Qiling Framework: Hack In Taiwan

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About xwings

JD.COM

Beijing, Stays in the lab 24/7 by hoping making the world a better place

- IoT Research
- Blockchain Research
- Fun Security Research

Qiling Framework

Cross platform and multi architecture advanced binary emulation framework

- https://qiling.io
- Lead Developer
- Founder

Badge Maker

Electronic fan boy, making toys from hacker to hacker

- Reversing Binary
- Reversing IoT Devices
- Part Time CtF player

Badge Designer for Hacking Conferences

Some Recent Talk (Partial)

- 2016, Qcon, Beijing, Speaker, nRF24L01 Hijacking
- 2016, Kcon, Beijing, Speaker, Capstone Unicorn Keystone
- 2017, Kcon, Beijing, IoT Hacking Trainer
- 2018, Kcon, Beijing, IoT Hacking Training
- 2018, Brucon, Brussel, Speaker, IoT Virtualization
- 2018, H2HC, San Paolo, Speaker, IoT Virtualization
- 2018, HITB, Beijing/Dubai, Speaker, IoT Virtualization
- 2018, beVX, Hong Kong, Speaker, HackCUBE - Hardware Hacking
- 2019, DEFCON USA, Qiling Framework Preview
- 2019, Zeronights, Qiling Framework to Public
- 2020, Nullcon GOA, Building Reversing Tools with Qiling
- 2020, HITB AMS, Building Reversing Tools with Qiling
- 2020, HITB Singapore, Training, How to Hack IoT with Qiling
- 2020, Blackhat USA, Building IoT Fuzzer with Qiing
- 2020, Blackhat Singapore, Building Fuzzer with Qiing

Qiling Framework

- Cross platform and cross architecture binary instrumentation framework
- Emulate and instrument ARM, ARM64, MIPS, X86 and X8664
- Emulate and instrument Linux, MacOS, iphoneOS, Windows and FreeBSD
- High-level Python API access to register, CPU and memory
- 1,100+ Github star, more than 3,000 pypi download, 40+ contributors worldwide
- Contributor from Dell, Intel, Fireeye and etc

About lazymio && kabeor

~ $ whoami
Lazymio

~ $ file Lazymio
The sheperd lab, JD security, Security Engineer.
CTF player, member of Lancet.
GeekPwn 2019 Hall of Fame.

~ $ ls -l Lazymio
Reverse engineering.
Binary analysis.
Writing code for fun.

~ $ which Lazymio
Github: https://github.com/wtdcode
Blog: https://blog.lazym.io/
Twitter: https://twitter.com/pwnedmio

Name: kabeor

The sheperd lab, JD security, Security Engineer.

Key Contributors of Qiling.

CTF player,BUUCTF reverse engineering first place.

University student.

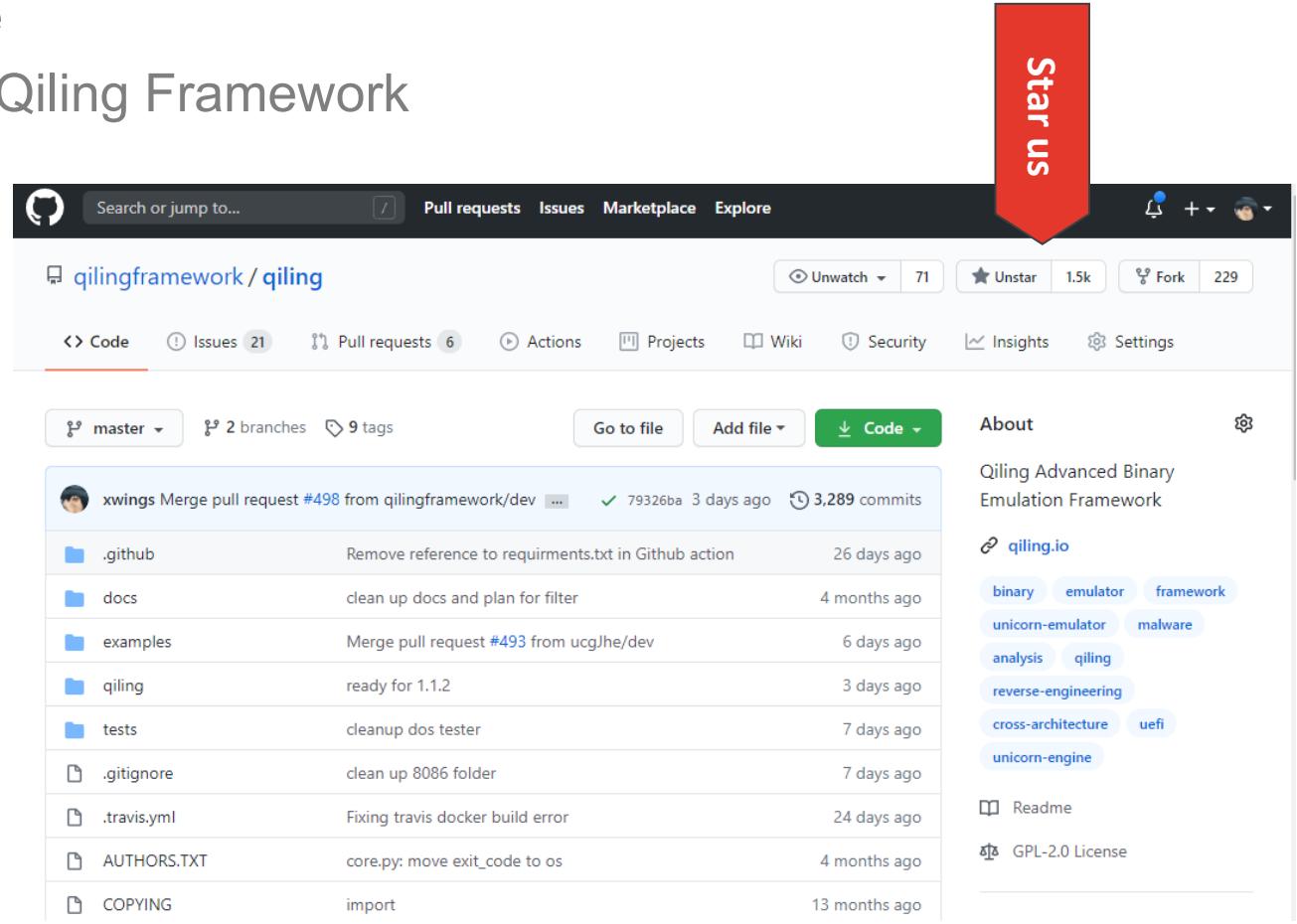
Github: https://github.com/kabeor

Blog: https://kabeor.cn

Twitter: https://twitter.com/Angrz3_K

https://github.com/qilingframework/qiling

- Features
- Insight Qiling Framewpork
- Building Application: Quick Start Guide
- Build dynamic analysis tools on top of Qiling Framework
- Demo: Solving MBR Challange
- Demo: IDAPro with Qiling Framework



Features

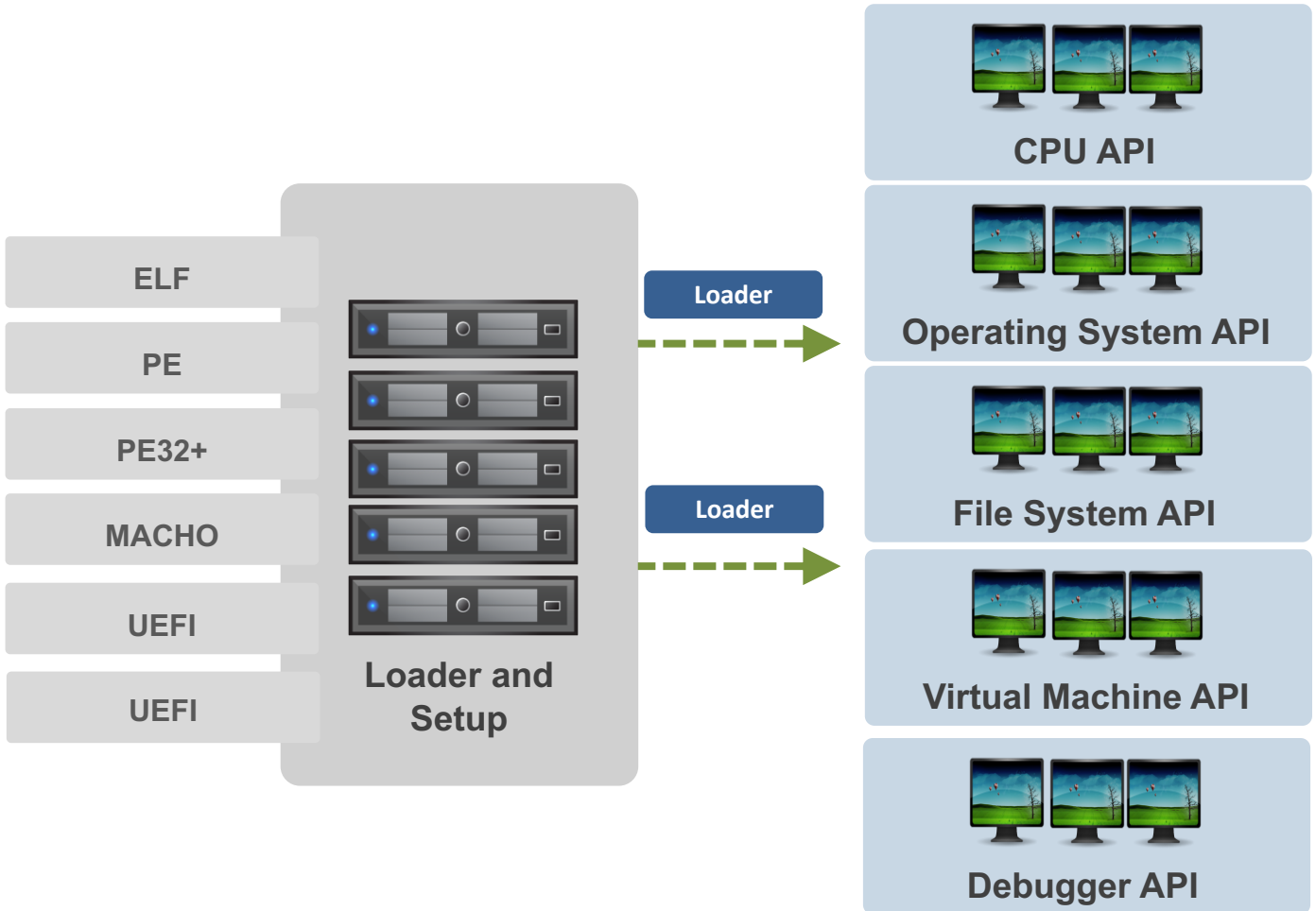
- Cross platform: Windows, MacOS, Linux, BSD, UEFI, MBR
- Cross architecture: X86, X86_64, Arm, Arm64, MIPS, 8086
- Multiple file formats: PE, MachO, ELF, UEFI(PE), COM
- Emulate & sandbox machine code in a isolated environment
- Provide high level API to setup & configure the sandbox
- Fine-grain instrumentation: allow hooks at various levels (instruction/basic-block/memory-access/exception/syscall/IO/etc)
- Allow dynamic hotpatch on-the-fly running code, including the loaded library
- True Python framework, making it easy to build customized analysis tools on top
- GDBServer support - GDB/IDA/r2
- IDA Plugin
- OS profiling support

