CyberSecurity: Principle and Practice

BSc Degree in Computer Science
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Lesson 12: Patching

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DIPARTIMENTO MATEMATICA

Disclaimer

All information presented here has the only purpose of teaching how reverse engineering works.

Use your mad skillz only in CTFs or other situations in which you are legally allowed to do so.

Do not hack the new Playstation. Or maybe do, but be prepared to get legal troubles 😊

Intro

Patching

Why do I need it?

You may need to fix binary bugged

You may need to change the behavior of the binary

You may not have the source code, so binary is the only way

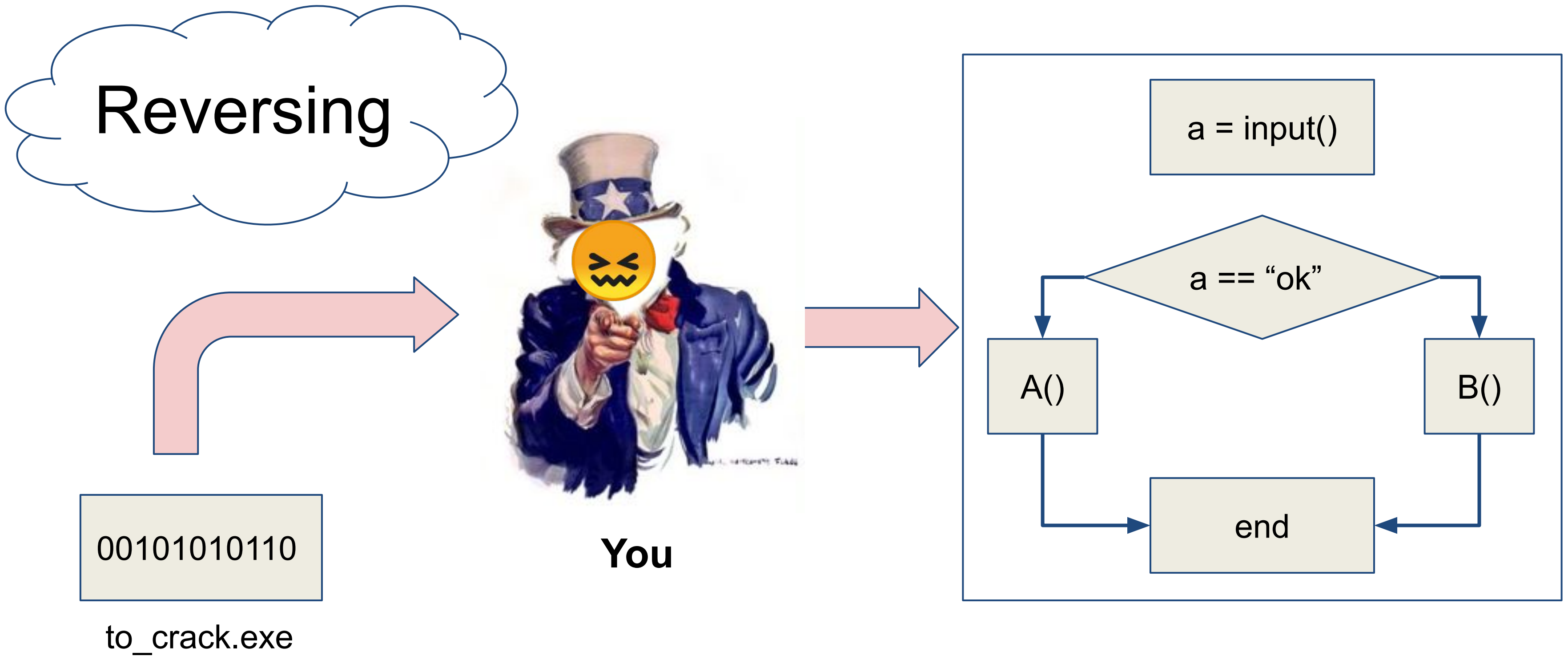
Patching

Change the program through static analysis

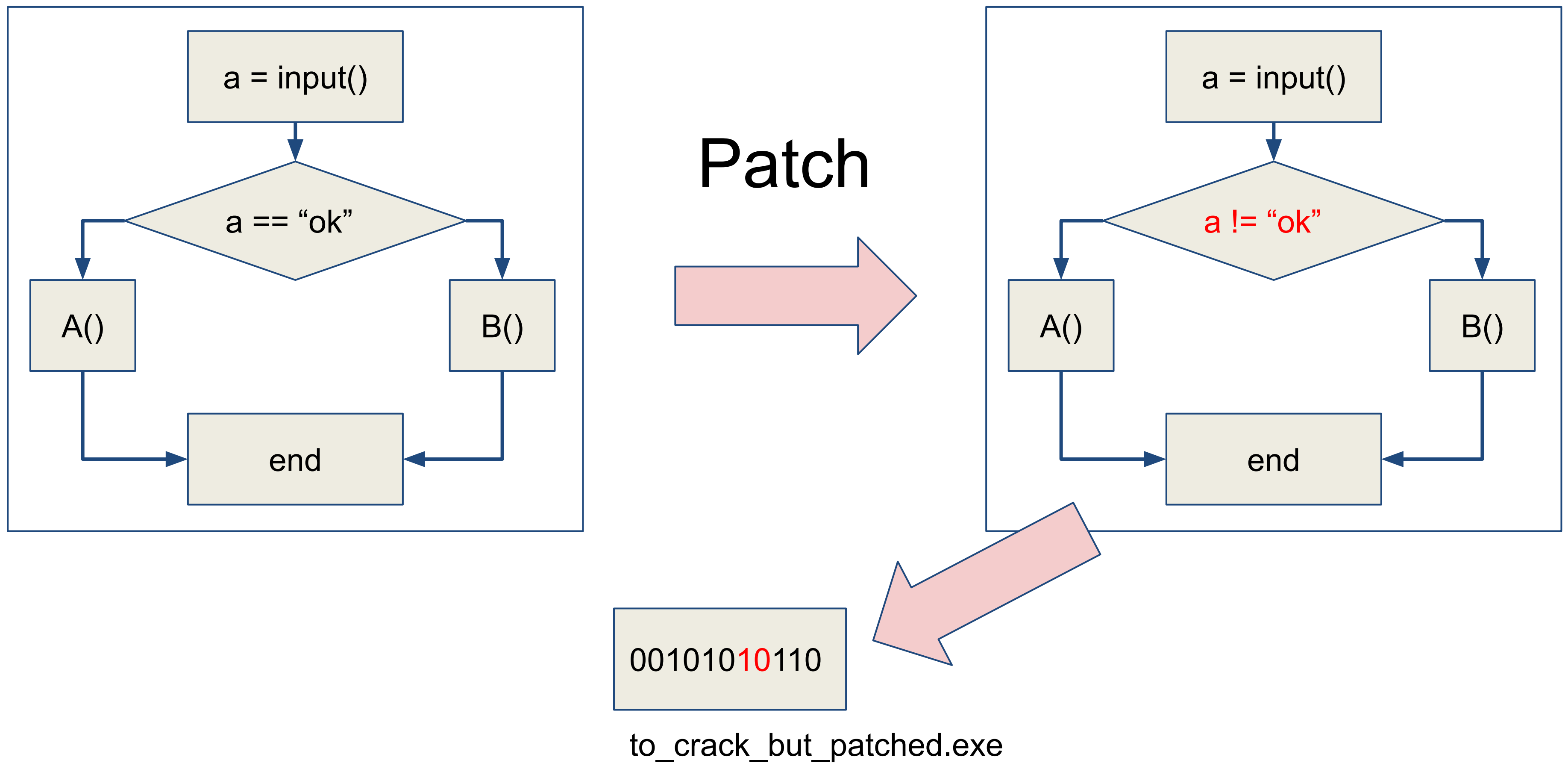
We understand what the binary does, and change its bytes for our purposes

Patching != instrumentation

How it is supposed to work



How it is supposed to work



Tools

Basically, all the static analyzers saw till now:

- IDA Pro ← $$$$$$ (free version doesn't work well)
- Binja ← $$$
- Ghidra ← free, but doesn't work
- Hex Editor ← Free and reasonable ok (for simple things)
- Radare2 ← Free and reasonable ok (for simple things)

Hex Editor Strategy

1. Make a copy of the binary
2. Use a disassembler to find the instruction(s) to patch
3. Look at the hex bytes and find them in the binary
4. Edit the bytes and save
5. Run the patched binary and pray

Opcodes x86: http://ref.x86asm.net/coder64.html

Find Hex Bytes in the binary

Easy way: Copy consecutive bytes from disassembler Hex View around the instruction to patch and search for them in the Binary using the Hex Editor. Then locate the exact byte(s) to patch.

