Project 3 - BufferOverflow

Network Security

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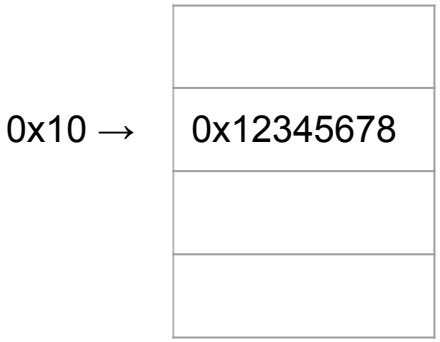
Outline

- Assembly Instructions
- Stack
- Stack Frame
- Buffer Overflow
- Endianness
- Non-Printable Characters
- Send payload to remote server
- More Info

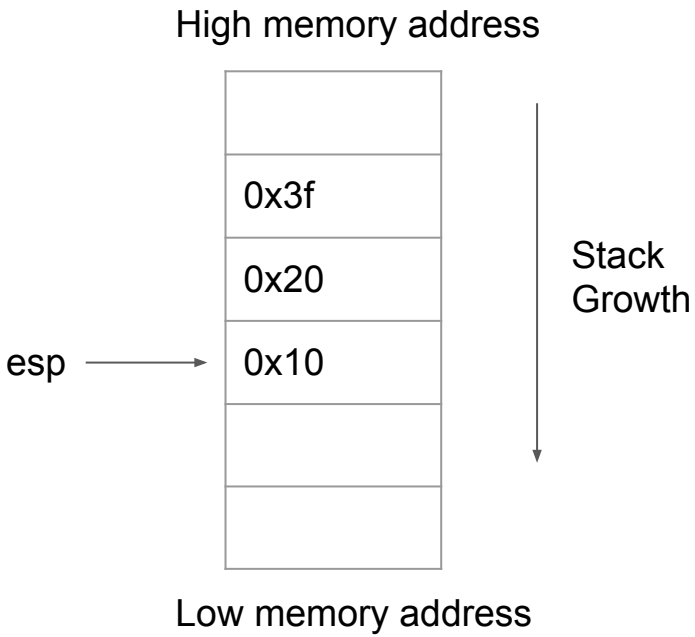
Assembly Instructions (Intel Syntax)

Opcode	Dest	Source	Result
`mov`	`eax,`	`0x10`	`# eax: 0x10`
`sub`	`eax,`	`0x01`	`# eax: 0x0f`
`add`	`eax,`	`0x0f`	`# eax: 0x1e`
`lea`	`ebx,`	`[eax-0xe]`	`# ebx: 0x10; eax: 0x1e;`
`mov`	`ebx,`	`[eax-0xe]`	`# ebx:` the value stored at 0x10 in Mem. i.e., 0x12345678