Supported Platform Overview

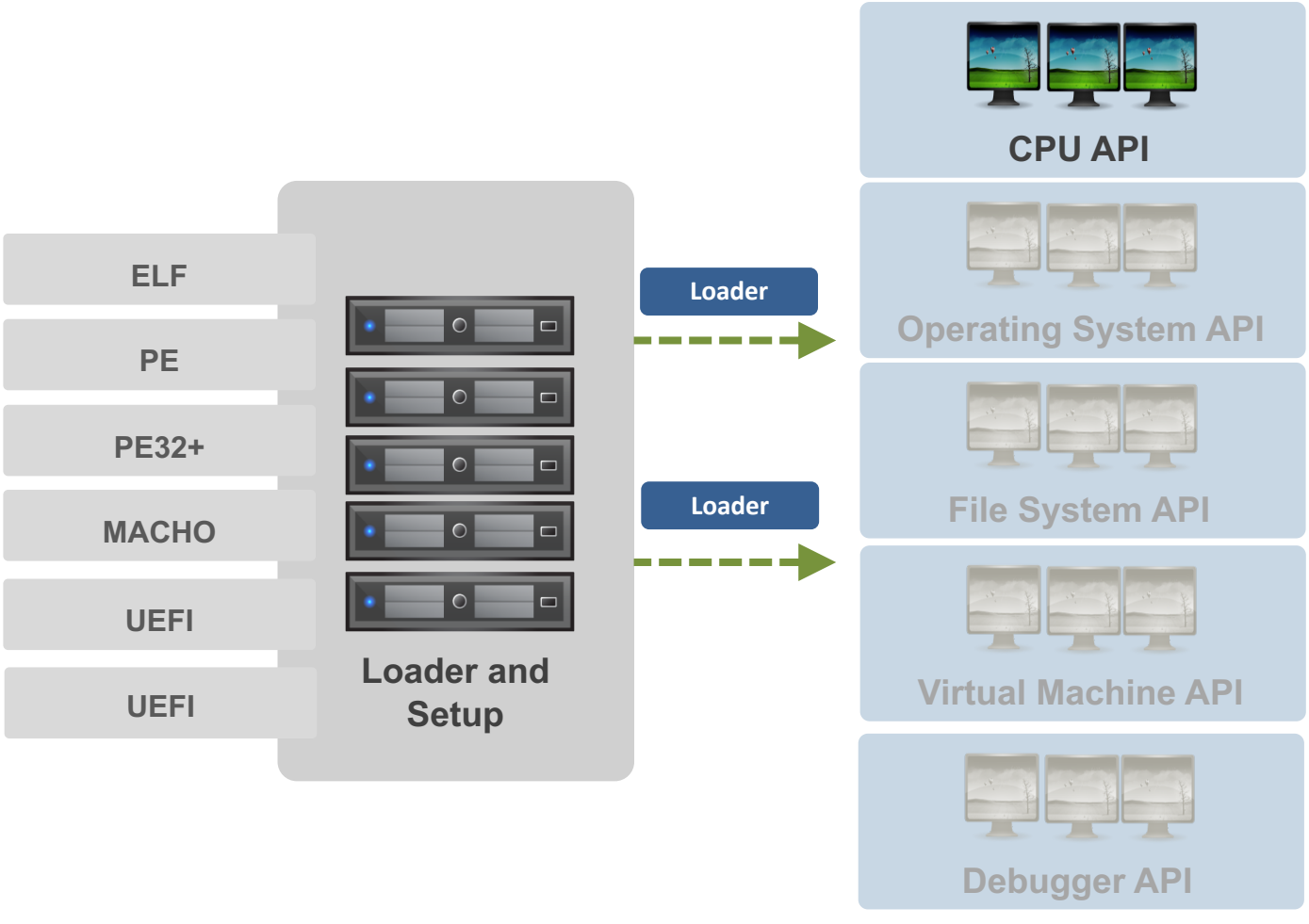
	8086	x86	x86-64	ARM	ARM64	MIPS
Windows (PE)	-	☑	☑	☐	☐	-
Linux (ELF)	☐	☑	☑	☑	☑	☑
MacOS (MachO)	-	☐	☑	-	-	-
BSD (ELF)	☐	☐	☑	☐	☐	☐
UEFI	-	☑	☑	-	-	-
DOS (COM)	☑	-	-	-	-	-
Architecture independent						
MBR		☑				

Qiling and APIs

Qiling Framework and Its API



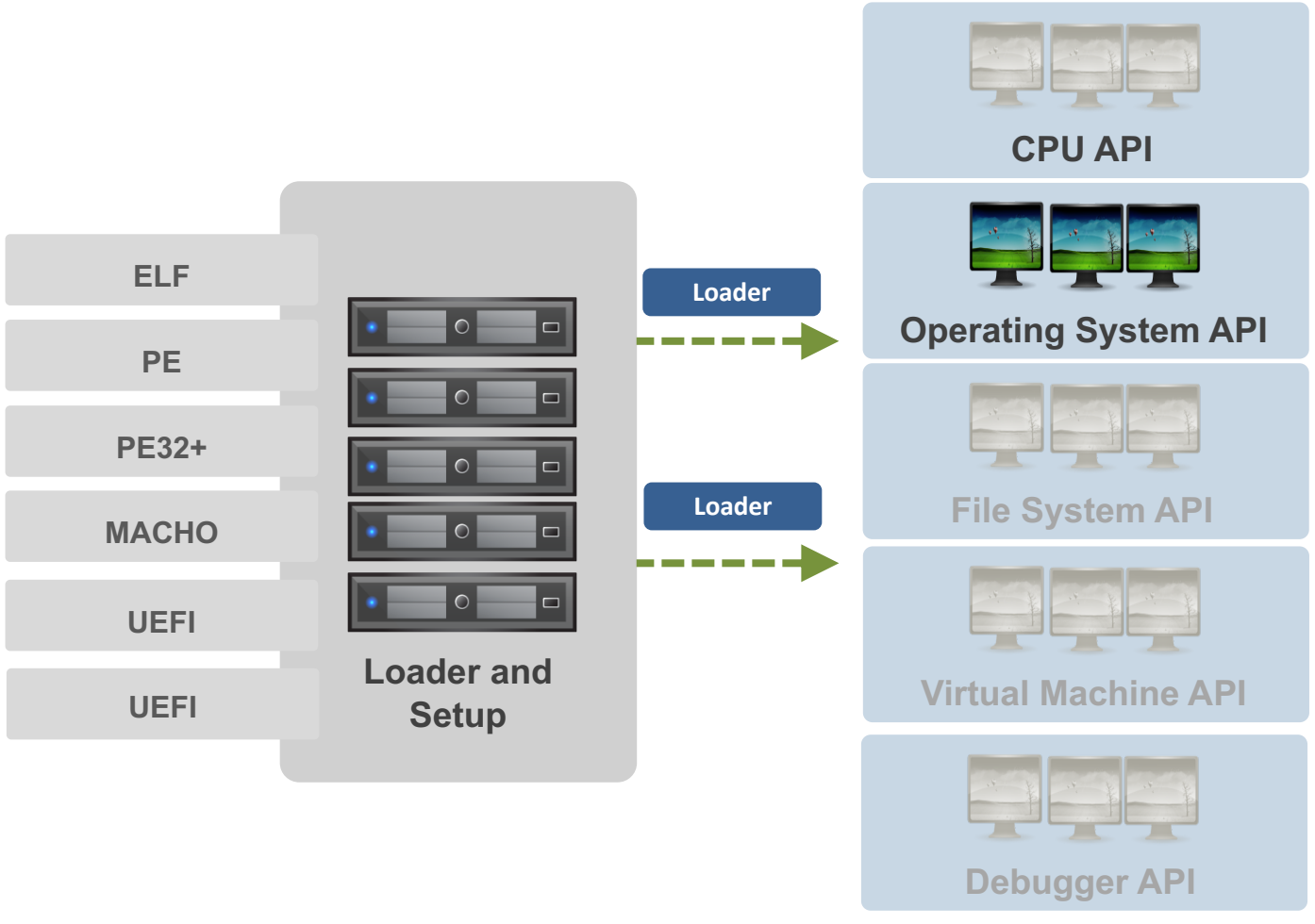
Qiling Framework: CPU



- Access to Register
- Reading register
  - ql.reg.eax
- Writing to register
  - ql.reg.eax = 0x41
- Differet Hooks
  - ql.hook_code
  - ql.hook_address
  - and more

