Laboratory 7 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

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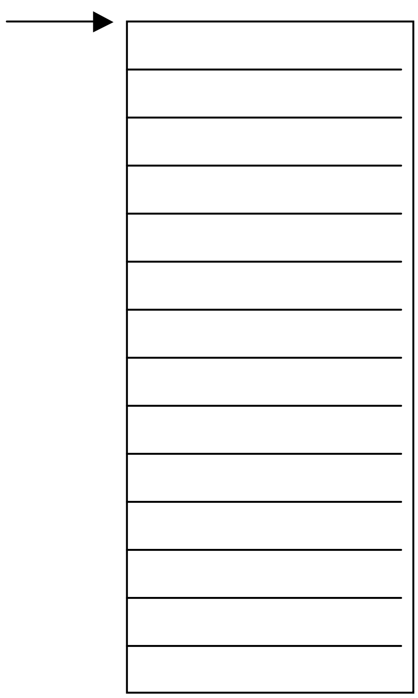
Initial state of the stack

%rsp=0xffffffffff8



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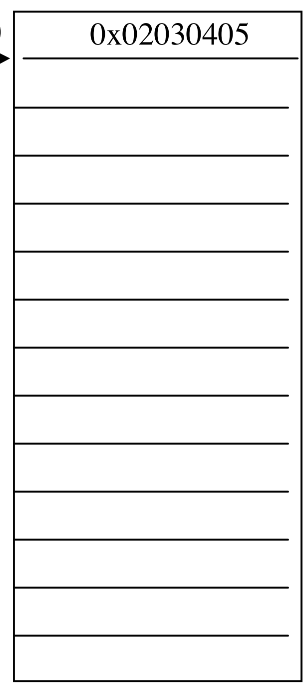
Push a word-size value in %rax on the stack (decrement %rsp and move Src to (%rsp)

(assume %rax = 0x0000000002030405)

push %rax

%rsp=0x ffffffffff0



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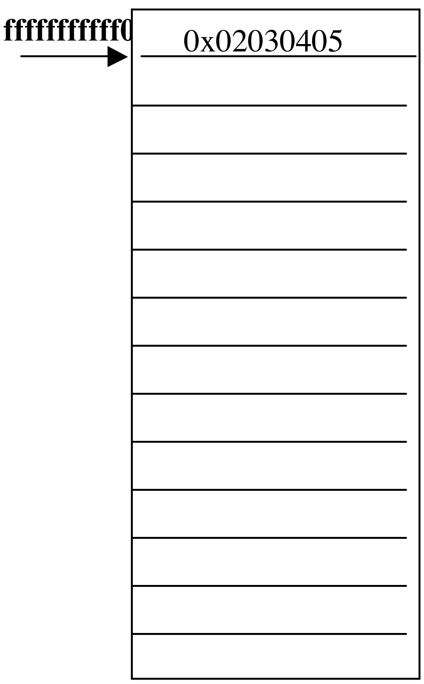
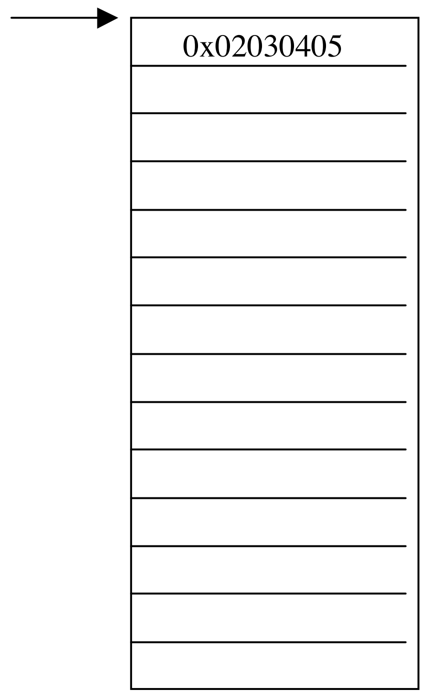
pop *dest*

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.
$rsp=0x ffffffffff0 	Pop %rbx (%rbx gets 0x0000000002030405) **$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).

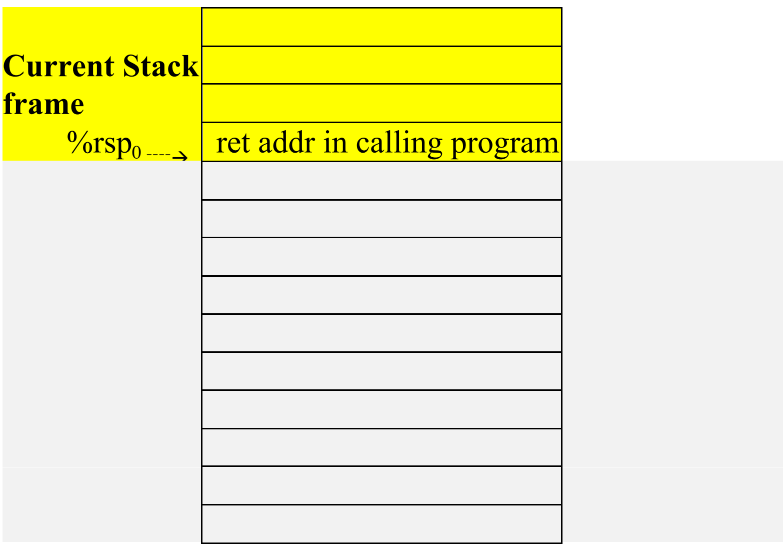
%rip ← (%rsp)

%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.