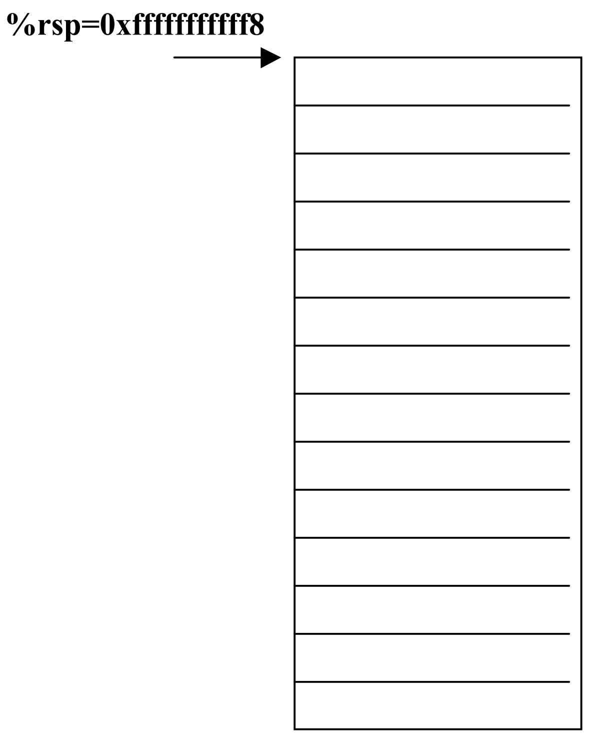
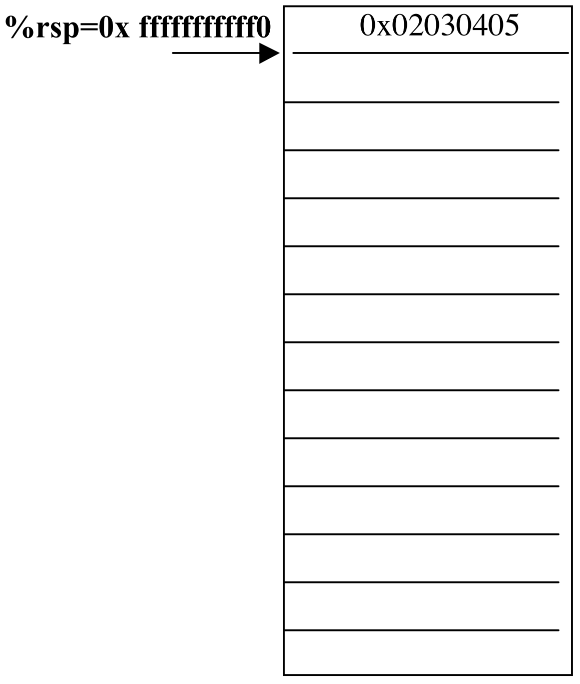
# Laboratory 9 Notes
# X86 Stack

- Certain instructions implicitly modify the stack pointer (**push**, **pop, call, ret**)
- %rsp (*stack pointer)* always holds a pointer into the current stack frame

**push** *src*

1. Make space on the stack by decrementing %rsp:
   %rsp ← %rsp – 8
2. Move *src* to the stack:
   (%rsp) ← src

| **Initial state of the stack** | **Push** a word-size value in %rax on the stack (decrement %rsp and move Src to (%rsp) |
|---|---|
|  | (assume %rax = 0x0000000002030405) **push %rax**  |

