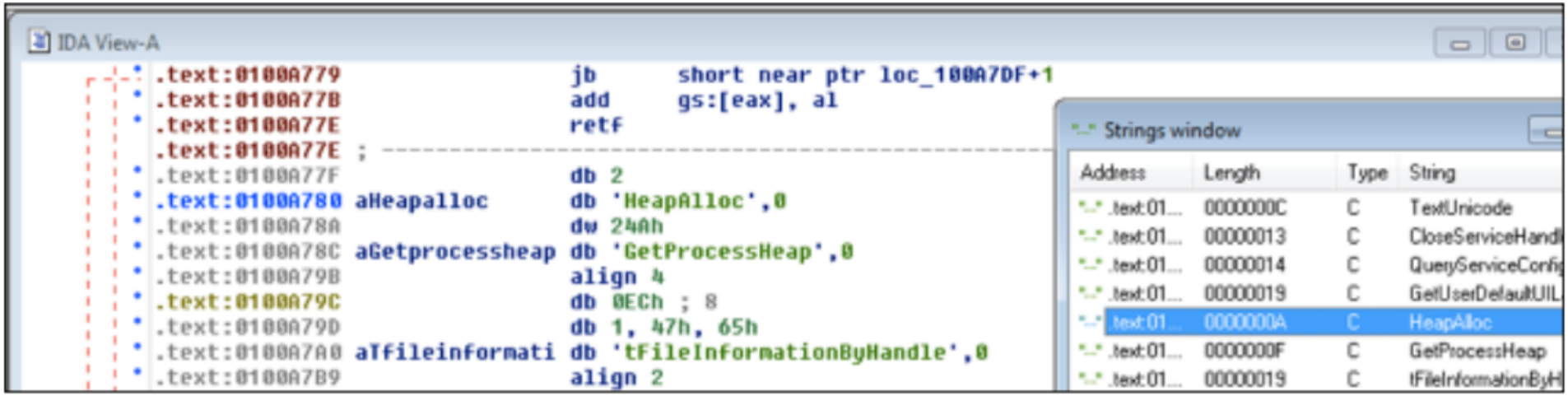
Returning to the Default View

- Windows, Reset Desktop
  - Restores GUI elements to their defaults
- Windows, Save Desktop
  - To save a new view

IDA Pro – Navigation

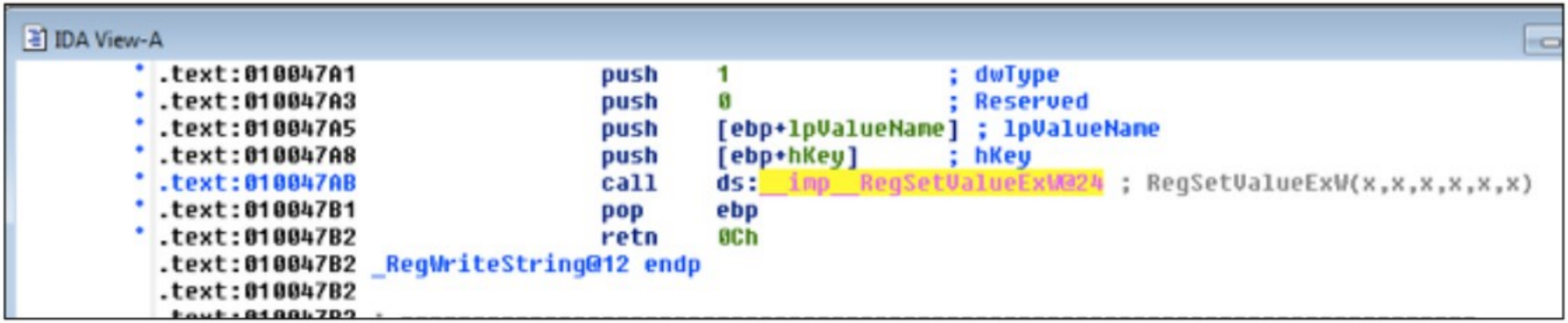
Imports or Strings

- Double-click any entry to display it in the disassembly window



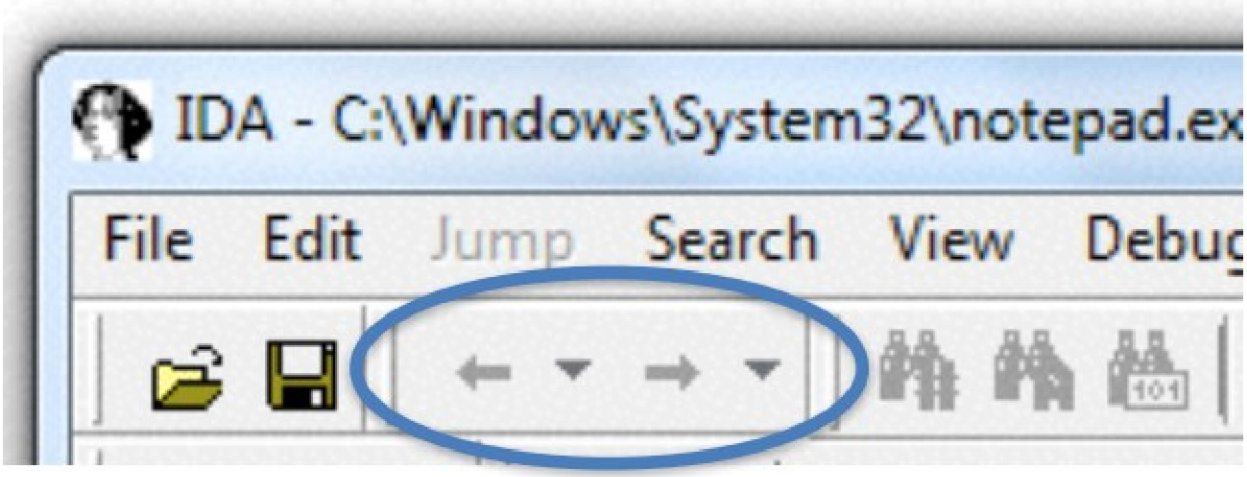
Using Links

- Double-click any address in the disassembly window to display that location



Using Links

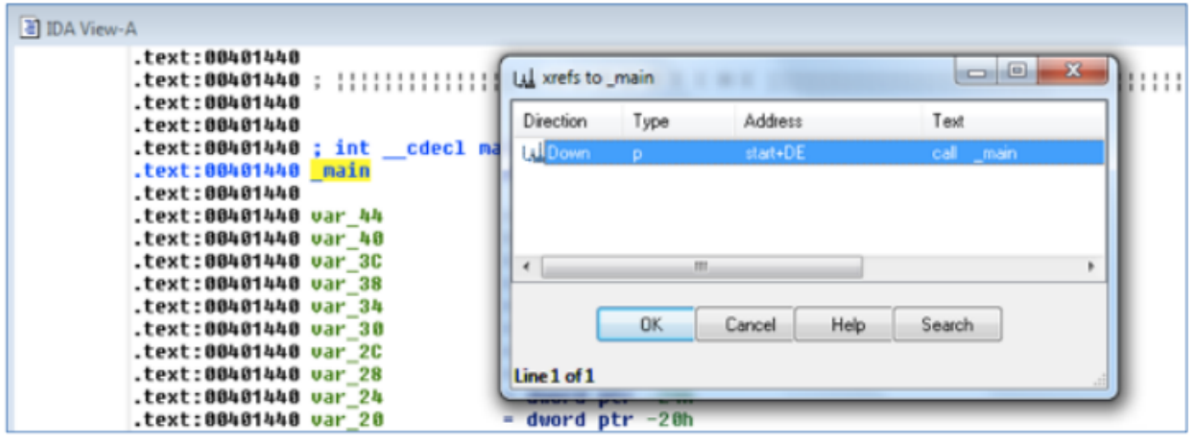
- Forward and Back buttons work like a Web
- browser



Cross-References and Links

- Links are function names, locations, and offsets

- Clicking a link and pressing [x] (key x) allows you to see everywhere that link is referenced and jump around



Common types of links

- ***Sub*** *(subroutine) links* are links to the start of functions such as ***printf*** and ***sub_4010A0***.

