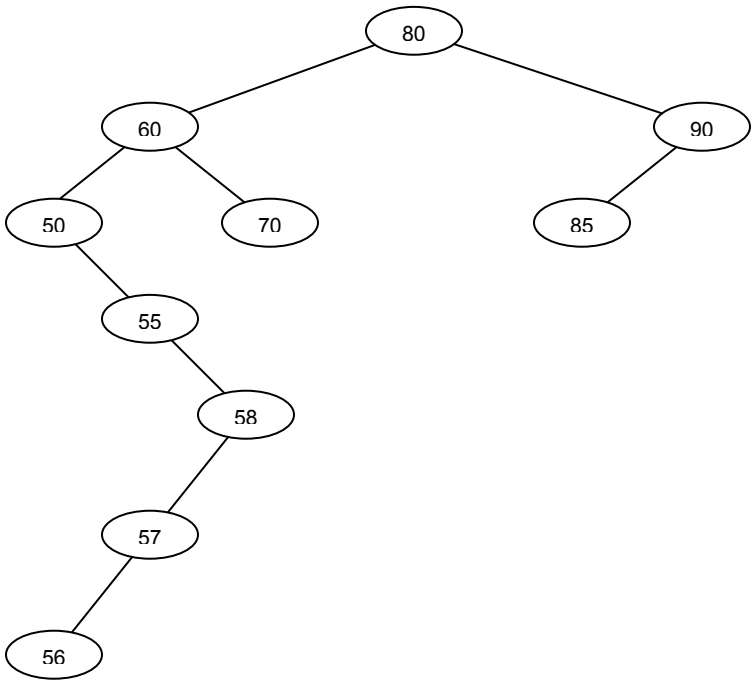
CS 202 - Fundamental Structures of Computer Science II
Spring 2003, Section 1
Quiz #1 Solution

Question: The following items are given: 80, 60, 70, 90, 85, 50, 55, 58, 57, 56.

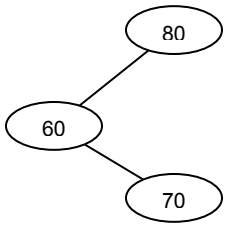
a. Insert them into a binary search tree in the given order. Draw the tree after all items are inserted.
b. Insert them into an AVL tree in the given order. Draw the tree after every rotation.
c. Insert them into a splay tree in the given order.
    i. Draw the tree after all items are inserted.
    ii. Draw the tree after item 57 is accessed.
    iii. Draw the tree after item 55 is accessed.

Answer:

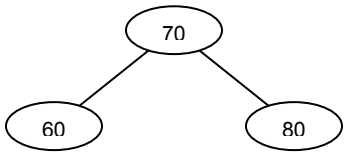
a. The binary search tree will be like the following after all items are inserted.



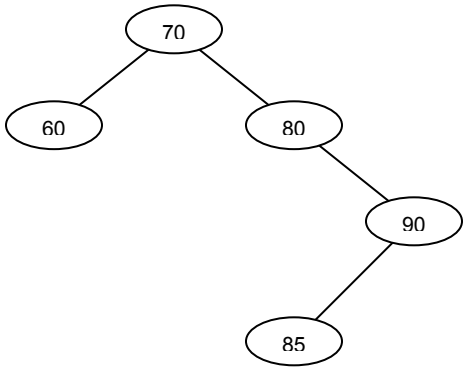
b. After inserting 80, 60, 70 into an empty AVL tree, we will obtain the following unbalanced tree.



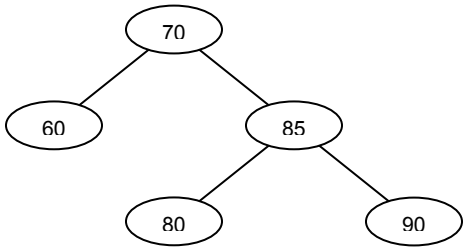
This requires left-right double rotation (case 2). After this rotation the tree will be as follows:



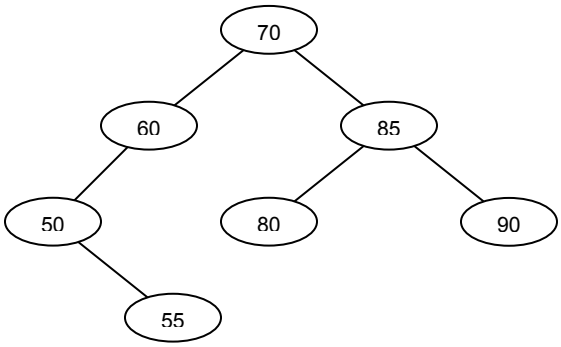
After we insert 90 and 85 to the tree above, we have the following tree below.