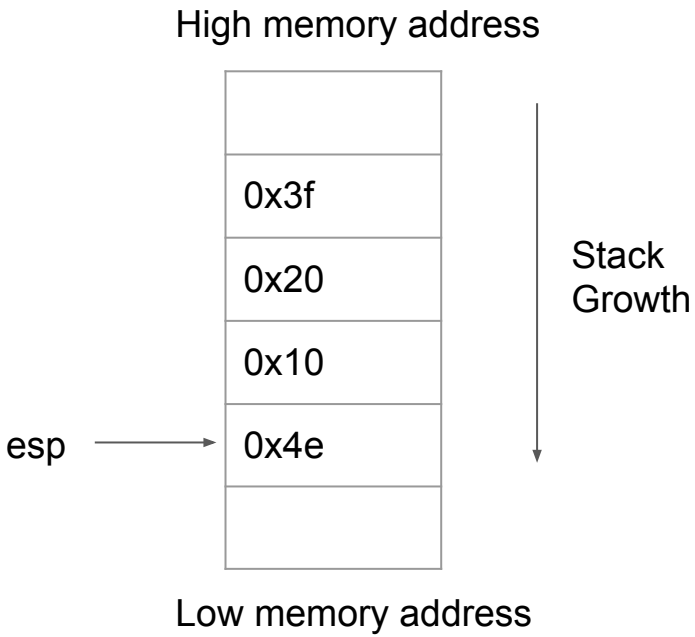
Stack

ESP(stack pointer) points to top of stack



Stack

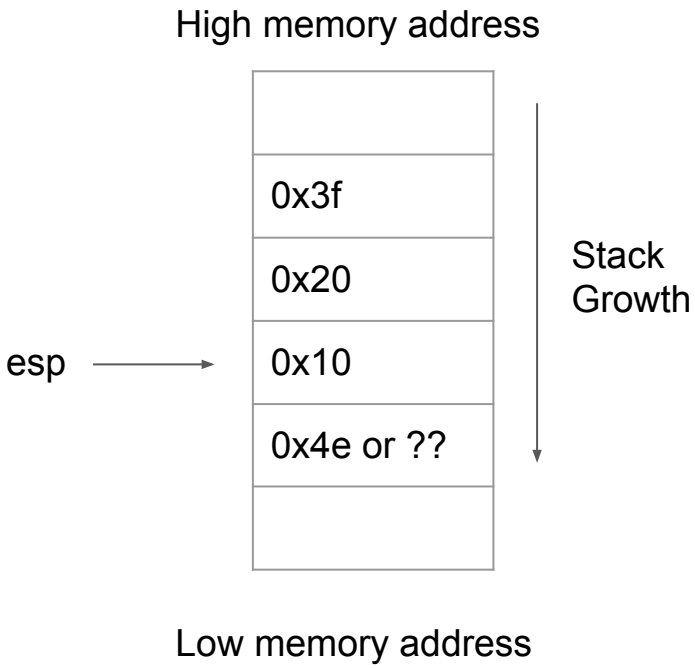
```
push   0x4e
```



Stack

```
push   0x4e

pop    eax    #now eax equals 0x4e
```

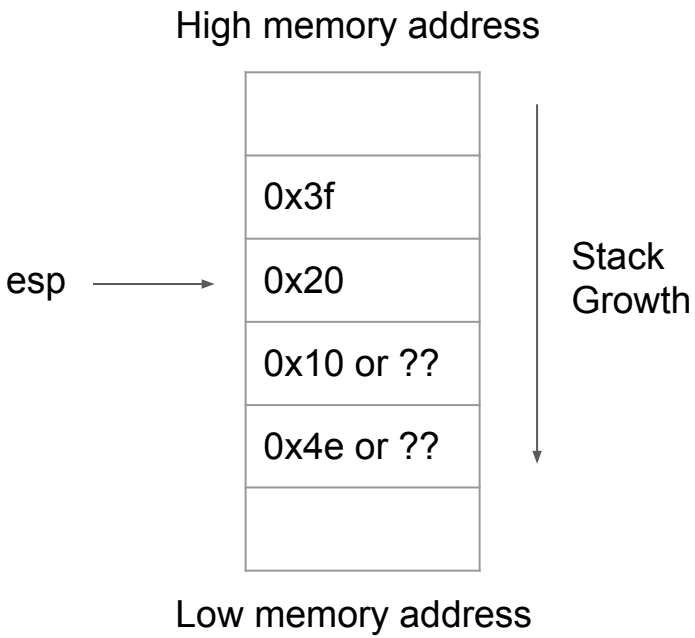


Stack

```
push   0x4e

pop    eax    #now eax equals 0x4e

pop    ebx    #now ebx equals 0x10
```



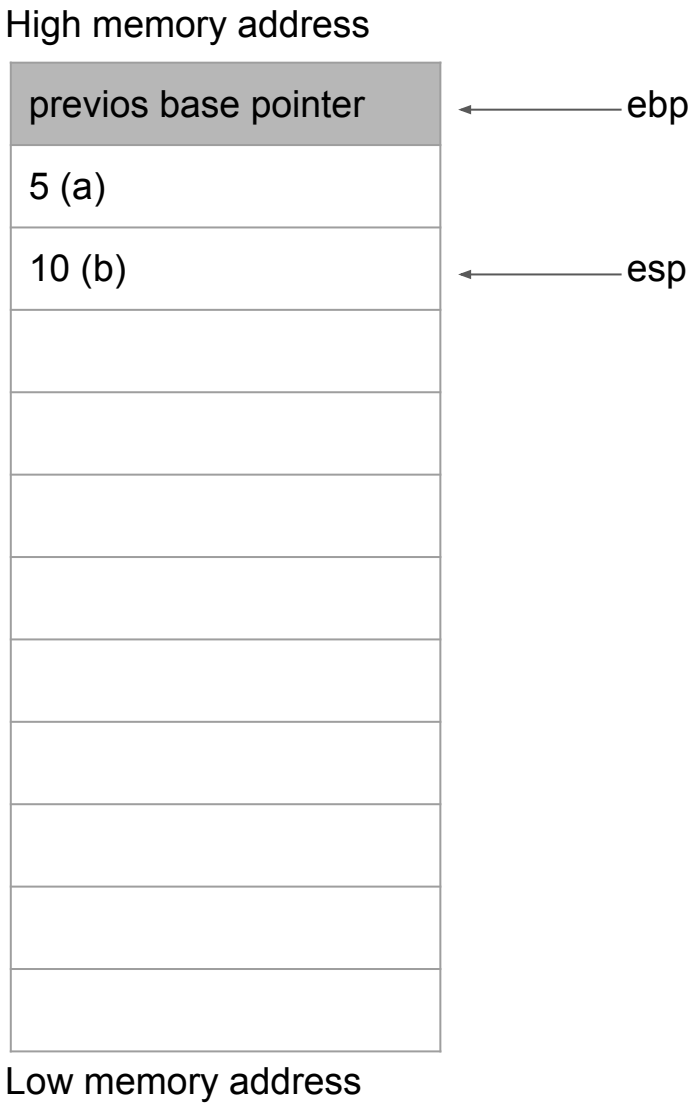
Stack Frame

example: main calls foo

1. Do stuff in main

```
1 int main(){
2       int a = 5;
3       int b = 10;
4 }
```

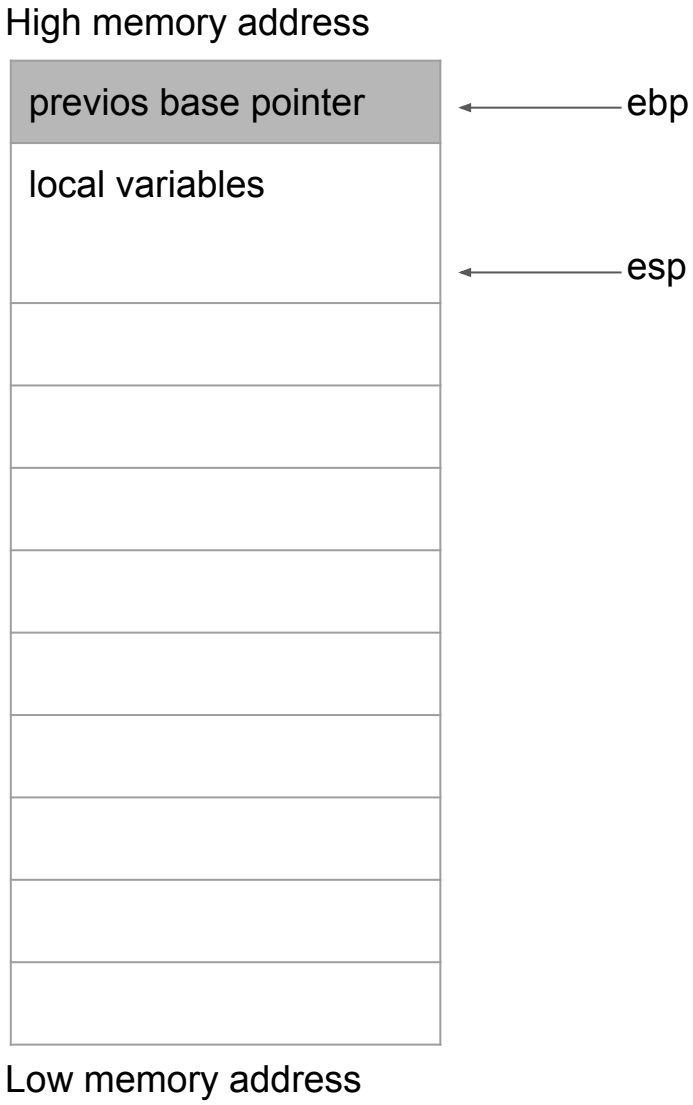
ex:
int a =5; (push 5)
int b = 10; (push 10)