- ***Loc*** *(location) links* are links to jump destinations such as ***loc_40107E*** and ***loc_401097***.

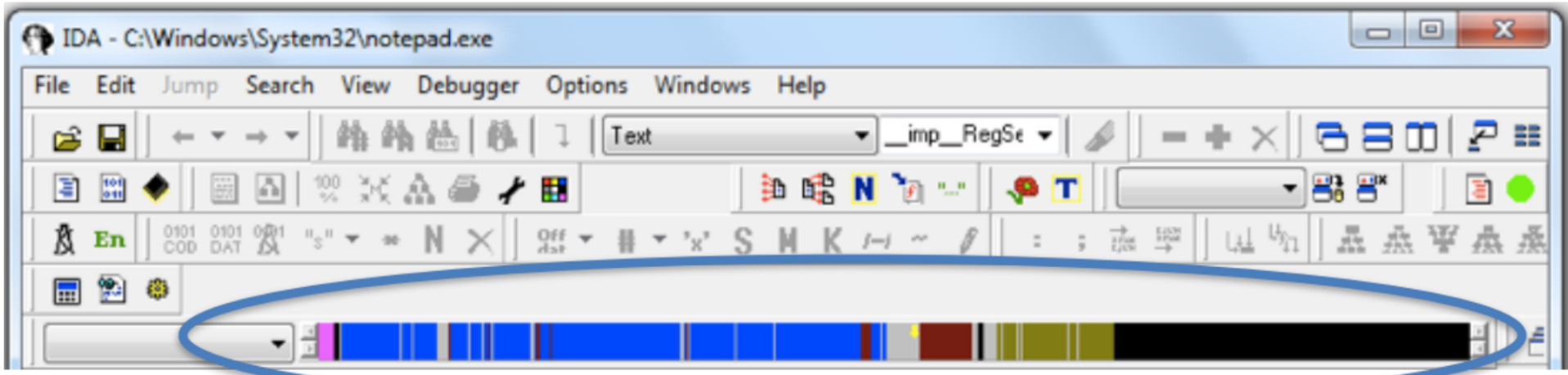
- ***Offset*** *links* are links to an offset in memory.

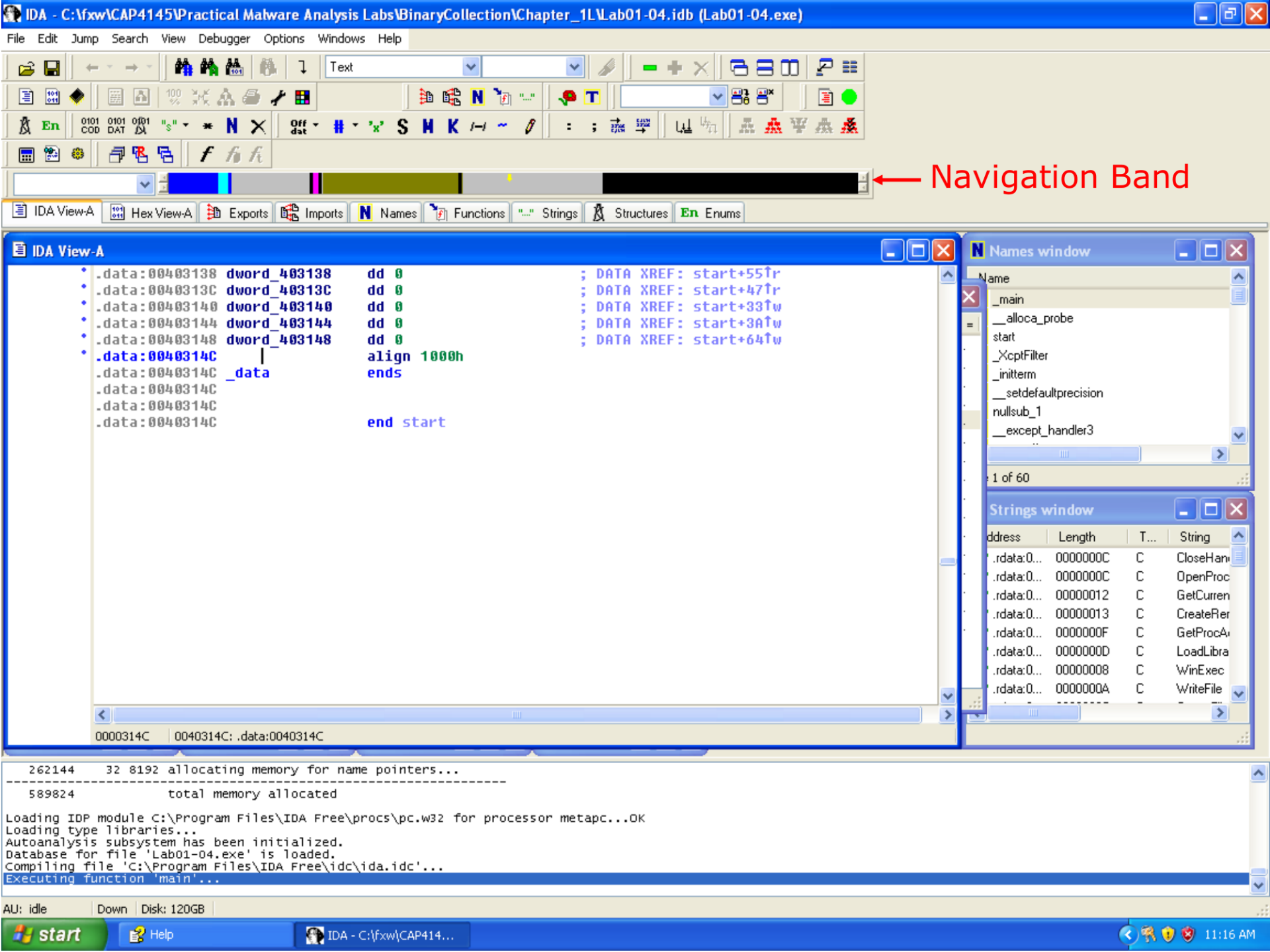
```
00401075          jnz     short ❶loc_40107E
00401077          mov     [ebp+var_10], 1
0040107E loc_40107E:                      ; CODE XREF: ❶❷sub_401040+35j
0040107E          cmp     [ebp+var_C], 0
00401082          jnz     short ❶loc_401097
00401084          mov     eax, [ebp+var_4]
00401087          mov     [esp+18h+var_14], eax
0040108B          mov     [esp+18h+var_18], offset ❶aPrintNumberD ; "Print Number= %d\n"
00401092          call    ❶printf
00401097          call    ❶sub_4010A0
```

Navigation Band

- Color-coded linear view of the loaded binary's address space
  - Light blue is library code (recognized by FLIRT signatures)
  - Red is compiler-generated code
  - Dark blue is user-written code
  - Pink is for imports
  - Gray is for defined data
  - Brown is for undefined data

