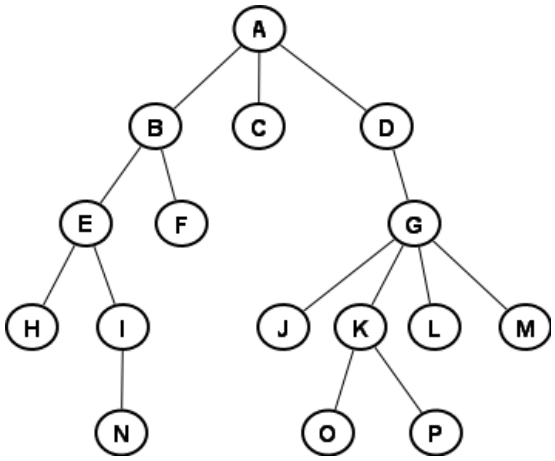
Data Structures and Programming

Spring 2017, Homework # 2

Due: April 25, 2017

1. (26 pts) For the following tree,
   (a) (2 pts) What are the leaves?
   (b) (2 pts) What are the children of D?
   (c) (2 pts) What is the depth of G?
   (d) (2 pts) What is the degree of G?
   (e) (2 pts) What are the ancestors of G?
   (f) (2 pts) What are the descendants of G?
   (g) (2 pts) What is the height of the tree?
   (h) (4 pts) Enumerate the nodes in pre-order.
   (i) (4 pts)Enumerate the nodes in post-order.
   (j) (4 pts) Give the left-child-right-sibling binary tree representation of the tree.



2. (14 pts) Suppose the preorder traversal of a binary tree is "A B C D E F G H I J" and inorder traversal is "C D E B F A I H G J" . Draw the tree. Show your work in detail.

3. (15 pts) Given n numbers $x_1, x_2, ..., x_n$,
   (a) (10 pts) write the pseudo-code of a sorting algorithm based on (ordinary) binary search trees. What is the worst case running time of the algorithm?
   (b) (5 pts) suppose the above algorithm is based on AVL trees, what is the worst-case running time?

4. (15 pts) Suppose we are given two sets of numbers A and B with m and n numbers, respectively, design an efficient algorithm to find $A \ominus B$ (the symmetric difference of A and B, which is equal to $(A \cup B) - (A \cap B)$). What is the running time of your algorithm?

5. (30 pts) Given the following AVL Tree:

   (a) (15 pts) Draw the resulting BST after 5 is removed, but before any rebalancing takes place. Label each node in the resulting tree with its balance factor. When deleting a node with both children, replace it with an appropriate value from the node's left subtree.

   (b) (15 pts) Now rebalance the tree that results from (a). Draw a new tree for each rotation that occurs when rebalancing the AVL Tree (you only need to draw one tree that results from an RL or LR rotation). Also label these trees with balance factors.