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We Secure the Internet.

CPIIS

Introduction to Reverse Engineering

Inbar Raz
Malware Research Lab Manager
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What is Reverse Engineering?

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WIKIPEDIA

Reverse engineering is the process of discovering the technological principles of a device, object, or system through analysis of its structure, function, and operation.

aka: Reversing, RE, SRE

Why do it?

Discover Trade Secrets

Find Vulnerabilities

Academic Research (Yeah, right…)

Circumvent [Copy] Protection

Patch Binary and Alter Behavior

Pure Curiosity

Analyse Protocols

Sounds awesome, right?

So where's the catch?

- Low-level is, well, low level…

```
for (Serial = 0, i = 0; i < strlen(UserName); i++) {
    CurChar = (int) UserName[i];
    Serial += CurChar;
    Serial = (((Serial << 1) && 0xFFFFFFFE) || ((Serial >> 31) && 1));
    Serial = (((Serial * CurChar) + CurChar) ^ CurChar);
}
UserSerial = ~((UserSerial ^ 0x1337C0DE) - 0xBADC0DE5);
```

```
00401000  push    ebp
00401001  mov     ebp, esp
00401003  push    ecx
00401004  push    ecx
00401005  and     dword ptr [ebp-4], 0
00401009  push    esi
0040100A  mov     esi, [ebp+8]
0040100D  push    edi
0040100E  push    esi
0040100F  call    ds:[00402008h]
00401015  mov     edi, eax
00401017  xor     edx, edx
00401019  test    edi, edi
0040101B  jle     00401047h
0040101D  movsx   ecx, byte ptr [edx+esi]
00401021  add     [ebp-4], ecx
00401024  mov     [ebp-8], ecx
00401027  rol     dword ptr [ebp-4], 1
0040102A  mov     eax, ecx
0040102C  imul    eax, [ebp-4]
00401030  mov     [ebp-4], eax
00401033  mov     eax, [ebp-8]
00401036  add     [ebp-4], eax
00401039  xor     [ebp-4], ecx
0040103C  inc     edx
0040103D  cmp     edx, edi
0040103F  jl      0040101Dh
00401041  cmp     dword ptr [ebp-4], 0
```

So where's the catch?

- Low-level is, well, low level…
- Needle in a haystack
  - Average opcode size:
    3 bytes
  - Average executable size:
    500KB (on WinXP)
  - There are executables, libraries, drivers….

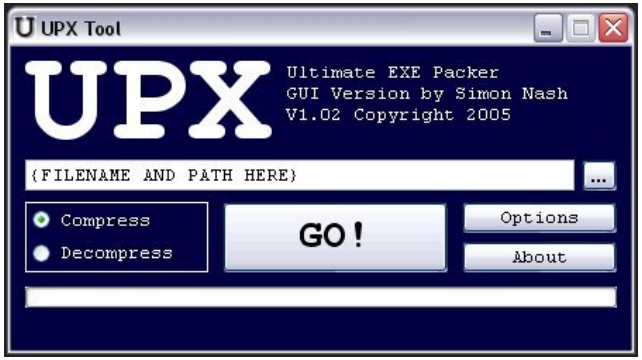
So where's the catch?

- Low-level is, well, low level…
- Needle in a haystack
- Sometimes, the code resists
  - Packers and compressors
  - Obfuscators

So where's the catch?

- Low-level is, well, low level…
- Needle in a haystack
- Sometimes, the code resists
- Sometimes, the code fights back
  - Detect reversing tools
  - Detect VMs and emulators

The Enigma Protector
Software Protection



THEMIDA

ASPACK SOFTWARE

softwareblades

A Battle of Wits

- Video clip: The Battle of Wits, “The Princess Bride”

A Battle of Wits

- Author writes code
- Reverser reverses it
- Author creates an anti-reversing technique
- Reverser bypasses it
- And so on…

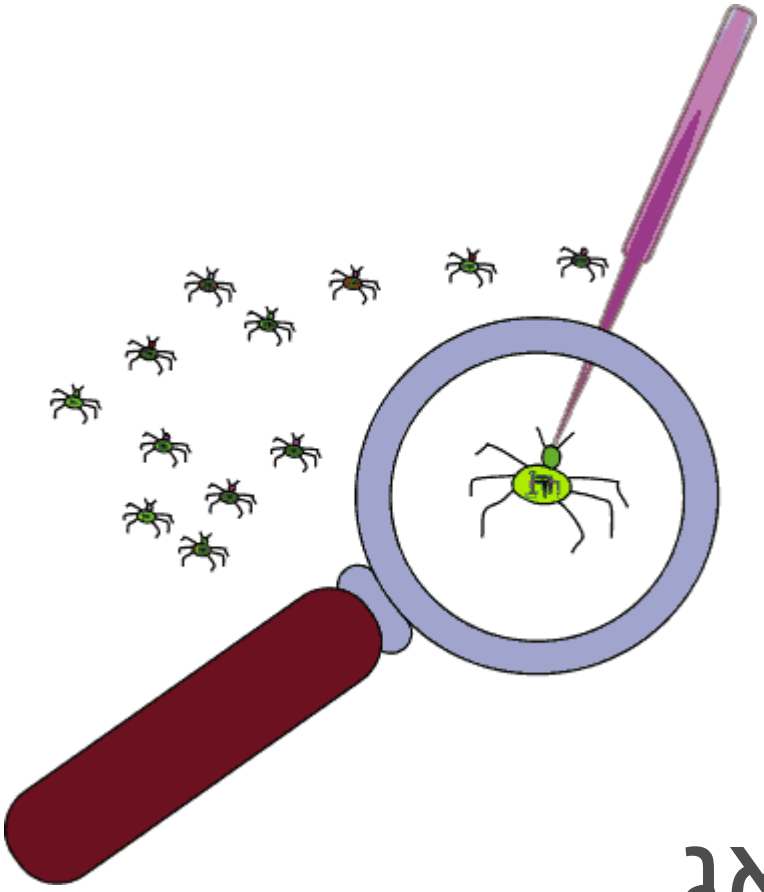
So what do you need in order to be a good reverser?

We'll come back to this…

Tools of the Trade

- Debugger (Dynamic code analysis)
- Disassembler (Static code analysis)
- Hex Editor
- PE Analyzer
- Resource Editor

