CS3323 Fall 2006 Assignment 5

Due Monday, Nov. 27, by 5pm.

- Assignments should be handed in by placing them in the CS3323 bin on E level of Gillin Hall.

1. (a) Draw the AVL tree resulting from the insertion of an item with a key 52 into the AVL tree of Figure 1 (show the tree after each rotation, if any).
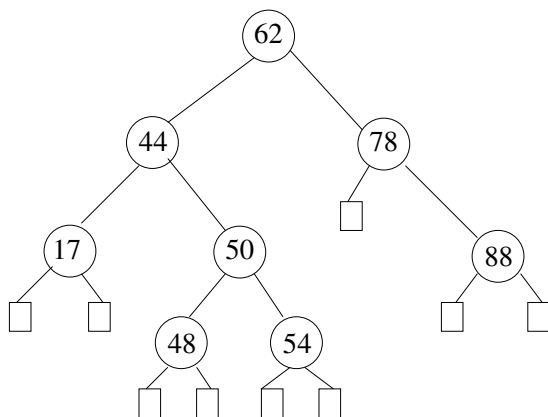

Figure 1: AVL tree for Question 1.

   (b) Draw the AVL tree resulting from the removal of the item with key 62 from the AVL tree of Figure 1 (show the tree after each rotation, if any).

   (c) Draw an example of an AVL tree such that a single remove operation causes rotations to propagate all the way to the root. (Use triangles to represent subtreees that are not affected by this operations.) The height of your example tree should be at least 5. Show the tree after each rotation.

2. In this problem, assume that the keys of all the letters are given as follows, and the subscripts do not affect the value of the keys (which are letters).

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Key     0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
24 25
Letter A B C D E F G H I J K  L  M  N  O  P  Q  R  S  T  U  V
W  X  Y  Z
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(a) Give the contents of the hash table that results when keys E_1 A S_1 Y Q U E_2 S_2 T I O N are inserted in that order into an initially empty 13-item hash table using linear probing (use $h(k) = k \bmod 13$ for the hash function for the k-th letter of the alphabeth).

(b) Give the contents of the hash table that results when keys E_1 A S_1 Y Q U E_2 S_2 T I O N are inserted in that order into an initially empty 13-item hash table using double hasing (use $h(k) = k \bmod 13$ for the hash function for the k-th letter of the alphabeth, and $h'(k) = 1 + (k \bmod 11)$ for secondary hashing function).

3. (a) What is the worst-case running time for inserting n items into an initially empty hash table, where collisions are resolved by chaining? What if each sequence is stored in sorted order? Assume that a hash table is an array of link-based sequences.

(b) How many probes are involved when double hashing is used to build a table consisting of n equal keys? Consider each successful or unsuccessful attempt to place an element in a hash to be a single probe.

4. (a) Draw the merge tree for an execution of the merge-sort algorithm on on the following input sequence: $(2, 5, 16, 4, 10, 23, 39, 18, 26, 15)$.

(b) Draw the quick-sort tree for an execution of the quick-sort algorithm on the input sequence from (a).

Suppose we choose the element at rank $\lfloor n/2 \rfloor$ as the pivot.

(c) What is the running time of this version of quick-sort on a sequence that is already sorted?