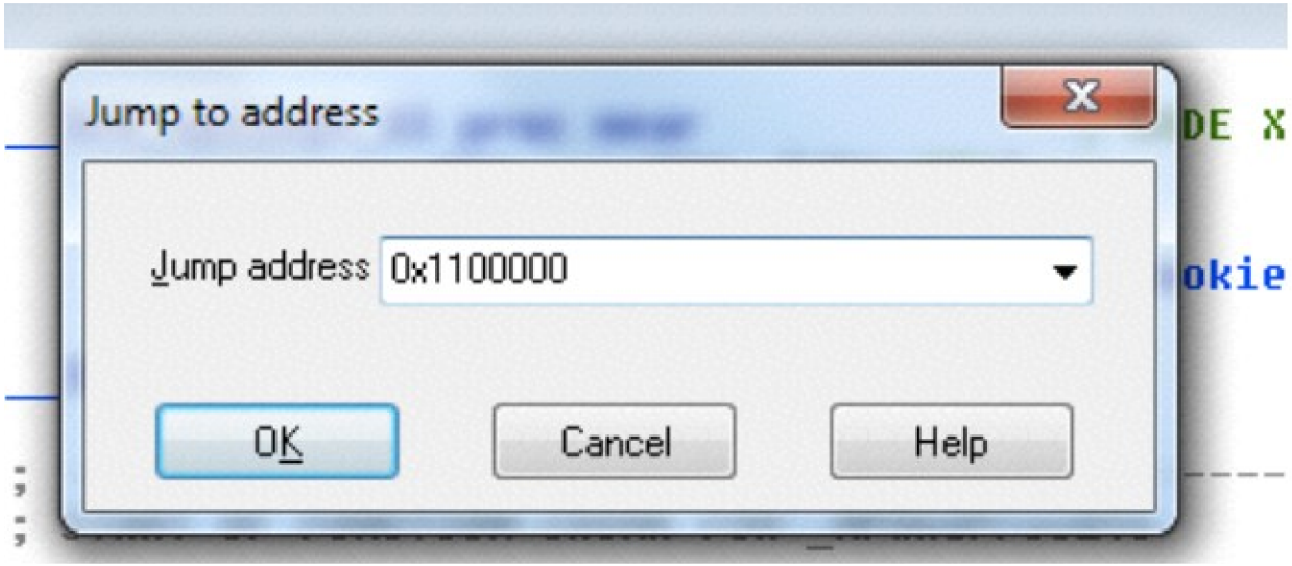
- You should perform malware analysis in the dark-blue region.




IDA - C:\fxw\CAP4145\Practical Malware Analysis Labs\BinaryCollection\Chapter_1L\Lab01-04.idb (Lab01-04.exe)
File Edit Jump Search View Debugger Options Windows Help
Navigation Band
IDA View-A Hex View-A Exports Imports Names Functions Strings Structures Enums
IDA View-A
.data:00403138 dword_403138 dd 0 ; DATA XREF: start+55↑r
.data:0040313C dword_40313C dd 0 ; DATA XREF: start+47↑r
.data:00403140 dword_403140 dd 0 ; DATA XREF: start+33↑w
.data:00403144 dword_403144 dd 0 ; DATA XREF: start+3A↑w
.data:00403148 dword_403148 dd 0 ; DATA XREF: start+64↑w
.data:0040314C align 1000h
.data:0040314C _data ends
.data:0040314C
.data:0040314C
.data:0040314C end start
0000314C 0040314C: .data:0040314C
Names window
Name
_main
__alloca_probe
start
_XcptFilter
_initterm
__setdefaultprecision
nullsub_1
__except_handler3
1 of 60
Strings window
ddress Length T... String
.rdata:0... 0000000C C CloseHan
.rdata:0... 0000000C C OpenProc
.rdata:0... 00000012 C GetCurren
.rdata:0... 00000013 C CreateRer
.rdata:0... 0000000F C GetProcA
.rdata:0... 0000000D C LoadLibra
.rdata:0... 00000008 C WinExec
.rdata:0... 0000000A C WriteFile
262144 32 8192 allocating memory for name pointers...
589824 total memory allocated
Loading IDP module C:\Program Files\IDA Free\procs\pc.w32 for processor metapc...OK
Loading type libraries...
Autoanalysis subsystem has been initialized.
Database for file 'Lab01-04.exe' is loaded.
Compiling file 'C:\Program Files\IDA Free\idc\ida.idc'...
Executing function 'main'...
AU: idle Down Disk: 120GB
start Help IDA - C:\fxw\CAP414... 11:16 AM

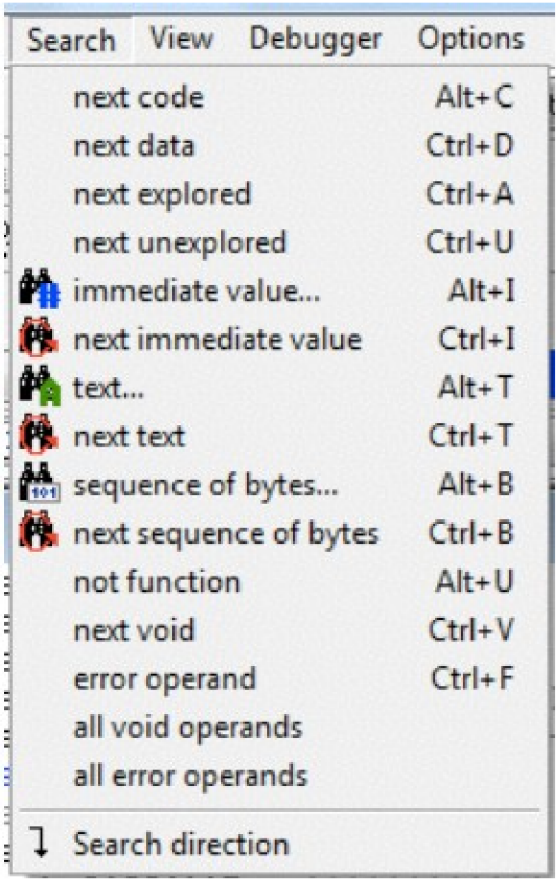
Jump to Location

- The [g] key lets you jump to a specific address or named location
  - ex. sub_401730 or printf



Searching

- You can also use the search option in the toolbar
  - Search → Next Code
  - Search → Text
  - Search → Sequence of Bytes



Using Cross-References

Using Cross-References (xref)

- **xref** in IDA Pro can tell you
  - where a function is called or
  - where a string is used.

- If you identify a useful function and want to know the parameters with which it is called,
  - you can use xref to navigate quickly to the location where the parameters are placed on the stack.
  - Interesting graphs can also be generated based on xref, which are helpful for performing analysis.

Code Cross-References

- XREF comment shows where this function is called
- But it only shows a couple of XREF by default.
- Click function name and press X

```
.text:00401440
.text:00401440 ; ||||||||||||||| S U B R O U T I N E |||||||||||||||||||||||||||||||||||||||
.text:00401440
.text:00401440
.text:00401440 ; int __cdecl main(int argc,const char **argv,const char *envp)
.text:00401440 _main           proc near               ; CODE XREF: start+DE↓p
.text:00401440
.text:00401440 var_44          = dword ptr -44h
.text:00401440 var_40          = dword ptr -40h
.text:00401440 var_3C          = dword ptr -3Ch
.text:00401440 var_38          = dword ptr -38h
.text:00401440 var_34          = dword ptr -34h
.text:00401440 var_30          = dword ptr -30h
.text:00401440 var_2C          = dword ptr -2Ch
.text:00401440 var_28          = dword ptr -28h
.text:00401440 var_24          = dword ptr -24h
.text:00401440 var_20          = dword ptr -20h
.text:00401440 var_1C          = dword ptr -1Ch
```

```
push    offset unk_403000
call    _initterm
call    ds:__p___initenv
mov     ecx, [ebp+envp]
mov     [eax], ecx
push    [ebp+envp]      ; envp
push    [ebp+argv]      ; argv
push    [ebp+argc]      ; argc
call    _main
add     esp, 30h
```

Code Cross-References

- A code XREF at ① tells us that this function (sub_401000) is called from inside the main function at offset 0x3 into the main function.