Stack Frame

example: main calls foo

1. Do stuff in main



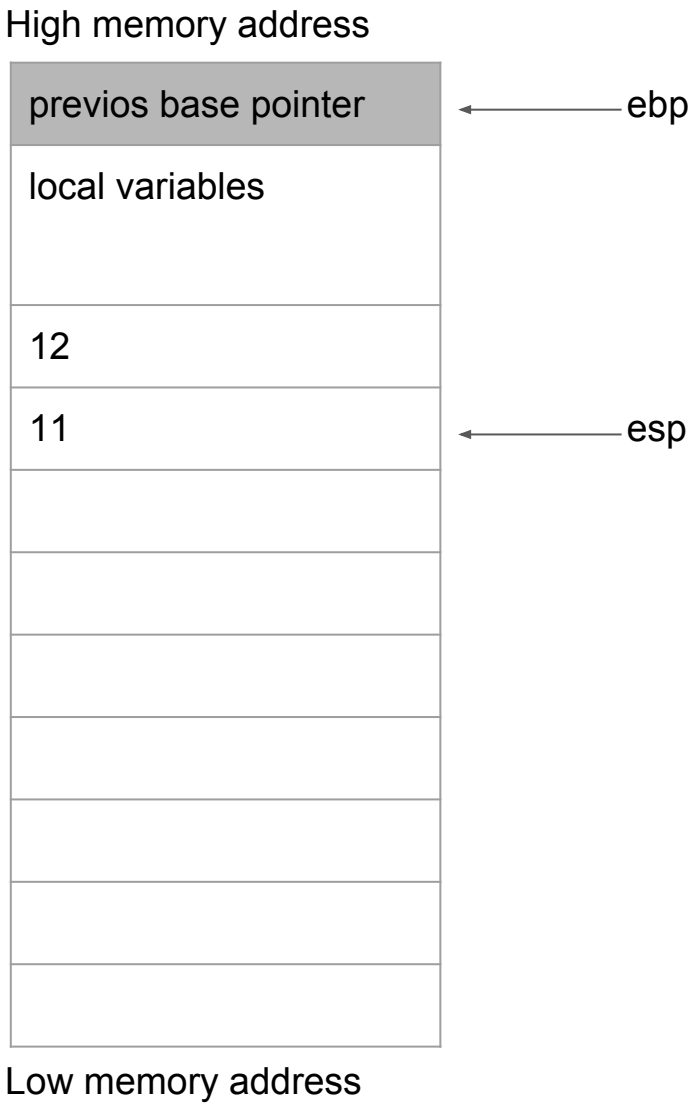
Stack Frame

example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo

```
1 int main(){
2       int a = 5;
3       int b = 10;
4       foo(11, 12);
5 }
```

ex:
foo takes two intergers
in main: foo(11, 12); (push 12, push 11)



Stack Frame

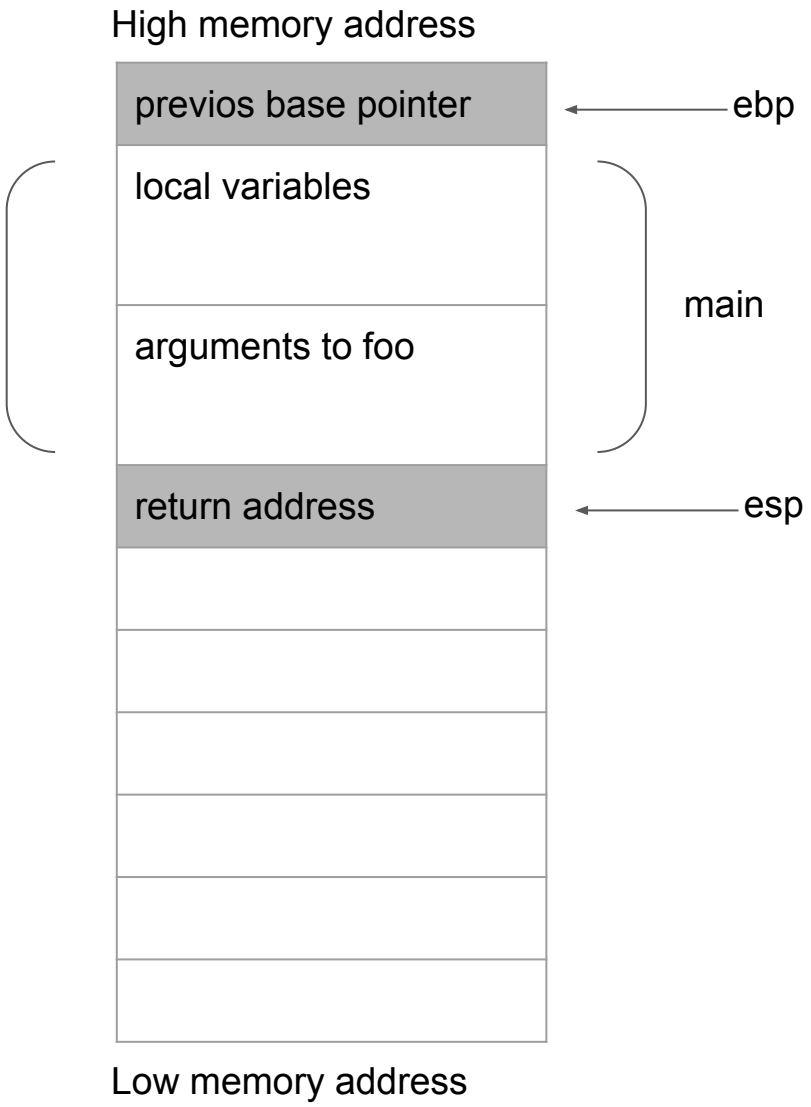
example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo
3. Set up stack frame for foo

