Malware Analysis with Reverse Engineering

Hands-on

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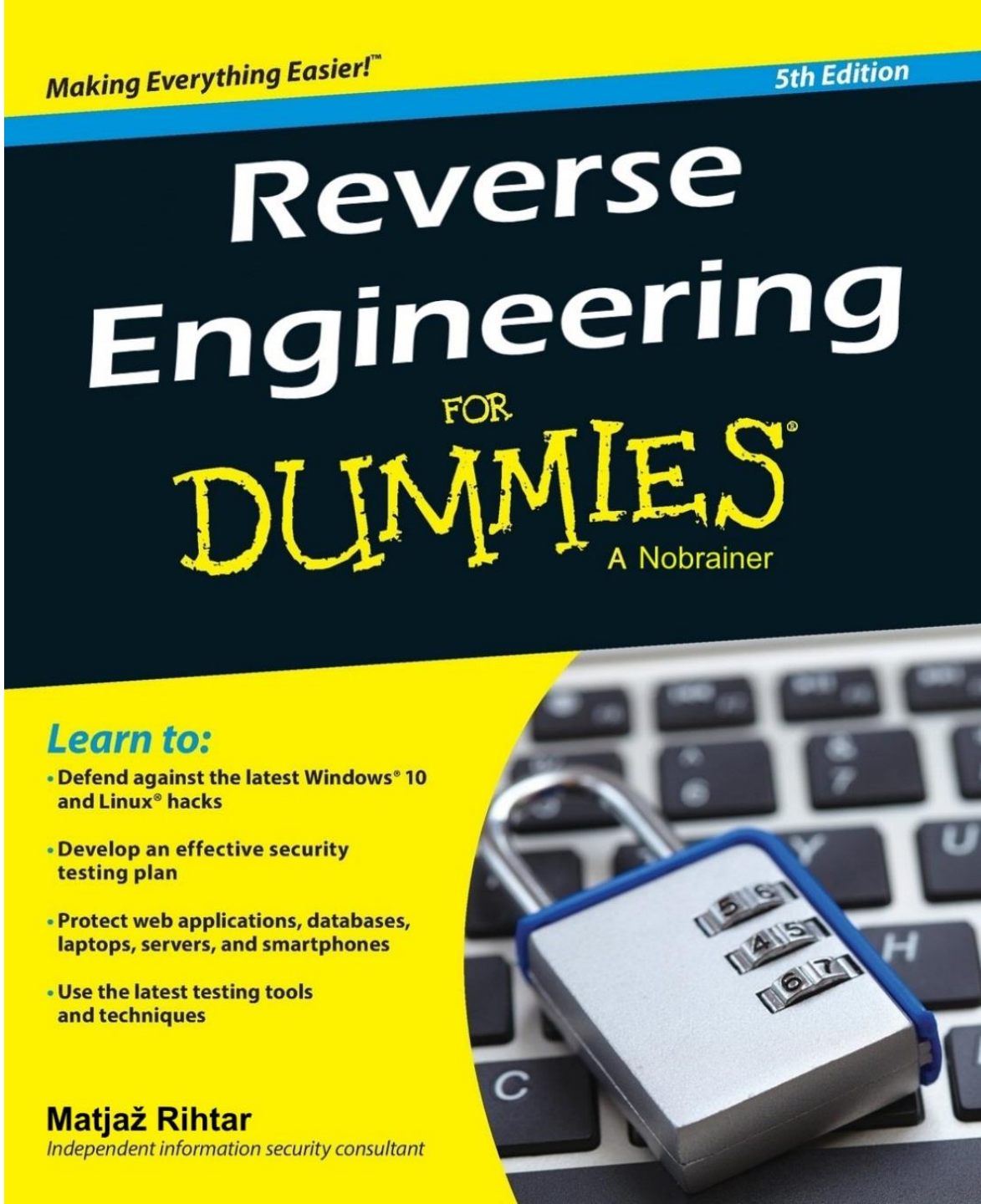
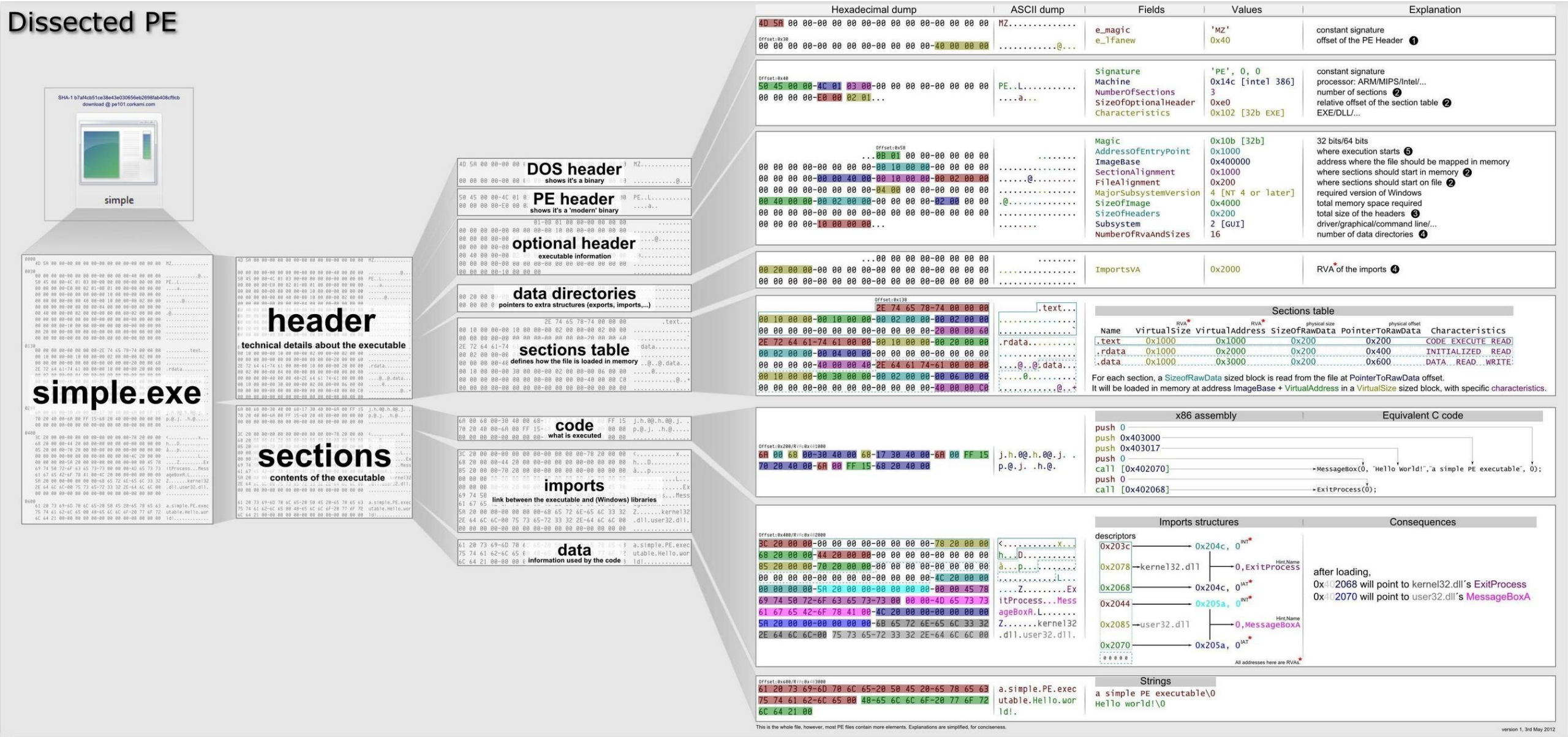


