Low level attacks
Assembly (part 2)

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Stack instructions

- `push operand`
- `pop address/register`
- Used for local variables
- Used to create cached copies
- Used for passing arguments to procedures

Load effective address

- Use `lea register, memory` to load a memory address into a register

Alert!

The use of square brackets in this case does not dereference!

Example

- `lea edi, [ebx+4*esi]`
- `lea eax, [var]`

Loops

- Conditional jumps can be used for implementing loops

```
MOV     CL, 10
L1:
<LOOP-BODY>
DEC     CL
JNZ     L1
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- Alternatively, `loop label` can be used
- It decrements ECX and jumps to `label` if not zero

```
mov ECX,10
l1:
<loop body>
loop l1
```

Example

Try `loops.asm`

Subroutines

- Subroutines are identified by labels
- Subroutines are called by `call label`
  - Pushes EIP into the stack, and jumps to `label`
- Each subroutine terminates with `ret`
  - Pops an address from the stack, and jumps to it

Example

Try `subroutine.asm`

Calling convention

- How to share subroutines?
- We must agree on some strategy to pass paramenters
- Several conventions do exist
- We will consider the C/C++ convention
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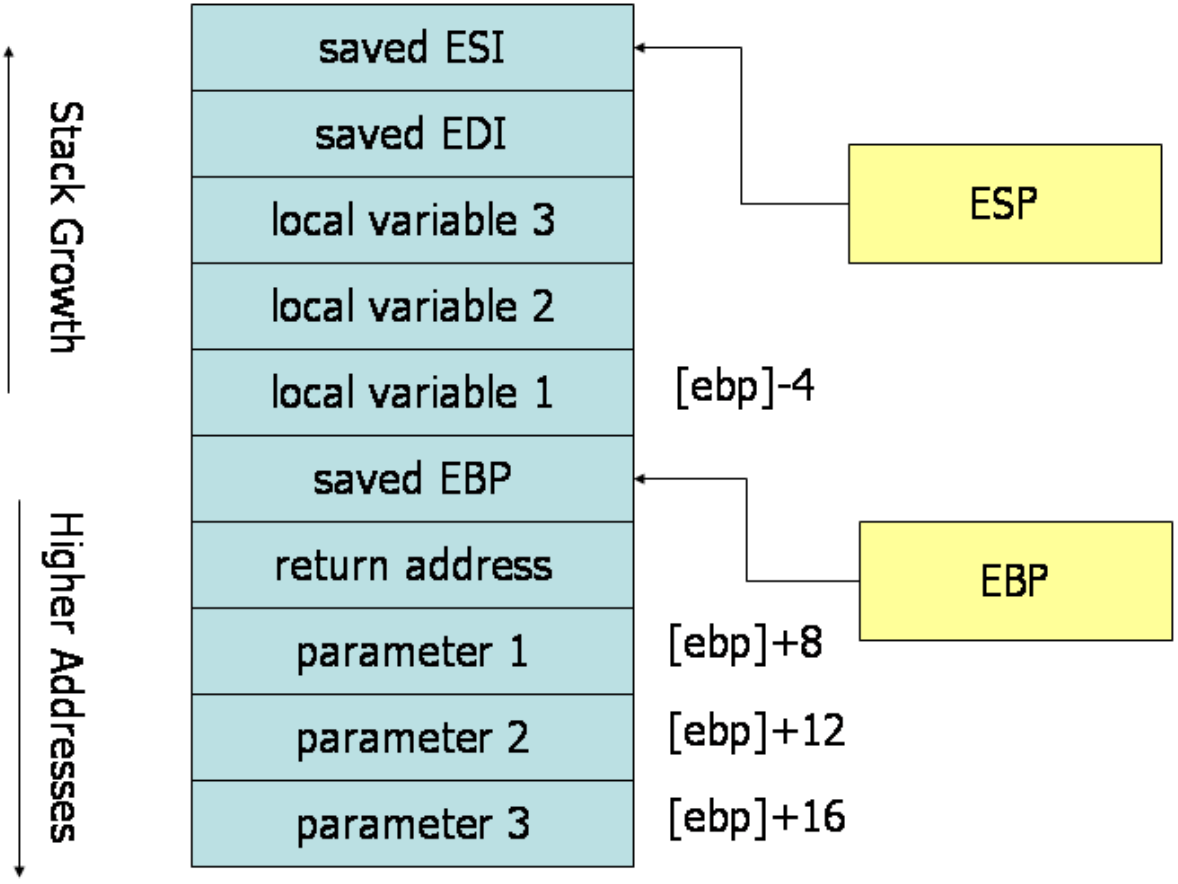
Two sets of rules

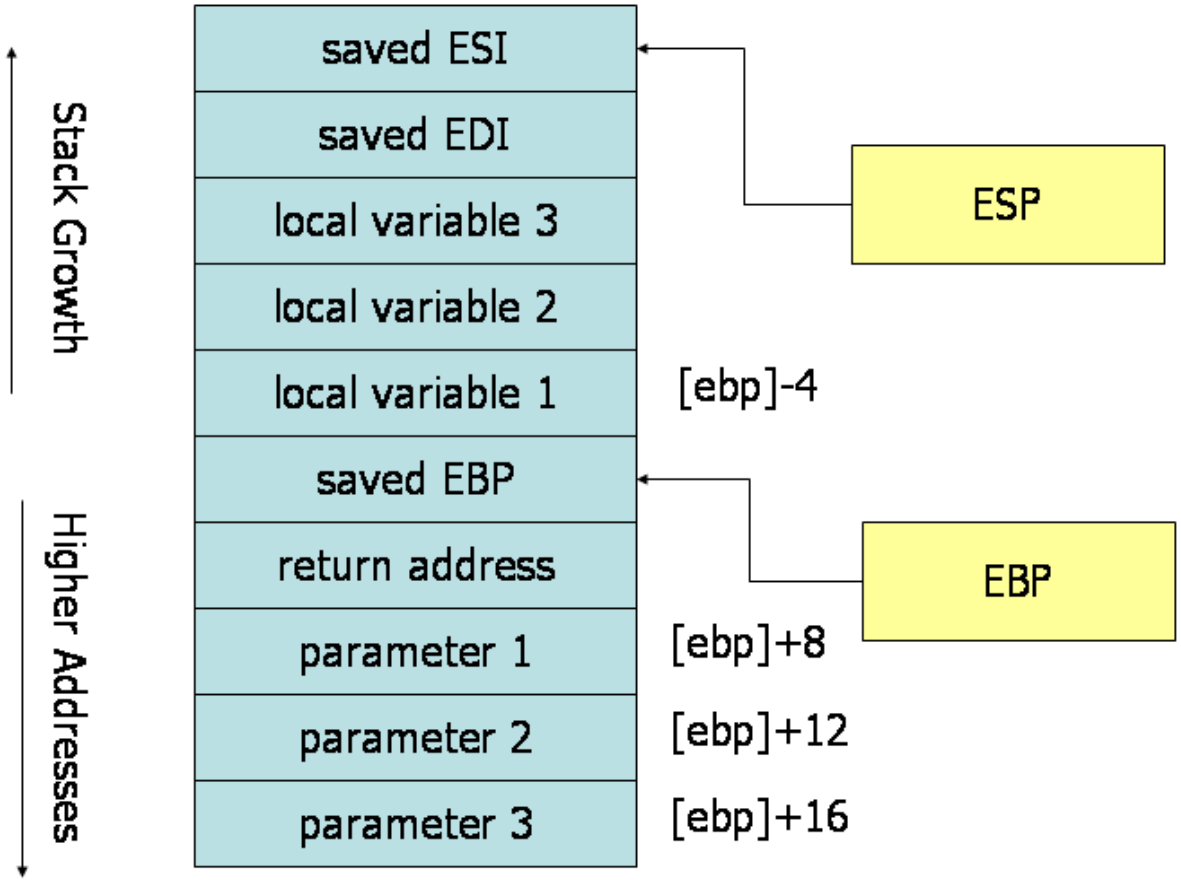
1. The first set is for the caller
2. The second set is for the callee

Caller rules



1. Push *caller-saved* registers: EAX, ECX, EDX
2. Push arguments in reverse order (allow varadics)
3. Use the `call` instruction (push return address, and jump)
4. Remove parameters from the stack (add their size to ESP)
5. Restore caller-saved registers (pop them from the stack)

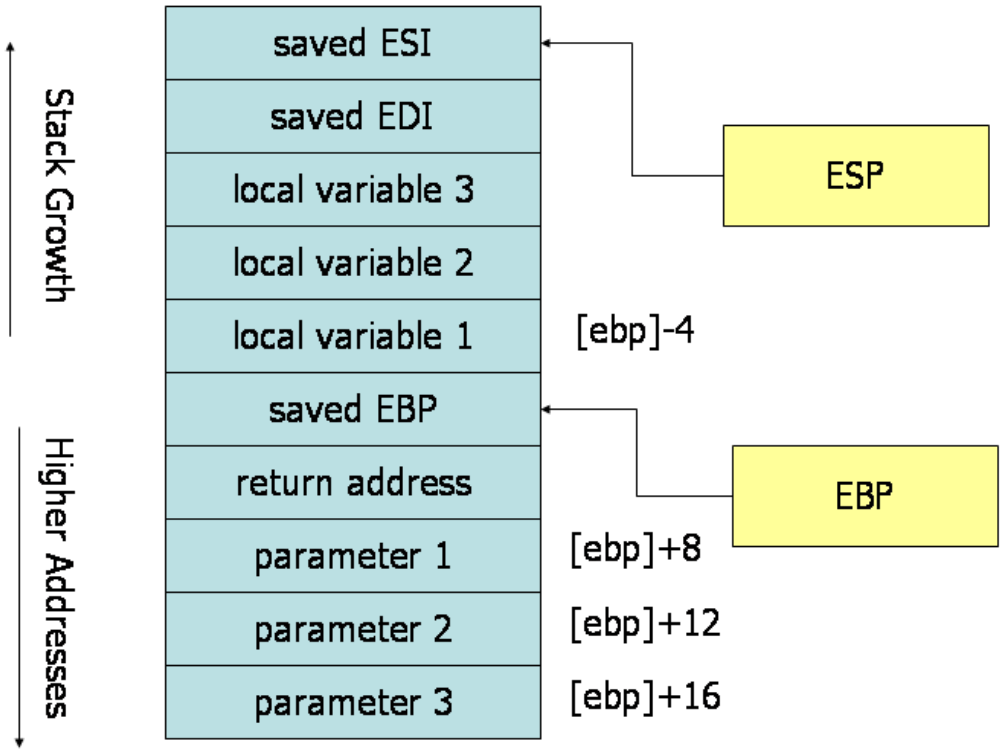
Callee rules (1)



Subroutine Prologue

1. Push EBP, and then copy ESP into EBP
   - All parameters are in EBP-offset
2. Allocate local variables in the stack
   - Subtract their size from ESP
   - All local variables are in EBP+offset
3. Push *callee-saved* registers: EBX, EDI, ESI

Callee rules (2)



Subroutine Epilogue

1. Leave the return value in EAX
2. Restore callee-saved registers (pop them)
3. Deallocate local variables