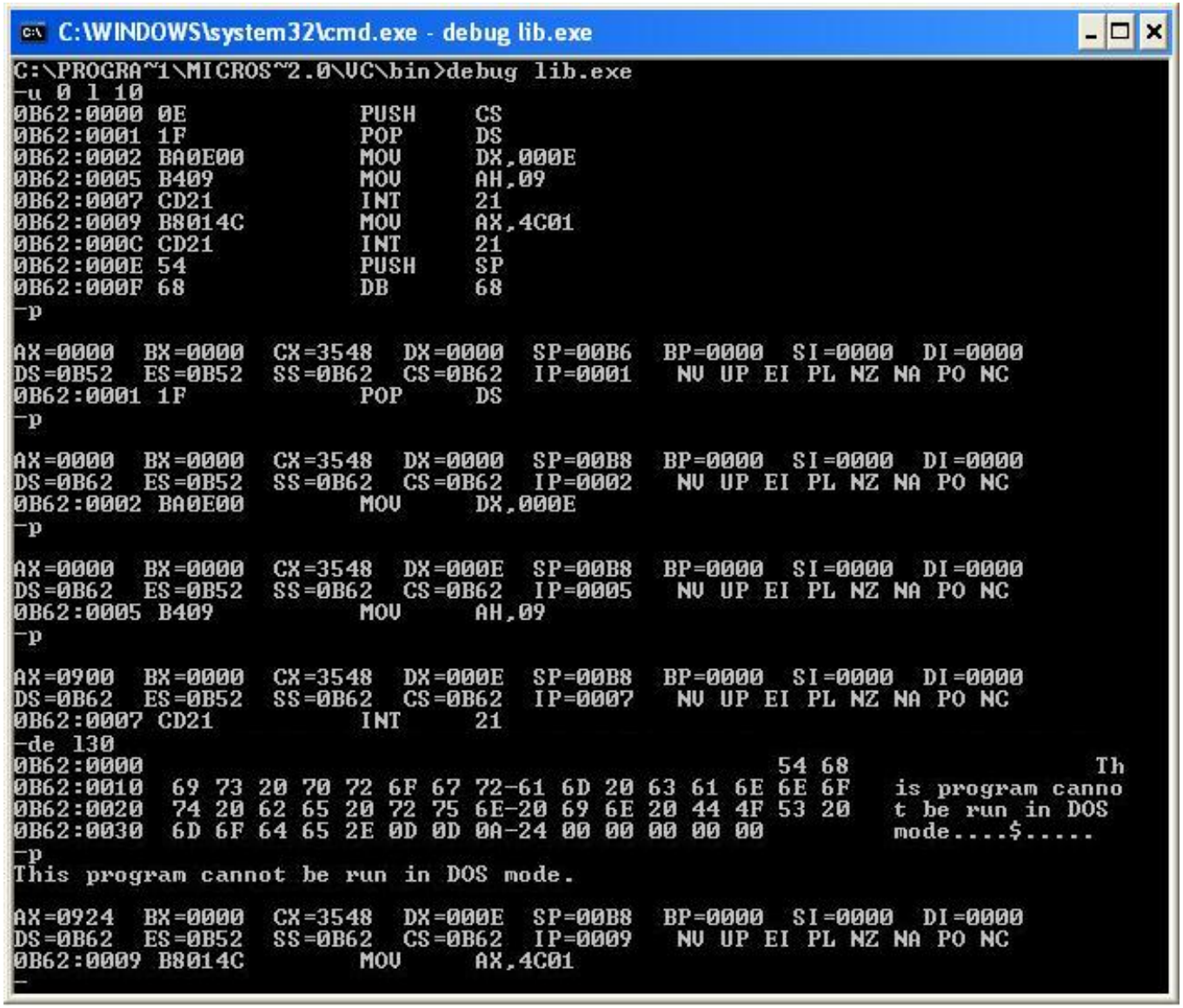
and more…



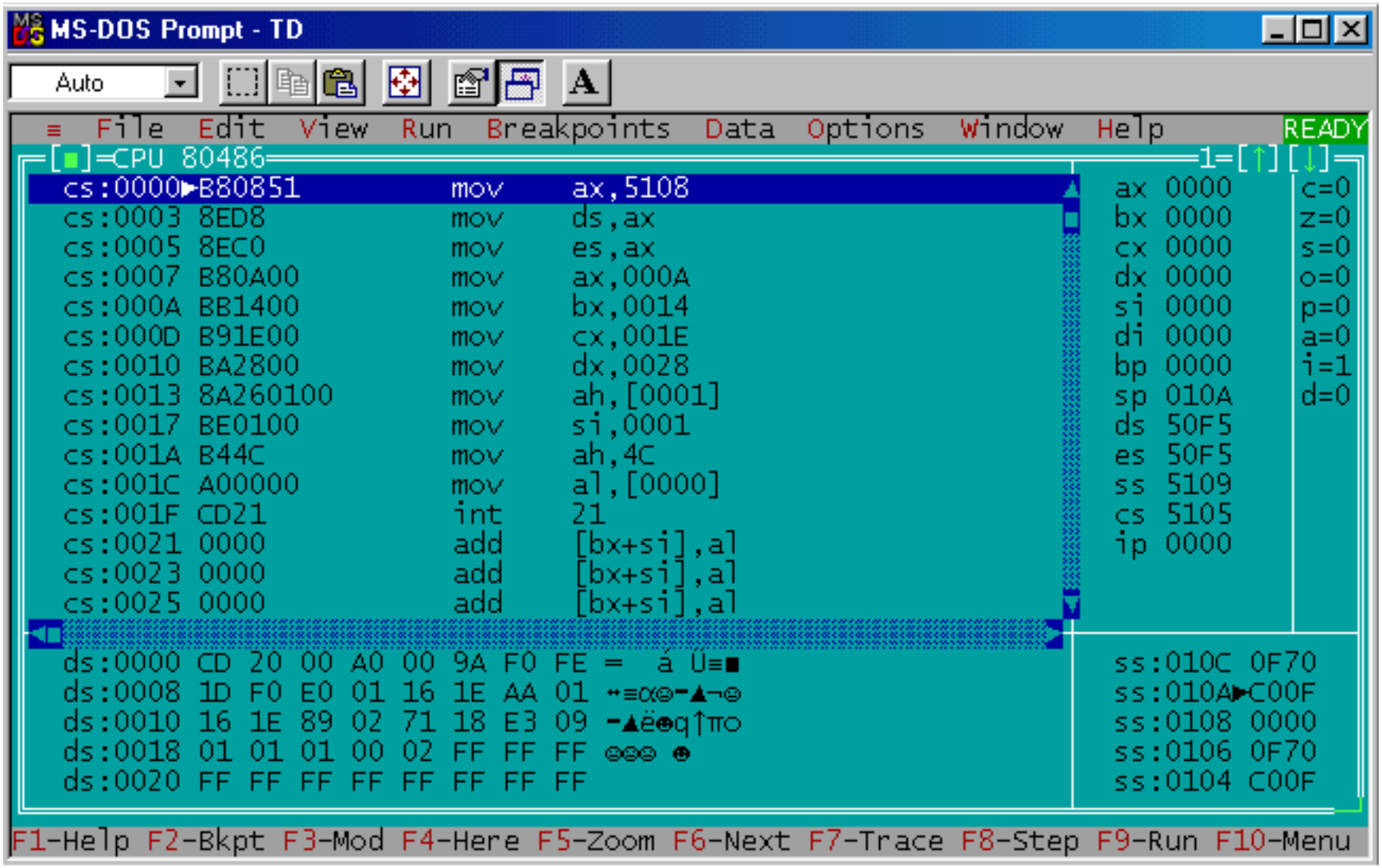
Debuggers

באג בדיזיין – זין בדיבאג

First, there was DEBUG…



GUI and much more: Turbo Debugger