Windows Executable



Example

- What does this code do?

```
… 0F 31 66 BB FF 00 66 F7 F3 …
```

- Disassembly

```
rdtsc
mov    bx, 0xFF
div    bx
```

- Explanation - a random generator

```
rdtsc                ; CPU time stamp counter → EDX:EAX
mov    bx, 0xFF      ; 255 → BX
div    bx            ; DX:AX % BX → DX (random [0..254])
```

Code patterns

- Recognizing
  - Architecture
  - Compiler
  - Language
  - Functions
  - Arguments
  - Results of functions
  - System calls

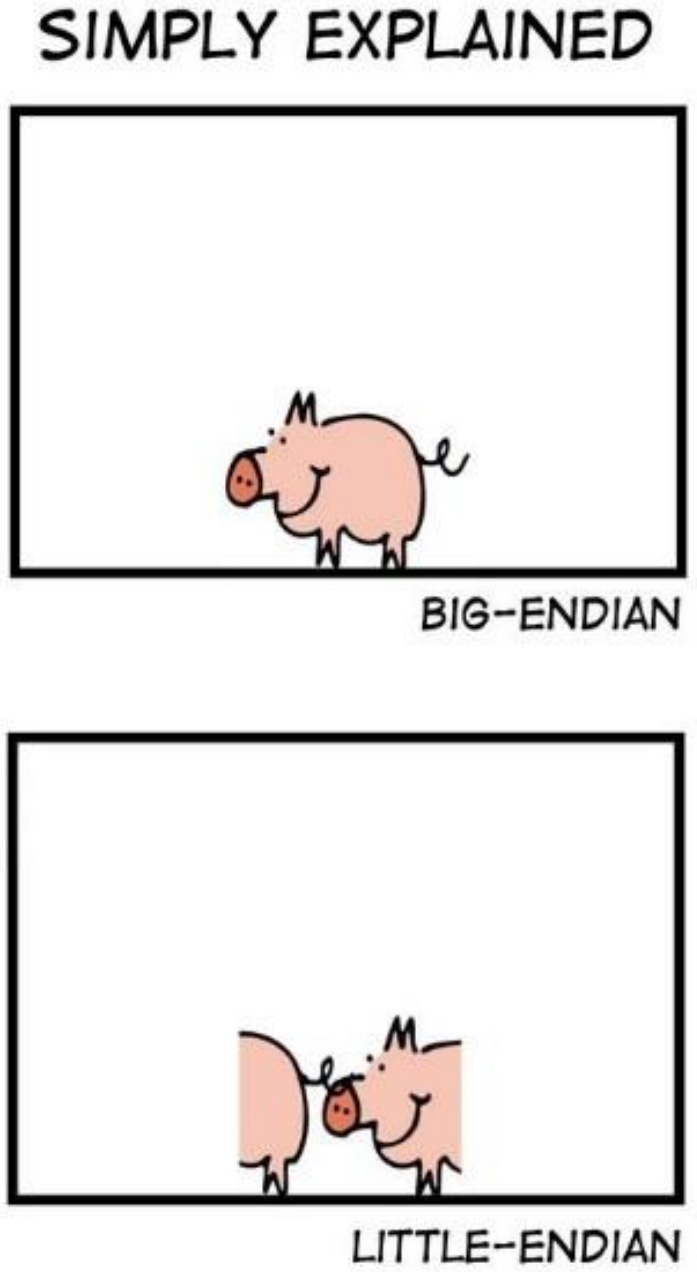
Spelling difficult words

I	C	S	T	O	E	B	I	S	C	U	I	T	B
O	E	E	D	N	E	H	C	A	N	I	P	S	M
U	L	Y	E	I	G	O	Y	U	G	W	I	U	A
C	E	L	L	O	A	A	O	E	R	S	N	U	N
O	R	P	I	N	S	C	L	P	I	E	E	I	G
T	Y	N	C	A	U	F	K	E	A	O	S	S	O
A	H	O	I	R	A	S	P	B	E	R	R	Y	E
T	C	M	O	T	S	L	A	S	A	G	N	E	S
O	I	M	U	N	R	B	E	G	A	B	B	A	C
P	W	I	S	N	A	L	M	O	N	D	P	P	E
L	D	S	P	A	E	I	N	I	H	C	C	U	Z
S	N	R	B	P	U	M	P	K	I	N	G	D	N
S	A	E	T	I	T	E	P	P	A	E	C	U	N
N	S	P	R	E	W	O	L	F	I	L	U	A	C

RASPBERRY
DELICIOUS
CABBAGE
PUMPKIN
BISCUIT
POTATO
YOLK
SPINACH
APPETITE
ZUCCHINI
CAULIFLOWER
CELERY
SANDWICH
SAUSAGE
ALMOND
PERSIMMON
MANGOES
LASAGNE
ONION

Important fundamentals

- Data structures and storage
  - Memory: byte/word/long/long long
  - CPU registers
  - Logical operators AND/OR/XOR
  - Endianness
    - Intel is little-endian
- CPU instructions
  - 32-bit/64-bit
  - Special: SSEx/AVX/…