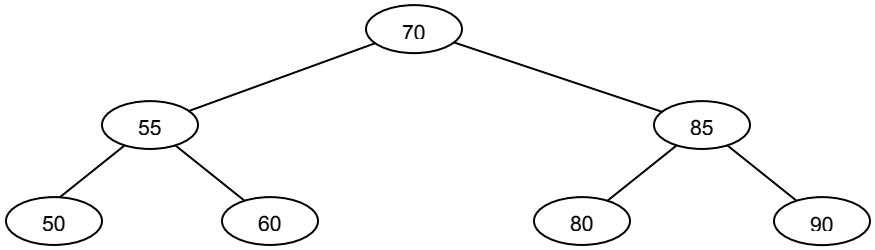
The tree above is unbalanced at node 80. We need a right-left double rotation. After this rotation the tree will look like below:



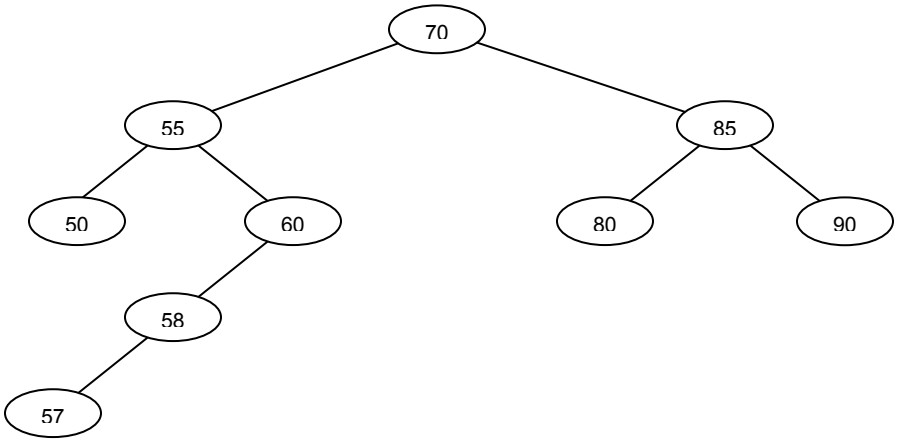
After we insert 50 and 55 to the tree above, we will obtain the tree below:



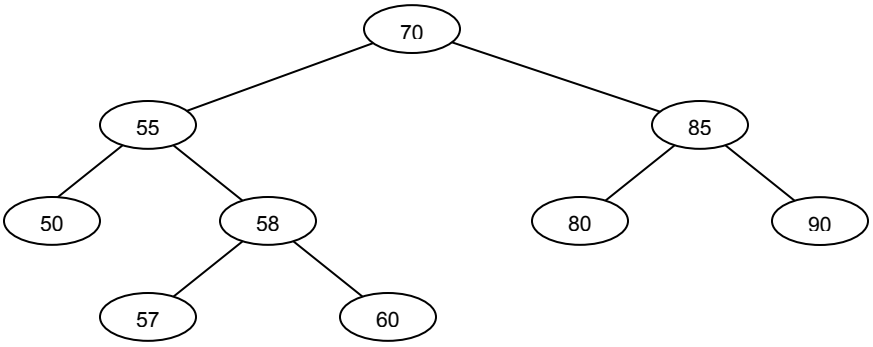
The tree above is unbalanced at node 60. We need to perform a left-right double rotation. After this rotation we will obtain the following tree below:



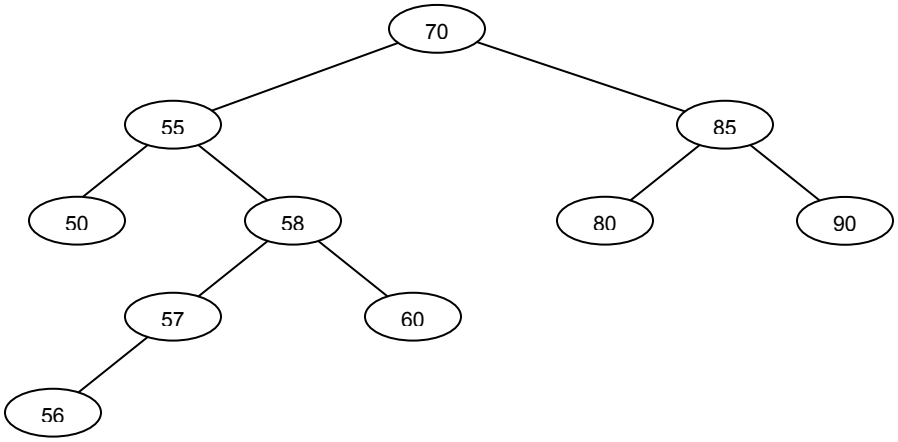
Afte we insert 58 and 57 to tree above, we will obtain the tree below:



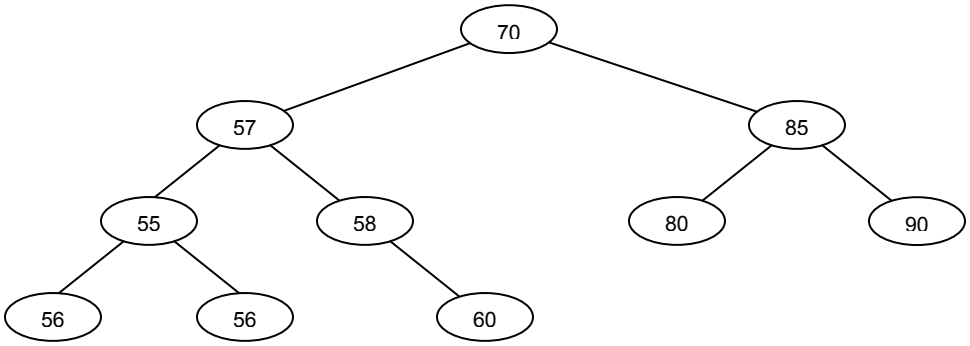
The tree above is unbalanced at node 60. We need a right single rotation. After we perform this rotation we obtain the tree below.



After we insert 56 to the tree above, we will obtain the tree below:

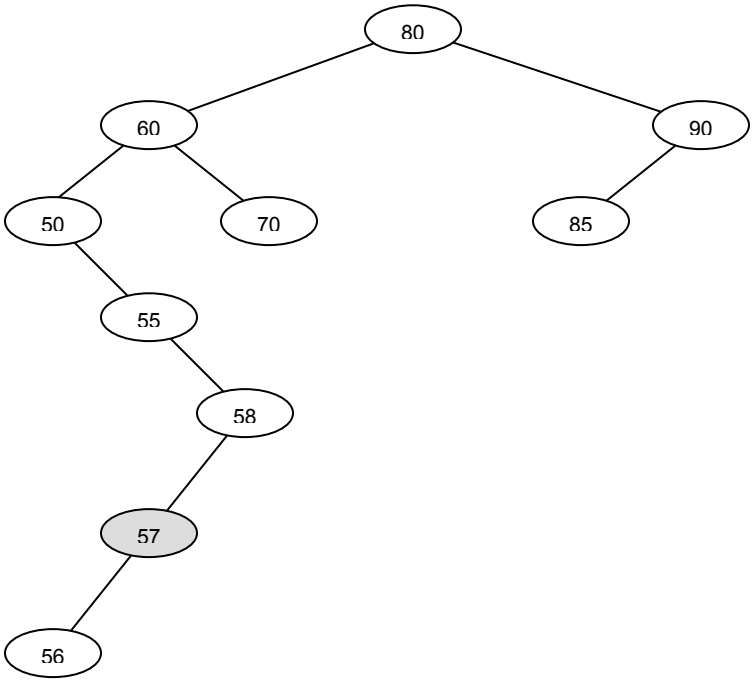


The tree above is unbalanced at node 55. We need to perform a right-left double rotation. After this rotation we will obtain the tree below.

