CMSC 430, March 3rd 2020

Hustle

Stacks

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- One thing I was trying to get across, but may have failed:
  - There are many ways to use stacks to store temporaries!
  - Only thing that matters: that it works.

Stacks: Part 1

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- In AMD64, there are two registers normally used for the stack:
  - **`rsp`** and **`rbp`**
- Importantly, these registers are not special!
  - In fact, in the architecture specification they are explicitely called out as *general purpose*

Stacks: Part 2

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- The idea behind having two:
  - The stack pointer points to the "top" of the stack
  - The base pointer points to the "bottom" of the stack
- The ’distance’ between the determines how many things are currently on the stack.

Stacks: Part 3

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- Let’s take a look:

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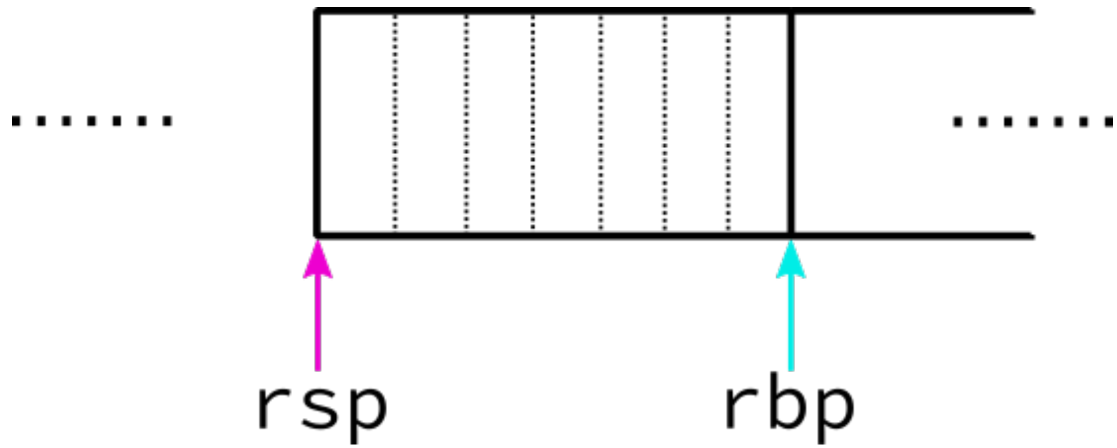

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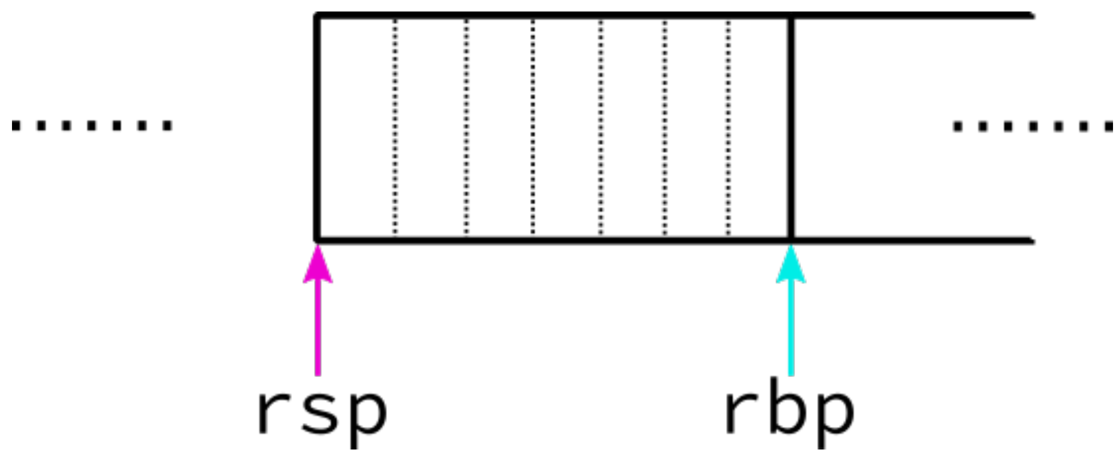