assembly: `call foo`

is equivalent to

```
push eip; #return address
mov eip,  address of foo()
```



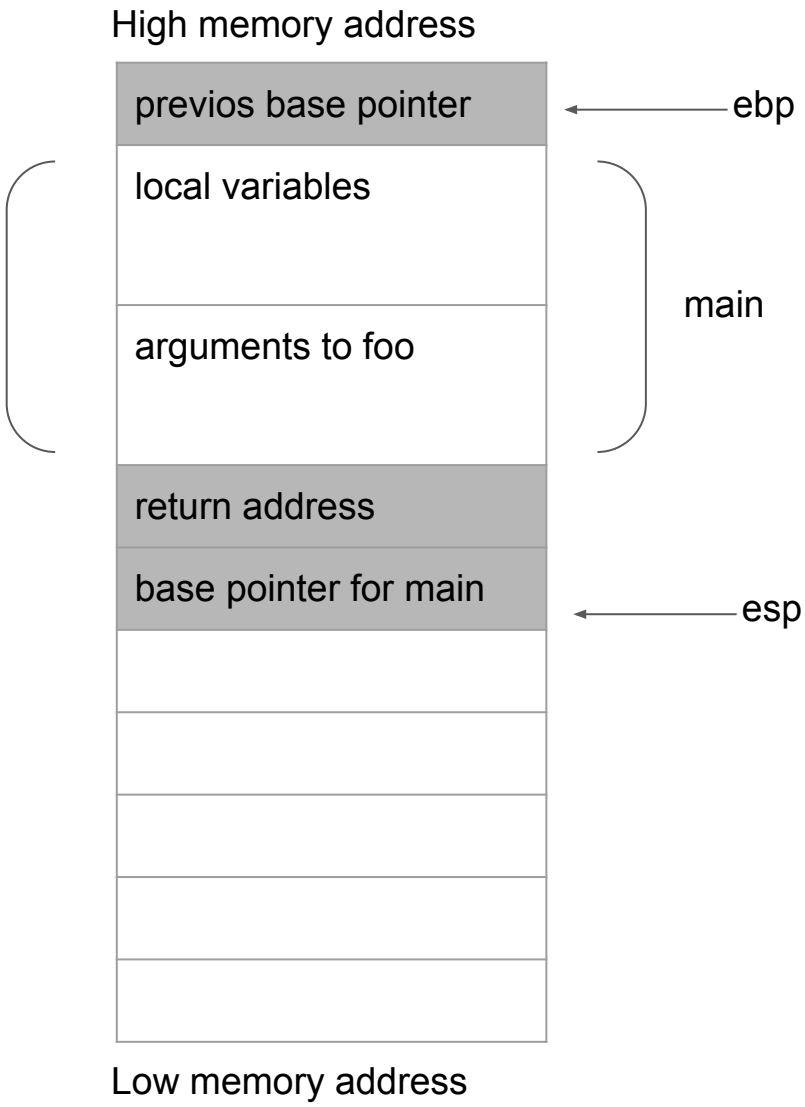
Stack Frame

example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo
3. Set up stack frame for foo

assembly:

```
call foo
...
foo:
push   ebp
```



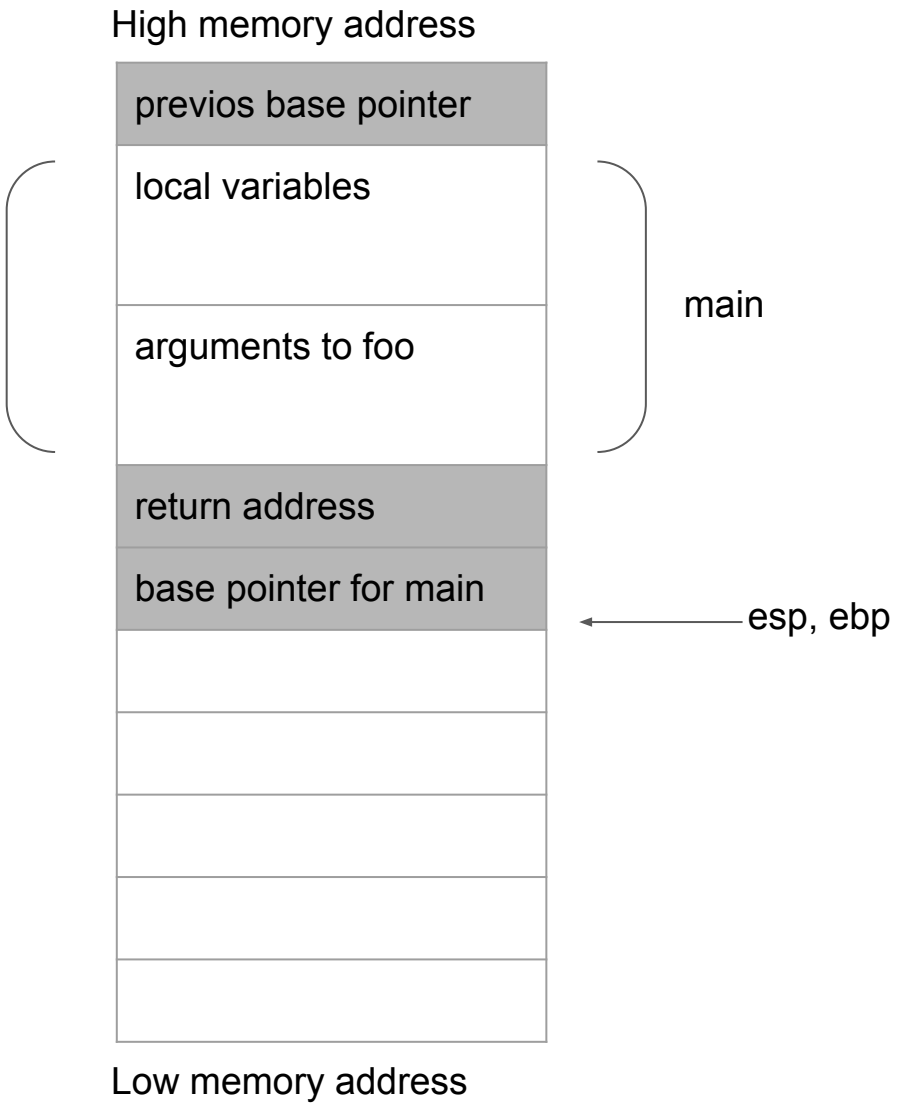
Stack Frame

example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo
3. Set up stack frame for foo

assembly:

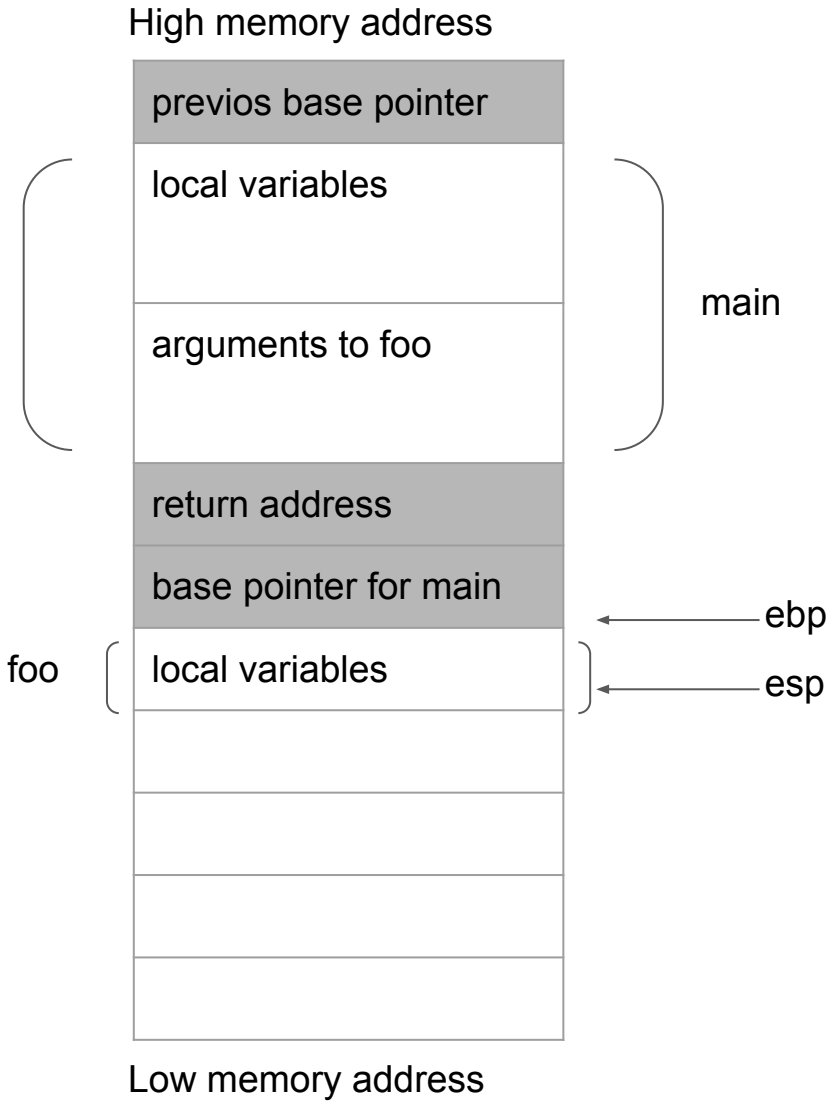
```
call foo
…
foo:
push   ebp
mov    ebp, esp
```



Stack Frame

example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo
3. Set up stack frame for foo
4. Do stuff in foo



Stack Frame

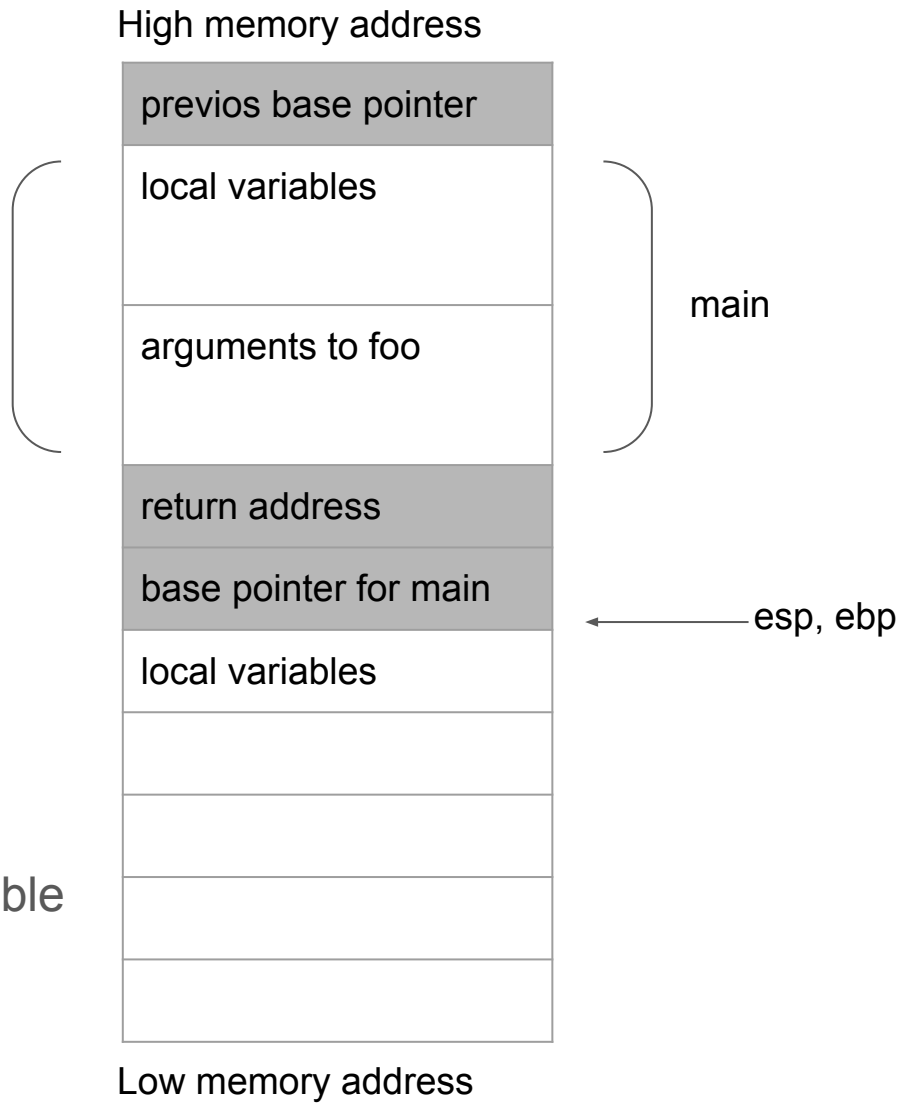
example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo
3. Set up stack frame for foo
4. Do stuff in foo
5. Return to main

