

# CSCI-400: Lambda Calculus Homework

Name: \_\_\_\_\_ CWID: \_\_\_\_\_

- A **printed** copy is due in class on Thursday, October 18.
  - Handwritten or typed answers are acceptable. If handwritten, please try and write clear and legibly.
1. Fully beta reduce each of the following lambda terms. Check your answer using the `lc` tool shown in class. **Do not use any shorthands in your evaluation.**

**Note:** it is acceptable to skip currying steps. You should not skip any other steps: show all of you work!

(a)  $(\lambda p.\lambda q.pqp)(\lambda x.\lambda y.y)(\lambda x.\lambda y.x)$

(b)  $(\lambda p.\lambda q.ppq)(\lambda x.\lambda y.y)(\lambda x.\lambda y.x)$

(c)  $(\lambda p.p(\lambda x.\lambda y.y)(\lambda x.\lambda y.x))(\lambda x.\lambda y.y)$

(d)  $(\lambda p.\lambda a.\lambda b.pab)(\lambda x.\lambda y.y)(\lambda f.(\lambda x.fx))(\lambda f.(\lambda x.f(fx)))$

(e)  $(\lambda c.c(\lambda x.\lambda y.y))(\lambda x.\lambda y.\lambda f.fxy)(\lambda f.\lambda x.f(fx))(\lambda f.\lambda x.f(f(fx)))$

2. Identify which variables are free and which are bound in each of the lambda terms:

(a)  $\lambda x.xy$

(b)  $(\lambda x.x)m$

**Note:** there was a typo on the previous version of this homework. You will get full credit for writing anything down for this question.