Finding interesting stuff in the code

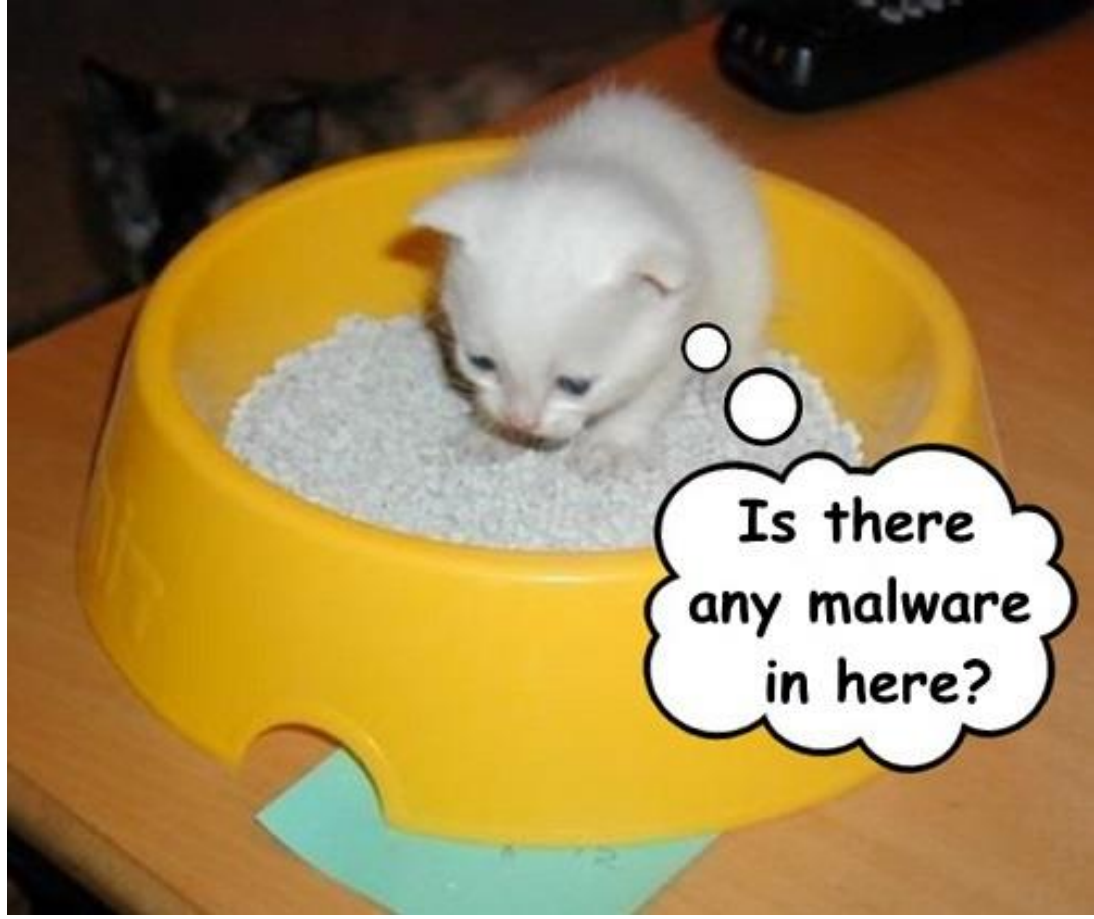
- Analysis of executables
  - EXE header
  - Imported DLLs
    - LoadLibrary
  - Strings
    - ASCII and Unicode
  - Constants
    - Precomputed values CRC32, MD5, …
  - Magic numbers
    - MZ for EXE/DLL files
    - Dates

OS Specifics

- Argument passing
  - Via stack and registers
  - cdecl, stdcall, fastcall
- Returning values
  - Modifying arguments on stack
  - Via pointers
  - Via registers
- Windows NT
  - CRT → main
  - GUI → WinMain