assembly: `leave`

is equivalent to

`mov esp, ebp` ←delete all local variable
`pop ebp`



Stack Frame

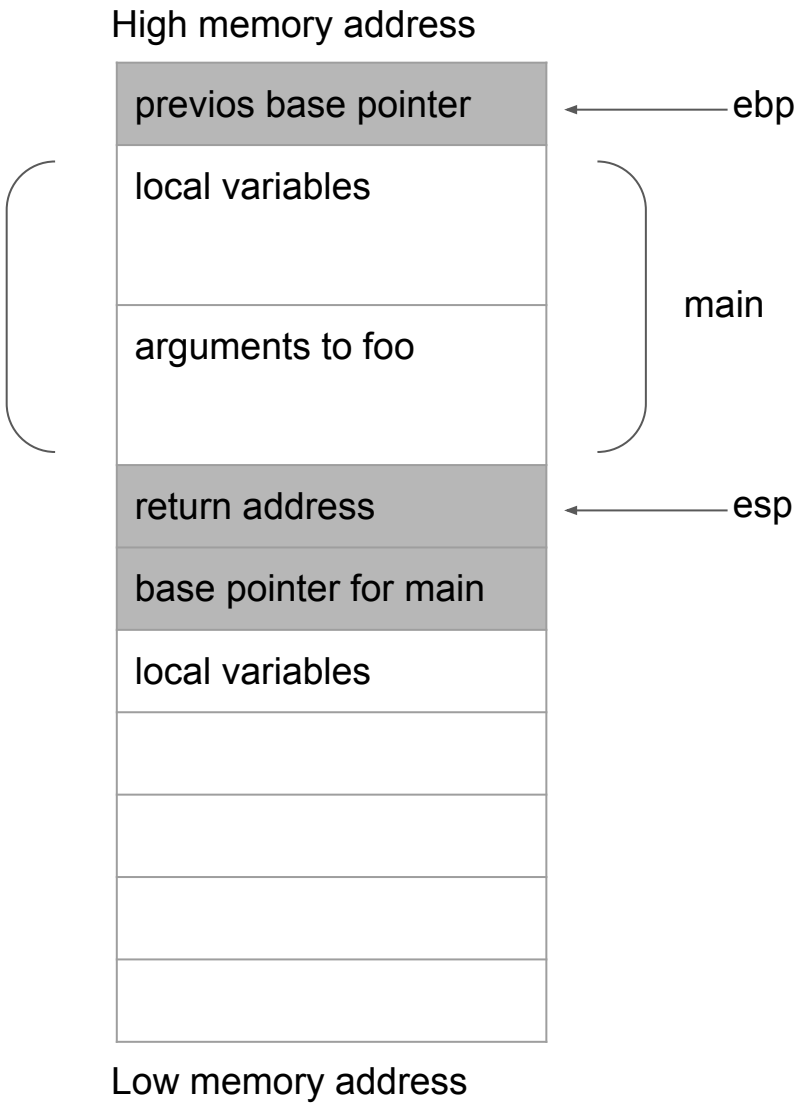
example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo
3. Set up stack frame for foo
4. Do stuff in foo
5. Return to main