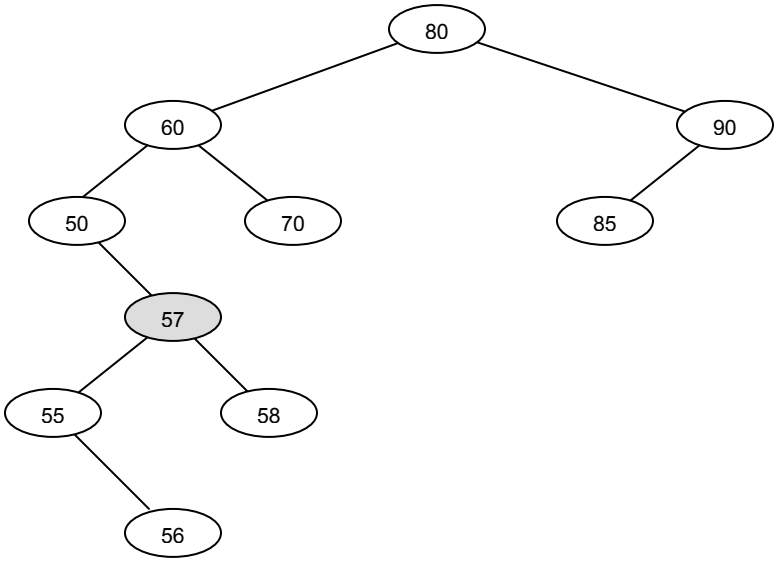


c. The answer is given for of the 3 questions below

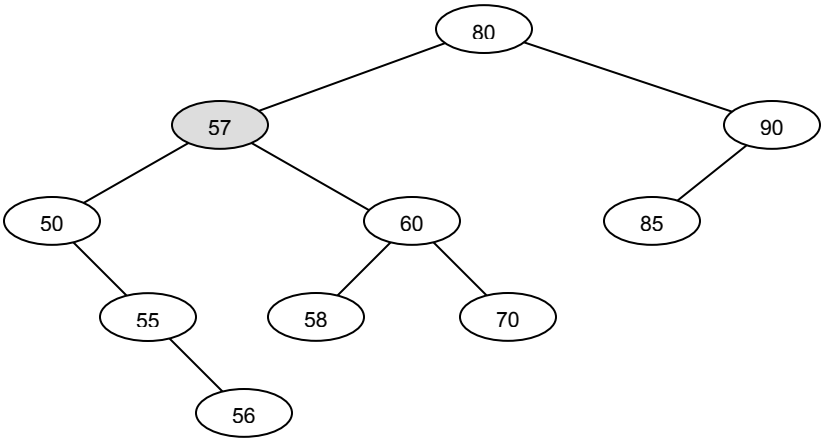
i. The tree will be as the tree below after inserting all items:



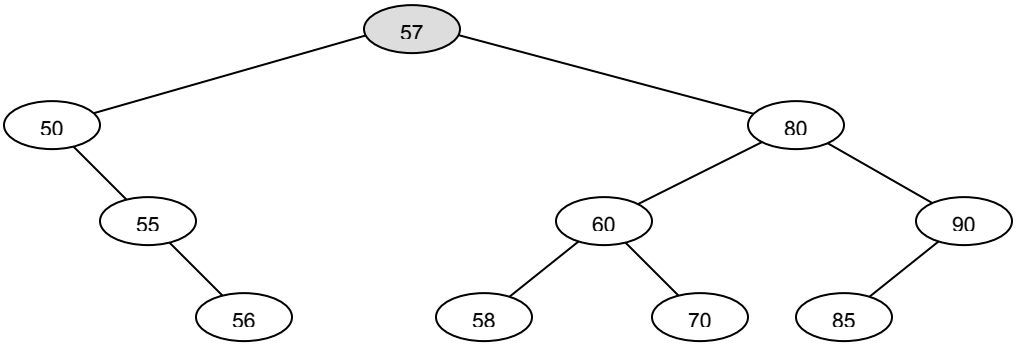
ii. After accessing node 57: we will pust 57 to the root by a series of operations. The first operation is double rotation. The tree will be like below after this operation:



Then, we need to perform a double rotation again to push 57 further towards to the root. We will obtain the tree below after this double rotation.



Finally, we need to rotate between 80 and 57 (single rotation) to make 57 a root node. We will obtain the tree below as the final answer.



iii. After accessing node 55 in the tree below, we need to perform a double rotation to push 55 to the root. This is the only operation required. After that we will have the following tree as the final answer.