Low level attacks
Format string vulnerabilities
(part 2)

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- How to leak sensitive memory addresses?
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We are going to answer all these questions!

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- Let's reach the format string!

```
<address><stackpop><read-code>
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- `address`: the address we want to read
- `stackpop`: format parameters such as `%u` or `%8x` to reach `<address>`
- `read-code`: format parameter `%s`

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- Find the right stackpop with
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  (see `printf_s_stackpop.py`)
- You have the right stackpop when the printed string ends with `|41414141|`

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- Possibly, prepend 1, 2 or 3 characters to align memory
- Use `gdb` to find the address of `unlinked`
- Replace `AAAA` with the address
- Replace `|%08x|` with `|%s|`
  (see `printf_s_build.py`)

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`(<junk><address>)`^{4}`<stackpop><write-code>`

- `junk`: four dummy bytes (eg. JUNK)
- `address`: the address we want to write
- `stackpop`: format parameters such as `%8x` to reach the format string (`%u` is problematic; why?)
- `write-code`: increase counter with `%`n`x` (where $n \geq 8$) and write with `%n`

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- Use `gdb` to find the address of `target`
- Replace the first part of the format string
  - The four addresses point to the four bytes of `target`
- Replace `|%08x|` with the write-code
  - See `printf_write_build.py`
  - Note that the padding function has been improved
    (we are going to print hexadecimal numbers)

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Note

- The address of the return address will be different if you run the program normally (out of `gdb`)
- The address has to be brute forced

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- Try `printf_retaddr_find.py`
  1. When you see the format string printed back, you have the right address! (it should be at 7 in the example)
  2. You also know the relative position of the format string (where you see `|41414141|`; it should be at 11 in the example)
  3. And you know the relative position of the return address (it should be at 6 in the example)
     - Either use `gdb` to find it, or
     - Recognize it in the output of `printf_retaddr_find.py`

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     - Either use `gdb` to find it, or
     - Recognize it in the output of `printf_retaddr_find.py`
- Let's try 1 - 4*(2 - 3)
  - `(gdb) p/x 0xADDR1 - 4*(OFFSET2 - OFFSET3)`

Find the address of the format string (2)

Use `printf_retaddr_build.py` without `gdb`

```
$ python -c "import os; os.system('''a.out `./printf_retaddr_build.py`' ''')"
```

```
This is noncompliant function:
JUNK%08x%08xJUNK%08x%08xJUNK%08x%08xJUNK%08x%08x|f7f

4b4e554a

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................................
................................
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- We can inject a shellcode
  - The shellcode will be at the end of the format string
  - The return address will jump to the shellcode
- We can cast a return-to-libc attack
  - The address of `system` will replace the return address
  - The string `/bin/sh` will be at the end of the format string
  - The address of this string will follow the return address

Let's see the first attack; the second is similar.

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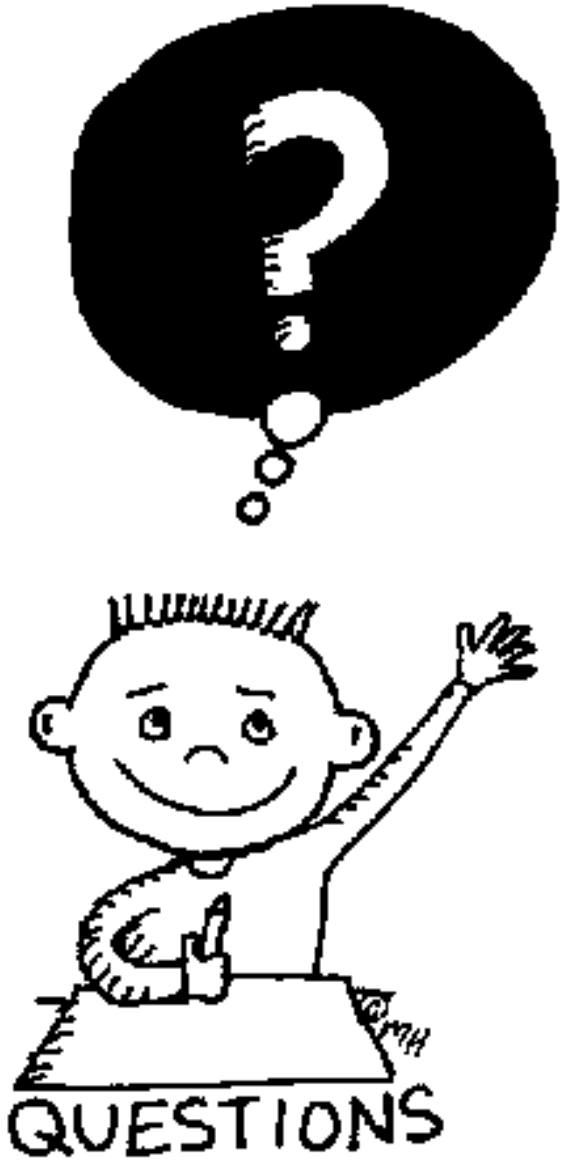
Run the exploit

- Change the owner of the executable to `root`
- Set the SUID bit
- Give in input our casted format string



END OF THE LECTURE