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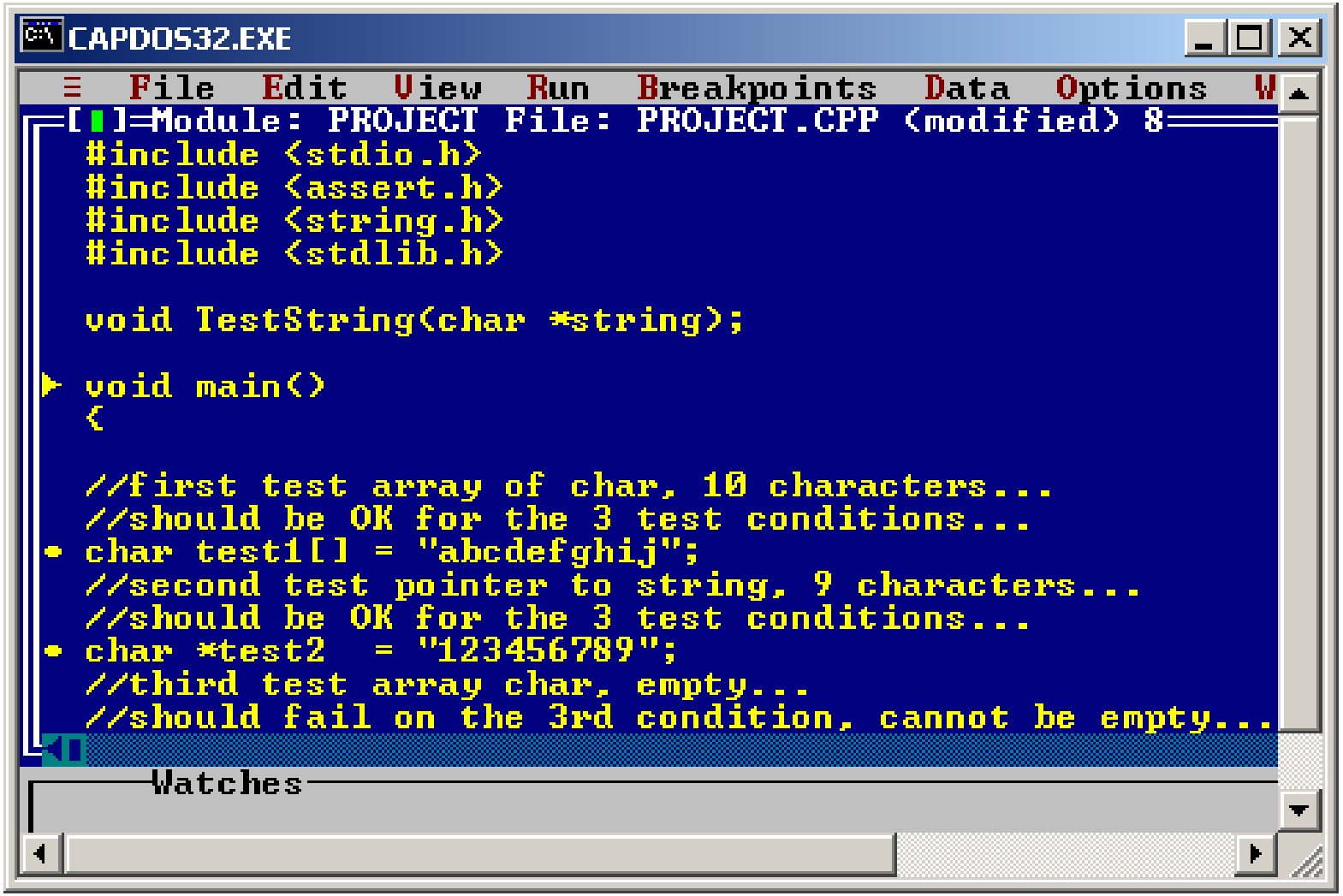

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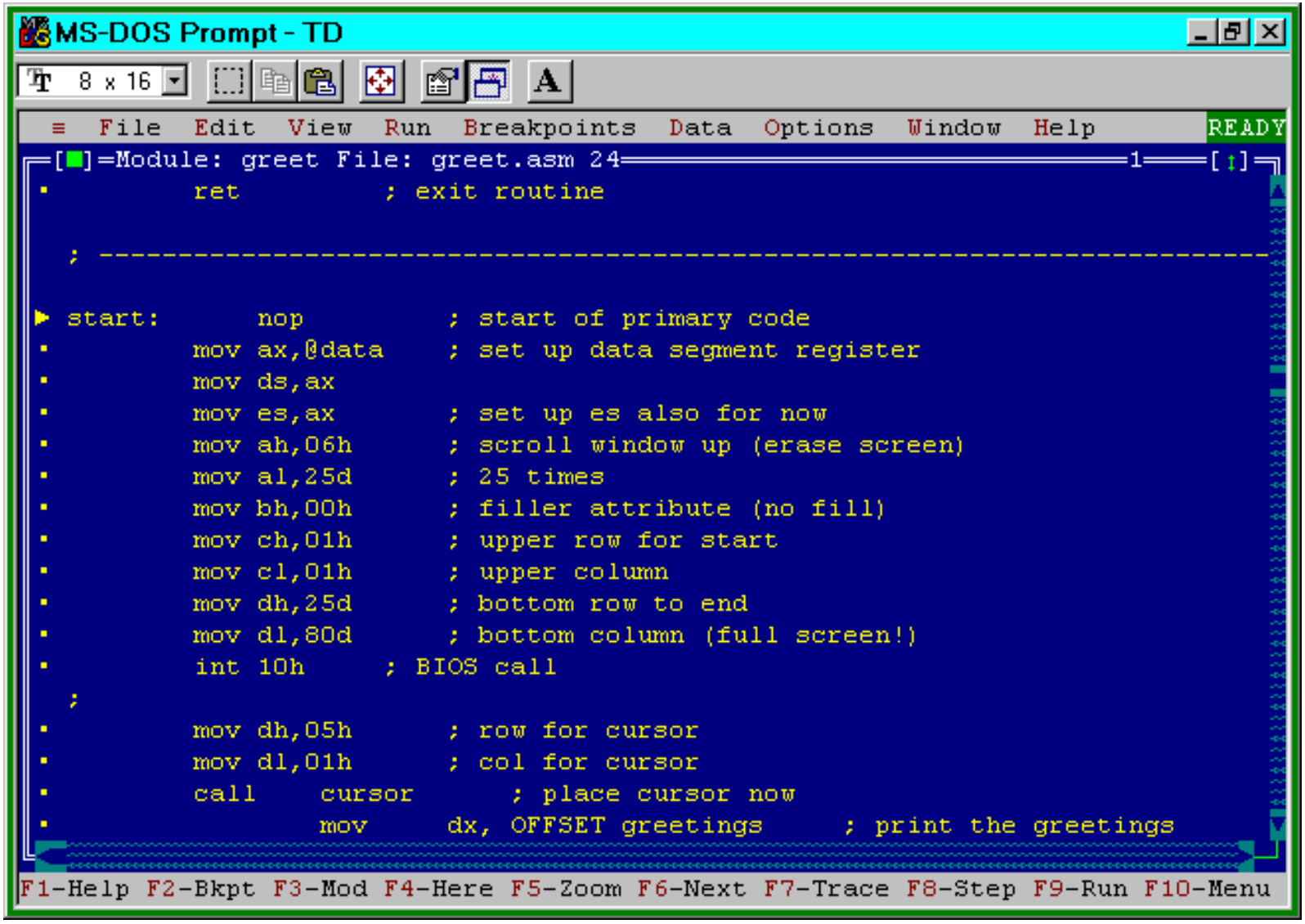