More APIs: https://docs.qiling.io

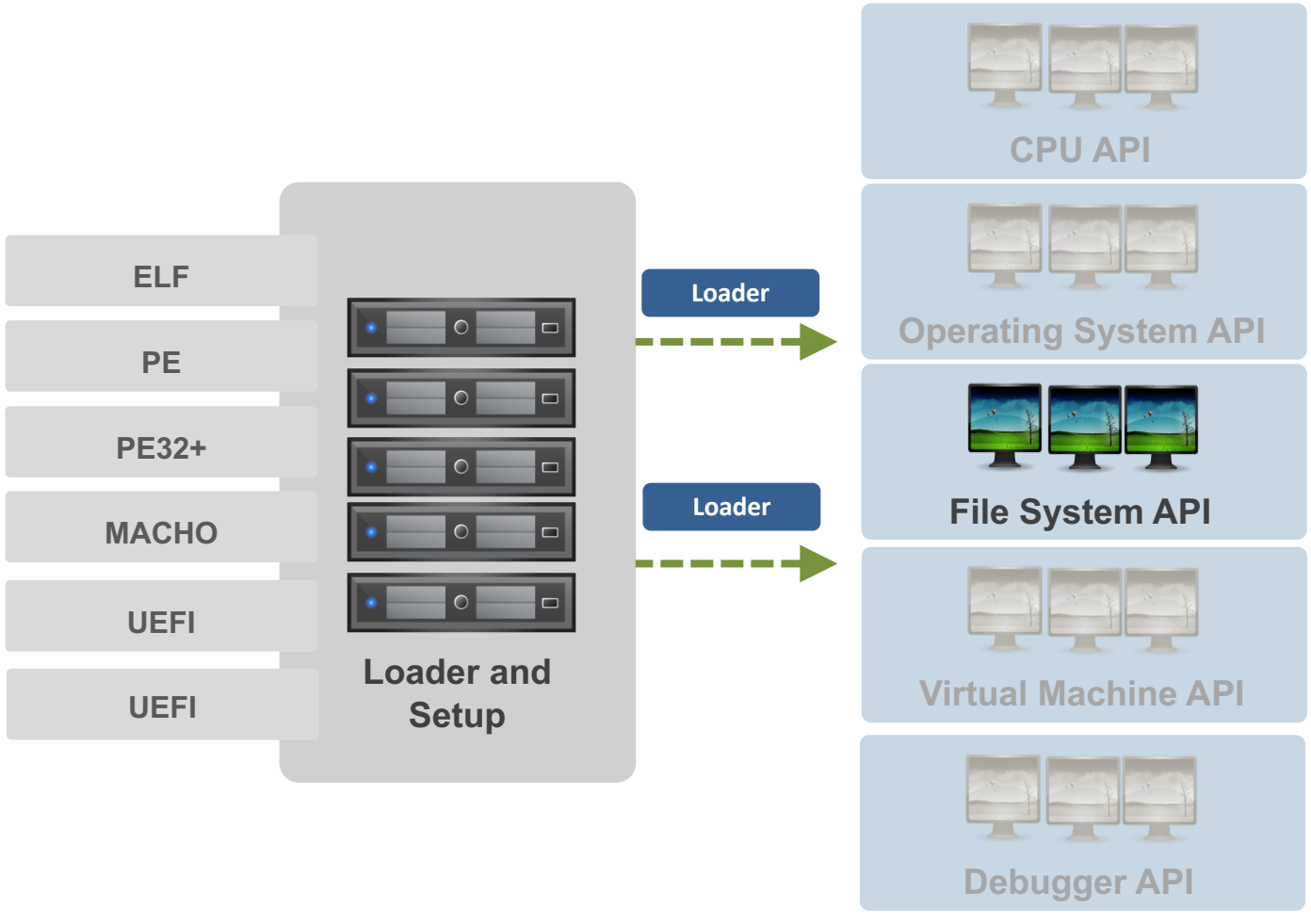
Qiling Framework: Operating System



- Access to memory
  - ql.mem.read()
  - ql.mem.write()
- Search pattern from memory
  - ql.mem.search()
- Stack related operation
  - ql.stack_pop
  - ql.stack_push
- Syscall replacement
  - ql.set_syscall()
  - ql.set_api()
- Replace library call with
  - ql.set_api()

More APIs: https://docs.qiling.io

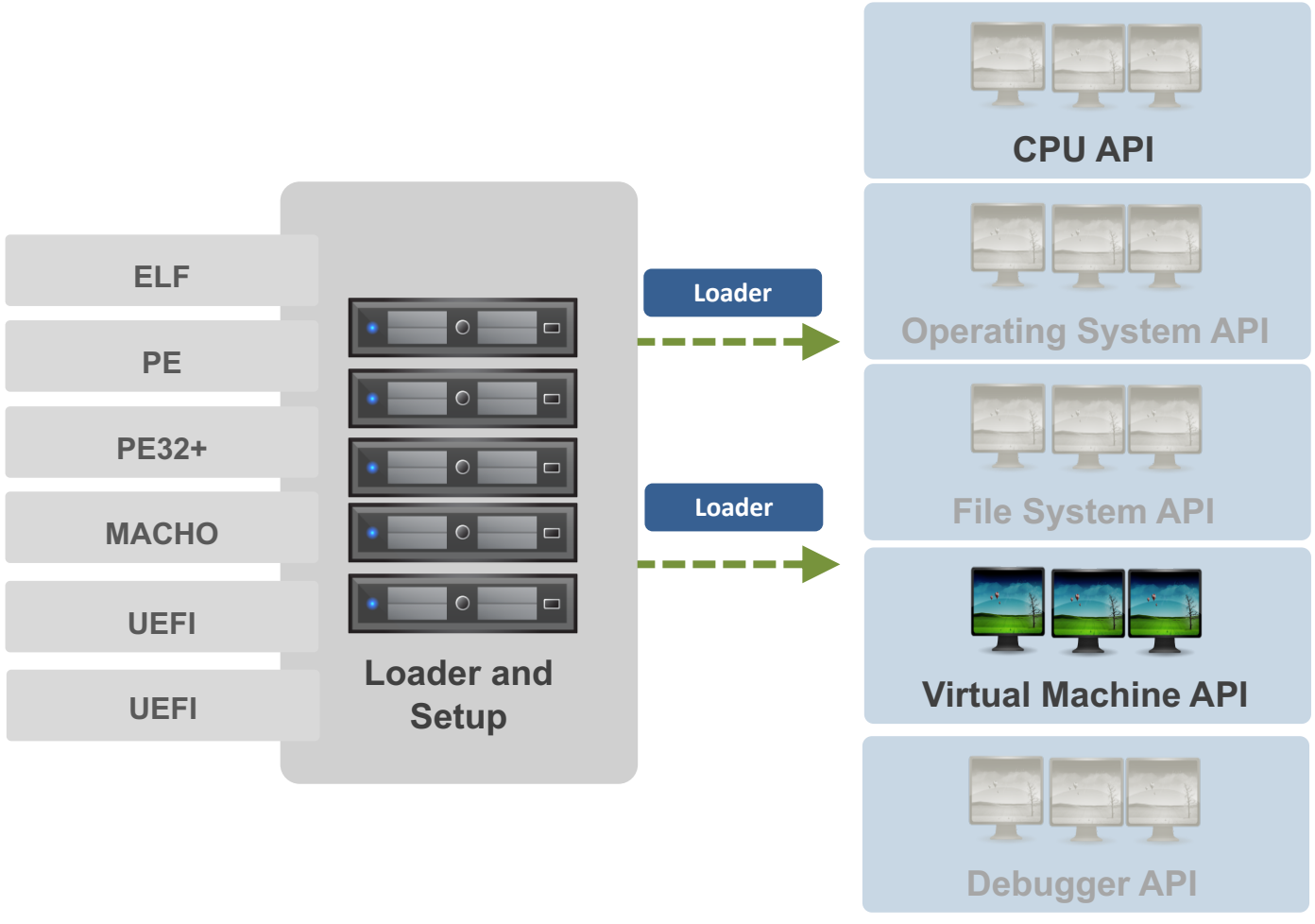
Qiling Framework: File System



- Map host file
  - ql.fs_mapper()
- Hijack accessed file
  - ql.fs_mapper(hijack_func)
- Stdio replacement
  - stdin
  - stdout
  - Stderr
- Patch file's memory before execution
  - ql.patch

