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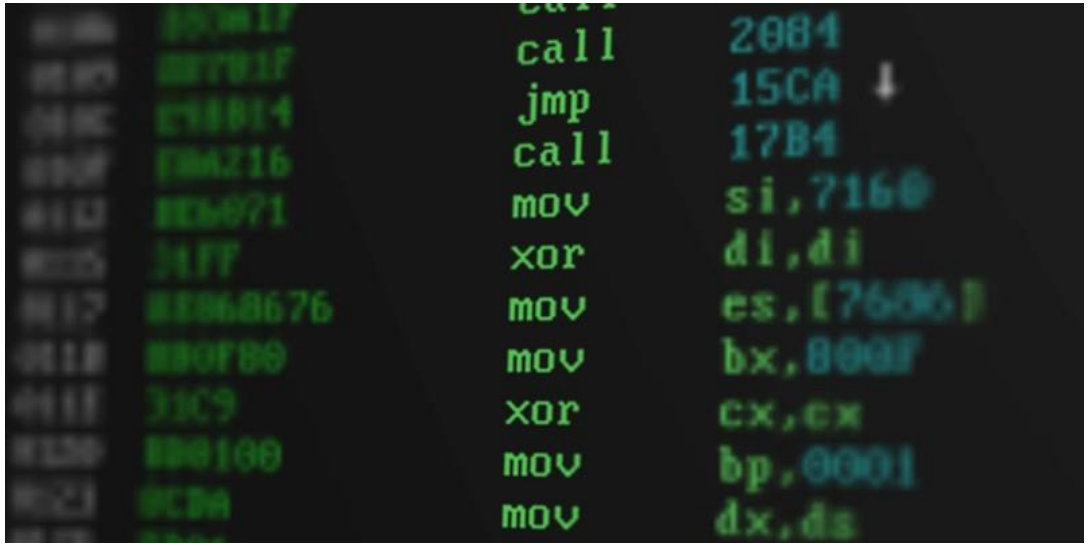
Reverse Engineering Course

x64



Barak Gonen

Differences Between x32 – x64

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- 64 bit registers
- 64 bit data & address busses
- New registers
- New calling convention
- Stack alignment
- RIP Relative Addressing Mode

64 Bit Registers

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All registers are extended to 64bit, notation “R”

RAX, RBX, RCX…

RBP, RSP…

RIP

RAX	EAX	AX	AH | AL

Effects of 64 Bit busses

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1. More data is copied in memory access
2. 2^64 address space *

* Assume no limitations by OS or CPU

64 Bit Address Canonical Form

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The “Unusable” address space saves chip complexity and cost

2^64-1 … 2^64 – 2^47	0xFFFFFFFFFFFFFFFF … 0xFFFF800000000000
Unusable	Unusable
2^47-1 … 0	0x00000FFFFFFFFFFF … 0

New Registers

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R7, R8, … R15

D - last double word bits (32). Example: R7D

W – last word bits (16). Example: R7W

B – last byte. Example: R7B

X64 Calling Convention

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Let’s study hands on ☺

https://godbolt.org/

Try using char, short, int, long long

```
#include <iostream>
long long sum(long long a, long long b, long long c, long long d);

int main(){
    long long result = sum(1, 2, 3, 4);
    printf("%lld", result);
    return 0;
}

long long sum(long long a, long long b, long long c, long long d){
    return a+b+c+d;
}
```

X64 Calling Convention – cont.

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Linux \ GNU version:

RDI

RSI

RDX

RCX

R8

R9

Other params- pushed to stack

Microsoft version:

RCX

RDX

R8

R9

Other params – pushed to stack

X64 Calling Convention – cont.

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Stack must be aligned to 16 bytes before any call instruction

Aids performance of Intel’s extended vector instruction set (SSE)

x32 Address Relocation Issue

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Problem: The address of a JMP changes

```
my_func:
    xor     eax, eax
my_label:
    ; do something
    jmp my_label
    ret
```

Process	JMP to (example) Address
Original function	00000001
After linking with another function	00000205
Loader assigned different address	00402245

Relocation tables are required

In x64, MOV EAX, [RIP] is possible – Relative addressing mode

Class Work

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https:\\data.cyber.org.il\reversing\reg64.exe

- איך מועברים הפרמטרים לפונקציה?
- הגיעו אל מסר ההצלחה *בלי לפצ'פץ'*

Home Work

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https:\\data.cyber.org.il\reversing\Crackme64.exe