

More on Tree Rotations

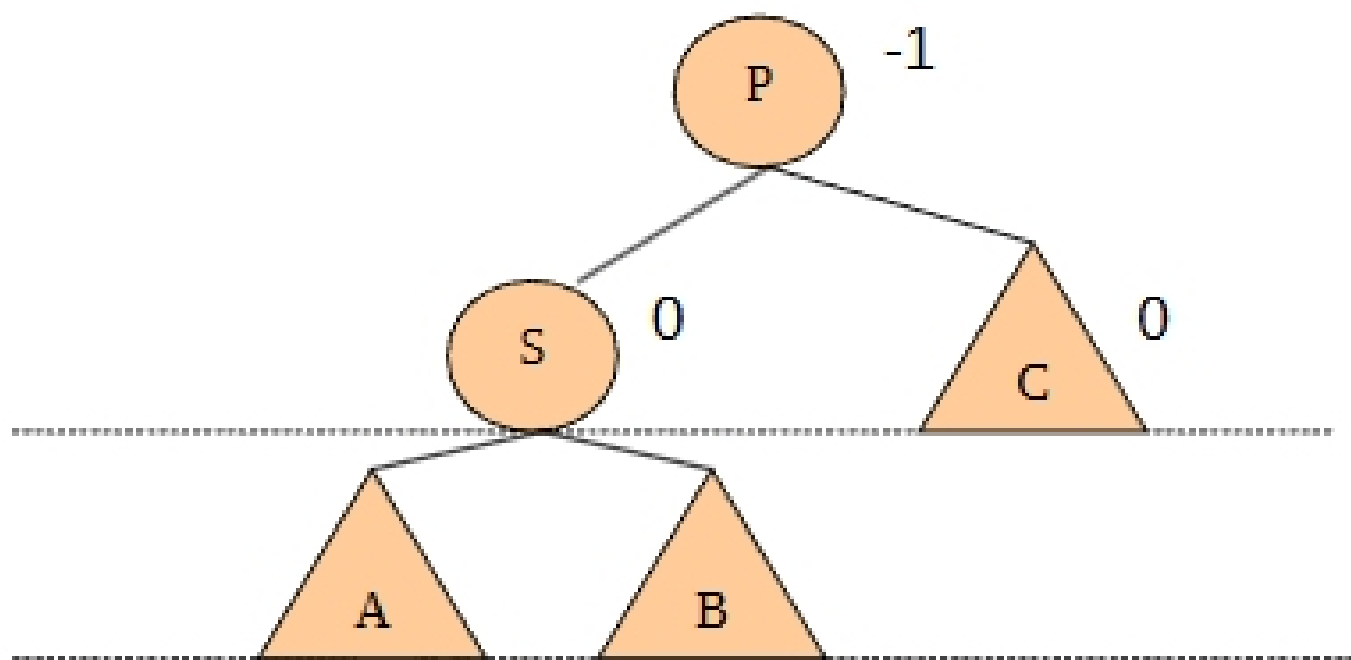
Single Rotations

Recall that the insertion of a new node into an AVL tree could occur in one of four different ways (two of which are symmetric to each other):