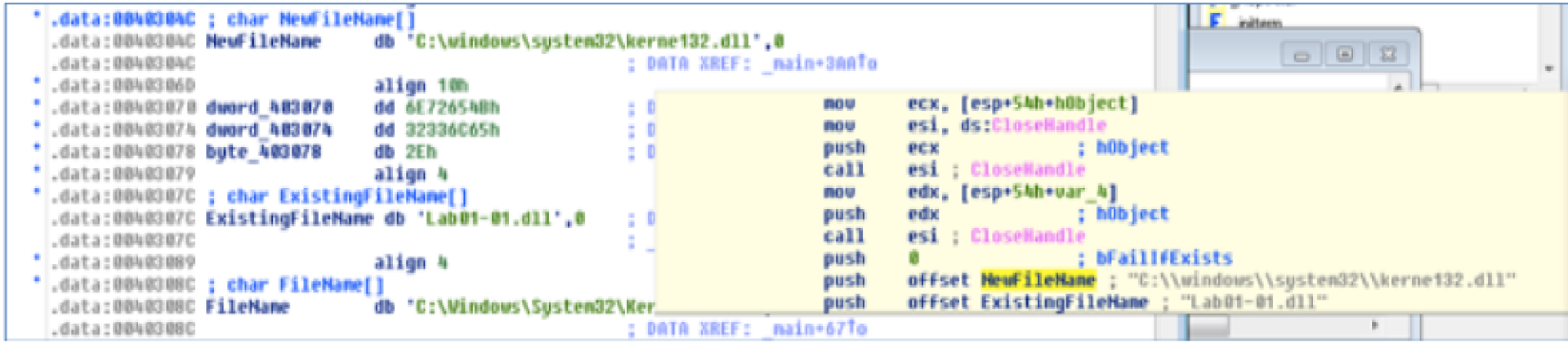
- The code XREF for the jump at ② tells us which jump takes us to this location, which in this example corresponds to the location marked at ③

```
00401000          sub_401000      proc near          ; ❶CODE XREF: _main+3p
00401000          push    ebp
00401001          mov     ebp, esp
00401003    loc_401003:                              ; ❷CODE XREF: sub_401000+19j
00401003          mov     eax, 1
00401008          test    eax, eax
0040100A          jz      short loc_40101B
0040100C          push    offset aLoop    ; "Loop\n"
00401011          call    printf
00401016          add     esp, 4
00401019          jmp     short loc_401003 ❸
```

Data Cross-References

Data Cross-References (XREF)

- Start with strings
- Double-click an interesting string
- Hover over DATA XREF to see where that string is used
- X shows all references



Data Cross-References

- Data XREF is used to track how data is accessed within a binary.
  - Data references can be associated with any byte of data that is referenced in code via a memory reference.

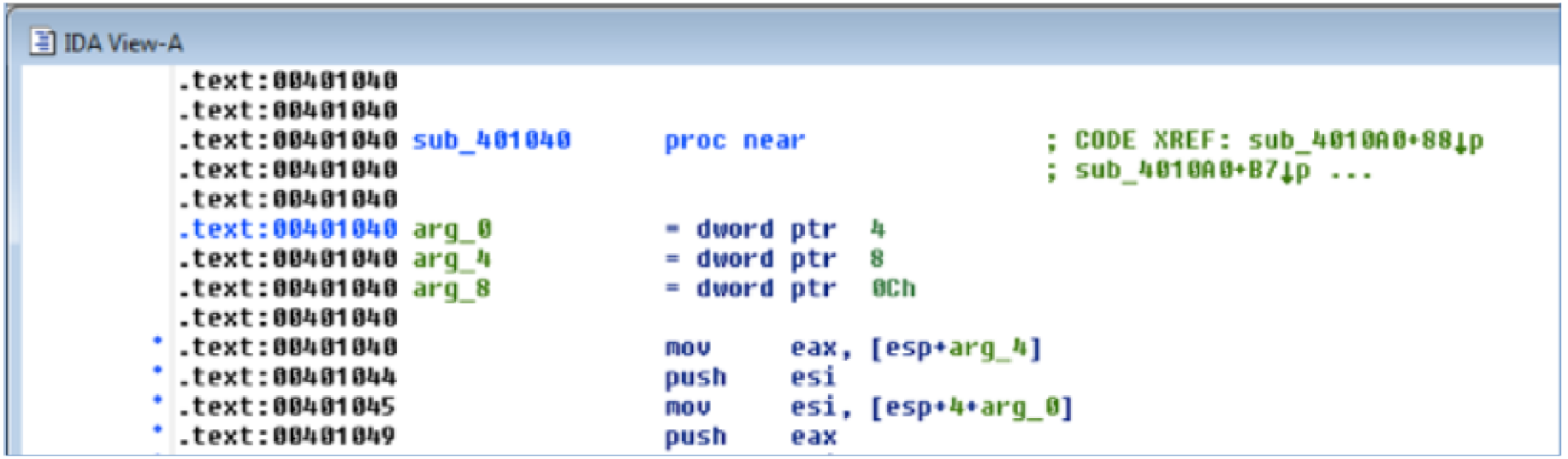
- For example, you can see the data XREF to DWORD 0x7F000001 at ①.
  - The corresponding XREF tells us that this data is used in the function located at 0x401020.
  - The following line shows a data cross-reference for the string <Hostname> <Port>.

```
0040C000 dword_40C000    dd 7F000001h          ; ❶DATA XREF: sub_401020+14r
0040C004 aHostnamePort   db '<Hostname> <Port>',0Ah,0  ; DATA XREF: sub_401000+3o
```

Analyzing Functions

Function and Argument Recognition

- One powerful aspect of IDA Pro is its ability to:
  - recognize functions,
  - label them (name them), and
  - break down local variables and parameters (name them).
  - It's not always correct



Function and Argument Recognition

- IDA Pro says this is an EBP-based stack frame used in the function.
- This means the local variables and parameters will be referenced via the EBP register throughout the function.

```
00401020 ; ============== S U B R O U T I N E ============================
00401020
00401020 ; Attributes: ebp-based frame ❶
00401020
00401020 function        proc near               ;  CODE XREF: _main+1Cp
00401020
00401020 var_C           = dword ptr -0Ch ❷
00401020 var_8           = dword ptr -8
00401020 var_4           = dword ptr -4
00401020 arg_0           = dword ptr  8
00401020 arg_4           = dword ptr  0Ch
00401020
00401020                 push    ebp
00401021                 mov     ebp, esp
00401023                 sub     esp, 0Ch
00401026                 mov     [ebp+var_8], 5
0040102D                 mov     [ebp+var_C], 3 ❸
00401034                 mov     eax, [ebp+var_8]
00401037                 add     eax, 22h
0040103A                 mov     [ebp+arg_0], eax
0040103D                 cmp     [ebp+arg_0], 64h
00401041                 jnz     short loc_40104B
00401043                 mov     ecx, [ebp+arg_4]
00401046                 mov     [ebp+var_4], ecx
00401049                 jmp     short loc_401050
0040104B loc_40104B:                             ;  CODE XREF: function+21j
0040104B                 call    sub_401000
00401050 loc_401050:                             ;  CODE XREF: function+29j
00401050                 mov     eax, [ebp+arg_4]
00401053                 mov     esp, ebp
00401055                 pop     ebp
00401056                 retn
00401056 function        endp
```

Listing 5-4: Function and stack example

Local Variables and Argument Recognition

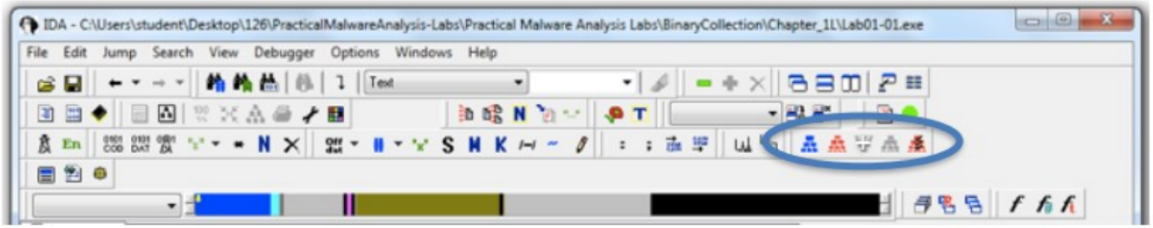
- IDA Pro has successfully discovered all local variables and parameters in this function.