More APIs: https://docs.qiling.io

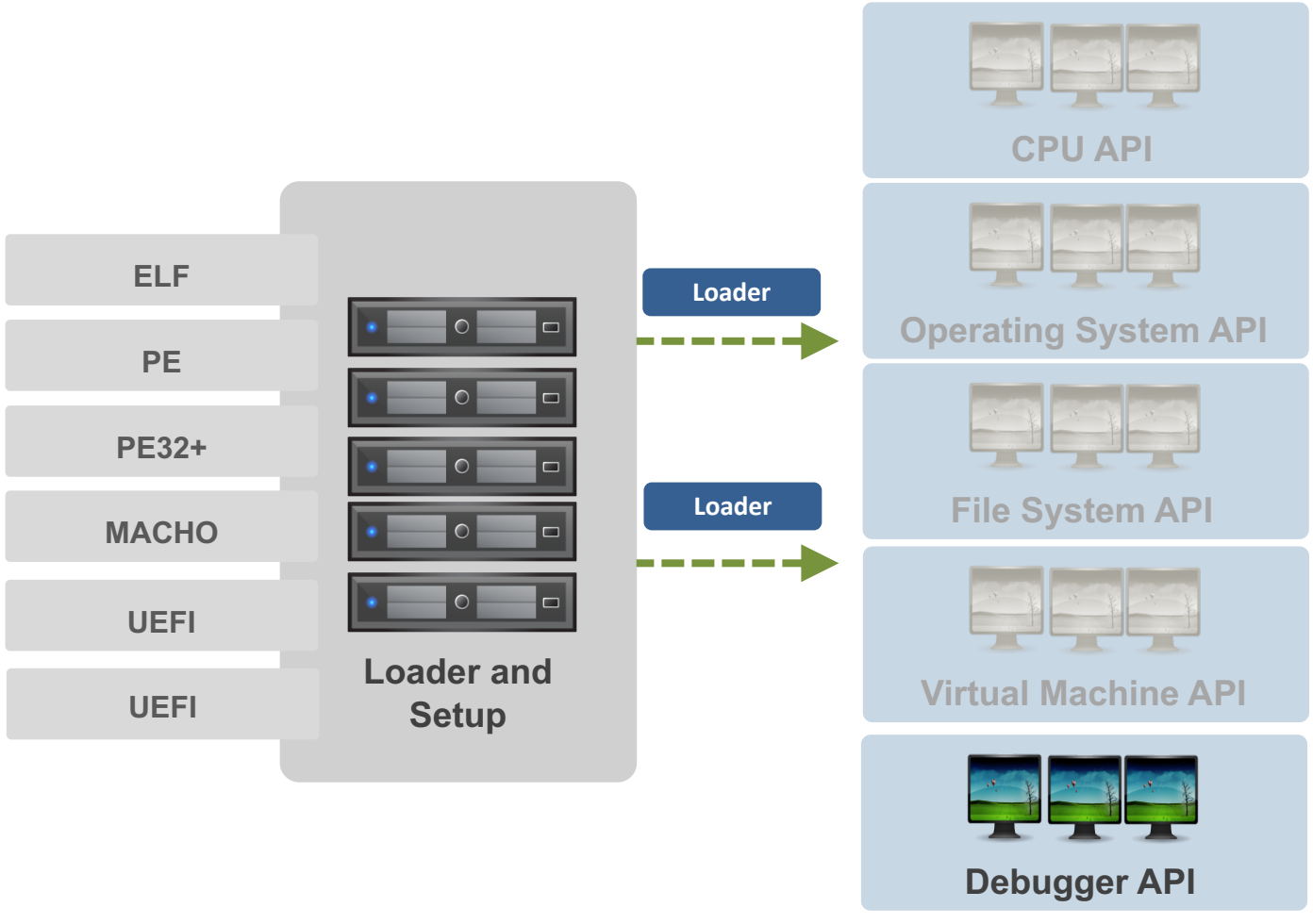
Qiling Framework: Virtual Machine



- Save current state
  - ql.save()
- Restore current state
  - ql.restore()
- Save/restore memory only
  - ql.mem.save()
- Save/restore register only
  - ql.reg.save()

More APIs: https://docs.qiling.io

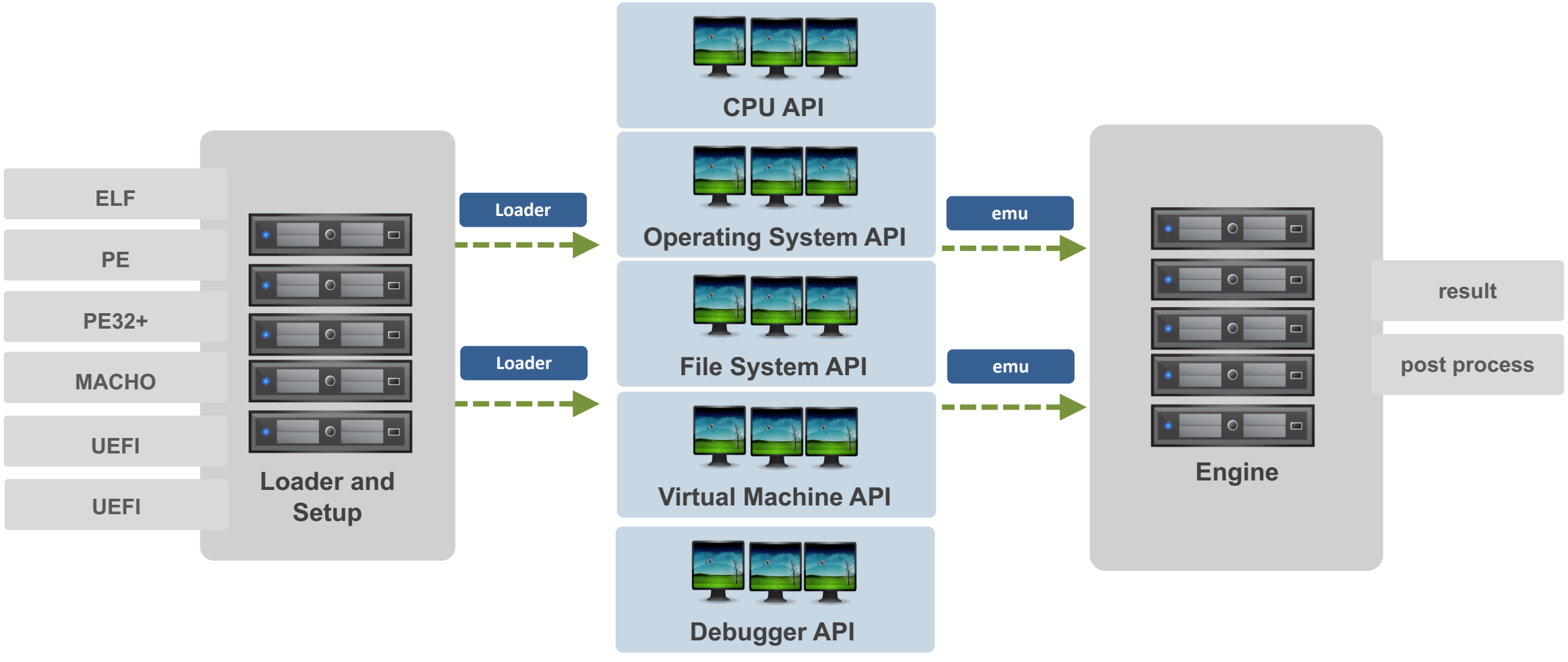
Qiling Framework: Debugger



- Open API for RSP compatible Debugger
- Build In debugger – Qdbg
  - Able to reverse debug
- Scrapable debug process

More APIs: https://docs.qiling.io

Qiling Framework: In a Nutshell



Base OS can be Windows/Linux/BSD or OSX

And not limited to ARCH

Build Application: Quick Start Guide

Build a Simple Disassembler

- Let Qiling loads the binary (loading + dynamic linking)
- Syscall & system API logging available, provided by default
- Program callbacks with Qiling hook capabilities: hook memory access, hook address range
- Repeat in a loop: run() → analysis → resume()

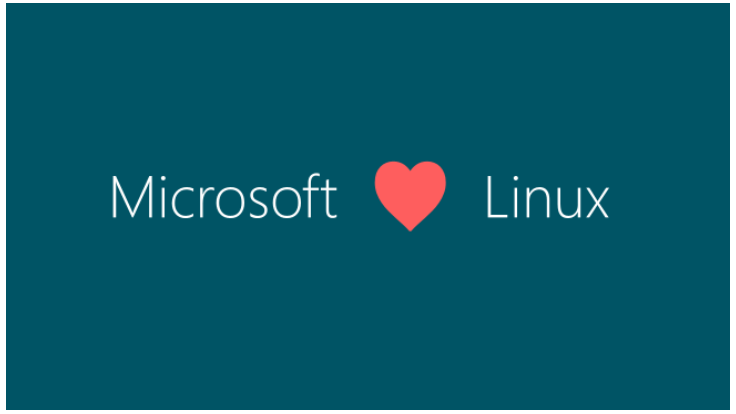
```
from unicorn import *
from capstone import *
from qiling import *

md = Cs(CS_ARCH_X86, CS_MODE_64)

def print_asm(ql, address, size):
    buf = ql.uc.mem_read(address, size)
    for i in md.disasm(buf, address):
        print(":: 0x%x:\t%s\t%s" %(i.address, i.mnemonic, i.op_str))


if __name__ == "__main__":
    ql = Qiling(["rootfs/x8664_linux/bin/x8664_hello"], "rootfs/x8664_linux")
    ql.hook_code(print_asm)
    ql.run()
```

Demo Setup



- Required OS
  - Ubuntu 18.04 / 20.04
  - WSL2

- Install Qiling Framework, Human Way
  - pip3 install qiling
- Install Qiling Framework, Hackers way
  - sudo apt-get update
  - sudo apt-get upgrade
  - sudo apt install python3-pip git cmake build-essential libtool-bin python3-dev automake flex bison libglib2.0-dev libpixman-1-dev clang python3-setuptools llvm
  - git clone https://github.com/qilingframework/qiling.git
  - cd qiling && sudo python3 setup.py