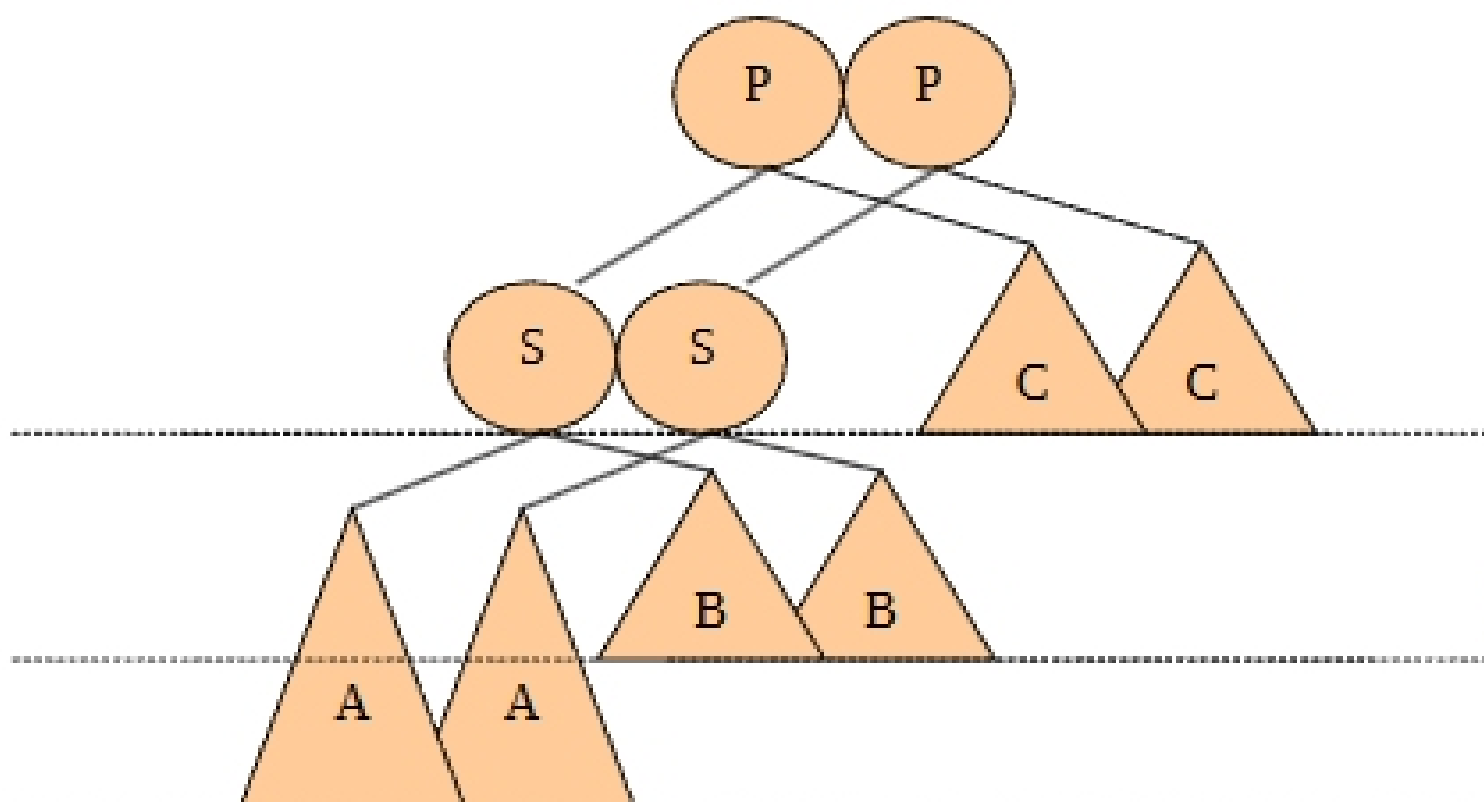
1. The new node is in the left subtree of the left child of a node.
2. The new node is in the right subtree of the left child of a node.
3. The new node is in the left subtree of the right child of a node.
4. The new node is in the right subtree of the right child of a node.

Cases 1 and 4 are symmetric as are cases 2 and 3.

Whenever an insertion of case 1 or 4 occurs, the resulting tree will be unbalanced and a **single rotation** can be used to rebalance the tree. Consider the following case 1 situation (insertion in left subtree of a left child):



