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(fx))(λu.z)a b

   d.) (2 pts) (λf.λy.λx.x(yf))yx f
2. (9 pts) Consider the OCaml type definition `myTree`:

```ocaml
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.