Next major step: Soft-ICE

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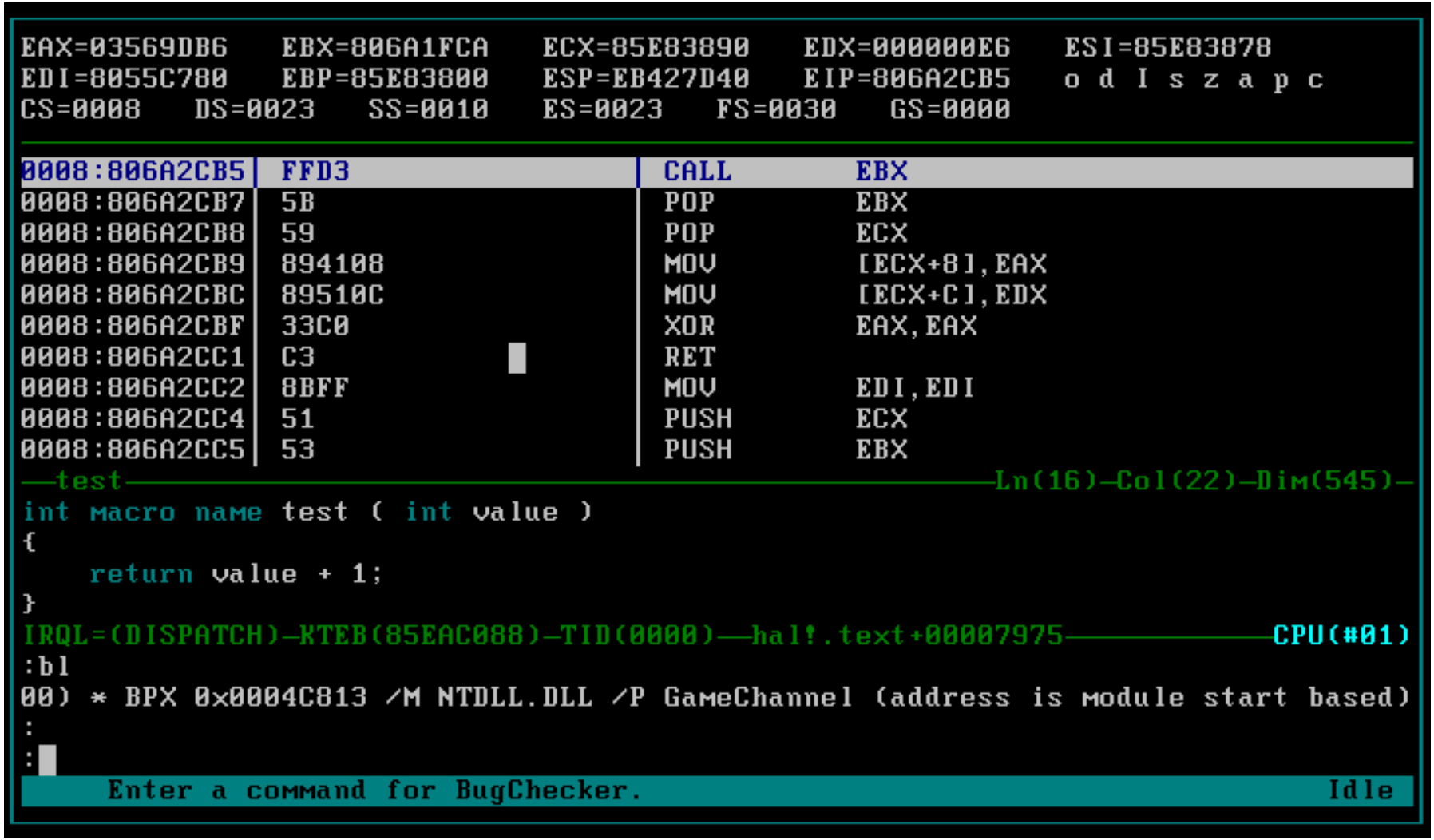
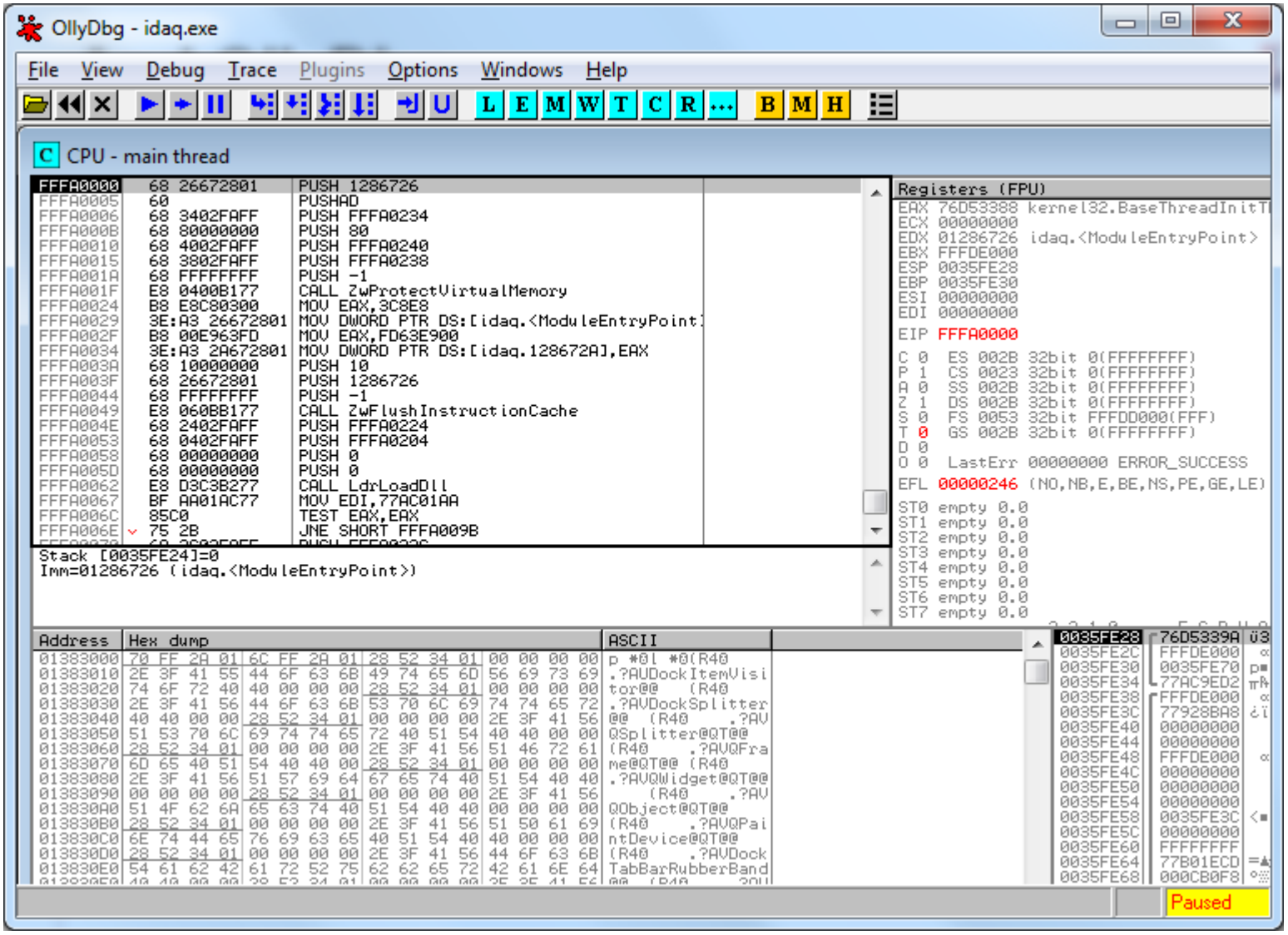
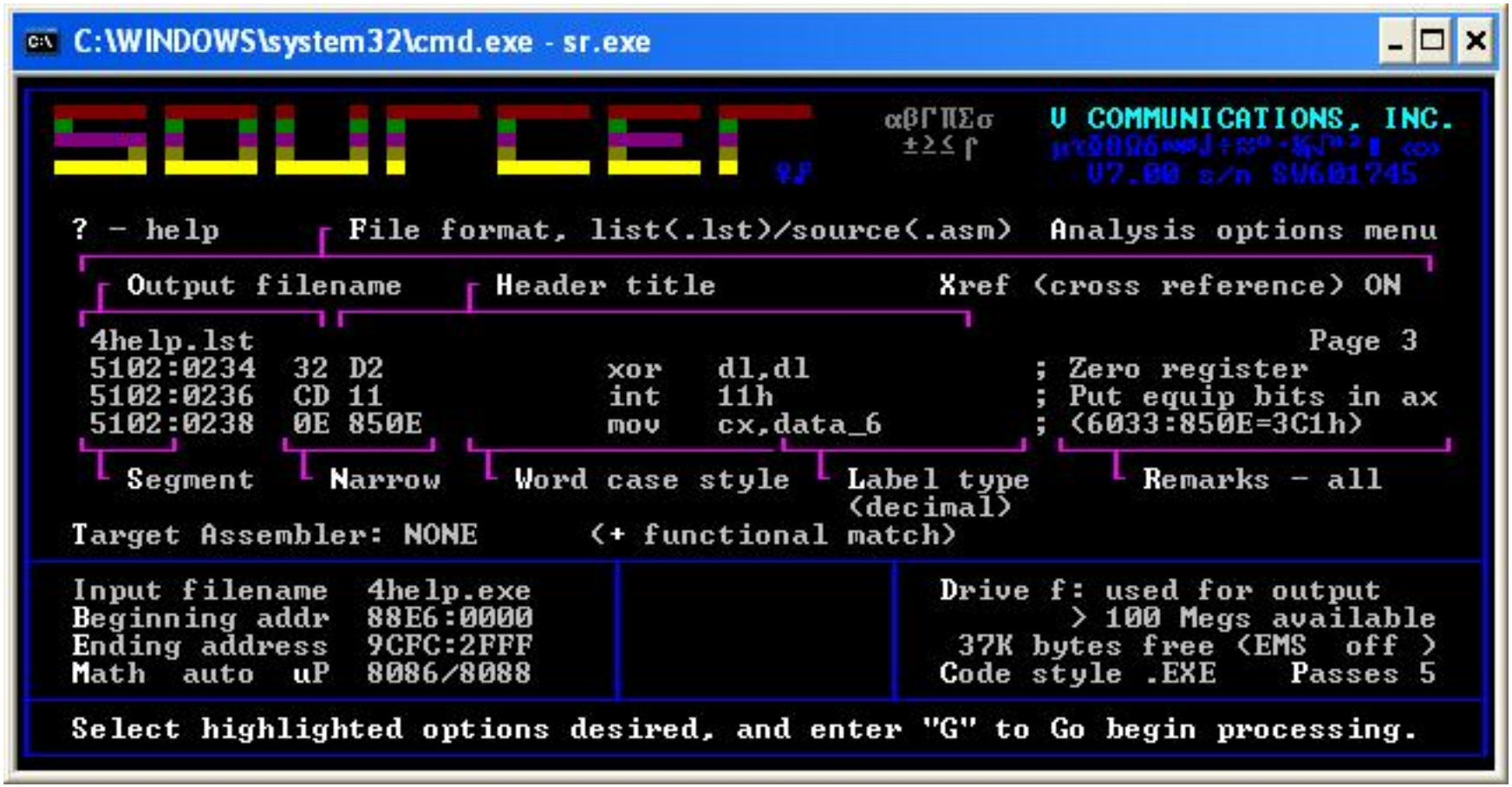