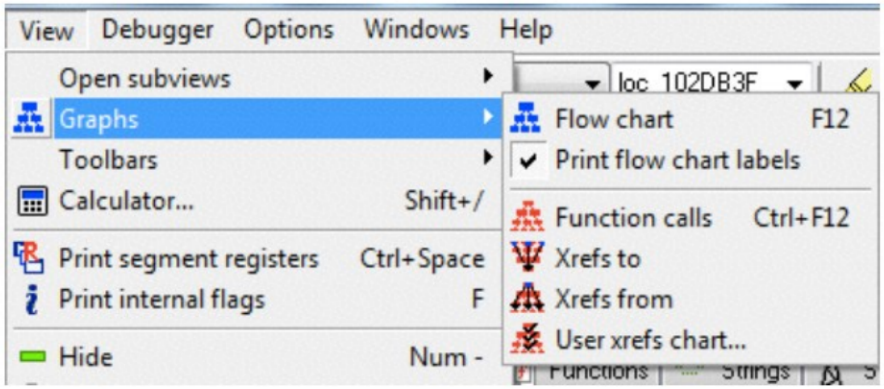
- It has labeled:
  - Local variables with the prefix var_ and suffix corresponding to their offset relative to EBP
  - parameters with the prefix arg_, and suffix corresponding to their offset relative to EBP

Using Graph Options

Graphing Options

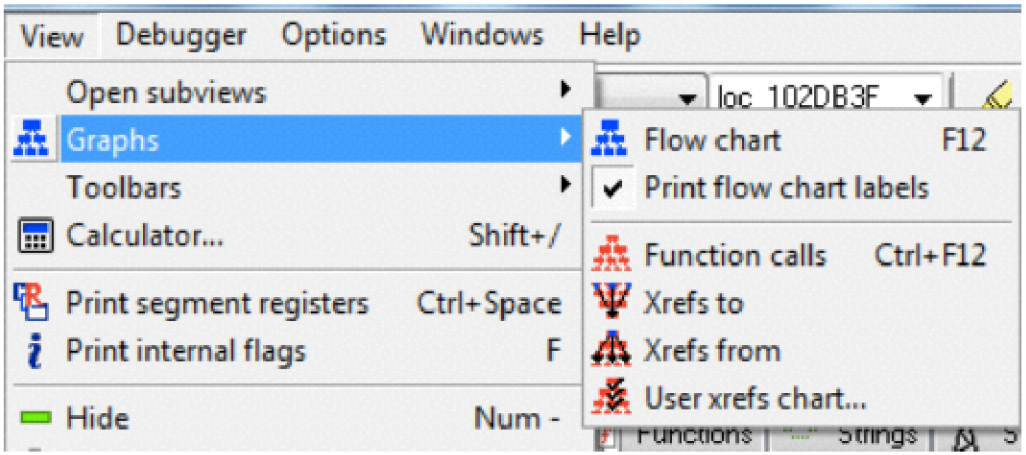
- IDA Pro can generate other graphs
  - Flow chart of the current function
  - Function calls for the entire program
  - Xrefs to/from a currently selected xref
  - User-specified xref graphs





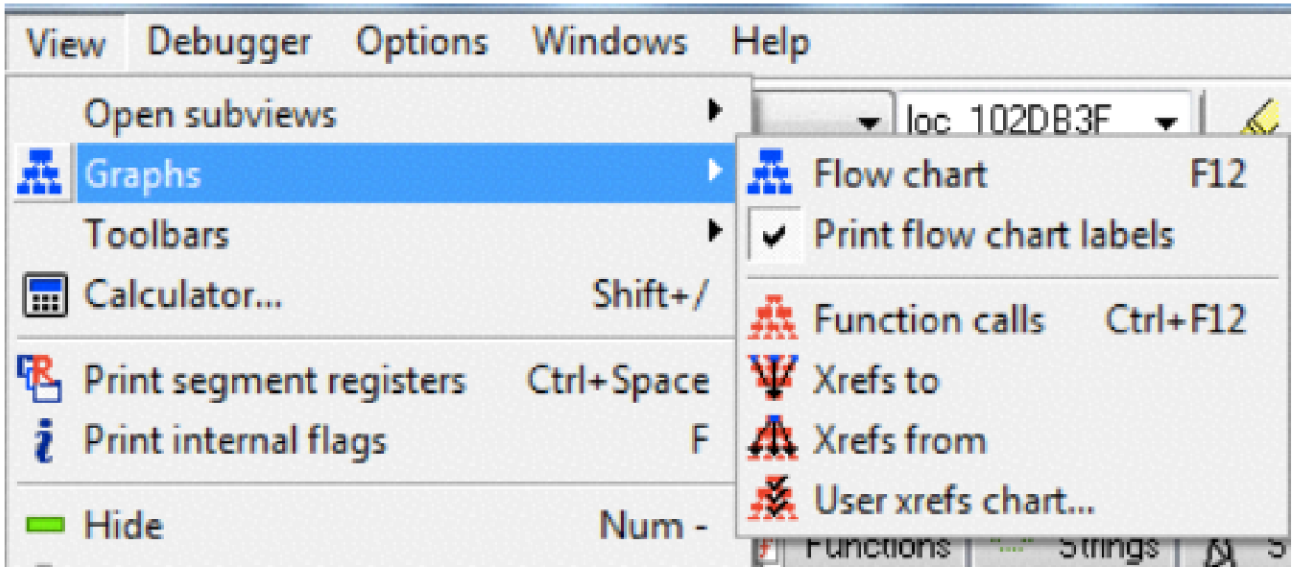
Graphing Options

- These are "Legacy Graphs" and cannot be manipulated with IDA
- The first two seem obsolete
  - Flow chart
    - Create a flow chart of the current function
  - Function calls
    - Graph function calls for the entire program