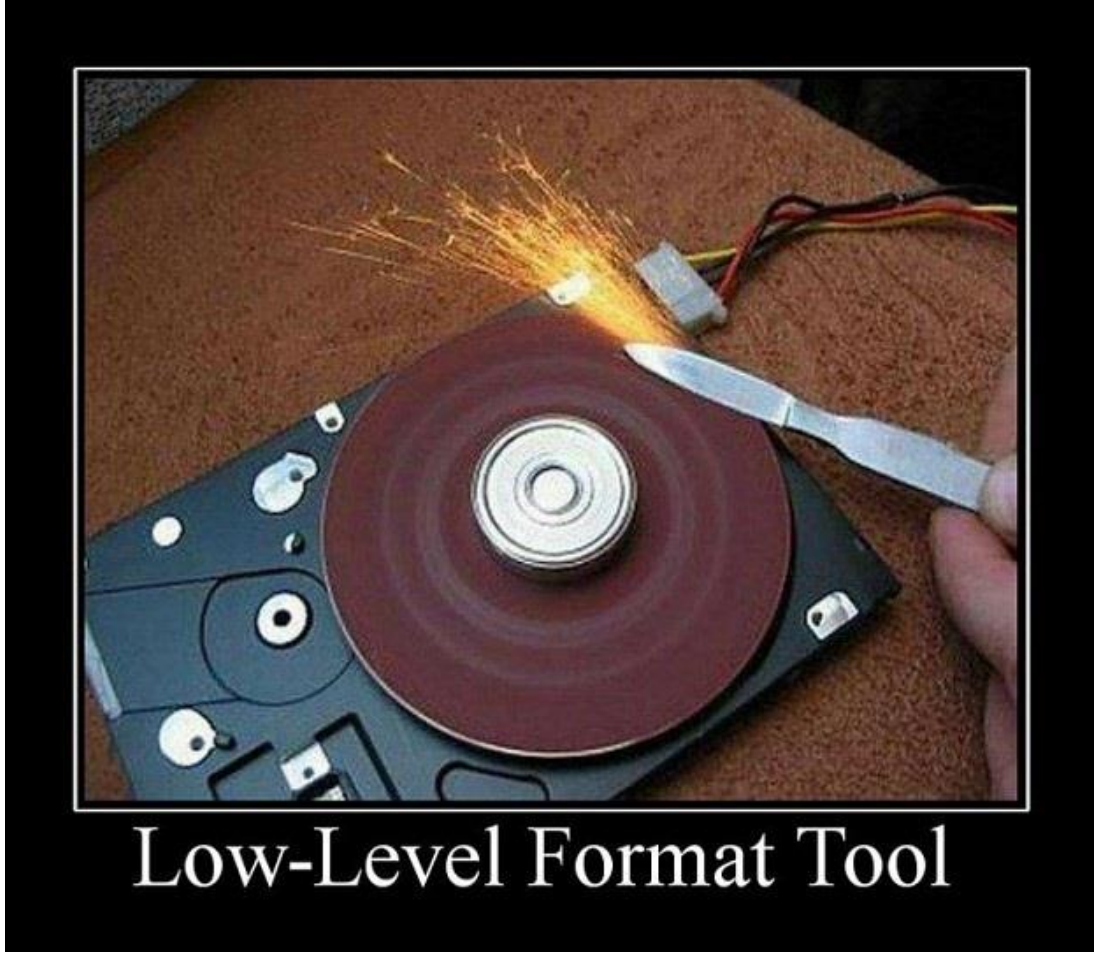
API Function hooks

- Microsoft Detours
  - Pro (x64) version: 10000 USD
- Others
  - madCodeHook
  - PolyHook
- Sandbox isolation
  - Sandboxie
  - Cameyo, Shade Sandbox, Shadow Defender, Cuckoo Sandbox, …
- Virtual machines
  - VMware Workstation, VirtualBox