And finally: OllyDbg



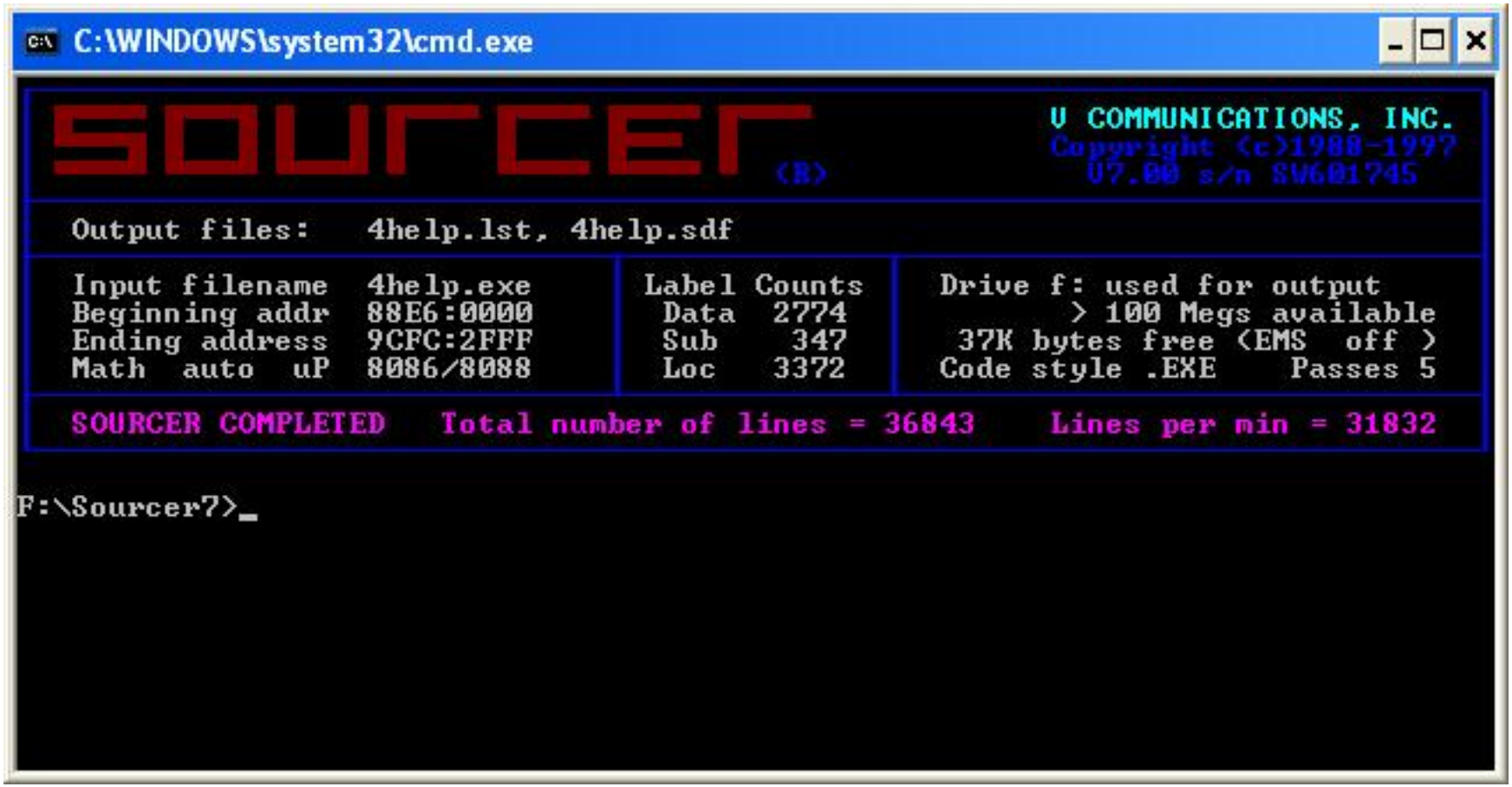
Disassemblers

The old world: Sourcer



The old world: Sourcer

Old ages: Sourcer



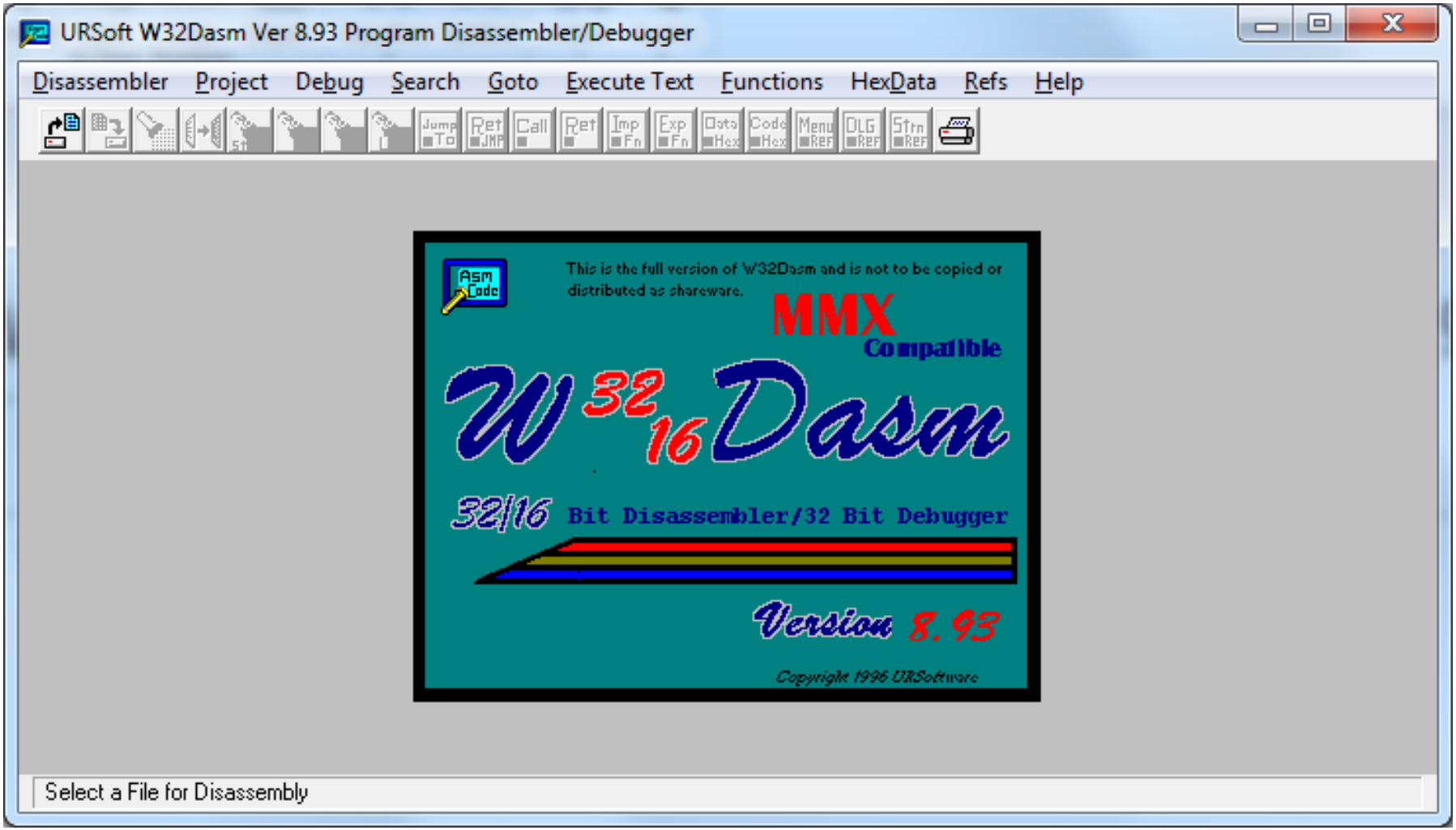
Old ages: Sourcer

4HELP.LST - Notepad

File Edit Format View Help

```
     = 0010                     data_977e       equ     10h                     ; (FFFF:0010=1068h)

                                ;------------------------------------------------------------  seg_a   ----

                                seg_a           segment byte public
                                                assume cs:seg_a  , ds:seg_a , ss:stack_seg_o

                                                                                ;* No entry point to code
88E6:0000  55                                   push    bp
88E6:0001  89 E5                                mov     bp,sp
88E6:0003  C4 06 080D                           les     ax,dword ptr ds:[80Dh]  ; (88E6:080D=570Eh) Load seg:of
88E6:0007  8C C2                                mov     dx,es
88E6:0009  A3 04E2                              mov     word ptr ds:[4E2h],ax   ; (88E6:04E2=5292h)
88E6:000C  89 16 04E4                           mov     word ptr ds:[4E4h],dx   ; (88E6:04E4=9A50h)
88E6:0010  BF 0808                              mov     di,808h
88E6:0013  1E                                   push    ds
88E6:0014 ú57                                   push    di                      ; PARAMETER_1
88E6:0015  9A 89B3:0655                         call    far ptr sub_17          ; (89B3:0655)
88E6:001A  89 EC                                mov     sp,bp
88E6:001C  5D                                   pop     bp
88E6:001D  CB                                   retf                            ; Return far

                                ;ßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßßß
                                ;                            SUBROUTINE
                                ;
                                ;         Called from:   88E6:013A, 013D, 0158, 015B, 0514, 0517
                                ;ÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜÜ

♀          4help.lst                            Sourcer v7.00   26-Dec-11   9:15 pm   Page 10

88E6:001E                       sub_7           proc    near
88E6:001E ú55                                   push    bp
88E6:001F  89 E5                                mov     bp,sp
88E6:0021  B8 01F4                              mov     ax,1F4h
88E6:0024  50                                   push    ax
88E6:0025  9A 93E8:1656                         call    far ptr sub_268         ; (93E8:1656)
88E6:002A  B8 0032                              mov     ax,32h
88E6:002D  50                                   push    ax
88E6:002E  9A 93E8:121F                         call    far ptr sub_254         ; (93E8:121F)
```