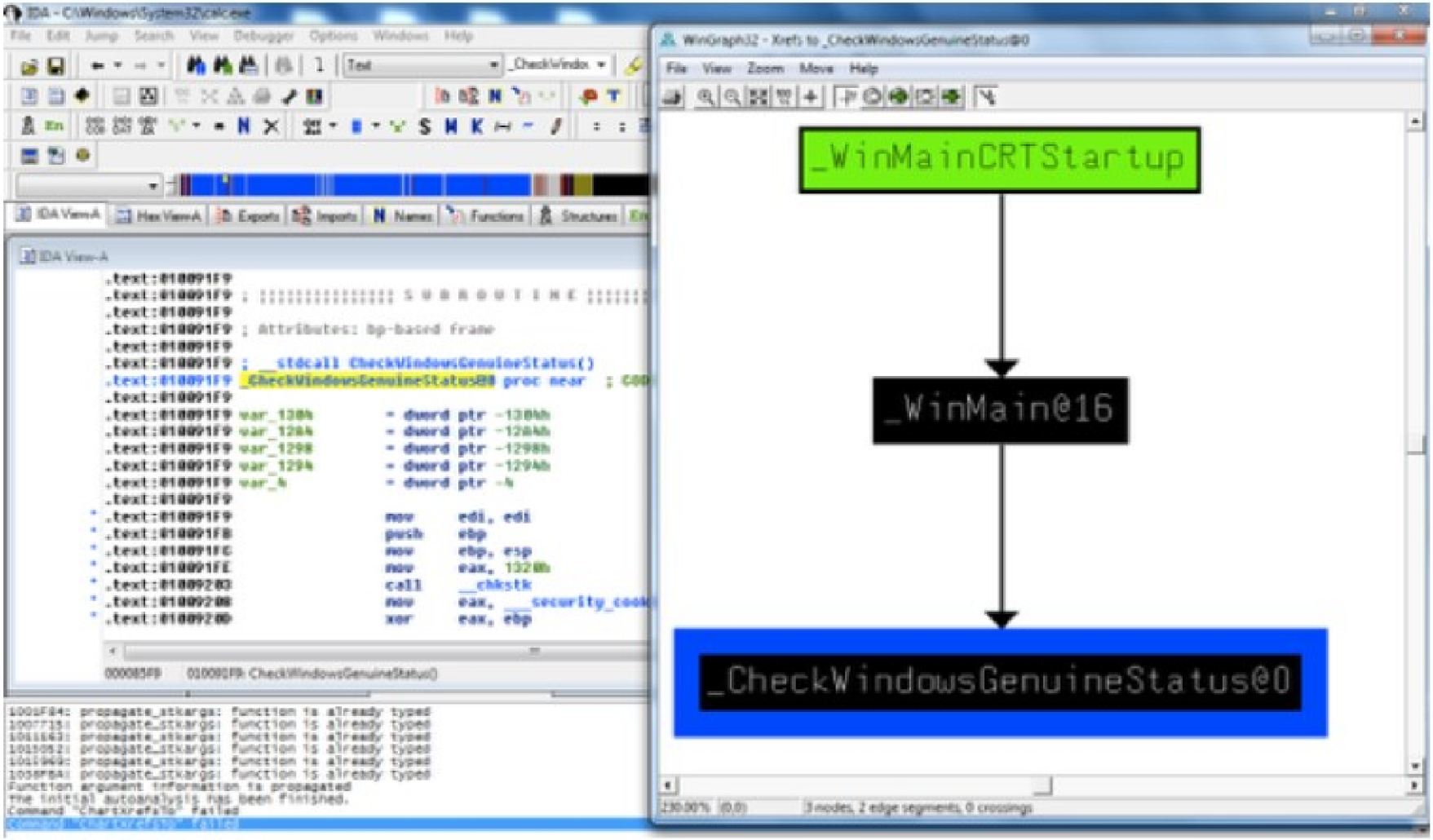


Graphing Options

- Xrefs to
  - Graphs XREFs to get to selected XREF
  - Can show all the paths that get to a function

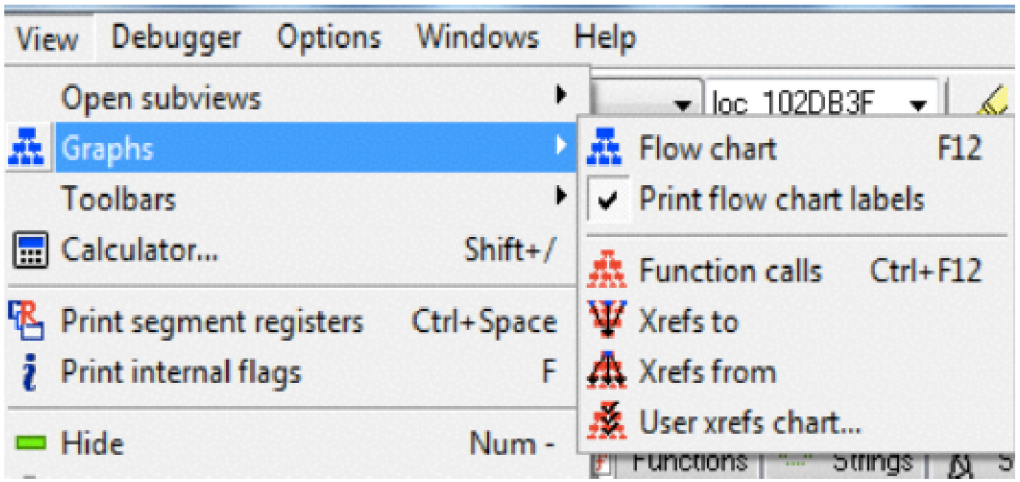


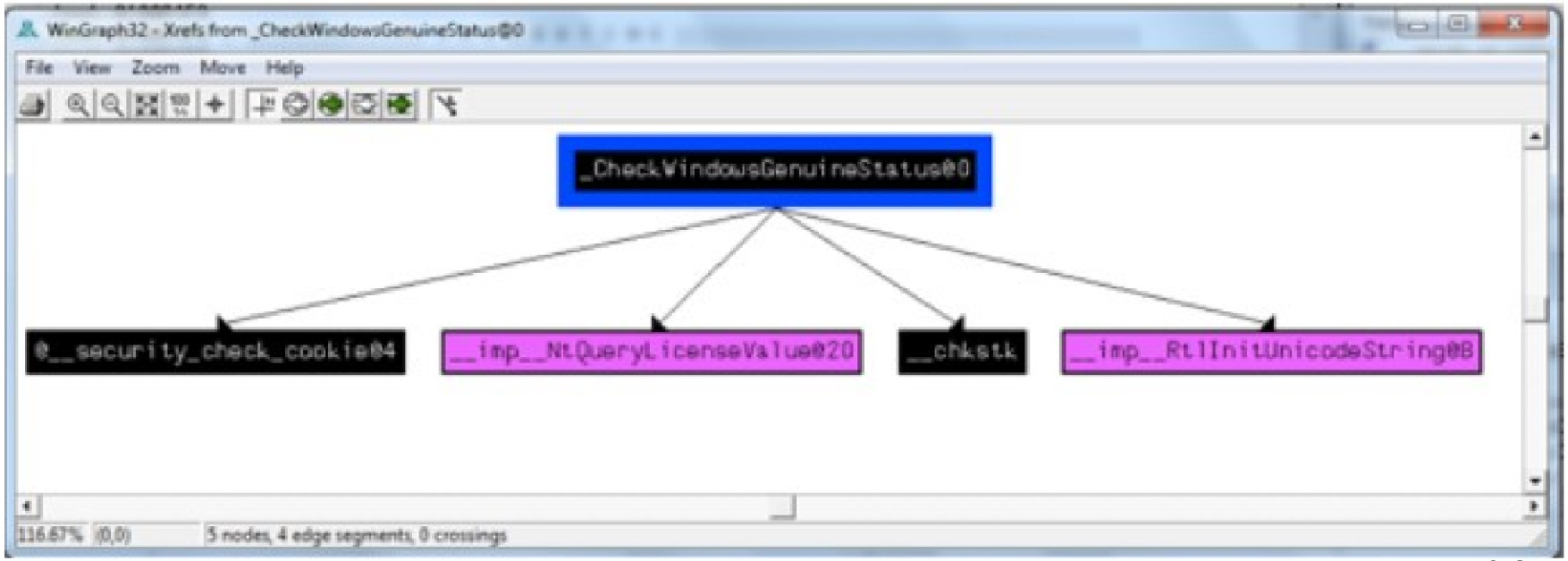
Windows Genuine Status in Calc.exe



Graphing Options

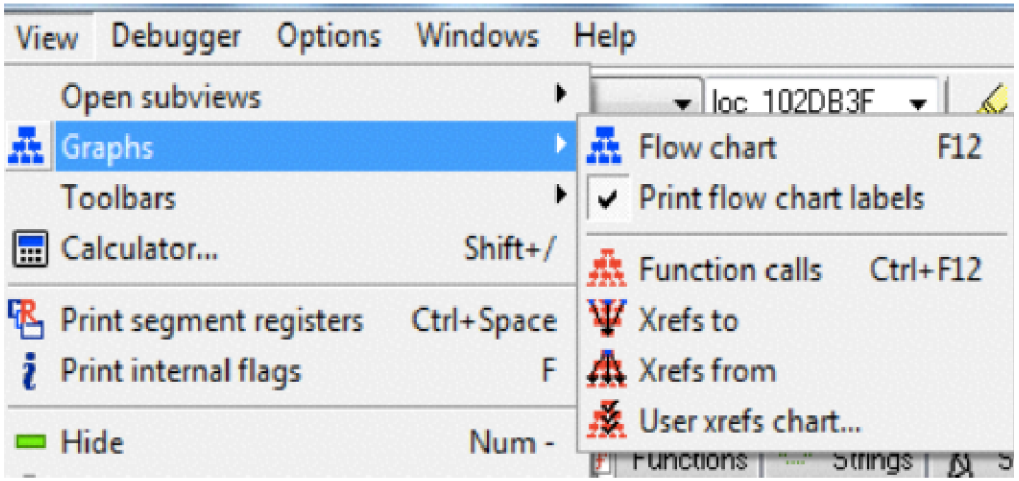
- **Xrefs from**
  - Graphs XREFs from selected XREF
  - Can show all the paths that exit from a function