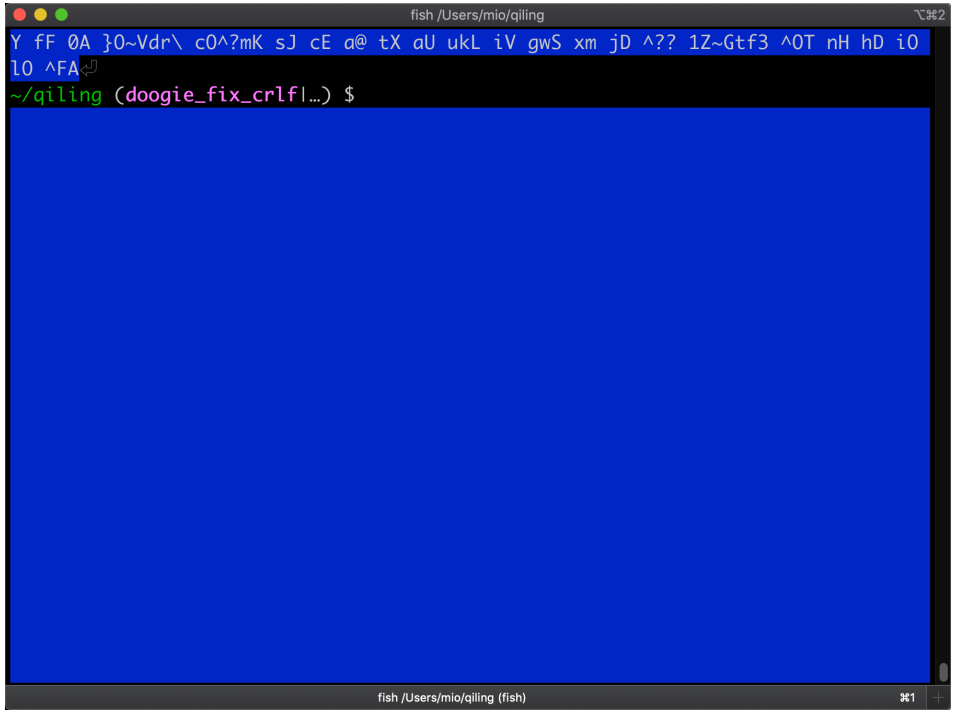
- More Information Refer to https://docs.qiling.io

Demo: Hacking MBR

Sample Analysis

- Sample:
  - Flare-On 5 (2018) Challenge 8 - doogie
- MBR file
- Quick look by qltool.
  - python3 qltool run -f examples/rootfs/8086/doogie/doogie.bin --rootfs examples/rootfs/8086/ --console False
- Try some inputs, but only get gibberish.
- Tips: Feburary 06, 1990.

```
~/q/e/r/8/doogie (doogie|…) $ file doogie.bin
doogie.bin: DOS/MBR boot sector; partition 1 : ID=0x7, activ
e, start-CHS (0x0,32,33), end-CHS (0x3ff,254,63), startsecto
r 2048, 41938944 sectors
~/q/e/r/8/doogie (doogie|…) $
```



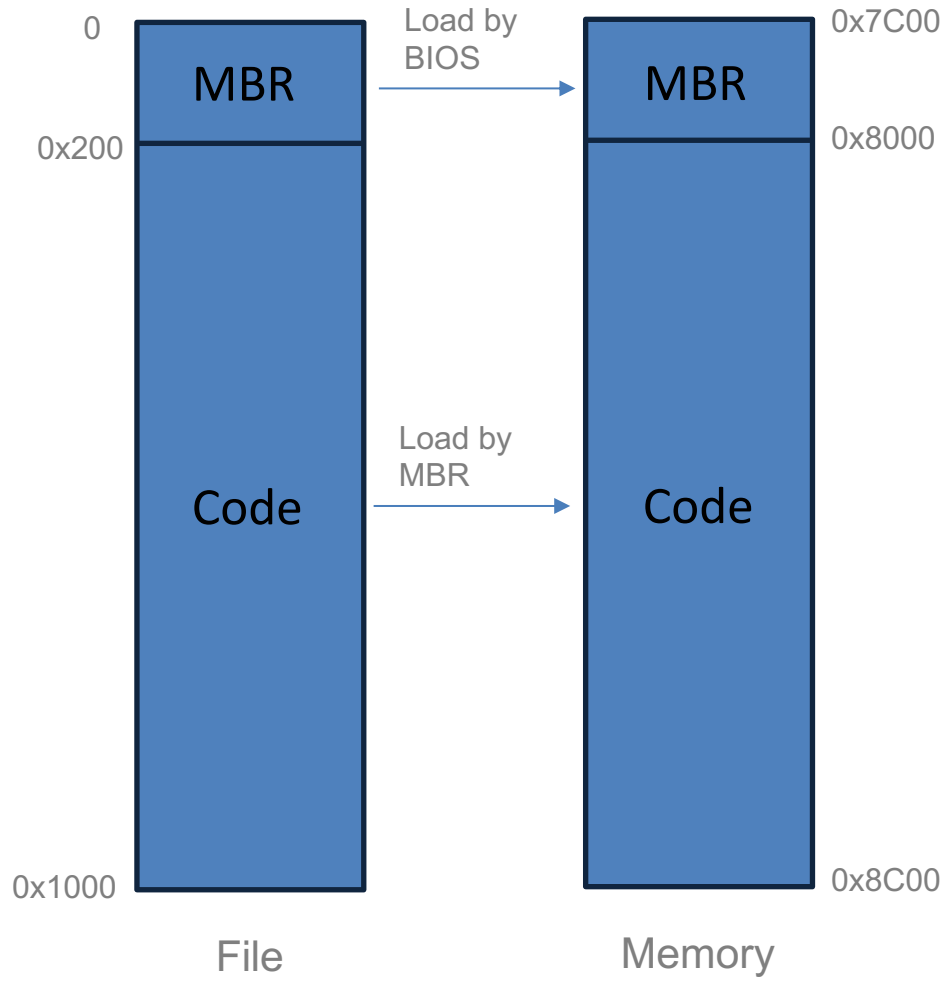
Sample Analysis: First Stage

- Like most operating systems, the program runs in two stage
  - MBR is responsible for loading code from file into 0x8000
  - Then it jumps to 0x8000 and execute the rest code

```
loc_7C00:                               ; DATA XREF: seg000:7C09↓o
                cli
                xor     ax, ax
                mov     ds, ax
                mov     ss, ax
                mov     es, ax
                lea     sp, loc_7C00
                sti
                mov     eax, 20h ; ' '
                mov     ds:byte_7C45, dl
                mov     ebx, 1
                mov     cx, 8000h
                call    sub_7C27
                jmp     near ptr byte_7C4C+3B4h ; jump to 0x8000

; =============== S U B R O U T I N E =======================================


sub_7C27        proc near               ; CODE XREF: seg000:7C21↑p
                xor     eax, eax
                mov     di, sp
                push    eax
                push    ebx             ; sectors offset = 1
                push    es
                push    (offset byte_7C4C+3B4h) ; destination address = 0x8000
                push    7               ; sectors count = 7
                push    10h
                mov     si, sp
                mov     dl, ds:byte_7C45
                mov     ah, 42h ; 'B'
                int     13h             ; DISK - IBM/MS Extension - EXTENDED READ
                mov     sp, di
                retn
sub_7C27        endp
```



Sample Analysis: Second Stage

- The logic which starts from 0x8000 is pretty clear
  - Firstly, it gets current datetime by INT 1a and then xors the string at 0x8809 with that datetime
  - Then, it reads user input and xors the same string at 0x8809 with the input
  - Lastly, it initializes the screen and print the ascii art

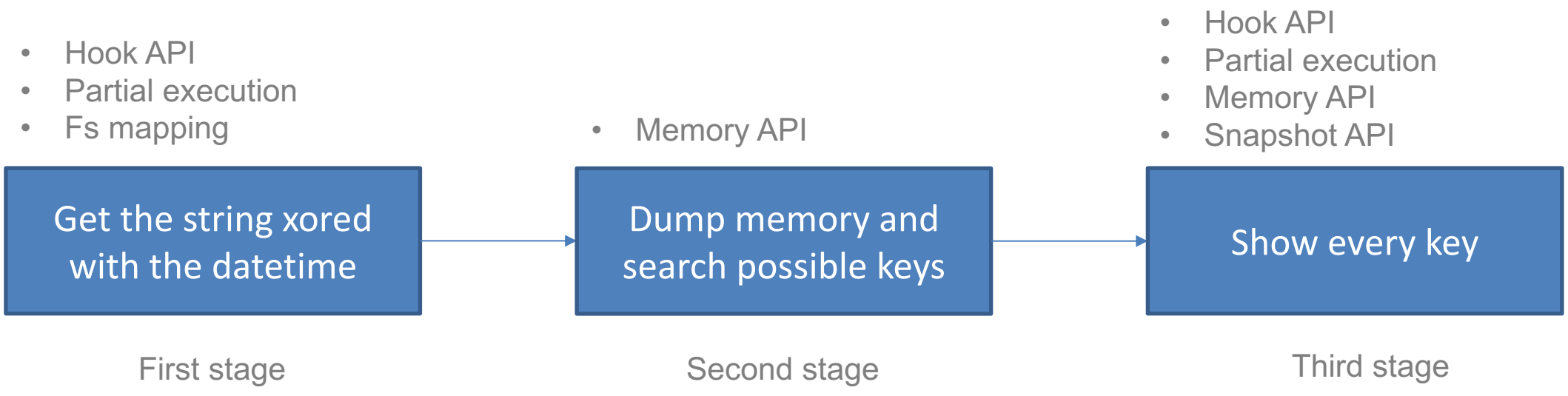
```
seg000          segment byte public 'CODE' use16
                assume cs:seg000
                ;org 8000h
                assume es:nothing, ss:nothing, ds:nothing, fs:nothing, gs:nothing
                call    sub_805B
                push    ds:word_87F2
                call    get_date_and_write_to_87EE
                push    4
                push    offset date_87EE
                call    xor8809
                add     sp, 4
                push    87F4h
                call    read_input
                add     sp, 4
                push    ax
                push    87F4h
                call    xor8809
                add     sp, 4
                call    initialize_screen
                push    0
                push    8809h
                call    print_ascii_art
                add     sp, 4
                mov     cx, 2607h
                mov     ah, 1
                int     10h             ; - VIDEO - SET CURSOR CHARACTERISTICS
                                        ; CH bits 0-4 = start line for cursor in character cell
                                        ; bits 5-6 = blink attribute
                                        ; CL bits 0-4 = end line for cursor in character cell

loc_803D:                               ; CODE XREF: seg000:803E↓j
                hlt
; ---------------------------------------------------------------------------
                jmp     short loc_803D
```

