Introduction to Computer Science
HW #5
Due: 2014/05/28

**Review Problems** (7.5% each)**:**

**Chapter 6:** Problem 40.

**Chapter 8:** Problems 20, 21, 28.

**M1.** (5%) Draw the BST (10 nodes) whose post-order traversal is 0,1,2,4,6,8,7,9,5,3.
**M2.** (5%) Draw the BST after 1.5 is inserted from the above tree in M1.
**M3.** (5%) Draw the BST after 9 is deleted from the above tree in M2.
**M4.** (5%) By replacing with its predecessor, draw the BST after 3 is deleted from the above tree in M3.

## Programming Problem I (20%):

Write a **prolog** program to compute $\sqrt{a}$ by the following iteration:

$$x_m \leftarrow \frac{x_{m-1} \cdot x_{m-1} + a}{2 \cdot x_{m-1}}$$

You need to write the function:

- ***sroot*(*X,M,SX*):** *sroot*(*X, m, SX*) to compute square root (*SX*) of *X* up to *m* iterations. Initial guess is 1. In other words, sroot(*X*, 1, 1) is true for any *X*.

Some more examples are listed below:

| | |
|---|---|
| sroot(2,1,X) | X=1 |
| sroot(2,2,X) | X=1.5 |
| sroot(2,3,X) | X=1.4166666666666667 |
| sroot(2,4,X) | X=1.4142156862745099 |
| sroot(2,5,X) | X=1.4142135623746899 |

## Programming Problem II (30%):

Write a class **MinHeap** which is derived from **AbsHeap** (in “absheap.h”).

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Implement the two virtual functions in AbsHeap. This is a binary min heap, so pop() always returns the element with the minimum key. You may assume **all keys are distinct**.

## BONUS (5%) Tracking Medians:

Given that integers are read from a data stream. Sometimes we need to track the median of elements read so far.

The task can be accomplished by a “median heap”, which pops the element with the median key (when the number of the elements is even, pop the one with the smaller key).
Write a class **MedianHeap** derived from **AbsHeap** which accomplish the above task.

**Hint:** Store the smaller half elements in a maxHeap and the others in a minHeap.

## How to submit:

Compress all your files into one single file and then submit electronically via Ceiba by the due date.