CSE 332: Data Abstractions
Assignment #3
October 8, 2014
due: Wednesday, October 15, 12:30 p.m., *before lecture begins*

Bundles: The problems in each written homework assignment will be divided into 2 groups (to facilitate distribution to grading TAs). You will turn in 2 corresponding bundles. Write your full name in the *upper left corner* of each bundle's top page, with your last name printed clearly in CAPITAL LETTERS. Each bundle should be stapled separately. We don't supply the stapler.

This week's turnin bundles: (A) problems 1–2, (B) problems 3–5.

There are 2 pages to this assignment.

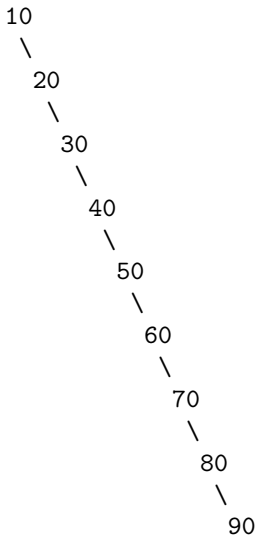
1. (a) Find the AVL tree that results from inserting the keys 186, 039, 991, 336, 778, 066, 564, 154, 538, and 645, in this order, into an initially empty tree. Show the AVL tree after each insertion (including possible rotations) is completed.
   (b) Show the result of deleting the key 186 from the final tree of part 1a.
   (c) Show the result of deleting the key 538 from the final tree of part 1b.

2. (a) Find the ordinary binary search tree that results from inserting the keys 1, 10, 2, 9, 3, 8, 4, 7, 5, 6, in this order, into an initially empty tree. You need only show the final result.
   (b) Find the AVL tree that results from inserting the keys 1, 10, 2, 9, 3, 8, 4, 7, 5, 6, in this order, into an initially empty tree. Show the AVL tree after each of the 10 insertions (including possible rotations) has completed.

3. Give pseudocode for a linear-time algorithm that verifies that an AVL tree is properly formed. Assume every node has fields `key`, `height`, `left`, and `right` and that keys can be compared with $<$, $==$, and $>$. The algorithm should verify all of the following:
   (a) The tree is a binary search tree.
   (b) The height information of every node is correct.
   (c) Every node is balanced.

   Use `assert` statements so that your pseudocode has an assertion failure if and only if the AVL tree is incorrect.

4. (a) Consider the following splay tree T:

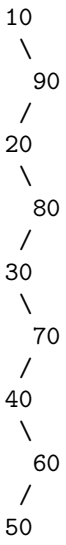


Find the result of splaying 90 in T. Show your tree after every zig-zig rotation.

(b) Suppose that splaying was done by performing single rotations, bottom up, as described in Section 4.5.1 of the textbook. For the splay tree T of part 4a, show what the result of splaying 90 would have been.

(c) Explain now why it would be a terrible idea to implement zig-zig rotations as suggested in part 4b. Describe a series of operations on T that would perform very poorly.

5. (a) Consider the following splay tree T:



Find the result of splaying 50 in T. Show your tree after every zig-zag rotation.

(b) What has happened to the trees after the splays of problems 4a and 5a and why is this a good thing?