initial AVL tree



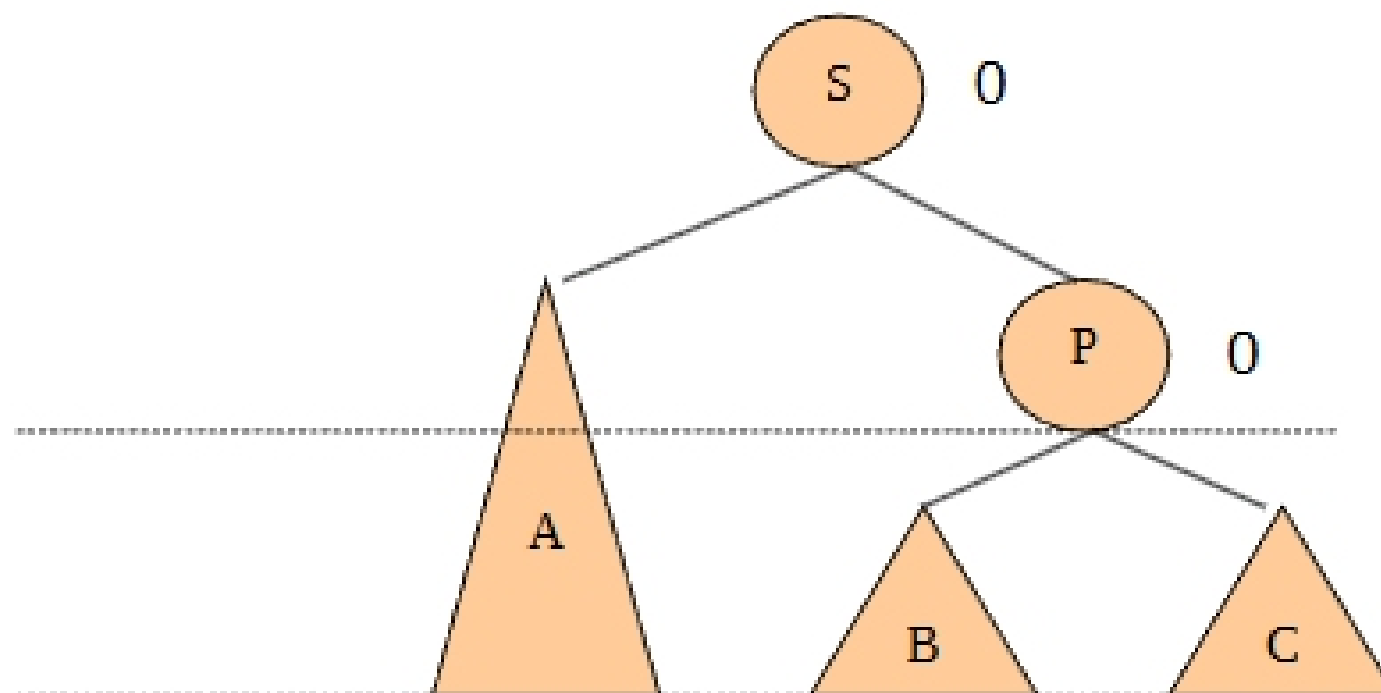
-2

-1

0

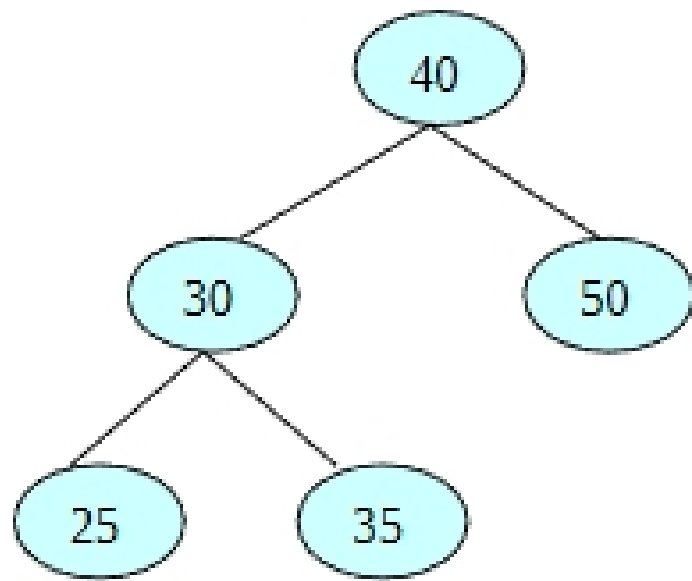
tree immediately after insertion into subtree A