Sample Analysis: Qiling's work

- What Qiling can do to speed up our analysis and find the key
  - Emulate the binary
  - Hook interrupts like INT 1a to give the program a specific time
  - Dynamic memory read/write API
  - Automatically test every key with partial execution and snapshot API
- The crack process can be divided into three stages
  - The key of this challenge is not unique, so we have to show every one

```python
if __name__ == "__main__":
    ql = first_stage()
    # resume terminal
    curses.endwin()
    keys = second_stage(ql)
    for key in keys:
        print(f"Possible key: {key}")
    # The key of this challenge is not unique. The real
    # result depends on the last ascii art.
    print("Going to try every key.")
    time.sleep(3)
    third_stage(keys)
    # resume terminal
    curses.endwin()
```



Crack: First stage

- The quick look before suggests that we have to set the datetime to Feburary 06, 1990
  - It's extremely easy to achieve that with **ql.set_api**
- The program also read disks directly
  - Use **ql.fs_mapper** API to emulate a disk
- Execute the program until 0x8018
  - At this time, the string at 0x8809 has been xored with date
- Dump memory at 0x8809 for the next stage
  - Use **ql.mem.read** API to dump memory

```
# In this stage, we get the encrypted data which xored with the specific date.
def first_stage():
    ql = Qiling(["rootfs/8086/doogie/doogie.bin"],
                "rootfs/8086",
                console=False,
                log_dir=".")
    ql.add_fs_mapper(0x80, QlDisk("rootfs/8086/doogie/doogie.bin", 0x80))
    # Doogie suggests that the datetime should be 1990-02-06.
    ql.set_api((0x1a, 4), set_required_datetime, QL_INTERCEPT.EXIT)
    # A workaround to stop the program.
    hk = ql.hook_code(stop, begin=0x8018, end=0x8018)
    ql.run()
    ql.hook_del(hk)
    return read_until_zero(ql, 0x8809)
```

```
seg000:8000     call    sub_805B
seg000:8003     push    ds:word_87F2
seg000:8007     call    get_date_and_write_to_87EE
seg000:800A     push    4
seg000:800C     push    offset date_87EE
seg000:800F     call    xor8809
seg000:8012     add     sp, 4
seg000:8015     push    87F4h
seg000:8018     call    read_input
```

```
February 06, 1990...  Despite being a 16-year-old reverse engineering genius, I seem to have forgotten the password to my PC. Can you help me???
```

```
def set_required_datetime(ql: Qiling):
    ql.nprint("Setting Feburary 06, 1990")
    ql.reg.ch = BIN2BCD(19)
    ql.reg.cl = BIN2BCD(1990%100)
    ql.reg.dh = BIN2BCD(2)
    ql.reg.dl = BIN2BCD(6)
```

Crack: Second stage

- Dump memory at 0x8809 for the next stage
  - Use ‘ql.mem.read’ API to dump memory
- Utilize some algorithms[1] to guess key size and search possible keys with the assumption that all the result should be printable ascii since it is likely an ascii art

```
# In this stage, we crack the encrypted buffer.
def second_stage(ql: Qiling):
    data = bytes(read_until_zero(ql, 0x8809))
    key_size = guess_key_size(data) # Should be 17
    seqs = []
    for i in range(key_size):
        seq = b""
        j = i
        while j < len(data):
            seq += bytes([data[j]])
            j += key_size
        seqs.append(seq)
    seqs_keys = cal_count_for_seqs(seqs)
    keys = search_possible_key(seqs, seqs_keys)
    return keys


def read_until_zero(ql: Qiling, addr):
    buf = b""
    ch = -1
    while ch != 0:
        ch = ql.mem.read(addr, 1)[0]
        buf += pack("B", ch)
        addr += 1
    return buf
```

[1]: https://trustedsignal.blogspot.com/2015/06/xord-play-normalized-hamming-distance.html

Crack: Third stage

- Execute until 0x8018 and take a snapshot
- Fill in the key in the memory and Skip reading user input
- After completing one round, resume the program to previous snapshot and try next key
- One of the correct keys is: ‘ioperateonmalware’


```python
def show_once(ql: Qiling, key):
    klen = len(key)
    ql.reg.ax = klen
    ql.mem.write(0x87F4, key)
    # Partial exectution to skip input reading
    ql.run(begin=0x801B, end=0x803d)
    echo_key(ql, key)
    time.sleep(3)

# In this stage, we show every key.
def third_stage(keys):
    # To setup terminal again, we have to restart the whole program.
    ql = Qiling(["rootfs/8086/doogie/doogie.bin"],
                "rootfs/8086",
                console=False,
                log_dir=".")
    ql.add_fs_mapper(0x80, QlDisk("rootfs/8086/doogie/doogie.bin", 0x80))
    ql.set_api((0x1a, 4), set_required_datetime, QL_INTERCEPT.EXIT)
    hk = ql.hook_code(stop, begin=0x8018, end=0x8018)
    ql.run()
    ql.hook_del(hk)
    # Snapshot API.
    ctx = ql.save()
    for key in keys:
        show_once(ql, key)
        ql.restore(ctx)
```

Demo: IDAPro Plugin

Sample Analysis

- Analysis sample:
  - Flare-On 5(2018) Challenge 6 - magic

- This challenge required enter 666 keys
- Only call validation function after each input

```
v20 = 0x2C16022663LL;
memset(v21, 0, sizeof(v21));
for ( i = 0; i < strlen("Run, Forrest, run!!"); i += 4 )
  seed ^= *&aRunForrestRun[i];
srand(seed);                                    // seed
if ( sub_402D47() )
{
  v3 = strlen(a2[1]);
  sub_402DCF(a2[1], v3, v11);
  sub_4037BF(*a2);
  puts("Generated first permutation!");
  exit(0);
}
puts("Welcome to the ever changing magic mushroom!");
printf("%d trials lie ahead of you!\n", 666LL);
for ( j = 0; j < 666; ++j )
{
  printf("Challenge %d/%d. Enter key: ", j + 1, 666LL);
  if ( !fgets(v10, 128, stdin) )                // input len=128
    return 0xFFFFFFFFLL;
  v5 = strlen(v10);
  sub_402DCF(v10, v5, v11);                     // validate input && change self
  for ( k = 0; k < strlen(v10); ++k )
    *(&v12 + k) ^= v10[k];
  sub_4037BF(*a2);
}
printf("Congrats! Here is your price:\n%s\n", &v12);
return 0LL;
}
```

Sample Analysis

- The validation function validates the user input in a loop.
- In each iteration of the validation loop, a different part of the entered key is validated.

```
__int64 __fastcall sub_402DCF(__int64 a1, unsigned __int64 a2, __int64 a3)
{
  __int64 result; // rax
  unsigned int i; // [rsp+2Ch] [rbp-4h]

  for ( i = 0; ; ++i )
  {
    result = i;
    if ( i >= 33uLL )
      break;
    if ( dword_605108[72 * i + 1] + dword_605108[72 * i + 2] > a2 )
      sub_402CC7();
    sub_402CDF((&off_605100)[36 * i], dword_605108[72 * i], *(_QWORD *)&dword_605108[72 * i + 4]);
    if ( !((unsigned int (__fastcall *)(__int64, _QWORD, char (**)[3]))(&off_605100)[36 * i])(
            dword_605108[72 * i + 1] + a1,
            dword_605108[72 * i + 2],
            &off_605100 + 36 * i + 4) )
    {
      sub_402CDF((&off_605100)[36 * i], dword_605108[72 * i], *(_QWORD *)&dword_605108[72 * i + 4]);
      sub_402CC7();
    }
    sub_402CDF((&off_605100)[36 * i], dword_605108[72 * i], *(_QWORD *)&dword_605108[72 * i + 4]);
    memcpy(
      (void *)(dword_605108[72 * i + 3] + a3),
      (const void *)(dword_605108[72 * i + 1] + a1),
      dword_605108[72 * i + 2]);
  }
  return result;
}
```