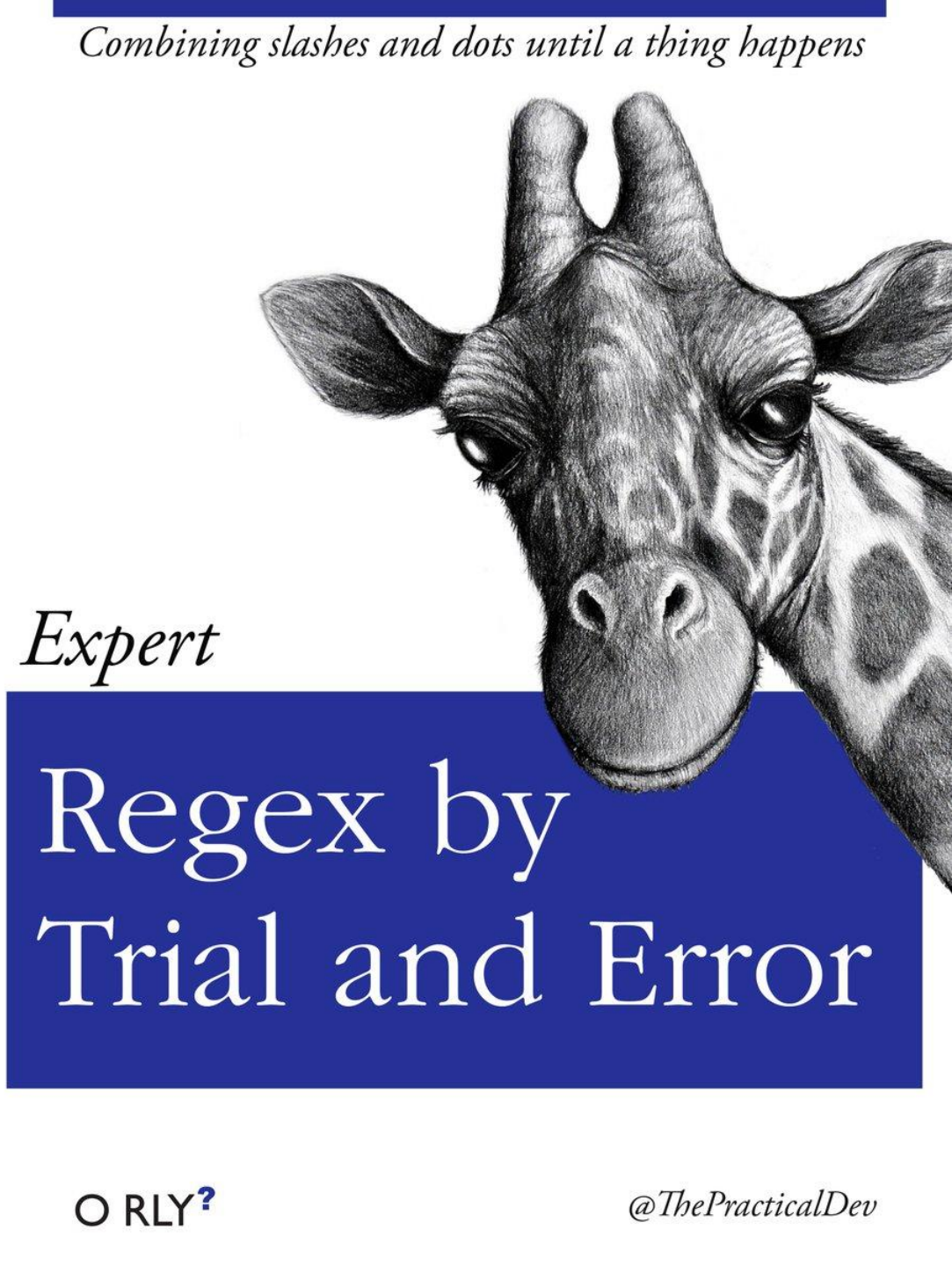
Tools

- Disassemblers
  - IDA Pro
- Decompilers
  - Hex-Rays
- Debuggers
  - OllyDbg, WinDbg, Radare, x64dbg, …
- System calls tracing
  - Sysinternals' Process Monitor
- Other tools
  - Hex editor, Wireshark, QEMU, calculator