assembly: `leave`

is equivalent to

```
mov esp, ebp
pop ebp ←
```



Stack Frame

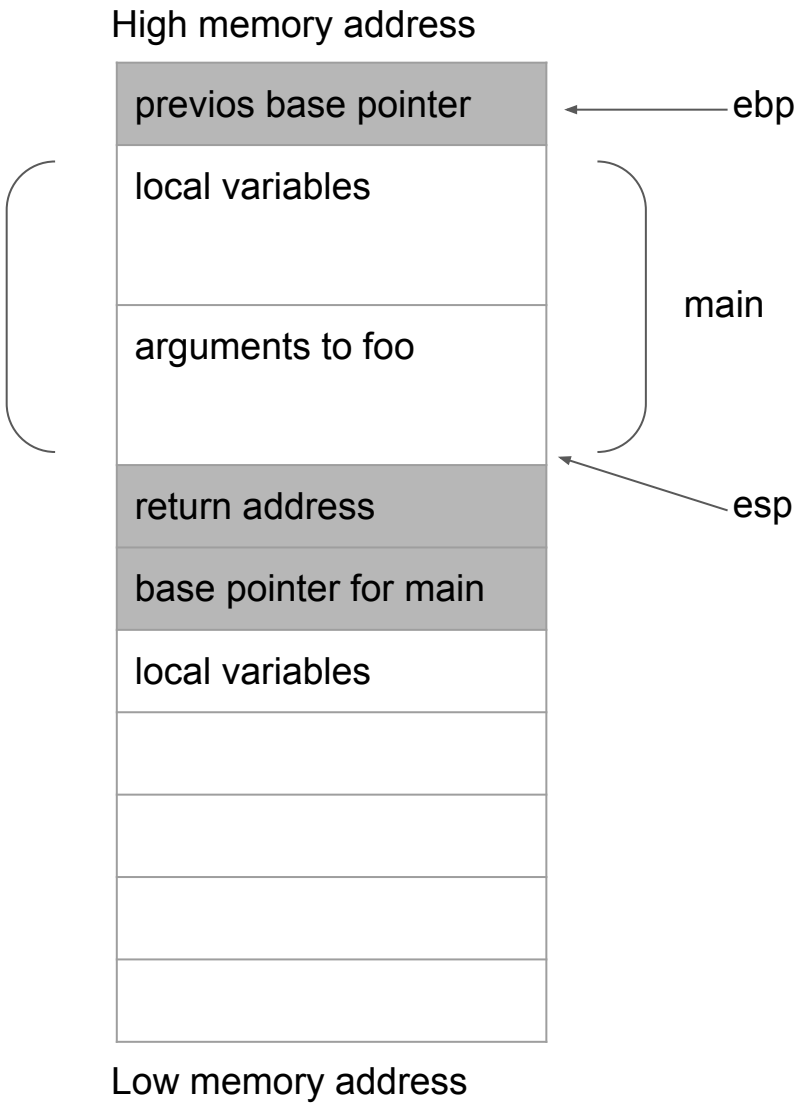
example: main calls foo

1. Do stuff in main
2. Set up arguments to call foo
3. Set up stack frame for foo
4. Do stuff in foo
5. Return to main

assembly: `ret`

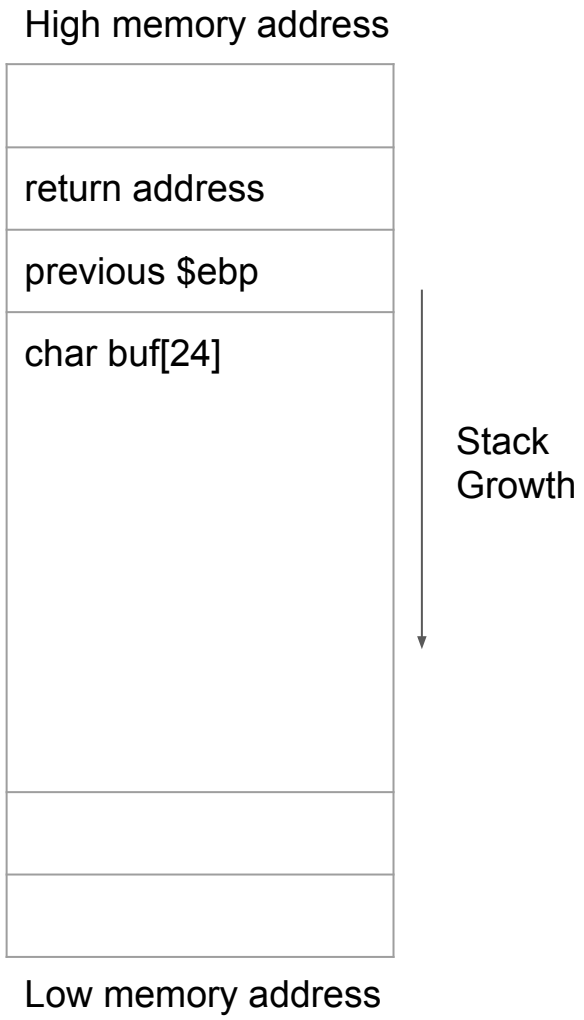
is equivalent to

`pop eip ←`



Buffer Overflow

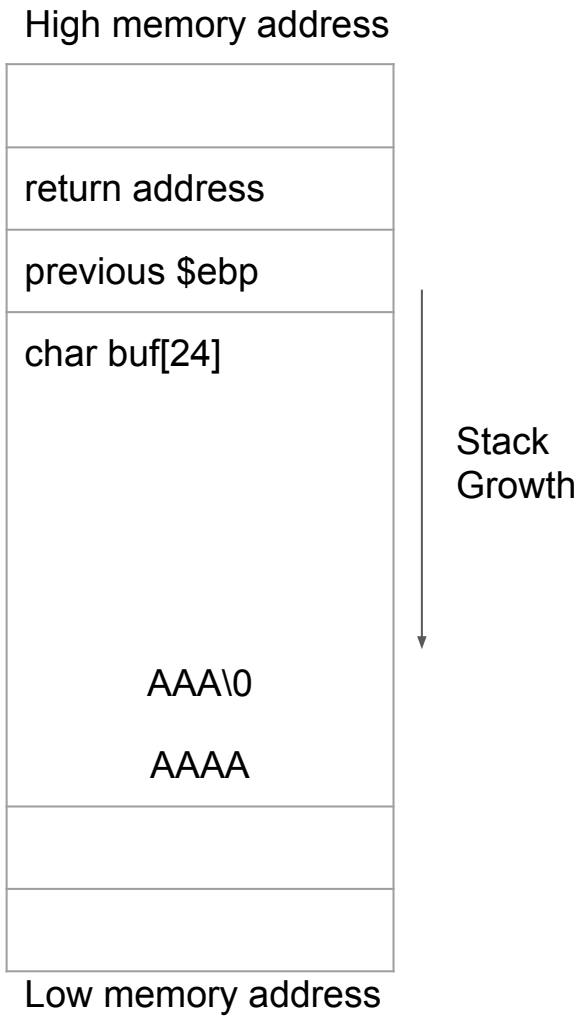
Overwrite the return address on the stack frame, to hijack the program control flow



Buffer Overflow

gets(buf);

