Worksheet 8A

Quiz 1: *Definition: Function Body and Closure Vector*

Fill in the assembly for the *function body* and *closure vector* for `(fn (x) (+ x one))` where `one` is a free variable.

Function Body

```
jmp fun_finish_#lambda_0
fun_start_#lambda_0:
; setup
push rbp
mov rbp, rsp
sub rsp, 8*3

; load free variables ... from where?

_____

_____

_____

_____
; <(+ x one)>
_____

_____
; teardown
mov rsp, rbp
pop rbp
ret
fun_finish_#lambda_0:
```

Closure Vector (arity, label, num-free, free-values)

```
; write arity
_____

_____
; write label
_____

_____

; write number of free vars (why?)
_____

_____

; write free vars
_____

_____

; bump r11 and set/tag rax
mov rax, r11

add r11, _____ ; how much?

add rax, 5
```

Quiz 2: *Call using Closure*

Fill in the assembly for the call `(inc 99)` where `inc` is a closure.

```
_____ ; push the args

_____

_____ ; load the closure pointer

_____ ; check tag & arity & strip tag

_____

_____ ; get call-target

_____ ; push "closure" as first arg!

_____

_____ ; call!

_____
```

Quiz 3: *Free Variables*

Fill in the definition of `free` which computes the free variables of an expression.

```
fn free(e: &Expr) -> im::HashSet<String> {
  match e {
    Num(_) | True | False | Input | Nil =>
      ____________________________________

    Add1(e) | Sub1(e) | Neg(e)
    | Loop(e) | Break(e) | Print(e) | Get(e, _) =>
      ____________________________________

    Call1(x, e) | Set(x, e) =>
      ____________________________________

    If(e1, e2, e3) =>
      ____________________________________

    Bin(_, e1, e2) | Vec(e1, e2) =>
      ____________________________________

    Call2(f, e1, e2) =>
      ____________________________________

    Block(es) =>
      ____________________________________

    Var(x) =>
      ____________________________________

    Let(x, e1, e2) =>
      ____________________________________

    Defn(defn) =>
      ____________________________________
      ____________________________________
}
```

Quiz 4: *Your turn!*

What is something you found confusing in today's lecture (or earlier)?