York University- Department of Computer Science and Engineering

SC/CSE 3401 3.00 – Functional and Logic Programming

Assignment 3

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1) This assignment is due on **March 21, 2012 at 3:45pm in course drop box.**
2) Please provide your first name, last name and student number on the first page of your assignment.
3) Review policy on academic honesty. The submitted assignment must be each individual's own work.
4) NO LATE ASSIGNMENTS!

Question 1. (2 marks) Write the following terms with as few parentheses as possible, without changing the meaning or structure of the term:

a) $(\lambda x.(\lambda y.(((xy)(zw))(xy))))$
b) $((\lambda x.(y(\lambda y.(xy))))z)$

Question 2. (6 marks) For each of the following terms,

   (i)   Restore all the dropped parentheses, without changing the meaning or structure.
   (ii)   Show the term calculation.
   (iii) Find the set of free variables, showing all steps.

a) $(\lambda x.xx)yz$
b) $\lambda zw.\lambda x.x\lambda y.y(zw)$

Question 3. (4 marks) Apply the following renaming operations. Are the results α-equivalent to the following terms? Explain.

a) $(x(\lambda xz.xz))\{x \backslash y\}$
b) $((\lambda x.xy)z)\{x \backslash y\}$

Question 4. (6 marks) Convert the following terms to β normal form:

a) $((\lambda x.(\lambda x.xy)z)y)$
b) $(\lambda x.(\lambda x.xy))(\lambda y.xy)$
c) $(\lambda y.(\lambda x.xy))(\lambda y.xy)$

Question 5. (8 marks)Assume that true (T) is defined as $\lambda xy.x$ and false (F) is defined as $\lambda xy.y$. Prove that the function $\lambda pq.qpq$ can implement AND in logic. Show all steps. (Hint: Show evaluation of AND for all four cases of the truth table).

Question 6. (10 marks) Write a function dist that finds the Euclidean distance between two points given their coordinates as lists. Your code must work for coordinates in any number of dimensions. If the lists of coordinates for the two points are not the same size, your code must return nil. You can assume that the lists contain numbers only.

Hint: You can define a second function to calculate squared distance.

For example, in 2D:
(dist '(1 2) '(1 4))
2

And in 3D:
(dist '(1 2 0) '(1 0 1))
2.236068

(dist '(1 2) '(1 0 1))
NIL