Sample Analysis

- After analysis, it is found that the verification algorithm is stored in magic_table.
- ”magic_table” is **encrypted** but it will **decrypt in memory** in each iteration of the validation loop.
- The verification algorithm will automatically change after each round of verification.

```
__int64 __fastcall sub_402DCF(__int64 input, unsigned __int64 input_len, __int64 a3)
{
  __int64 result; // rax
  unsigned int i; // [rsp+2Ch] [rbp-4h]

  for ( i = 0; ; ++i )
  {
    result = i;
    if ( i >= 33uLL )
      break;
    if ( magic_table[i].input_offset + magic_table[i].input_len > input_len )
      failed();                                 // exit
    Enc_Dec(magic_table[i].func, magic_table[i].func_sz, magic_table[i].key);
    if ( !(magic_table[i].func)(magic_table[i].input_offset + input, magic_table[i].input_len, magic_table[i].target) )
    {
      Enc_Dec(magic_table[i].func, magic_table[i].func_sz, magic_table[i].key);
      failed();                                 // exit
    }
    Enc_Dec(magic_table[i].func, magic_table[i].func_sz, magic_table[i].key);
    memcpy((magic_table[i].output_offset + a3), (magic_table[i].input_offset + input), magic_table[i].input_len);// change opcode
  }
  return result;
}
```

```
.text:0000000000400C55 87 50 57          byte_400C55     db 87h, 50h, 57h [      ; DATA XREF: .data:magic_table+o
.text:0000000000400C58 83 07 A1 BE 47 08 46 21+          dq 21460847BEA10783h, 5A16E746A4712F14h, 0E4CD87E5A602B2A1h
.text:0000000000400C58 14 2F 71 A4 46 E7 16 5A+          dq 673331E1E4E5AD46h, 1A36CCFEF05AF9DFh, 08FCB72A88EC020C8h
.text:0000000000400C58 A1 82 02 A6 E5 87 CD E4+          dq 0AFB41EBA3D16771h, 229CE926ABDFEECFh, 709D77A2B3E0FBC0h
.text:0000000000400C58 46 AD E5 E4 E1 31 33 67+          dq 0D4827E8F9DB83497h, 102B48575AE4368Eh, 3C32B492AD4ED883h
.text:0000000000400C58 DF F9 5A F0 FE CC 36 1A+          dq 27642822234B6E4Ch, 52F30846E9A3BBA9h, 4F53707FC9CC5A72h
.text:0000000000400C58 CB 20 C0 8E A8 72 CB BF+          dq 25AC30BBB082C6FEh, 18589736A52A1A5h, 5778ED6C9C8702CDh
.text:0000000000400C58 71 67 D1 A3 EB 41 FB 0A+          dq 0FA9166EB90710E00h, 51689656F17A71DEh, 0C2A31F2BCD9812FFh
.text:0000000000400C58 CF EE DF A8 26 E9 9C 22+          dq 309E3569C80F2DE8h, 34DE28FAEFD0D2C3h, 6EBE43DECE96C71Dh
.text:0000000000400C58 C0 FB E0 B3 A2 77 9D 70+          dq 0CE54F23EB3FF8C98h, 4F0B2641A29A1D9Ch, 2E4420BD6E517B8Eh
.text:0000000000400C58 97 34 B8 9D 8F 7E 82 D4+          dq 0B6119B4B845861A4h, 362B7197E8C8F151h, 0EAFC1B71D8AD0266h
.text:0000000000400C58 BE 36 E4 5A 57 48 2B 10+          dq 0EE348DDA58FF7A03h, 4884EA4A4C0A0B59h, 0E9104B8BFE93D88h
.text:0000000000400C58 83 D8 4E AD 92 B4 32 3C+          dq 4AFD99760E705A87h, 47352D3A8D636911h, 8D2103044F8E6C44h
.text:0000000000400C58 4C 6E 4B 23 22 28 64 27+          dq 0CE30FA8D11E7DB73h, 66412C0F99611B72h, 6B14D7434EC5EEEEh
.text:0000000000400C58 A9 BB A3 E9 46 08 F3 52+          dq 0E2227D5028FE7135h, 0BD4D67CB2AAE1EAAh, 0D3AF8CE52AFBDDB7h
.text:0000000000400C58 72 5A CC C9 7F 70 53 4F+          dq 24B88FFC86999CE5h, 6CB8525C8D47C3C8h, 36387D23D66561F9h
.text:0000000000400C58 FE C6 82 B0 B8 30 AC 25+          dq 12914DFDF41727EFh, 480AF64E8AFA03A0h, 54606611742D8F0Ah
.text:0000000000400C58 A5 A1 52 6A 73 89 85 01+          dq 17D0DC565EDD23C4h, 73C47CDC8066B038h, 67F8F40AEF64FBC6h
.text:0000000000400C58 CD 02 87 9C 6C ED 78 57+          dq 8D88ED7B4F72461Dh, 51562D093DF4F5C7h, 08E16E52A0D898F49h
.text:0000000000400C58 00 0E 71 90 E8 66 91 FA+          dq 5681803E602C9412h, 600ED9FE5F021977h, 082F308E067D7F999h
```

Sample Analysis

- We will use qiling to:
  - emulate this challenge
  - decrypt magic_table
  - cover bytes to asm

- Use IDA Pro Hex-Rays Decompiler to:
  - decompile the verification algorithm

Encrypted → Decrypted → Decompile

```
byte_400C55     db 87h, 50h, 57h        ; DATA XREF: .data:magi
46 21+          dq 21460847BEA10783h, 5A16E746A4712F14h, 0E4CD8
16 5A+          dq 673331E1E4E5AD46h, 1A36CCFEF05AF9DFh, 0BFCB7
CD E4+          dq 0AFB41EBA3D1671h, 229CE926ABDFEECFh, 709D77
33 67+          dq 0D4827E8F9DB83497h, 102B48575AE436BEh, 3C32B
36 1A+          dq 27642822234B6E4Ch, 52F30846E9A3BBA9h, 4F5370
CB BF+          dq 25AC30BBB082C6FEh, 18589736A52A1A5h, 5778ED6
FB 0A+          dq 0FA9166EB90710E00h, 51689656F17A71DEh, 0C2A3
9C 22+          dq 309E3569C80F2DE8h, 34DE28FAEFD0D2C3h, 6EBE43
9D 70+          dq 0CE54F23EB3FF8C98h, 4F0B2641A29A1D9Ch, 2E442
82 D4+          dq 0B6119B48845861A4h, 36287197E8C8F151h, 0EAFC
2B 10+          dq 0EE348DDA5BFF7A03h, 48B4EA4A4C0A0B59h, 0E910
32 3C+          dq 4AFD99760E705AB7h, 47352D3A8D636911h, 8D2103
64 27+          dq 0CE30FABD11E7DB73h, 66412C0F99611B72h, 6B14D
F3 52+          dq 0E2227D5028FE7135h, 0BD4D67CB2AAE1EAAh, 0D3A
53 4F+          dq 24BBBFFC86999CE5h, 6CB8525C8D47C3C8h, 363B7D
AC 25+          dq 12914DFDF41727EFh, 480AF64E8AFA03A0h, 546066
85 01+          dq 17D0DC565EDD23C4h, 73C47CDC8066B03Bh, 67F8F4
78 57+          dq 8D88ED7B4F72461Dh, 51562D093DF4F5C7h, 0BE16E
91 FA+          dq 56B1803E602C9412h, 600ED9FE5F021977h, 0B2F30
68 51+          dq 158349D548DAC94Fh, 18C333FB0C6BE8A6h, 0CEF39
A3 C2+          dq 0A8A7605B2DB998ADh, 68FE2EAA2BD42F88h, 0FAE1
9E 30+          dq 87C3AF489E97732Ch, 9105793D3F62A8F1h, 0A9ED0
DE 34+          dq 0FCC6C80A76ADAE0Bh, 0E088546B20A50859h, 0E4F
BE 6E+          dq 52742720FDB93280h, 0C309AFB3D71AB9EBh, 2C3F6
54 CE+          dq 7DA7274301FF612Bh, 0CBA3F22455335539h, 8F0AC
0B 4F+          dq 99B9847A292D4A2Ch, 0C3C2939831AD4756h, 0B62E
44 2E+          dq 0D0ED590E5A4C43C3h, 0C939E780645BFB3Eh, 0B0B
11 B6+          dq 9B0E8CFD5323D736h, 0B0F7DE0A7F561D18h, 0D3BE
28 36+          dq 427C8469E6675A3Ah, 78FF332BF2A2F5C7h, 4B3B7D
FC EA+          dq 0BAC446F96BC591EAh, 0BA627DF99F75648Fh, 8F33
```

```
400C55                  sub_400C55      proc near               ;
400C55
400C55                  var_58          = qword ptr -58h
400C55                  var_4C          = dword ptr -4Ch
400C55                  var_48          = qword ptr -48h
400C55                  var_38          = qword ptr -38h
400C55                  var_30          = qword ptr -30h
400C55                  var_28          = qword ptr -28h
400C55                  var_20          = qword ptr -20h
400C55                  var_18          = qword ptr -18h
400C55                  var_10          = qword ptr -10h
400C55                  var_6           = byte ptr -6
400C55                  var_5           = byte ptr -5
400C55                  var_4           = dword ptr -4
400C55
400C55 55                               push    rbp
400C56 48 89 E5                         mov     rbp, rsp
400C59 48 89 7D B8                      mov     [rbp+var_48], rdi
400C5D 89 75 B4                         mov     [rbp+var_4C], esi
400C60 48 89 55 A8                      mov     [rbp+var_58], rdx
400C64 C7 45 FC 00 00 00 00             mov     [rbp+var_4], 0
400C6B E9 19 01 00 00                   jmp     loc_400D89
400C70                          ; ---------------------------------------------------------------------------
400C70
400C70                  loc_400C70:                             ;
400C70 8B 45 FC                         mov     eax, [rbp+var_4]
400C73 48 8D 14 C5 00 00 00 00          lea     rdx, ds:0[rax*8]
400C7B 48 8B 45 A8                      mov     rax, [rbp+var_58]
400C7F 48 01 D0                         add     rax, rdx
400C82 48 8B 00                         mov     rax, [rax]
400C85 48 85 C0                         test    rax, rax
400C88 75 7A                            jnz     short loc_400D04
400C8A 8B 45 FC                         mov     eax, [rbp+var_4]
400C8D 48 8D 14 C5 00 00 00 00          lea     rdx, ds:0[rax*8]
```

```
__int64 __fastcall sub_400C55(__int64 a1, unsigned int a2, __int64 a3)
{
  __int64 v4; // [rsp+20h] [rbp-38h]
  __int64 v5; // [rsp+28h] [rbp-30h]
  __int64 v6; // [rsp+30h] [rbp-28h]
  __int64 v7; // [rsp+38h] [rbp-20h]
  __int64 v8; // [rsp+40h] [rbp-18h]
  __int64 v9; // [rsp+48h] [rbp-10h]
  char v10; // [rsp+52h] [rbp-6h]
  char v11; // [rsp+53h] [rbp-5h]
  unsigned int i; // [rsp+54h] [rbp-4h]

  for ( i = 0; i < a2; ++i )
  {
    if ( *(8LL * i + a3) )
    {
      v11 = *(i + a1);
      v6 = 0LL;
      v5 = 1LL;
      v4 = 0LL;
      while ( v11 )
      {
        v6 = v5 + v4;
        v4 = v5;
        v5 = v6;
        --v11;
      }
      if ( v6 != *(8LL * i + a3) )
        return 0LL;
    }
    else
    {
      v10 = *(i + a1);
      v9 = 0LL;
```

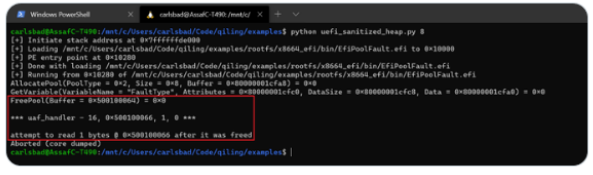
What Else

More Features and Demo Code

You Retweeted

Assaf Carlsbad
@assaf_carlsbad

A sanitized heap recently got merged into @qiling_io. Enable it to detect pool overflows, underflows, out-of-bounds reads, use-after-free bugs, and double or totally invalid frees. Special thanks to @domenuk, @pr0me, and the rest of the BaseSAFE guys for the ideas and motivation.



