

Practice Mid-Term Exam 1

CS 6510, Spring 2016

February 10

Instructions: You have eighty minutes to complete this open-book, open-note, closed-interpreter exam.

1) [100 pts] The following expression is evaluated using the `lambda.rkt` interpreter:

```
{let {[g {lambda {x} {lambda {y} {+ y x}}]}}
  {let {[x 13]}
    {let {[f {g 6}]}
      {f x}}}}
```

(**Note:** the actual exam will use either `lambda.rkt` or `store-with.rkt`.) Describe a trace of the evaluation in terms of arguments to an `interp` function for every call; there will be 15 calls. The `interp` function takes two arguments — an expression and an environment — so show both for each call. For each number, variable, and `lambda` expression, show the result value, which is immediate. To simplify your job, you do not need to show results for other expressions, but you can show results if you prefer. Use the following abbreviations to save time:

```
X0 = the whole expression
X1 = {lambda {x} {lambda {y} {+ y x}}}
X2 = {let {[x 13]} {let {[f {g 6}]} {f x}}}
X3 = {let {[f {g 6}]} {f x}}
```

Answers

4) [100 pts]

Using X_i as a shorthand for (parse 'X_i):

```
expr =  $X_0$ 
env  = mt-env

expr =  $X_1$ 
env  = mt-env
result = (closV 'x  $\{\text{lambda } \{y\} \{+ y x\}\}$  mt-env) =  $C_1$ 

expr =  $X_2$ 
env  = (extend-env (bind 'g  $C_1$ ) mt-env) =  $E_1$ 

expr =  $13$ 
env  =  $E_1$ 
result = (numV 13)

expr =  $X_3$ 
env  = (extend-env (bind 'x (numV 13))  $E_1$ ) =  $E_2$ 

expr =  $\{g\ 6\}$ 
env  =  $E_2$ 

expr =  $g$ 
env  =  $E_2$ 
result =  $C_1$ 

expr =  $6$ 
env  =  $E_2$ 
result = (numV 6)

expr =  $\{\text{lambda } \{y\} \{+ y x\}\}$ 
env  = (extend-env (bind 'x (numV 6)) mt-env) =  $E_3$ 
result = (closV 'y  $\{+ y x\}$   $E_3$ ) =  $C_2$ 

expr =  $\{f\ x\}$ 
env  = (extend-env (bind 'f  $C_2$ )  $E_2$ ) =  $E_4$ 

expr =  $f$ 
env  =  $E_4$ 
result =  $C_2$ 

expr =  $x$ 
env  =  $E_4$ 
result = (numV 13)
```

expr = $\boxed{\{+ y x\}}$
env = $(\text{extend-env } (\text{bind 'y } (\text{numV } 13)) E_3) = E_5$

expr = \boxed{y}
env = E_5
result = $(\text{numV } 13)$

expr = \boxed{x}
env = E_5
result = $(\text{numV } 6)$