input: AAAAAAA

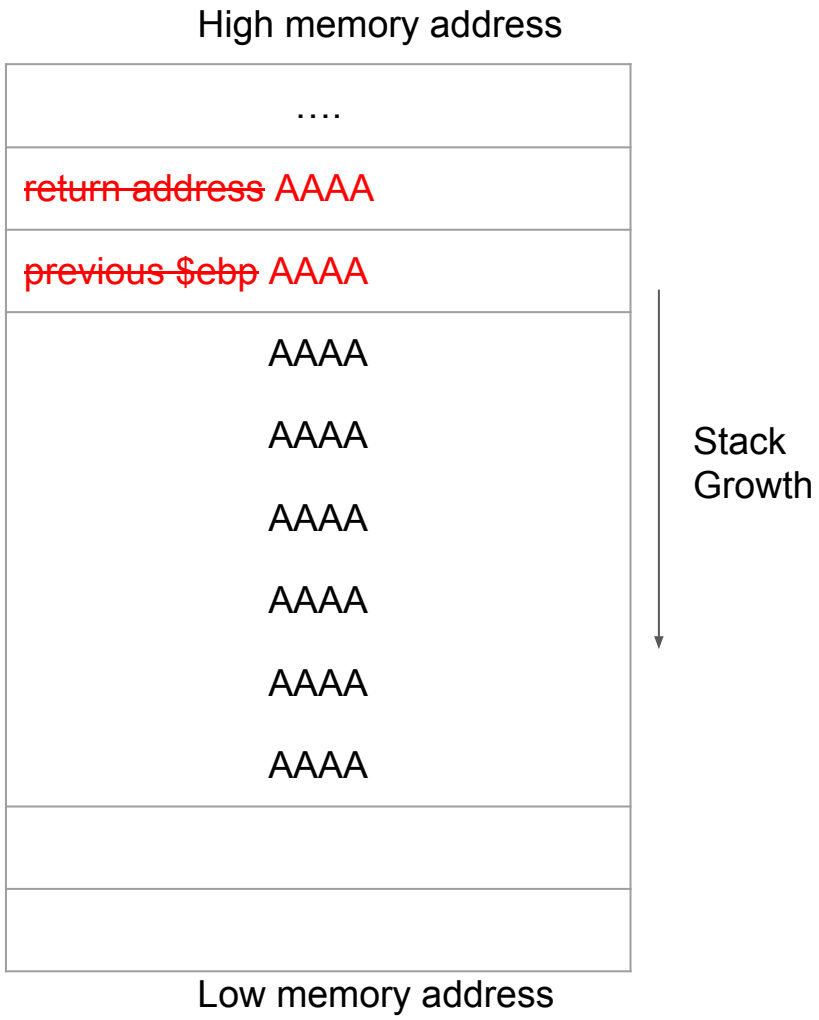


Buffer Overflow

gets(buf);

input: AAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAA….

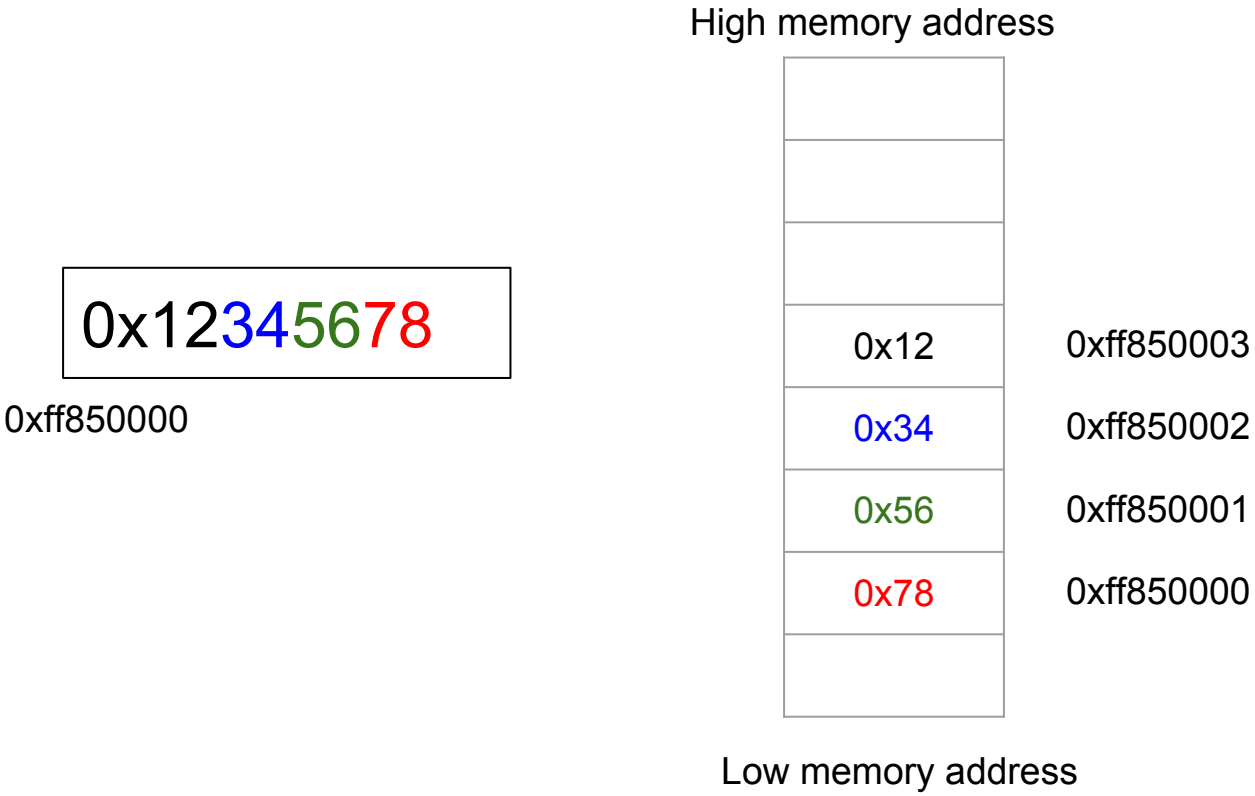
If you overwrite the original return address with the address of `magic()`, it will transfer control to `magic()` after this function return.



Endianness

Byte order for x86 is little endian

The least significant byte (LSB) value is at the lowest address. The other bytes follow in increasing order of significance.



Non-Printable Characters

Create non-printable string 0x08 0x04 0x88 0xe5

```
$ echo -ne [your malicious string]
```

```
$ echo -ne "\x08\x04\x88\xe5"
?[1m%
```

Save them into a file

```
$ echo -ne [your malicious string] > [filename]
```

```
$ echo -ne "\x08\x04\x88\xe5" > payload.txt
```

Check the content in the file

```
$ xxd [filename]
```

```
$ xxd payload.txt
00000000: 0804 88e5                                ....
```

Send payload to remote server

Connect to your target machine

$ nc -q -2 140.113.194.66 [your port nuber]

e.g.

$ nc -q -2 140.113.194.66 12345

Connect and send your payload in a file to the target machine

$ nc -q -2 140.113.194.66 [your port nuber] < [filename]

e.g.

$ nc -q -2 140.113.194.66 12345 < payload.txt

```
$ nc -q -2 140.113.194.66 12345 < payload.txt
FLAG{this is a fake flag}
```

More Info

X86 Assembly
http://www.ibiblio.org/gferg/ldp/GCC-Inline-Assembly-HOWTO.html#s3
https://en.wikibooks.org/wiki/X86_Assembly/GAS_Syntax

GDB
http://csapp.cs.cmu.edu/2e/docs/gdbnotes-ia32.pdf
https://beej.us/guide/bggdb/

You are free to use any other tools.

GET STARTED EARLY!