Meeting 17: Functions

Today
- Heapify
  Go over Epilogue in HW 4
  Go over Quiz 4

Quiz 4: 7.45 mean, 7.75 median, 0.35 stddev
HW 4: 7.11 mean, 7. median, 3.54 stddev

Midterm next Thu.
- Evening 7:30-9:30 pm
  7:45 pm - 9:45 pm

Shift HW 6 1 week

```python
x = 0
def f(y):
    return x + y
x = 2
print(f(40))
```

```python
def Bob(fvars, y):
    x = fvars[0]
    return x + y
f = create_closure(Bob, [x])
x = 2
print(getfunptr(f)(getfvars(f), 40))
```

```python
x = [1]
def f(y):
    return x[0] + y
x = [0]
print(f(40))
```
What variables to heapify?

Looking at scope 2

\[ x = l - 1 \]

\[ x \text{ is free!} \]

Compiler function

\[ \text{free vars}(P) \]

- after heapification additions
Computing Free Vars

\[\lambda z : \gamma = \text{return } x + y + z\]

Free: \([x, y, z]\]

Free: \([x, y, z]\]

Pass \(\text{fv}(e)\)

Base case: \(\text{Name}(x) \rightarrow \text{set}([x])\)

"Pass Through Cases": Addl \((e_1, e_2)\)

\(\Downarrow\)

\(f_1 = \text{fv}(e_1)\)

\(f_2 = \text{fv}(e_2)\)

return \(f_1 \cup f_2\)

"Interesting Case": Lambda

\[\text{helper func}\]

\(p_1, \ldots, p_n\) parameters

\(l_1, \ldots, l_m\) locals

\(e\) body

\(fve = \text{fv}(e)\)

return \(fve - \{l_1, \ldots, l_m\}\)
Staging

0. $P_1$ compiler

1. $P_1 +$ closed functions
   - No Heapify Pass
   - All Env. are C3
   - Need: Closure Conversion

2. $P_1 +$ heapify all variables

\[ x = 1 \]
\[ y = x \]
\[ \Rightarrow \]
\[ x = \{ -1 \} \]
\[ y = \{ 2 \} \]
\[ x[0] = 1 \]
\[ y^{103} = 0 \]

3. $P_1 +$ real heapify - heapify from
   - notes

Bonus: $P_1 +$ super optimized heapify