- Even with both **rsp** and **rbp** we have to keep track of things

Stacks: Part 4

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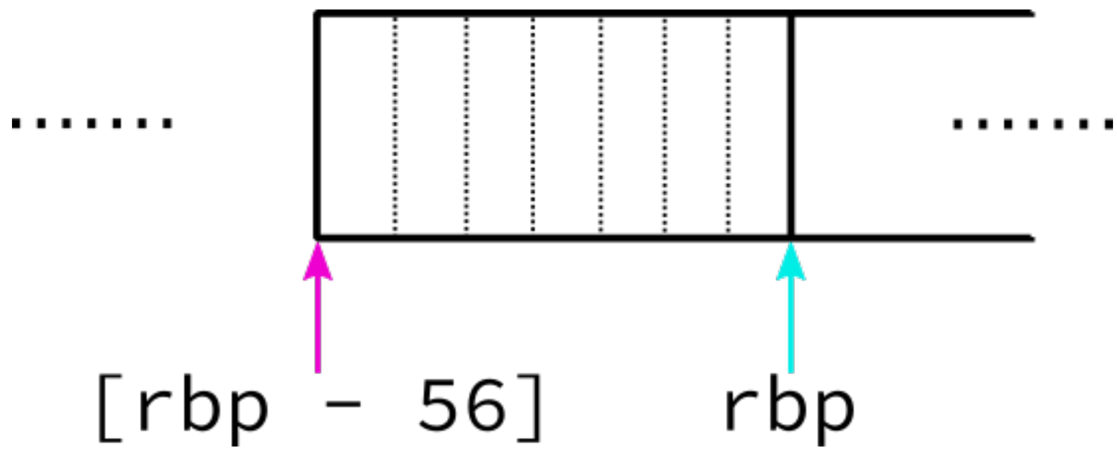

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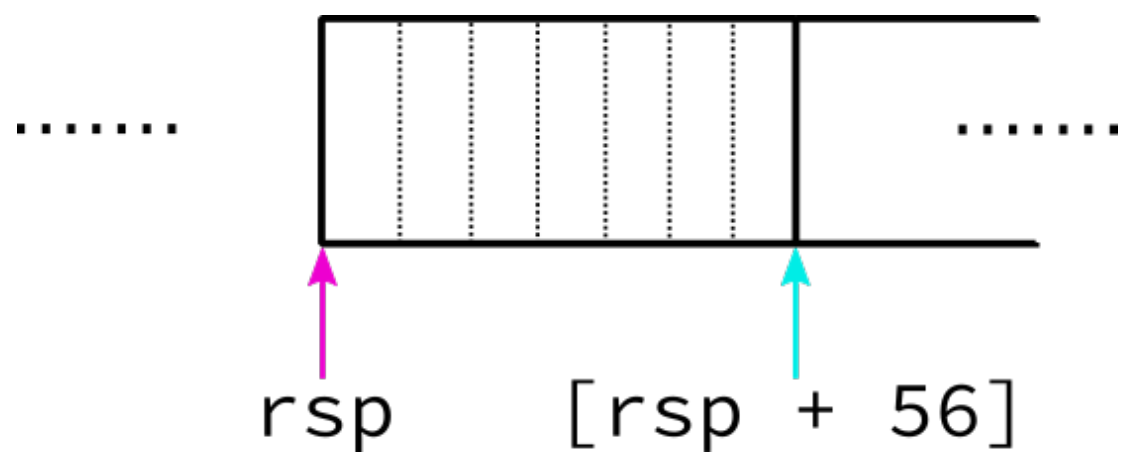

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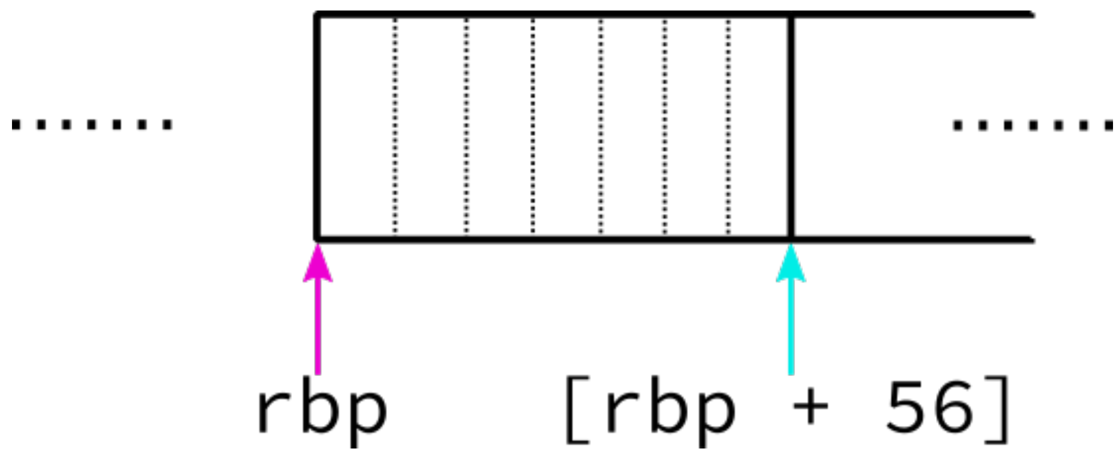