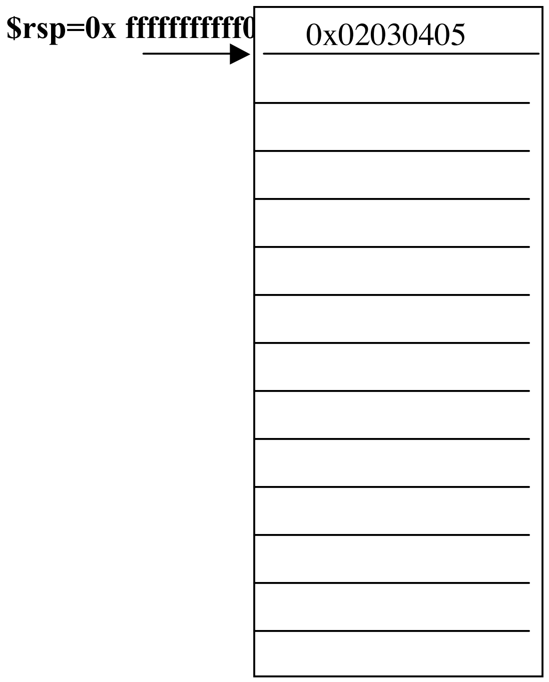
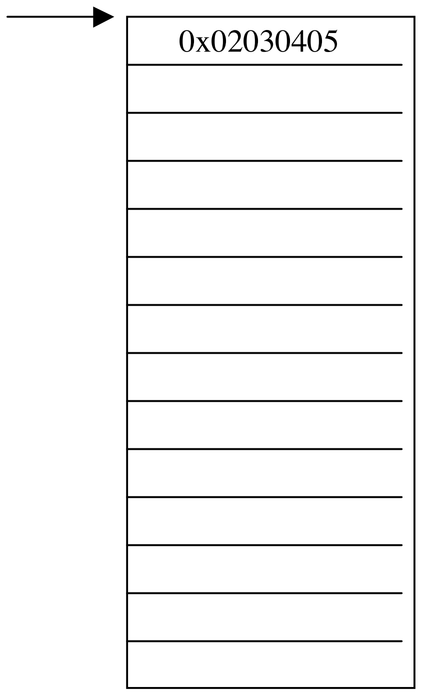
**pop** *dest*

1. Move contents of top of stack to the *dest*

   dest ← (%rsp)

2. Release space on the stack by incrementing %rsp.

   %rsp ← %rsp + 8

| **Initial State of Stack** | **Pop** a word-size value from the stack.<br><br>Pop %rbx<br><br>(%rbx gets 0x0000000002030405)<br><br>**$rsp=0x ffffffffff8** |
|---|---|
|  |  |

**call** *function* 1. Pushes the *return address* on stack (return address is the address of the instruction *following* the function call)

%rsp ← %rsp - 8
(%rsp) ← %rip (already updated for next instruction)

2. Puts the starting address of the *function* in %rip:

%rip ← starting address of *function*

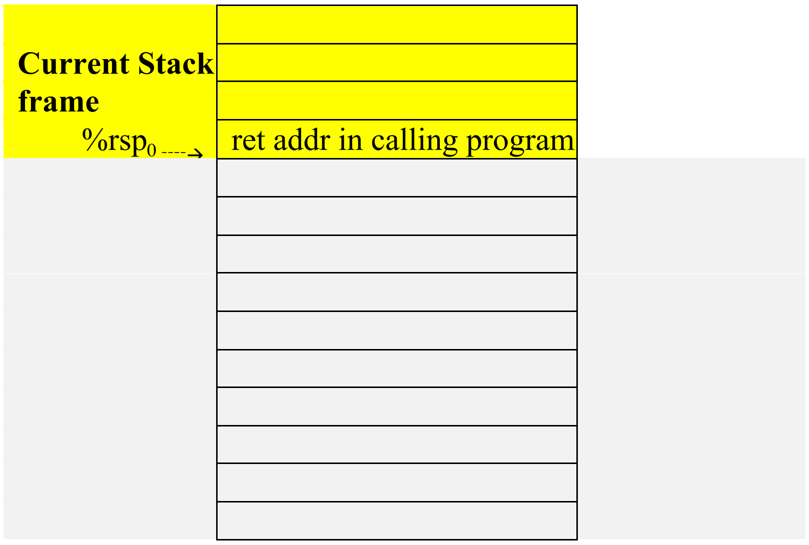
**ret** 1. Pops the return address from the top of the stack into %rip (to resume execution of the *calling* function).

%rip ← (%rsp)
%rsp ← %rsp + 8

## Conventions for drawing stack diagrams

To record the contents of the stack to understand how the stack is used, using the following notation:

- We use the model of memory where the stack has low addresses at the bottom and high at the top. Each row in the stack represents a word. The initial **%rsp** with a subscript of **0** is pointing to the top of the current stack frame



- Trace the effect on the stack of executing each instruction in the program by moving the position of the **%rsp** when it changes, (incrementing the subscript for each new value), and by recording new values on the stack as they are stored there.

- When the stack starts to empty, continue with the same notation, except use the right hand side of the stack diagram to indicate the changes.

- Also record changes to relevant registers.