Debugging

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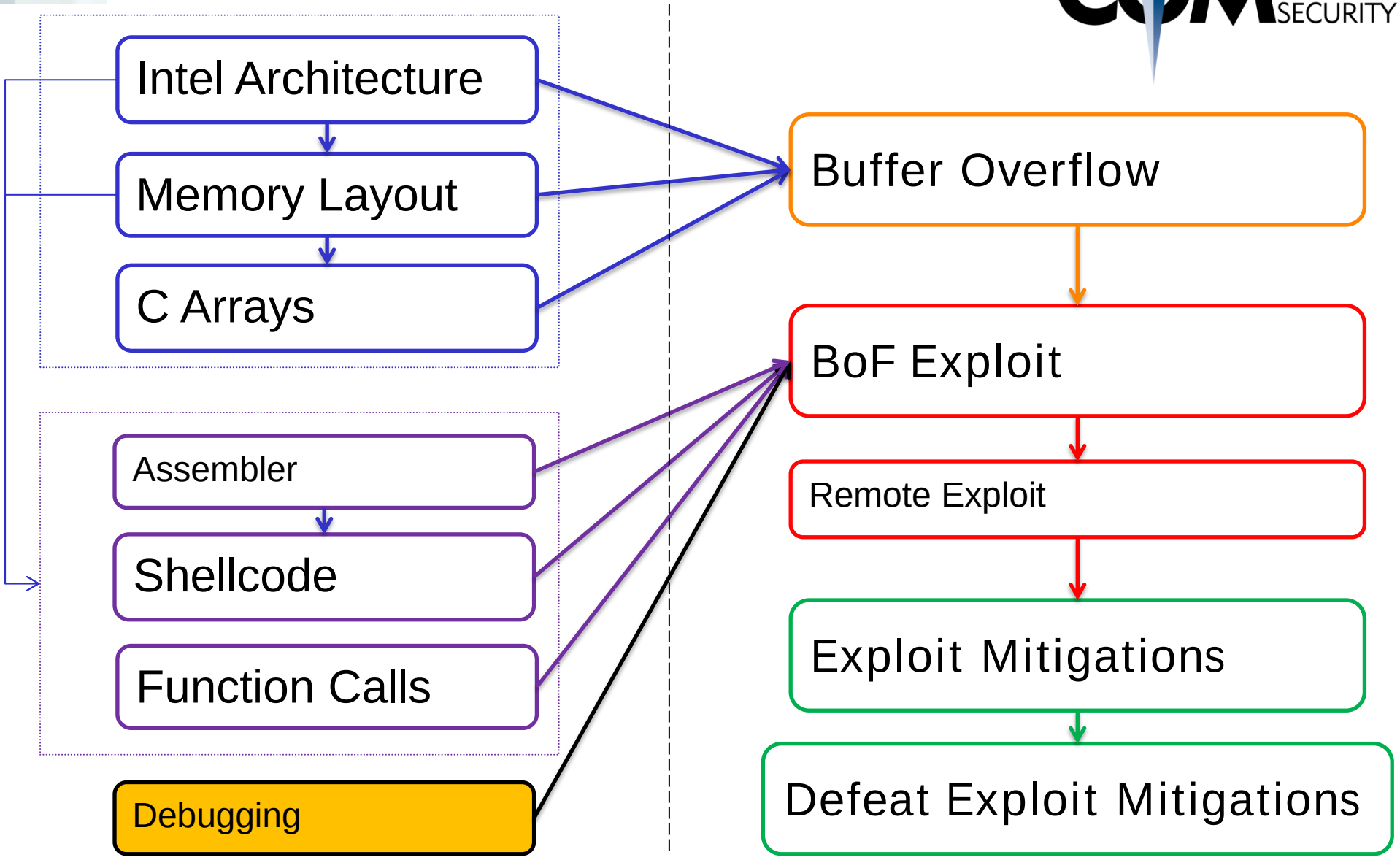
Content


Intel Architecture
Memory Layout
C Arrays
Assembler
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Debugging
Buffer Overflow
BoF Exploit
Remote Exploit
Exploit Mitigations
Defeat Exploit Mitigations

Debugging

Inspect state of a program while its running

Debugging

Start GDB:

```
$ gdb <filename>
```

Load a file while being in gdb:

```
(gdb) file <filename>
```

Start the program:

```
(gdb) run
```

Debugging

Inspecting code:

Where am i?

```
(gdb) where
```

Disassemble a function:

```
(gdb) disas main
Dump of assembler code for function main:
   0x0000000000400b64 <+0>:    push   %rbp
   0x0000000000400b65 <+1>:    mov    %rsp,%rbp
   0x0000000000400b68 <+4>:    sub    $0x150,%rsp
   0x0000000000400b6f <+11>:   mov    %edi,-0x144(%rbp)
   0x0000000000400b75 <+17>:   mov    %rsi,-0x150(%rbp)
```