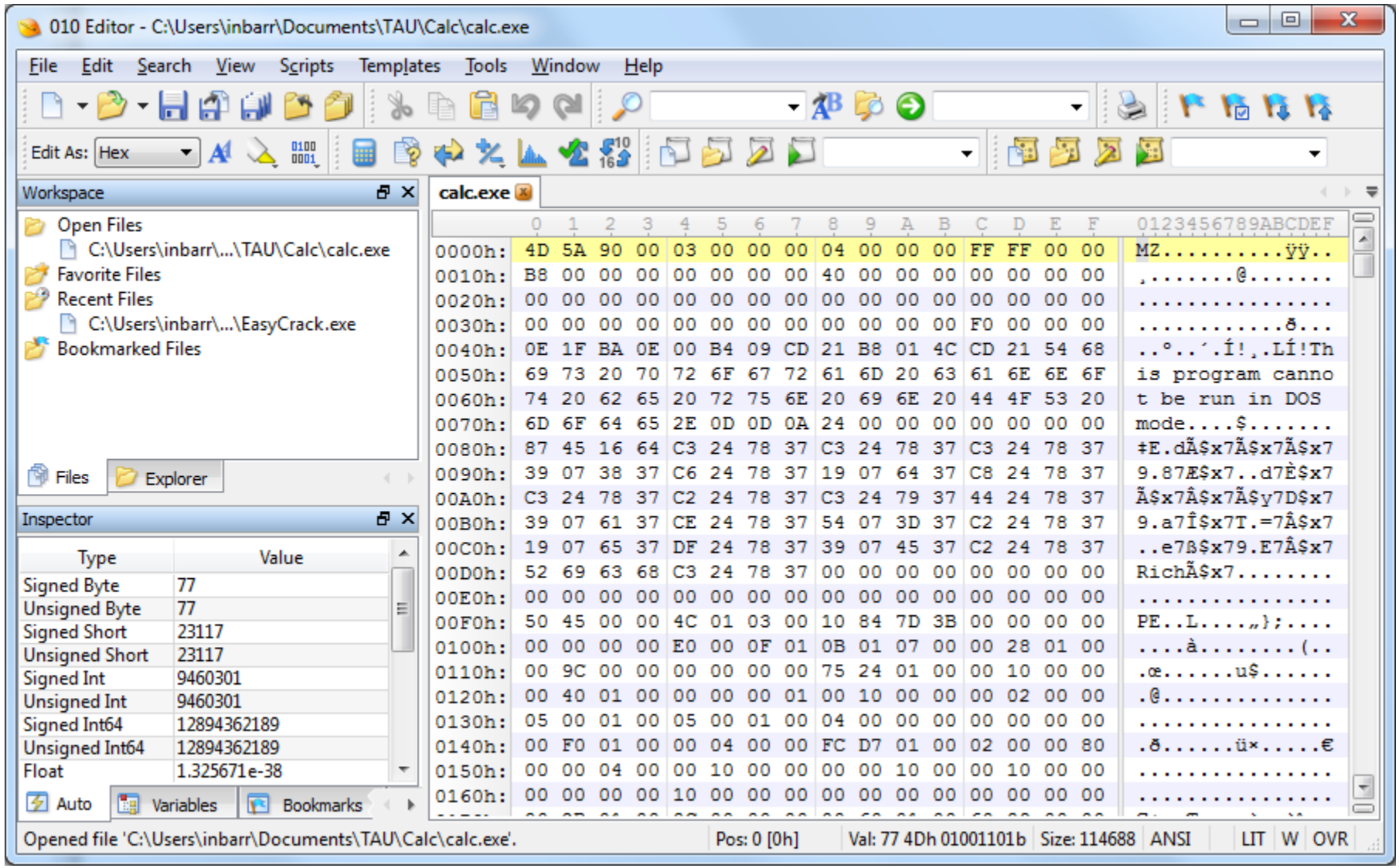
Welcome to Windows: W32DASM



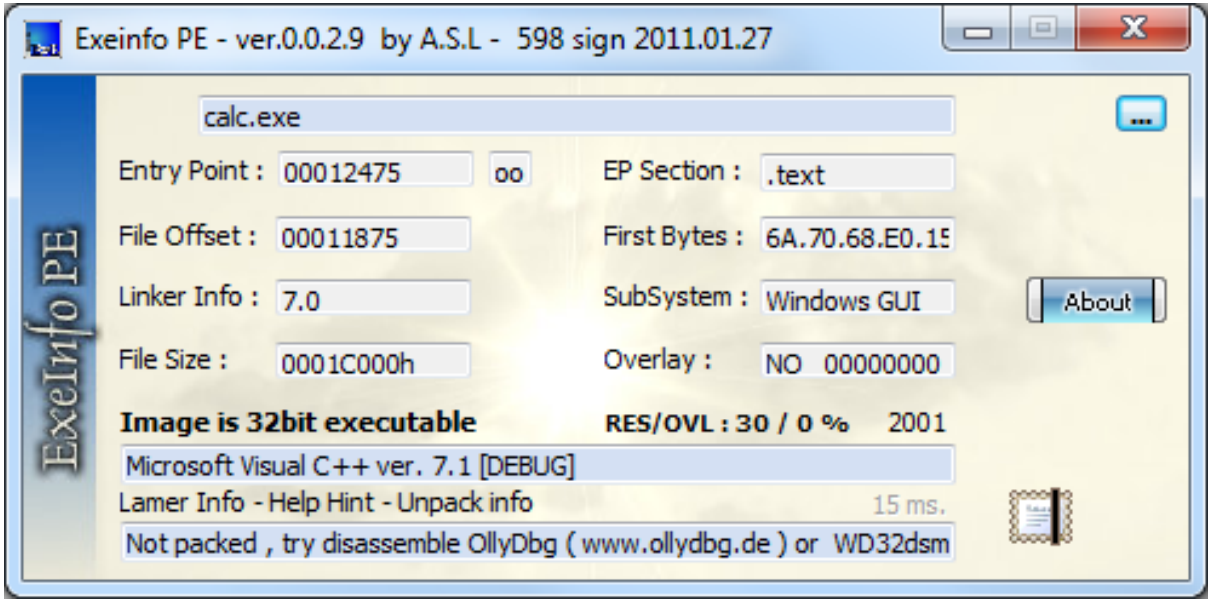
The Holy Grail: IDA-Pro

- Started as an Interactive Dis-Assembler, enabling user interaction with the disassembler's decisions.
- Slowly evolved into an automatic RE tool:
  - Built-in full-control script language
  - Library recognition (including user-generated)
  - Function prototype information
    - Display
    - Propagate throughout the code
  - Support for plug-ins
  - Support for Python scripting
  - Multi-architecture, cross-platform support
  - Full incorporation with built-in and external debuggers