Graphing Options

- User xrefs chart...
  - Customize graph's recursive depth, symbols used, to or from symbol, etc.
  - The only way to modify legacy graphs



Using Graphing Options

Button	Function	Description
	Creates a flow chart of the current function	Users will prefer to use the interactive graph mode of the disassembly window but may use this button at times to see an alternate graph view. (We'll use this option to graph code in Chapter 6.)
	Graphs function calls for the entire program	Use this to gain a quick understanding of the hierarchy of function calls made within a program, as shown in Figure 5-8. To dig deeper, use WinGraph32's zoom feature. You will find that graphs of large statically linked executables can become so cluttered that the graph is unusable.
	Graphs the cross-references to get to a currently selected cross-reference	This is useful for seeing how to reach a certain identifier. It's also useful for functions, because it can help you see the different paths that a program can take to reach a particular function.

Button	Function	Description
	Graphs the cross-references from the currently selected symbol	This is a useful way to see a series of function calls. For example, Figure 5-9 displays this type of graph for a single function. Notice how `sub_4011f0` calls `sub_401110`, which then calls `gethostbyname`. This view can quickly tell you what a function does and what the functions do underneath it. This is the easiest way to get a quick overview of the function.
	Graphs a user-specified cross-reference graph	Use this option to build a custom graph. You can specify the graph's recursive depth, the symbols used, the to or from symbol, and the types of nodes to exclude from the graph. This is the only way to modify graphs generated by IDA Pro for display in WinGraph32.

Enhancing Disassembly

Warning

- There's no Undo, so if you make changes and mess them up, you may be sorry
  - But you manually change it back

Renaming Locations

- Renaming functions & variables by pressing key [n]
  - sub_401000 or arg_4 don't tell you much
  - Rename them to something more useful!

- Example: You can change a name like sub_401000 to ReverseBackdoorThread
  - Change it in one place; IDA will change it everywhere else

Renaming Locations

Table 6-2. Function Operand Manipulation

Without renamed arguments

```
004013C8  mov   eax, [ebp+arg_4]
004013CB  push  eax
004013CC  call  _atoi
004013D1  add   esp, 4
004013D4  mov [ebp+var_598], ax
004013DB  movzx ecx, [ebp+var_598]
004013E2  test  ecx, ecx
004013E4  jnz   short loc_4013F8
004013E6  push  offset aError
004013EB  call  printf
004013F0  add   esp, 4
004013F3  jmp   loc_4016FB
004013F8 ; ---------------------
004013F8
004013F8 loc_4013F8:
004013F8  movzx edx, [ebp+var_598]
004013FF  push  edx
00401400  call  ds:htons
```

With renamed arguments

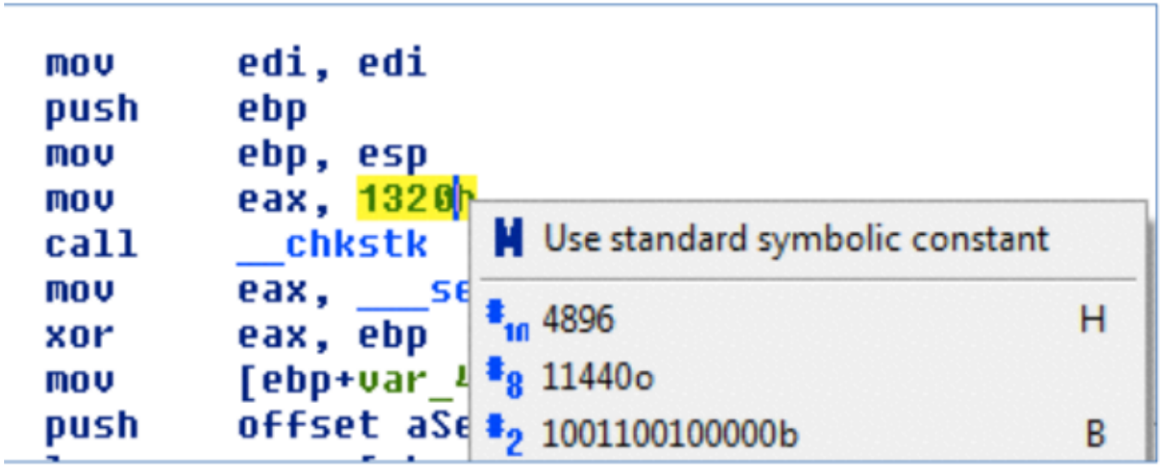
```
004013C8  mov   eax, [ebp+port_str]
004013CB  push  eax
004013CC  call  _atoi
004013D1  add   esp, 4
004013D4  mov   [ebp+port], ax
004013DB  movzx ecx, [ebp+port]
004013E2  test  ecx, ecx
004013E4  jnz   short loc_4013F8
004013E6  push  offset aError
004013EB  call  printf
004013F0  add   esp, 4
004013F3  jmp   loc_4016FB
004013F8 ; ---------------------
004013F8
004013F8 loc_4013F8:
004013F8  movzx edx, [ebp+port]
004013FF  push  edx
00401400  call  ds:htons
```

Comments

- You can add comments to lines too!
- Press the colon (:) to add a single comment
- Press semicolon (;) to echo this comment to all Xrefs

Formatting Operands

- Hexadecimal by default
- Right-click to use other formats
  - You can change the format of the data
  - ex. 0x61 → 'a' → 97
  - Hex: [h/q]
  - decimal: [h] ; key [h] toggles hex and decimal
  - char: [r]
  - binary: [b]



Using Named Constants

- Makes Windows API arguments clearer

Before symbolic constants

```
mov     esi, [esp+1Ch+argv]
mov     edx, [esi+4]
mov     edi, ds:CreateFileA
push    0     ; hTemplateFile
push    80h   ;
dwFlagsAndAttributes
push    3     ;
dwCreationDisposition
push    0     ;
lpSecurityAttributes
push    1     ; dwShareMode
```

After symbolic constants

```
mov     esi, [esp+1Ch+argv]
mov     edx, [esi+4]
mov     edi, ds:CreateFileA
push    NULL   ; hTemplateFile
push    FILE_ATTRIBUTE_NORMAL ;
dwFlagsAndAttributes
push    OPEN_EXISTING         ;
dwCreationDisposition
push    NULL                  ;
lpSecurityAttributes
push    FILE_SHARE_READ       ; dwShareMode
```

