

# CSCI 305, Homework # 8

YOUR NAME HERE

Due date: Midnight, Tuesday, June 5

**Binary search trees with equal keys.** This is problem 12-1 in the book.

Equal keys pose a problem for the implementation of binary search trees.

- a. What is the asymptotic performance of TREE-INSERT when used to insert  $n$  items with identical keys into an initially empty binary search tree?

We propose to improve TREE-INSERT by testing before line 5 to determine whether  $z.key == x.key$  and by testing before line 11 to determine whether  $z.key == y.key$ .

If equality holds, we implement one of the following strategies. For each strategy, find the asymptotic performance of inserting  $n$  items with identical keys into an initially empty binary search tree. (The strategies are described for line 5, in which we compare the keys of  $z$  and  $x$ . Substitute  $y$  for  $x$  to arrive at the strategies for line 11.)

- b. Keep a boolean flag  $x.b$  at node  $x$ , and set  $x$  to either  $x.left$  or  $x.right$  based on the value of  $x.b$ , which alternates between FALSE and TRUE each time we visit  $x$  while inserting a node with the same key as  $x$ .
- c. Keep a list of nodes with equal keys at  $x$ , and insert  $z$  into the list.
- d. Randomly set  $x$  to either  $x.left$  or  $x.right$ . (Give the worst-case performance and informally derive the expected running time.)