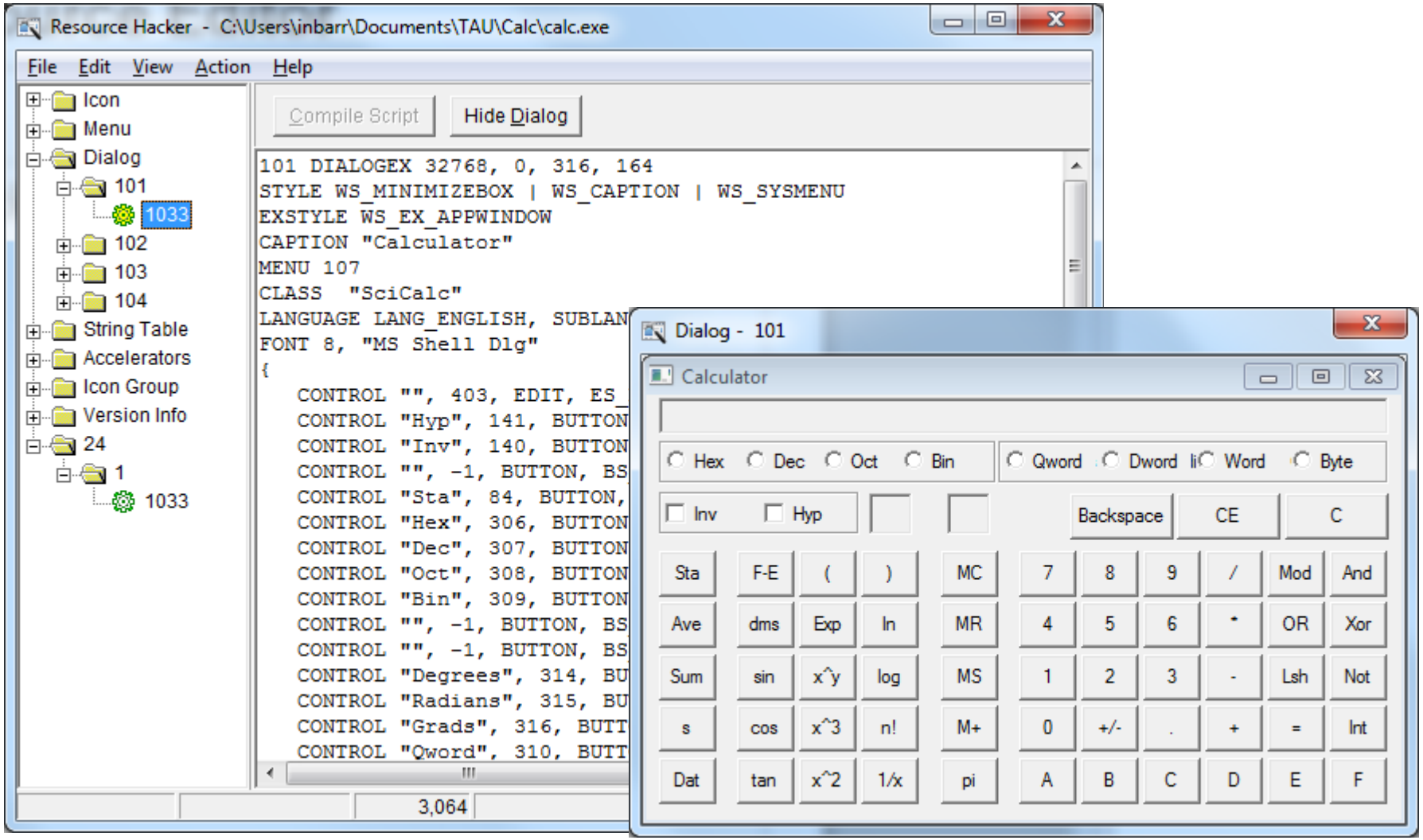
Hex-Editor



PE Analyzer



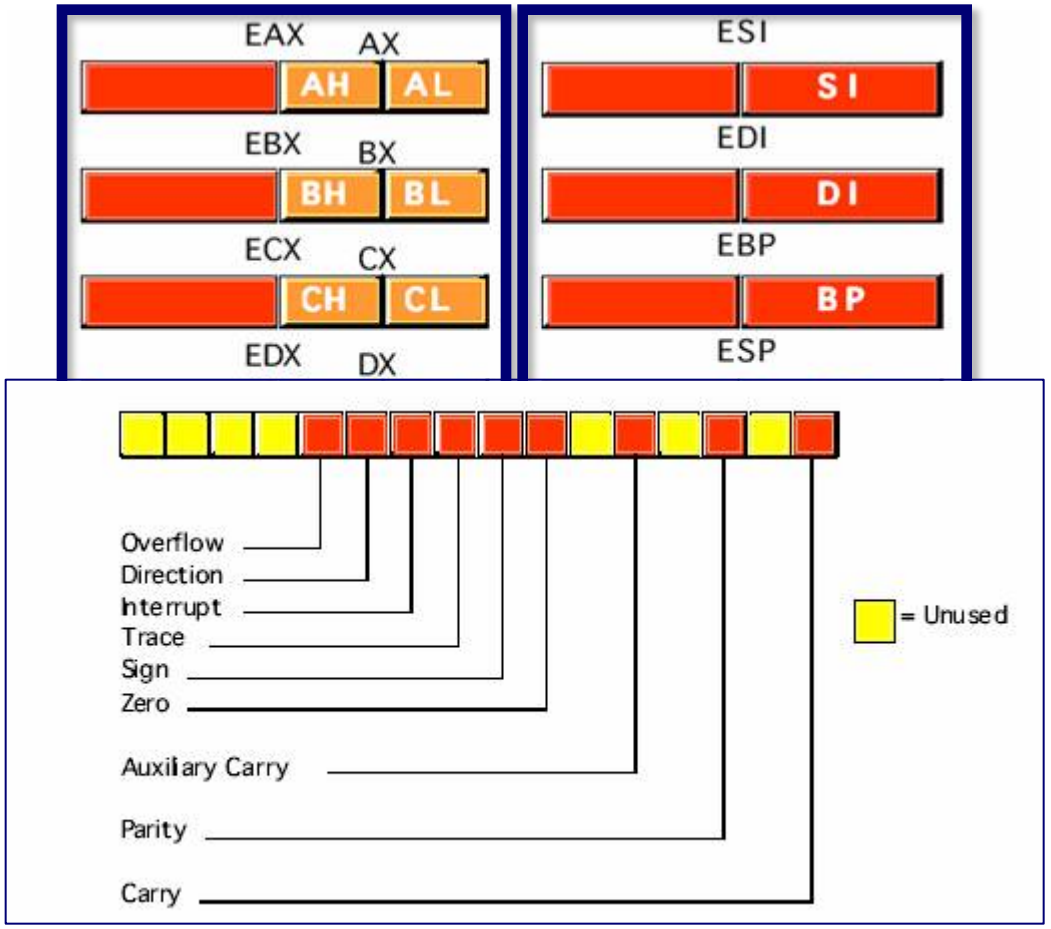
Resource Editor



Let’s play with them tools…

60 seconds on x86 registers

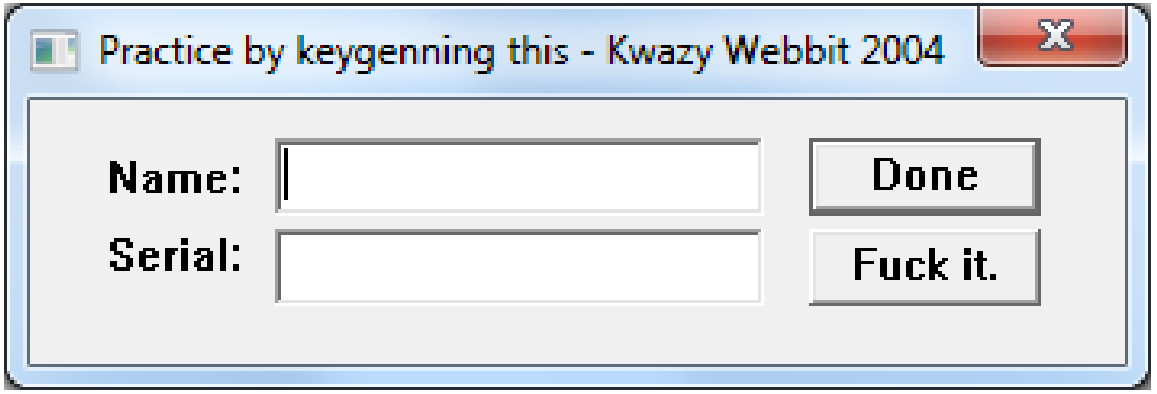
- General purpose registers:
  32bit/16bit/8bit
- Index registers:
  32bit/16bit
- Segment registers:
  16bit
- Flags:
  32bit/16bit



Exercise 1:
Static Reversing

Exercise 1: Static Reversing

- Target: a 2004 “Crack-Me”

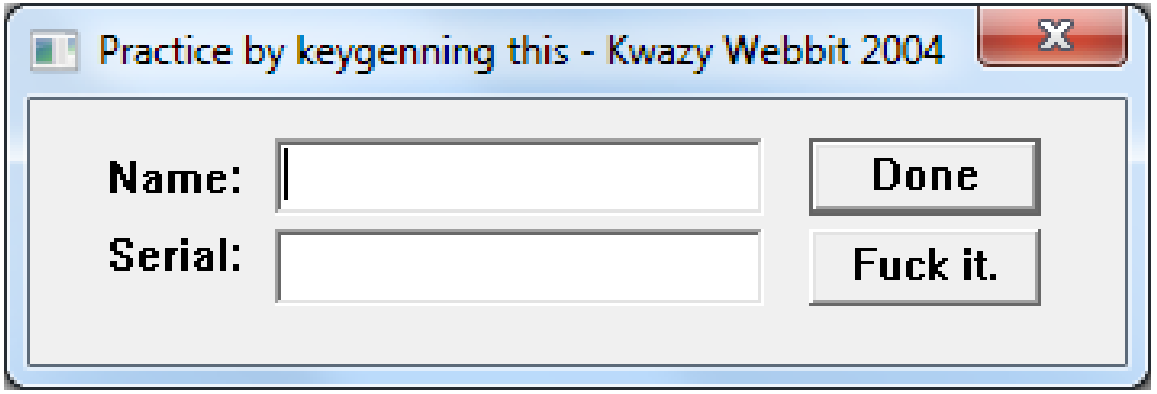


- Tools: IDA-Pro

Exercise 2:
Dynamic Reversing

Exercise 2: Dynamic Reversing

- Target: a 2004 “Crack-Me”

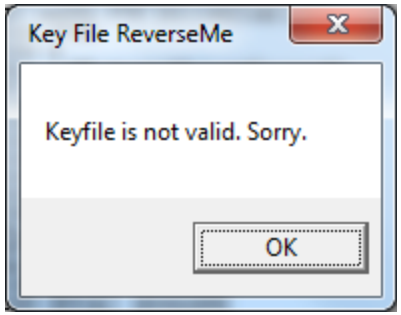


- Tools: OllyDbg, IDA-Pro

Exercise 3:
Simple Anti-Debugging

Exercise 3: Simple Anti Debugging

- Target: a 2006 “Crack-Me”



- Tools: OllyDbg

Reversing Malware

- Malware is comprised of the following building blocks:
  - Infection Vector
  - Concealment
  - Operation
  - Communications

- Check Point's Anti-Malware Software Blade sits at the gateway
- Therefore, communications interest us the most

Introducing: Spy Eye

- A *CrimeWare ToolKit*, originating in Russia.
- Used mostly for stealing financial information, but will settle for any other identity information and key logging…
- Like any serious trojan, Spy Eye compresses its traffic and encrypts it
  - Compression is performed using a public library (LZO)
  - Encryption algorithm is proprietary

Act 1:
Encryption

Act 2:
Configuration Download

Act 3:
Another Encryption

So what do you need in order to be a good reverser?

What makes a good reverser?

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Qualities

- Patient
- Curious
- Persistent
- Outside-the-Box Thinking

- Optional: Good lookin’

Knowledge

- Assembly Language
- Some High-Level programming
  - Best: origin of binary
- Operating System Internals
  - API
  - Data Structures
  - File Structures
- Good scripting skills
- Anti-Debugging Tricks

Outside-the-Box Thinking

And remember, kids:

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Binary **Reverse Engineer**

=?

Which means…

Questions?

Thank you!

inbarr@checkpoint.com

Credits

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