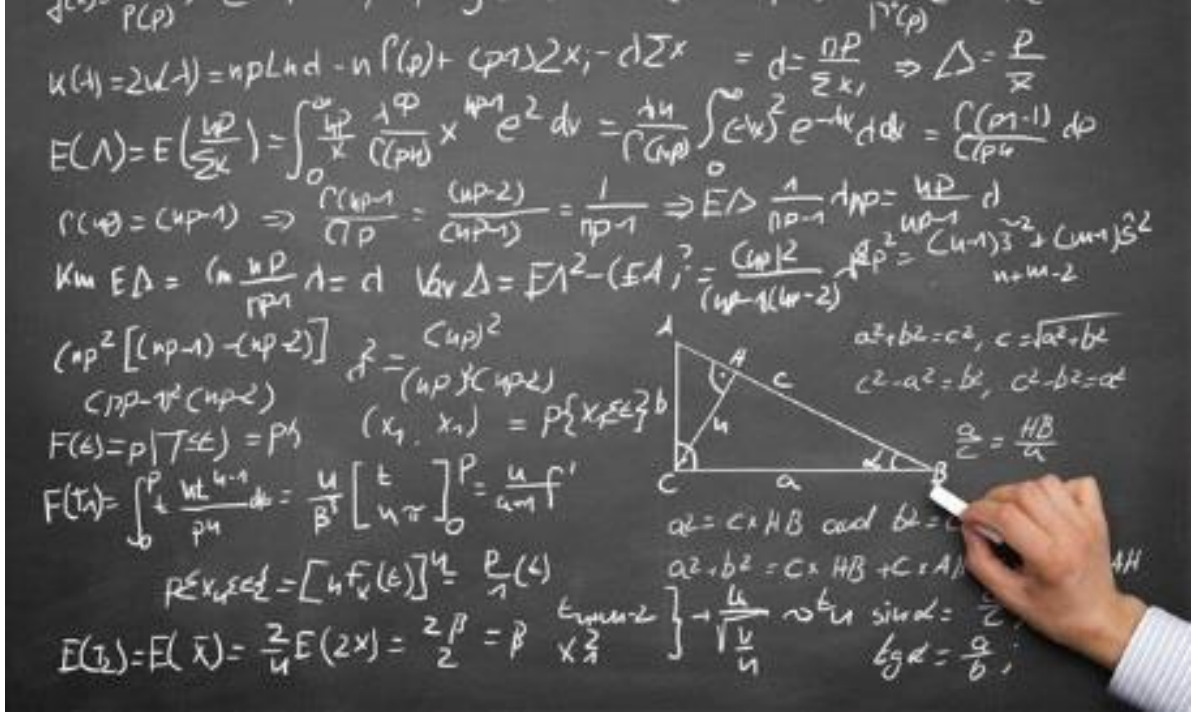


Example in practice

- Regex Match Tracer
  - IDA Pro
  - OllyDbg
  - Hex editor
  - Process Monitor



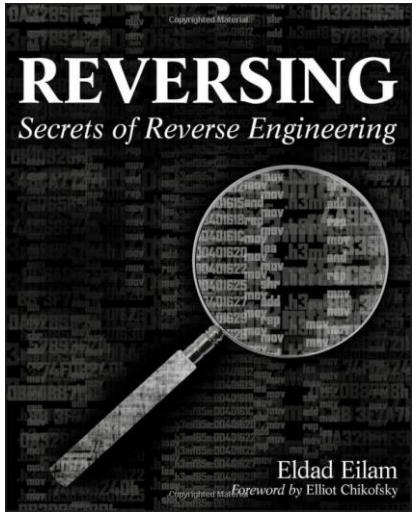
Complications

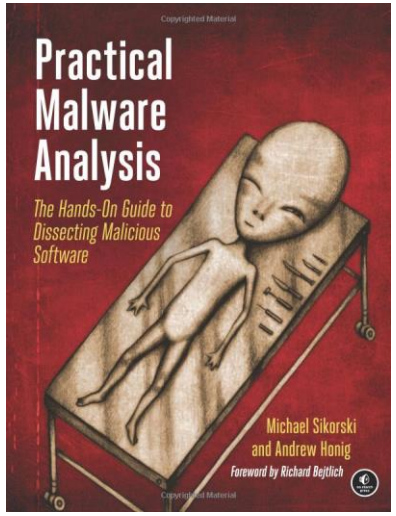


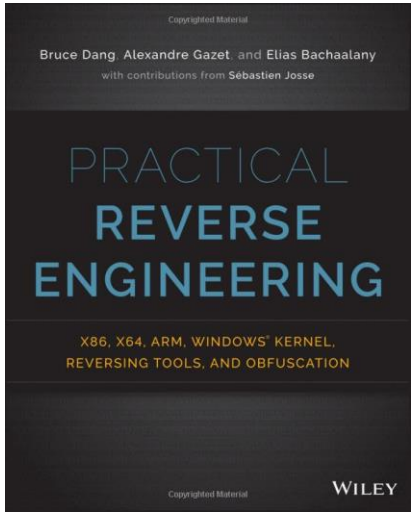
- Code obfuscation
  - Hiding text strings
  - Inserting garbage code
- EXE packers/crypters
  - Armadillo, ASPack, PECompact, UPX, …
  - Packer detectors: PEiD, DIE (Detect It Easy), RDG Packer Detector, …
- Code virtualization
  - Reversed code is virtual machine’s byte code
- Anti-debugging measures
  - IsDebuggerPresent, FindWindow, CsrGetProcessId, …
  - TitanHide (kernel driver)