Debugging

Setting a breakpoint:

```
(gdb) break *0x0000000000400be3
Breakpoint 1 at 0x400be3
```

Info about set breakpoints:

```
(gdb) info breakpoints
Num     Type           Disp Enb Address            What
1       breakpoint     keep y   0x0000000000400be3 <main+127>
```

Delete a breakpoint:

```
(gdb) delete 1
```

Debugging

Continue execution:

```
(gdb) continue
```

Single step:

```
(gdb) step
```

Debugging

Reaching a breakpoint:

```
(gdb) run test test
Starting program: /home/hacker/bfh/challenge1 test test

Breakpoint 1, 0x0000000000400834 in main (argc=3,
argv=0x7fffffffea28) at challenge1.c:47
47        handleData(argv[1], argv[2]);
```

Backtrace:

```
(gdb) backtrace
#0  0x0000000000400834 in main (argc=3, argv=0x7fffffffea28) at challenge1.c:47
```

Debugging

Inspecting registers:

```
(gdb) info register
rax            0x7fffffffecae     140737488350382
rbx            0x0    0
rcx            0x0    0
rdx            0x7fffffffecb3     140737488350387
rsi            0x7fffffffecb3     140737488350387
…
```

Debugging

Inspecting memory:

```
(gdb) x/32x 0x7fffffffe940
0x7fffffffe940:  0x00000000  0x00000000  0xf781bb45  0x00007fff
0x7fffffffe950:  0x00000000  0x00000000  0xffffea28  0x00007fff
0x7fffffffe960:  0x00000000  0x00000003  0x004007e0  0x00000000
0x7fffffffe970:  0x00000000  0x00000000  0xa2dfa5c8  0x1175d69a

(gdb) x/8b 0x7fffffffe940
0x7fffffffe940:  0x00  0x00  0x00  0x00  0x00  0x00  0x00  0x00

(gdb) x/8g $rsp-8
0x7fffffffe928:  0x0000000000400640  0x00007fffffffea28
0x7fffffffe938:  0x0000000300000000  0x0000000000000000
0x7fffffffe948:  0x00007ffff781bb45  0x0000000000000000
0x7fffffffe958:  0x00007fffffffea28  0x0000000300000000
```

x/<count><format><unit>

Debugging

x/<count><format><unit>

Format:

- x: Hexadecimal
- d: Decimal
- i: instructions
- s: string
- c: character

Unit:

- b: bytes
- w: Words (4 bytes, 32 bit)
- g: Giant words (8 bytes, 64 bit)

Debugging

If compiled with debugging symbols (-ggdb)

```
(gdb) list
```

Local variables

```
(gdb) info locals
```

Debugging

```
(gdb) info file
Symbols from "/home/hacker/bfh/day2/challenge3".
Local exec file:
   `/home/hacker/bfh/day2/challenge3', file type elf64-x86-64.
   Entry point: 0x400640
   0x0000000000400200 - 0x000000000040021c is .interp
   0x000000000040021c - 0x000000000040023c is .note.ABI-tag
   0x000000000040023c - 0x0000000000400260 is .note.gnu.build-id
   0x0000000000400260 - 0x000000000040027c is .gnu.hash
   0x0000000000400280 - 0x00000000004003a0 is .dynsym
   0x00000000004003a0 - 0x0000000000400455 is .dynstr
   0x0000000000400456 - 0x000000000040046e is .gnu.version
   0x0000000000400470 - 0x00000000004004b0 is .gnu.version_r
   0x00000000004004b0 - 0x00000000004004c8 is .rela.dyn
   0x00000000004004c8 - 0x0000000000400588 is .rela.plt
   0x0000000000400588 - 0x00000000004005a2 is .init
   …
```

Debugging

Important settings:

Attach to a running process, and follow forks:

```
(gdb) set follow-fork-mode child
```

This will be important for the remote exploit challenge

Debugging

Attach to already existing processes:

```
(gdb) attach <pid>
```

Debugging

Allow creation of core files:

```
$ ulimit -c unlimited
```

Use a core file:

```
$ gdb <binary> <corefile>
```

Debugging

More gui:

```
$ gdb -tui
```

```
(gdb) layout asm
(gdb) layout regs
```

Debugging

Helpful GDB Plugins:

PEDA

- PEDA - Python Exploit Development Assistance for GDB
- https://github.com/longld/peda

GEF

- GDB Enhanced Features
- https://github.com/hugsy/gef

Lisa.py

- LLDB
- Lisa.py: An Exploit Dev Swiss Army Knife.
- https://github.com/ant4g0nist/lisa.py

Voltron

- Voltron is an extensible debugger UI toolkit written in Python.
- https://github.com/snare/voltron