Using Named Constants

- Makes Windows API arguments clearer

Before symbolic constants

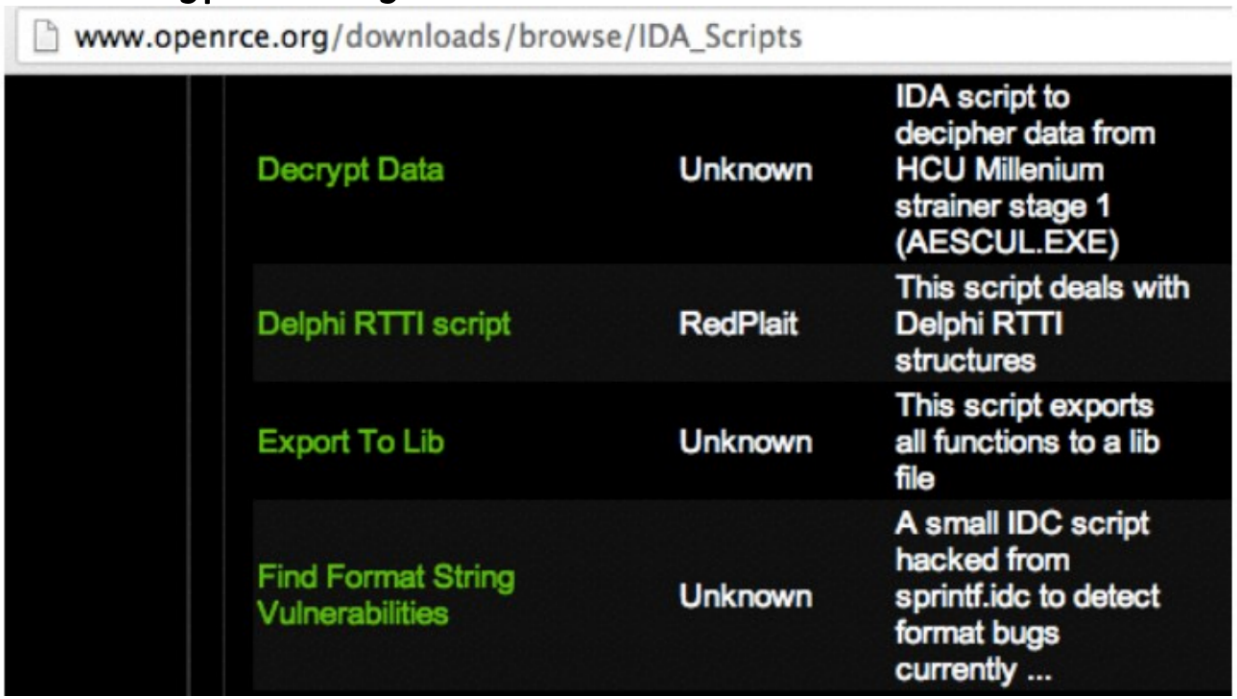
```
mov     esi, [esp+1Ch+argv]
mov     edx, [esi+4]
mov     edi, ds:CreateFileA
push    0     ; hTemplateFile
push    80h   ;
dwFlagsAndAttributes
push    3     ;
dwCreationDisposition
push    0     ;
lpSecurityAttributes
push    1     ; dwShareMode
```

After symbolic constants

```
mov     esi, [esp+1Ch+argv]
mov     edx, [esi+4]
mov     edi, ds:CreateFileA
push    NULL   ; hTemplateFile
push    FILE_ATTRIBUTE_NORMAL ;
dwFlagsAndAttributes
push    OPEN_EXISTING         ;
dwCreationDisposition
push    NULL                  ;
lpSecurityAttributes
push    FILE_SHARE_READ       ; dwShareMode
```

Extending IDA with Plug-ins

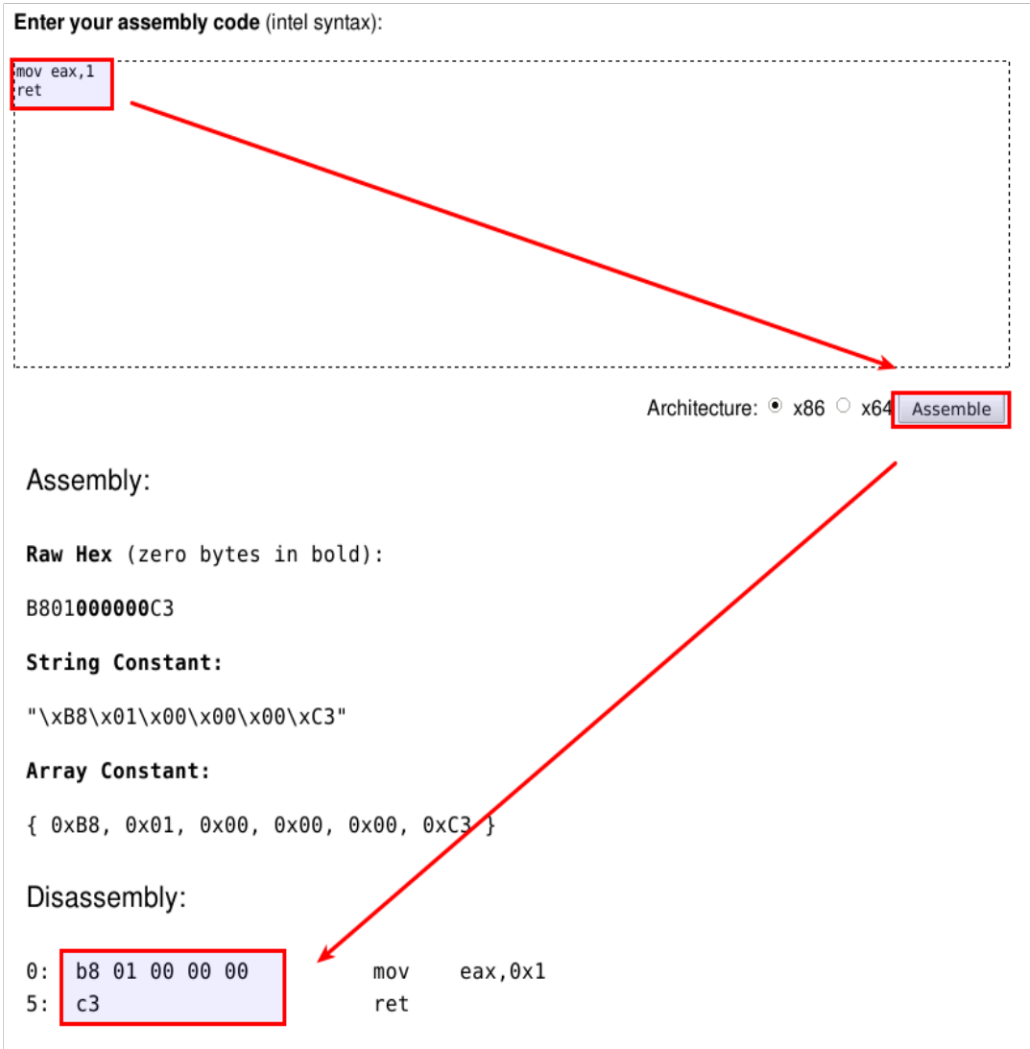
- IDA Pro has plenty of plugins
  - Interface by using the IDA API
    - IDC
    - IDAPython (not available in IDA Free)
  - Some Useful Plugins:
    - Fentanyl – Patch Assembly in IDA
    - Hex-Rays Decompiler (Costs fat stacks of cash)
    - KANAL – Krypto Analyzer



X-86 Assemble/Disassemble

- Online x86 / x64 Assembler and Disassembler
  - https://defuse.ca/online-x86-assembler.htm#disassembly

- Online x86 / x64 Assembler and Disassembler
  - https://defuse.ca/online-x86-assembler.htm#disassembly



Main Sources for these slides

- *Michael Sikorski and Andrew Honig, "Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software"; ISBN-10: 1593272901.*
- *Xinwen Fu, "Introduction to Malware Analysis," University of Central Florida*
- *Sam Bowne, "Practical Malware Analysis," City College San Francisco*
- *Abhijit Mohanta and Anoop Saldanha, "Malware Analysis and Detection Engineering: A Comprehensive Approach to Detect and Analyze Modern Malware," ISBN: 1484261925.*

Thank you