   - Add their size to ESP
   - Better alternative, copy EBP into ESP
4. Restore the previous EBP (pop it)
5. Return to the caller by executing `ret`

Callee rules (3)

Instruction `leave` is equivalent to

- `mov esp, ebp`
- `pop ebp`

It is a shortcut for 3 and 4 in the previous slide.

Example

Try `convention.asm`

Integration with the C/C++ libraries

- Declare used functions: `extern printf`
- The entry point is the function `main`
- Use everything we just learned about assembly!

Example

Write and read

- Use `printf` to write in STDOUT
- Use `scanf` to read from STDIN
- Let's have a look at `printf.asm` and `scanf.asm`

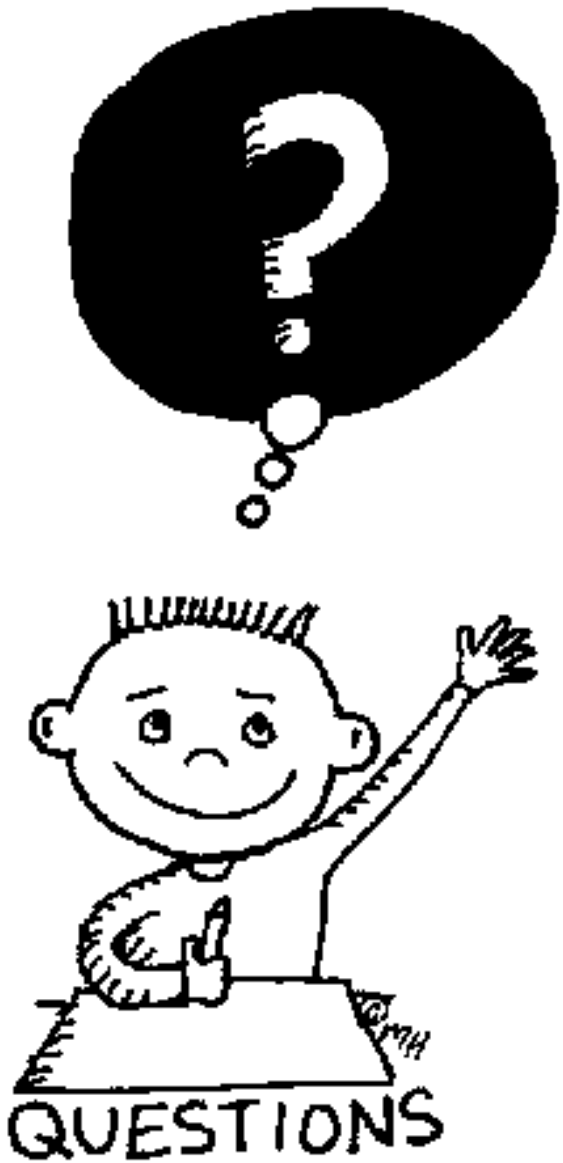
Exercises

Read a sequence of positive integers terminated by -1, and

1. Print the maximum number of the sequence
2. Print the sum of all numbers
3. Print the sum of all even numbers
4. Print the size of the largest subsequence of even numbers

Read a sequence of N integers (N read from STDIN), and

5. Print 1 if the sequence is a palindrome, otherwise print 0
6. Print the most frequent number
7. Print the less frequent number



END OF THE LECTURE