Literature

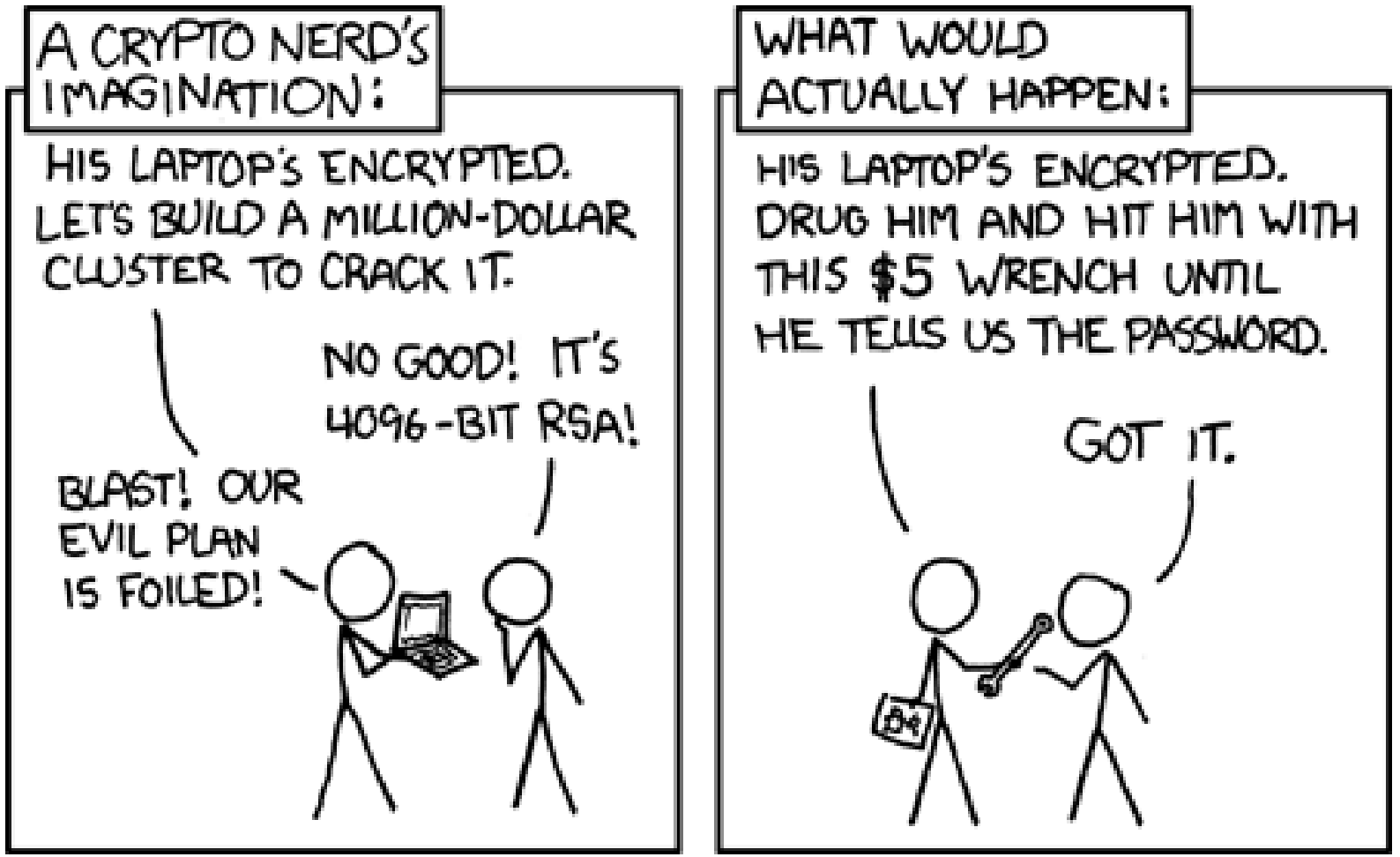
- Reversing - Secrets of Reverse Engineering (Eilam, 2005)
- Practical Malware Analysis (Sikorski, 2012)
- Practical Reverse Engineering (Dang, 2014)
- Reverse Engineering for Beginners (Yurichev, 2018)







Questions?


A CRYPTO NERD'S IMAGINATION:
HIS LAPTOP'S ENCRYPTED. LET'S BUILD A MILLION-DOLLAR CLUSTER TO CRACK IT.
NO GOOD! IT'S 4096-BIT RSA!
BLAST! OUR EVIL PLAN IS FOILED!
WHAT WOULD ACTUALLY HAPPEN:
HIS LAPTOP'S ENCRYPTED. DRUG HIM AND HIT HIM WITH THIS $5 WRENCH UNTIL HE TELLS US THE PASSWORD.
GOT IT.