Homework 8 – Due Friday, March 16, 2012

Reminders  Collaboration is permitted, but you must write the solutions by yourself without assistance, and be ready to explain them orally to a member of the course staff if asked. You must also identify your collaborators. Getting solutions from outside sources such as the Web or students not enrolled in the class is strictly forbidden.

Exercises  These should not be handed in, but the material they cover may appear on exams.

- Write out pseudocode for deleting an element from a heap using the two basic operations (heapify up/down) that we saw in class.
- Write out pseudocode for insertion in and deletion from a binary search tree.

Problems to be handed in. Please submit each problem on a separate sheet of paper.

1. Give algorithms for implementing the following operations on a binary search tree:

   (a) Average-Keys: Given a node $x$, returns the average value of the keys in the subtree rooted at $x$. (Hint: Separately compute the number of nodes and the sum of the keys). For full credit your procedure should run in $O(n)$ time.

   (b) Range-Search: Given an interval $[a, b]$ and a tree $T$, returns a list of all the nodes with keys in the range $a, b$.

   There is an easy $O(n)$ solution, but if you are careful you can solve the problem in time $O(k + h)$ where $k$ is the number of nodes in the range and $h$ is the height of the search tree.

   Analyze the running time of your algorithm carefully. Remember that some of the homework grade is for the clarity of your explanation.