Problem Set 6

Assigned: October 30
Due: November 8

For problems 2, 3.B, and 4, you may draw the data structure by hand and upload pictures.

Problem 1

Suppose that you have a binary tree with numerical labels on the nodes. Write an algorithm in pseudo-code to test whether this is a correctly formed binary search tree. Hint: Use in-order search.

Problem 2

Carry out the following operations in sequence on the binary search tree shown below. Show the final state of the tree when all the operations have been executed.

Add(5)
Add(22)
Add(35)
Delete(32)
Delete(20)
Problem 3

A. Convert the following expression to prefix and to postfix:

$$(3*(x/y)) * ((x^2) - 1)$$

B. Draw the corresponding expression tree.

Problem 4

Suppose you start with the heap shown below. Show the final state of the heap after executing the four commands: **add(1), add(4), deleteMin(), deleteMin()**

```
3
  /   \
8     5
 /   /   \
15   10   6
 /   /   /   \
17  20  12   9
```

Problem 5

You are given an unsorted array $A$ of ints with no repeated elements, and asked to find the $K$th largest elements in descending sorted order. For example if $A$ is the array $[11,6,1,2,15,7,4,8,20]$ and $K = 3$, then the answer should be $[20,15,11]$. Describe how you would modify selection sort and heapsort to solve this problem (two separate answers). What is the worst case running time of your algorithms, as a function of $N = A$.length and $K$?

You may assume that you are describing your algorithm for the benefit of someone who already knows the standard versions of selection sort and heapsort. So you can either (a) write the complete code; (b) write pseudo-code; or (c) describe in English how to modify the standard algorithm; whichever you prefer.