CMSC330 Spring 2015 Quiz #3

Name _____

Discussion Time (circle one): **10am 11am 12pm 1pm 2pm 3pm**

Discussion TA (circle one): Amelia Casey Chris Mike Elizabeth Eric Tommy

Instructions

- Do not start this test until you are told to do so!
- You have 15 minutes for this quiz.
- This is a closed book exam. No notes or other aids are allowed.
- Answer essay questions concisely in 2-3 sentences. Longer answers are not needed.
- For partial credit, show all of your work and clearly indicate your answers.
- Write neatly. Credit cannot be given for illegible answers.

1. (6 pts) Lambda Calculus

   Evaluate the following λ−expressions as much as possible. Show each alpha conversion and/or beta-reduction.

   Recall that application is left-associative, i.e., x y z is equivalent to (x y) z

   a.) (1 pt) (λf.λx.f) a

   b.) (1 pt) (λx.x) (λx.x) b

   c.) (2 pts) (λf.λx.f (f x)) (λu.z) a b

   d.) (2 pts) (λf.λy.λx.x (y f)) y x f

2. (9 pts) Consider the OCaml type definition *myTree*:

```
type myTree =
   Nil
  | Leaf of int
  | Node of myTree * myTree
```

A value of the type myTree is made up of Nil elements; Leaf elements, which have an associated integer value; and Node elements, which have two myTree children. Here are some example myTree values

```
Node(Leaf 1, Leaf 2)
Node(Node(Leaf 1,Leaf 2), Leaf 3)
Node(Leaf 1, Node(Leaf 2, Node(Leaf 3, Nil)))
```

Write a function called *switch* that swaps the children of each Node in a myTree. E.g.:

```
switch Node(Leaf 1, Leaf 2)                 =>   Node(Leaf 2, Leaf 1)
switch Node(Leaf 1, Node(Leaf 2, Nil))      =>   Node(Node(Nil, Leaf 2), Leaf 1)
switch (Leaf 1)                             =>   Leaf 1
```

Your code must work in linear time (i.e. don't cycle through a myTree multiple times). You are not allowed to use any OCaml library functions. You may use helper functions.