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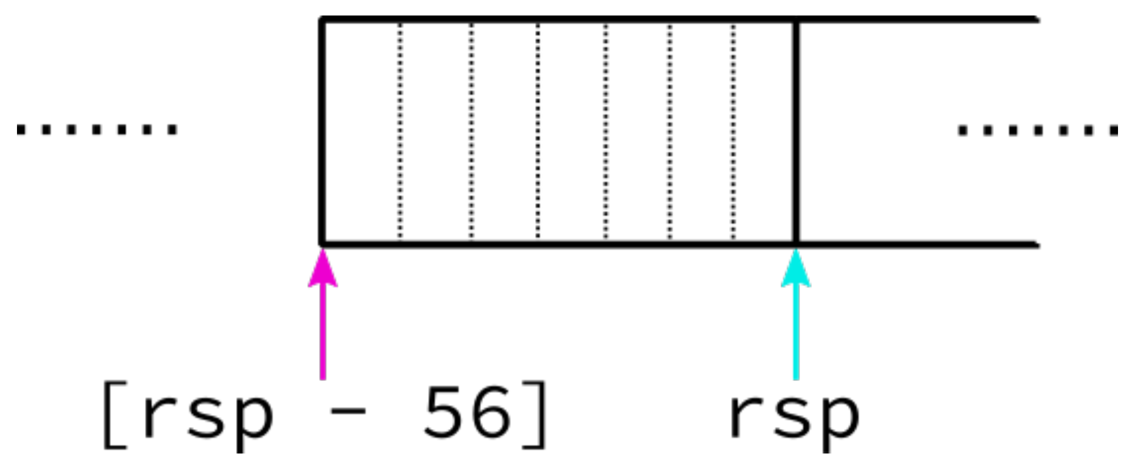

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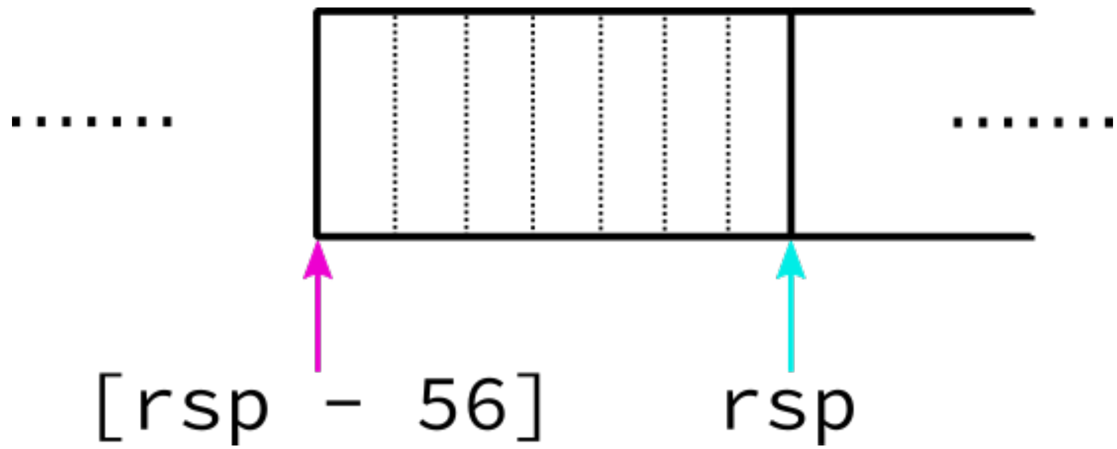

