

Low level attacks

Disassembler and debugger

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A.Y. 2019/2020

- It is instructive to disassemble simple programs

```
objdump -M intel -D <binary-file>
```

Example

- Try `variable.c`
- Try `array.c`
- Try `if.c`
- Try `while.c`
- Try `for.c`

Different compilers produce different assembly!

Debugger setup

- We are going to use `gdb` (GNU Debugger)
- Add `set disassembly intel` to `~/.gdbinit`
- Add the flag `-g` to `gcc` to compile with extra debugging information

Try on `for.c`

- Run the debugger passing a binary file as first argument
- Try the `list` command
- Try `disassemble main`

- Breakpoints break execution before specific instructions

Example

- Add a breakpoint to `main` function

Register inspection

- `info registers`
- `info register <register>`
e.g., `info register eip`

x/nfu addr

- *n*: number of units (default is 1)
- *f*: display format (default is *x*)
 - *o*: octal
 - *x*: hexadecimal
 - *u*: unsigned decimal
 - *t*: binary
 - *i*: instruction
- *u*: size of unit (default is *w*)
 - *b*: byte
 - *h*: halfword, 2 bytes
 - *w*: word, 4 bytes
 - *g*: giant, 8 bytes
- *addr*: can be a register (*\$eip*), an address (*0x8048416*), or a variable (*&i*)

Little-endian vs big-endian machines

- Compare `x & 0xff` and `(x >> 24) & 0xff`
- If bytes are in reverse order, your machine is little-endian
- Take this into account when exploiting

Assembly stepping

- `step` and `next` work on C instructions
- Add `i` suffix to execute one assembly instruction
- That is, use `stepi` and `nexti`

GDB Cheat Sheet

<http://darkdust.net/files/GDB%20Cheat%20Sheet.pdf>

Use assembly in C/C++

- Use instruction `__asm__ (<assembly-code-here>)`
- Compile with `-masm=intel`

Example

Try `find_start.c`

Disable protection mechanisms

- Disable Address Space Layout Randomization (ASLR):

```
sudo bash -c 'echo 0 > /proc/sys/kernel/randomize_va_space'
```


(default value is 2)
- Compile with `-fno-stack-protector` to disable canaries
- Compile with `-z execstack` to enable executable stack

Buffer overflow

- Essentially, writing after the last element of an array
- Target EIP to control execution of the running program

Example

- 1 Try `buffer.c`
- 2 Try `buffer2.c`

Core dump

- Activate core dump generation with
`ulimit -c unlimited`
- Analyze core with `gdb -q -c core`

Overflow into the return address

- Try `overflow.c`
- Function `gets()` does not bound its argument
- Find the address of function `unlinked_code`, say `0x0804845b`
- Try the following:

```
for i in $(seq 30 50); do
    echo $i;
    python -c "print('A'*$i + '\x5b\x84\x04\x08')" | a.out;
done
```

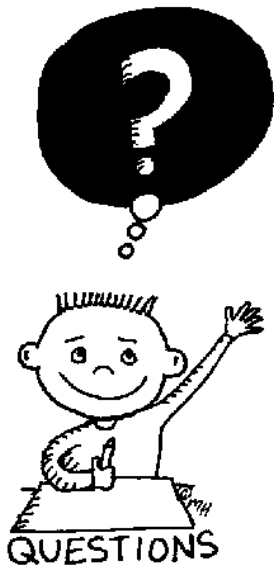
- Try `serial.c`
- Identify the address of call `do_valid_stuff()`, say `0x08048618`

Exercise 1

Can you force EIP to be `0x08048618`?

Exercise 2

- `'d'*8 + 'DD'` is a valid serial code
- Can you provide a different, valid serial code?



END OF THE
LECTURE