המרכז
לחינוך סייבר
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Reverse Engineering Course

Dynamic Analysis

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Dynamic Analysis

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- Easier to understand code functionality
  - Check values in registers, memory
  - Check stack: arguments and return addresses
- Modify code on the fly
- We shall learn:
  - WinDbg
  - x32dbg

TeaParty

- https://data.cyber.org.il/reversing/TeaParty.zip
- Copy both exe and pdb file to dedicated library

LM

- Load TeaParty and list all modules – “lm”

```
0:000> lm
start    end        module name
00420000 00427000   TeaParty C (private pdb symbols)
54170000 54183000   VCRUNTIME140   (deferred)
5fee0000 5ff8f000   atcuf32    (deferred)
74c30000 74d4f000   ucrtbase   (deferred)
76cc0000 76ebe000   KERNELBASE   (deferred)
770c0000 771a0000   KERNEL32   (deferred)
77310000 774aa000   ntdll      (pdb symbols)
```

X

- If debug info is present, any function can be searched
- X moduleName!*anything*
  - * is wildcard

```
0:000> x teaparty!main
00421080          TeaParty!main (void)
```

- Too Easy ☺

Finding main with the stack

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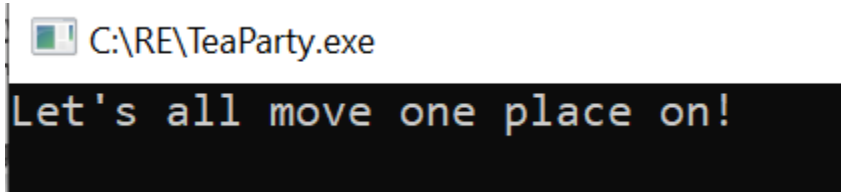
- Step 1: take whatever program prints and search
- Step 2: any print should be called from main (if we go back enough)
- Step 3: look at the stack- return addresses

Find main, again

- Delete pdb file
  - C:\symbols\TeaParty
- Run program and check output



Search for Strings

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- https://docs.microsoft.com/en-us/windows-hardware/drivers/debugger/s--search-memory-
- S –a : search for **a**scii string
  - S –a startAddress L:endAddress string

```
0:000> s -a 420000 L?427000 "Let's"
00423018  4c 65 74 27 73 20 61 6c-6c 20 6d 6f 76 65 20 6f  Let's all move o
```

  - S –sa startAddress L:endAddress
    - Will search for any ascii string
    - -su for unicode

Display Memory

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- da – Display Ascii
- da 423018
- Play with it: db, dw, dd

Start

- bp $exentry
- g
- ba – BreakPoint Access
  - r – read
  - Number – memory size
- bl – List BreakPoints

```
0:000> bp $exentry
0:000> g
Breakpoint 0 hit
eax=00effc40 ebx=00d6b000
eip=004212f7 esp=00effbe8
cs=0023  ss=002b  ds=002b
TeaParty+0x12f7:
004212f7 e893030000
0:000> ba r1 423018
```

View the Stack

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- g – run (to breakpoint)
- kb – view stack

```
0:000> kb
 # ChildEBP RetAddr  Args to Child
00 00eff618 74c6a655 74d409fc 74d400e0 00d6b000 ucrtbase!__crt_stdio_output::outpu
01 00effabc 74c6a71f 3e3cfa39 74d409fc 74d400e0 ucrtbase!<lambda_0be4ab1c2a6918fda
02 00effaf0 74c6a7d7 00effb24 00effb10 00effb28 ucrtbase!__crt_seh_guarded_call<ir
03 00effb34 74c6a77c 00000004 00000000 00000000 ucrtbase!common_vfprintf<__crt_stc
04 00effb4c 00421035 00000004 00000000 74d3f318 ucrtbase!__stdio_common_vfprintf+0
WARNING: Stack unwind information not available. Following frames may be wrong.
05 00effb6c 00421067 74d3f318 00423018 00000000 TeaParty+0x1035
06 00effb8c 00421096 00423018 00effbe4 0042127a TeaParty+0x1067
07 00effb98 0042127a 00000001 01145210 01146550 TeaParty+0x1096
08 00effbe4 770d6359 00d6b000 770d6340 00effc50 TeaParty+0x127a
09 00effbf4 77377c24 00d6b000 13cfba69 00000000 KERNEL32!BaseThreadInitThunk+0x19
0a 00effc50 77377bf4 ffffffff 77398fdd 00000000 ntdll!__RtlUserThreadStart+0x2f
0b 00effc60 00000000 004212f7 00d6b000 00000000 ntdll!_RtlUserThreadStart+0x1b
```

Main

- Copy address to disassembly window

Disassembly

Address: 421096 ☑ Follow current instruction

```
0042107e cc          int     3
0042107f cc          int     3
00421080 55          push    ebp
00421081 8bec        mov     ebp, esp
00421083 b801000000  mov     eax, 1
00421088 85c0        test    eax, eax
0042108a 740f        je      TeaParty+0x109b (0042109b)
0042108c 6818304200  push    offset TeaParty+0x3018 (00423018)
00421091 e8aaffffff  call    TeaParty+0x1040 (00421040)
00421096 83c404      add     esp, 4
00421099 eb0d        jmp     TeaParty+0x10a8 (004210a8)
0042109b 6838304200  push    offset TeaParty+0x3038 (00423038)
004210a0 e89bffffff  call    TeaParty+0x1040 (00421040)
004210a5 83c404      add     esp, 4
004210a8 33c0        xor     eax, eax
004210aa 5d          pop     ebp
004210ab c3          ret
```

Go Up

- If we are deep inside the stack:
- gu – Go Up

r

- Any register can be shown
  - r eax
  - r eip
- … Or set
  - r eax = 1
  - r eip = … ☺

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a, u

- Any instruction can be modified
- a address
  - Then, write assembly instruction
  - Press extra enter to exit
- View memory
  - u address
  - Or simply disassembly window

Memory Window

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- Tip: easy to track any variable

Memory

Address: @ebp+8

```
00000000`00EFFBA0  01 00 00 00 10 52 14 01
00000000`00EFFBD0  00 00 00 00 40 FC EF 00
```

Exercise

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- Do it all over again
- Find several ways to modify main so it will let us drink tea ☺

Homework

- https://data.cyber.org.il/reversing/Secret.zip