Be sure that Hex Editor and Disassembler share the same view (type of Endian, number of grouped bytes in the view...)

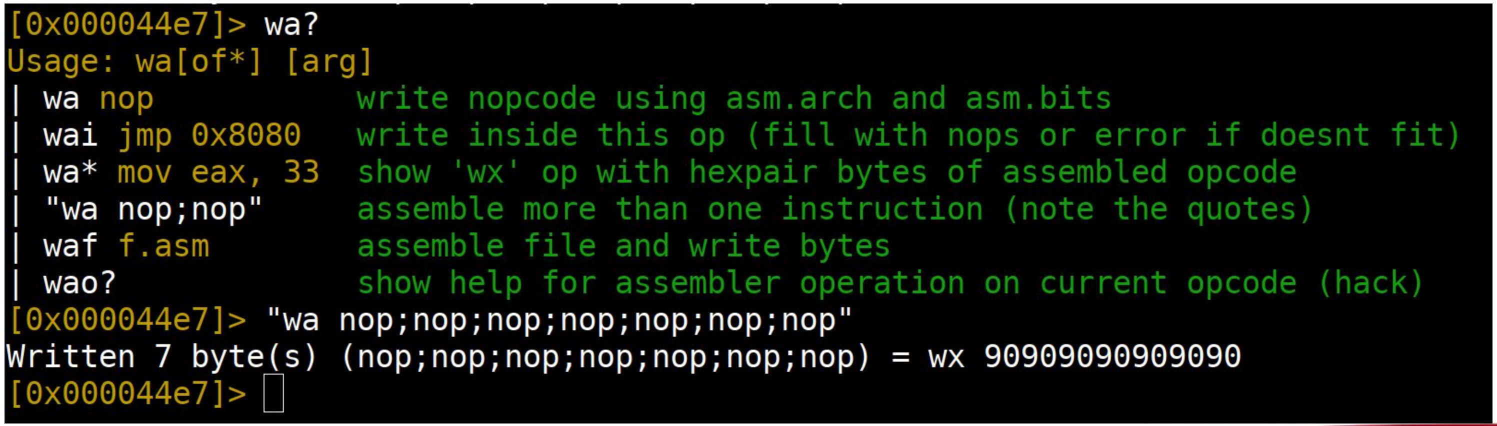
Little Endian Single grouped	Little Endian Double grouped
0x11 0x22 0x33 0x44	0x2211 0x4433

Hard way: calculate the Relative Virtual Address (Learn Here)

PLEASE NOTE: Always compare a bunch of bytes (hex editor vs disassembler) to see if you found the right area

Radare2 Strategy

1.	Make a copy of the binary	
2.	Open the binary in write mode	r2 -w <binary>
3.	Launch the analysis	aaaaa
4.	Seek for the wanted function	s <function name>
5.	Print Decompiled Function	pdf
6.	Understand what to patch	“use brain”
7.	Go to the address to patch	s <address>
8.	Patch using wa instruction	
9.	Double check with pdf	



```
[0x000044e7]> wa?
Usage: wa[of*] [arg]
| wa nop            write nopcode using asm.arch and asm.bits
| wai jmp 0x8080    write inside this op (fill with nops or error if doesnt fit)
| wa* mov eax, 33   show 'wx' op with hexpair bytes of assembled opcode
| "wa nop;nop"      assemble more than one instruction (note the quotes)
| waf f.asm         assemble file and write bytes
| wao?              show help for assembler operation on current opcode (hack)
[0x000044e7]> "wa nop;nop;nop;nop;nop;nop;nop"
Written 7 byte(s) (nop;nop;nop;nop;nop;nop;nop) = wx 90909090909090
[0x000044e7]> 
```

Funny things you can do

- fill with NOP
- invert branches (JE <-> JNE)
- remove branches (NOP/JMP)
- change some constant (e.g., strings/number)
- paste new functions (not so common, but can happen)

Questions? Feedback? Suggestions?