Low level attacks
Shellcode (part 1)

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  - Real UID: who started the process
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- Similarly, there are real and effective group ids
- If SUID is set, effective UID is set to the user owning the file
- If SGID is set, effective GID is set to the group owning the file
- `exec*` functions start new processes... acting for the effective user and group!

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Problems we have to face

- Inject our shellcode in a vulnerable buffer
- Jump to the first instruction of our shellcode

Shellcode injection

- Try `victim.c`
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The NOP Method

```
<NOPs (0x90)> <shellcode> <padding> <saved return address>
```

- We will jump in the NOP sled
- The more NOPs, the more likely the injection
- Follow the instructions in `attack-victim.txt`

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- Now try `exit_shellcode.c`

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- The first instruction can be replaced by
  `xor ebx, ebx`
- The second instruction can be replaced by
  `xor eax, eax`
  `mov al, 1`
- Try `exit2.asm` and `exit2_shellcode.c`

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Problems to face

- We cannot use zeros
- We should use relative addressing as much as possible
- Can we get the address of `filename`?

Create a real shellcode (2)

Try `shellcode.asm`

Make text segment writable

Run `ld` with option `-N`

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- Now get the machine code and try it with `shellcode2.c`

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Better to extract the shellcode automatically

```
objdump -D -M intel shellcode.o | grep -P ":\t" |
   sed 's/.*:\t//' | sed 's/\s*\t.*$//' |
   sed 's/ /\\x/g' | sed 's/\(.*\)/"\x1"/'
```

Create a real shellcode (3)

Now check `shellcode-with-p.asm`

Exercise

Extract the shellcode and inject in `shellcode2.c`

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Example

- Replace the return address with the address of `system()`
- Leave 4 bytes (it is the return address of `system()`)
- Write the address of the string to execute
- Follow the instructions in `ret2libc.txt`
- Also check `bypass-suid-drop-policy.txt`

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Return Oriented Programming (ROP)

Chain several calls to small instruction sets terminated by `ret`

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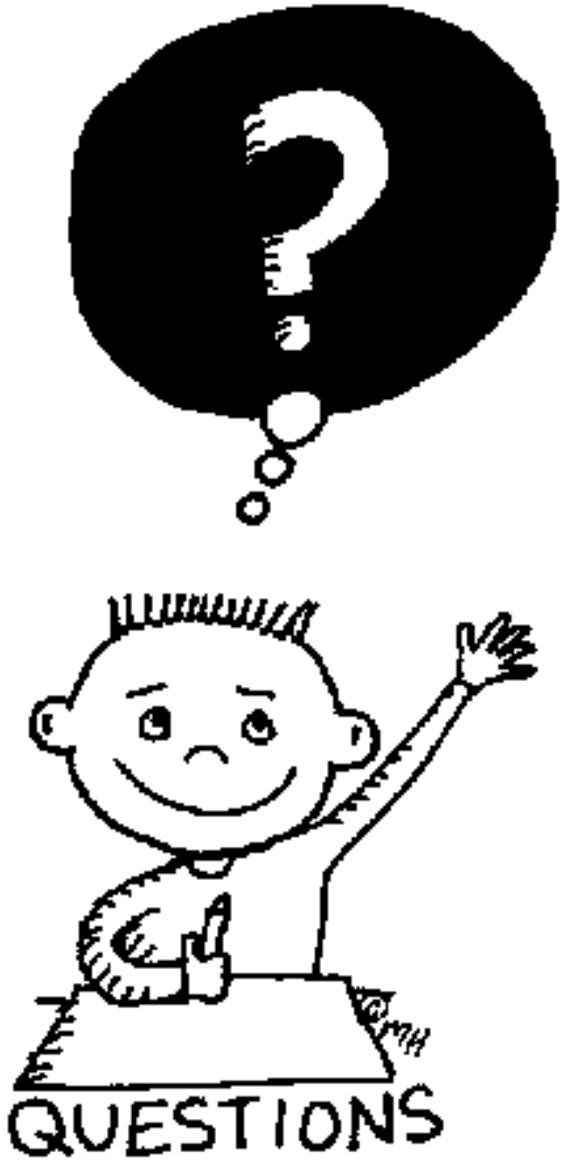
- ASLR: Address Space Layout Randomization
  - Randomly change addresses at each execution



END OF THE LECTURE