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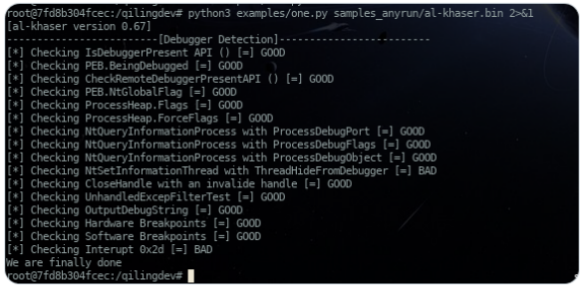
Simone Berni (0ssigeno)
@0ssig3no

Step after step, we are almost done @qiling_io



12:28 AM · Apr 21, 2020 · Twitter Web App

Qiling Framework
@qiling_io

After hijacking syscall and Windows API, Qiling now can hijack ".so" functions! You can set callback on function enter/exit, or replace entire function.

Checkout: docs.qiling.io/en/latest/hija...

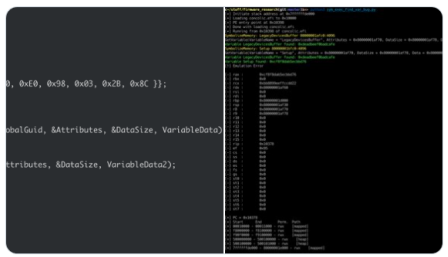
```
from qiling import *
from qiling.const import *

def my_puts(ql):
    addr = ql.func_arg[0]
    print("Hijack Libc puts(%s)" % ql.mem.string(addr))

if __name__ == "__main__":
    ql = Qiling(["rootfs/x8664_linux/bin/x8664_hello"], "rootfs/x8664_linux", output="debug")
    ql.set_api('puts', my_puts, QL_INTERCEPT.ENTER)
    ql.run()
```

11:51 AM · Jun 12, 2020 · Twitter Web App

You Retweeted

liba2k
@liba2k

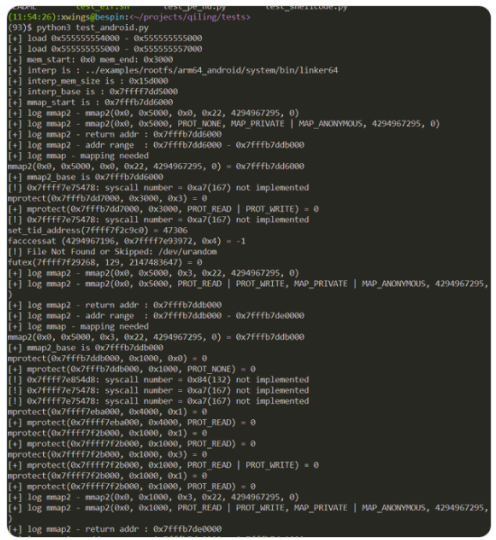
Utilizing symbolic execution in UEFI drivers to get to a vulnerable path. Using @qb_triton and @qiling_io. Thanks to @assaf_carlsbad and @JonathanSalwan for their help.



10:20 PM · Jun 3, 2020 · Twitter Web App

Qiling Framework
@qiling_io

We got our first ARM64 Android binary working on Qiling Framework! Thanks to justfoxing github.com/qilingframewor...



11:57 AM · Apr 23, 2020 · Twitter Web App

Qiling Framework
@qiling_io

Qiling now enables API hooking with OnEnter & OnExit interception, so you can easily override system functions. As usual, cross platform and multi-architecture supported. For more details, please visit:

docs.qiling.io/en/latest/hija...

** Remember to star our GitHub !

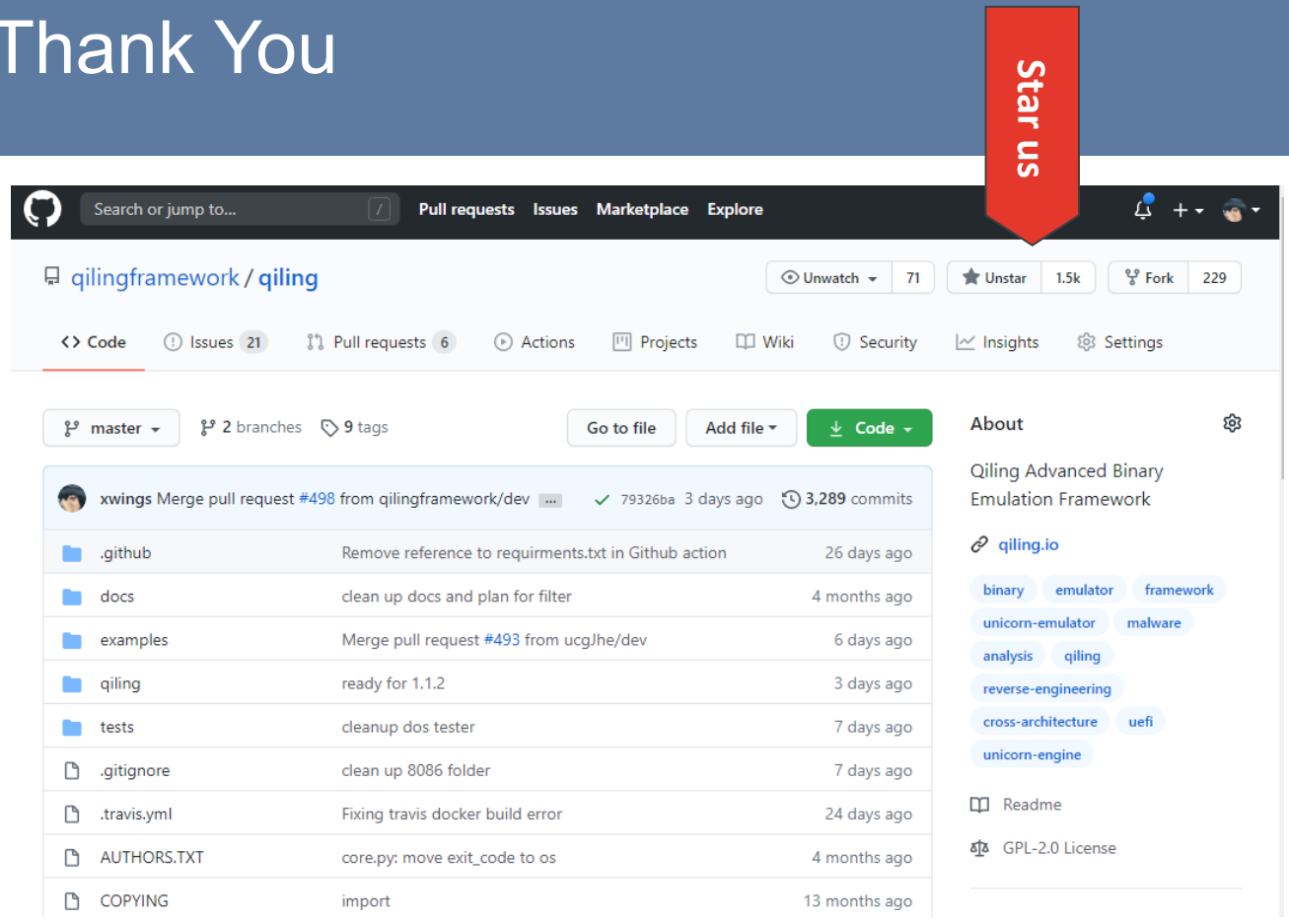
```
from qiling import *
from qiling.const import *
from qiling.os.windows.fncc import *
from qiling.os.windows.utils import *

@winapi(cc=CDECL, params={
    "str": STRING
})
def my_puts(ql, address, params):
    ret = 0
    ql.nprint("\n+++++++++\nmy random Windows API\n+++++++++\n")
    string = params["str"]
    ret = len(string)
    return ret


def my_onenter(ql, address, params):
    print("\n++++++++\nmy OnEnter")
    print("lpSubKey: %s" % params["lpSubKey"])
    params = ({'hKey': 2147483649, 'lpSubKey': 'Software', 'phkResult': 4294954932})
    print("+++++++++\n")
    return  address, params


def my_onexit(ql):
    ql.nprint("\n+++++++++\nmy OnExit")
    ql.nprint("+++++++++\n")


def my_sandbox(path, rootfs):
    ql = Qiling(path, rootfs, output = "debug")
    ql.set_api("_cexit", my_onenter, intercept = QL_INTERCEPT.ENTER)
    ql.set_api("puts", my_puts)
    ql.set_api("atexit", my_onexit, intercept = QL_INTERCEPT.EXIT)
    ql.run()

if __name__ == "__main__":
    my_sandbox(["rootfs/x8664_windows/bin/x8664_hello.exe"], "rootfs/x8664_windows")
```

10:34 PM · May 29, 2020 · Twitter Web App

https://docs.qiling.io

One Last Thing

Thank You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