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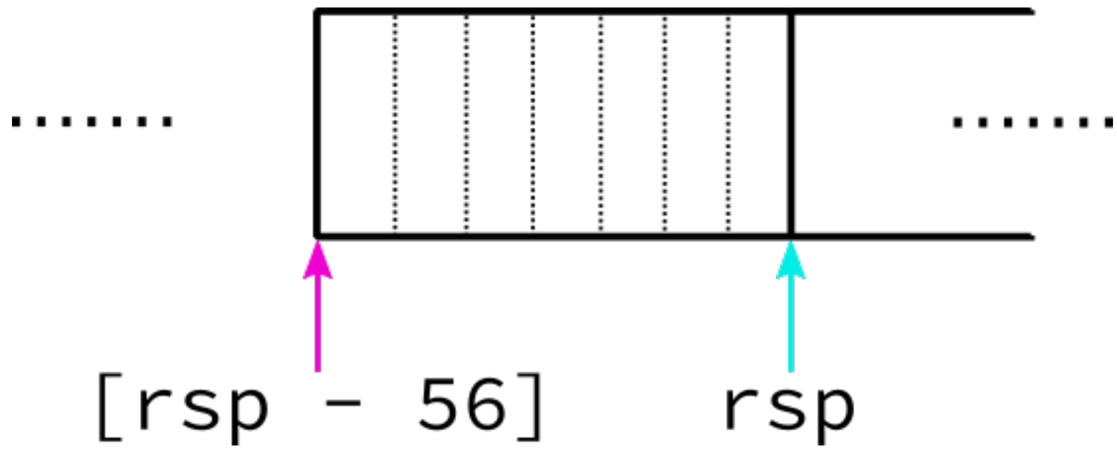

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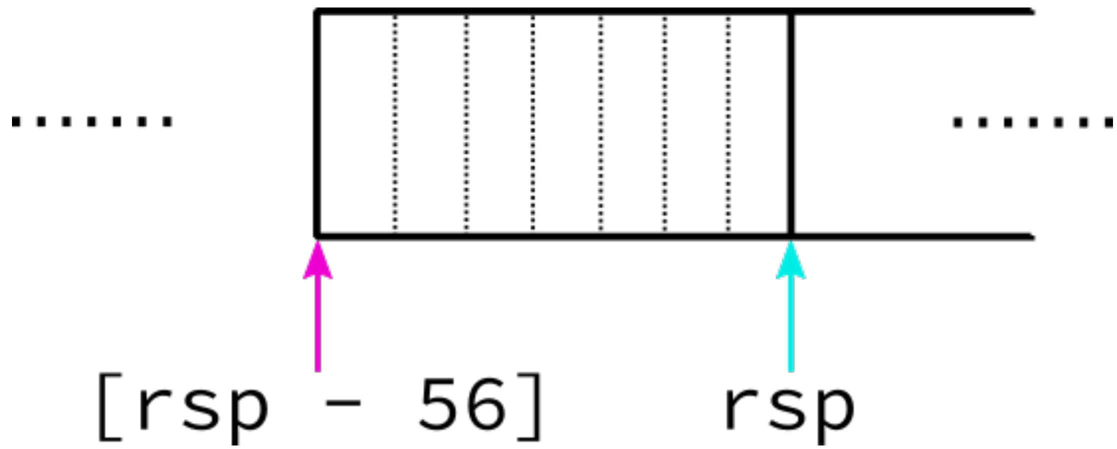

- Why not use **rbp**?
    - Because **rbp** is special to C
    - :(

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- Today is an RTS day.
  - Which is also a compiler day, to take advantage of our new RTS!

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- We will use the heap to implement *boxed values*

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    - Box = not on the stack
- In general, boxed values are things you need to derefence a pointer to get.
- But not all things that you need to dereference a pointer are 'boxed'

Boxing Day

```
racket> ; show box and unbox
```

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  - **cons**

Getting Box/Car on track

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- Goal for today:
- Understand how things like **box** and **cons** are implemented

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  - v = ... | (box v) | (cons v v) | ’()

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- Idea:
  - Make distinction between flat and boxed values
  - Then make distinctions between the flat (immediate) and boxed values

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- Moving on.

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```
(define imm-shift        1)
(define imm-type-mask    (sub1 (shift 1 imm-shift)))
(define imm-type-int     0)
(define imm-val-true     3)
(define imm-val-false    1)
```

From grifters to hustlers

- Which becomes:

```
(define result-shift     3)
(define result-type-mask (sub1 (shift 1 result-shift))
(define type-imm         0)
(define type-box         1)
(define type-pair        2)
```

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- We need more in order to disambiguate the values

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(define type-imm         0)
(define type-box         1)
(define type-pair        2)
(define imm-shift         (+ 3 result-shift))
(define imm-type-mask     (sub1 (shift 1 imm-shift)))
(define imm-type-int      (shift 0 result-shift))
(define imm-val-true     (shift 1 result-shift))
(define imm-val-false    (shift 2 result-shift))
(define imm-val-empty    (shift 3 result-shift))
```

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```
MOV RAX, [RDI]
MOV RAX, [RDI + 8]
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- we call this **`offset`**

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- someone asked about how many ’lets’ we can have:
- run the following at your terminal
    - **`ulimit -a`**
- If I did my math right (always questionable), we should be able to store ~1 million let-bound variables.

Let’s write it!