The new node has been inserted into the left subtree (A) of node S which is the left child of node P. The tree is now unbalanced and is temporarily not an AVL tree. To restore the balance in the tree and return it to the status of an AVL tree, a single rotation of S about P is needed as shown below:

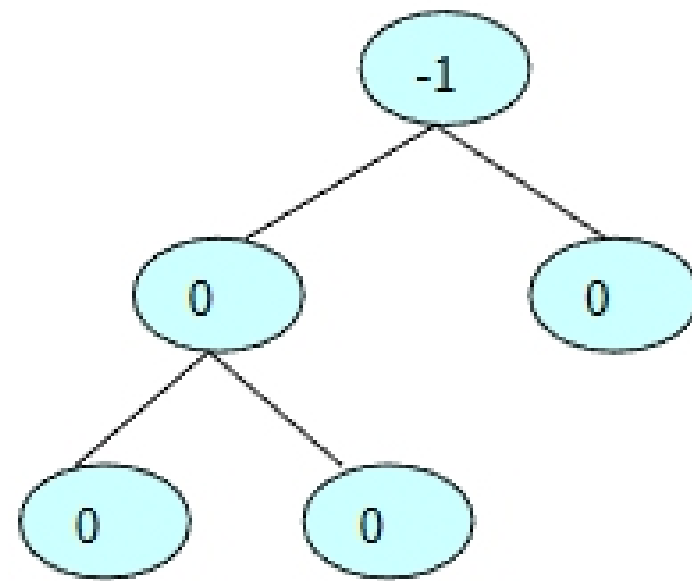


Rebalanced tree is now an AVL tree

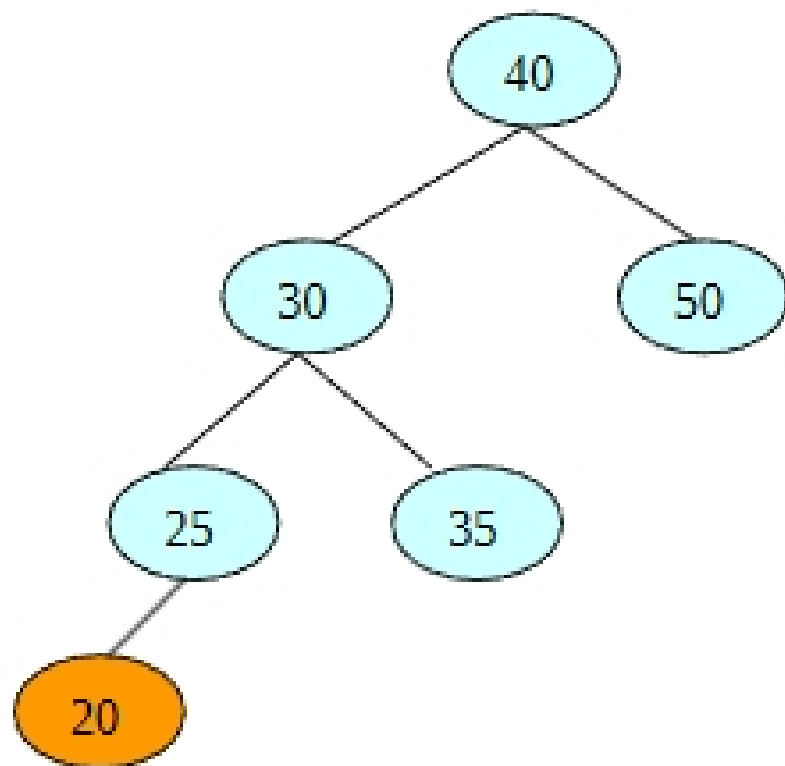
Example – Case 1 Insertion



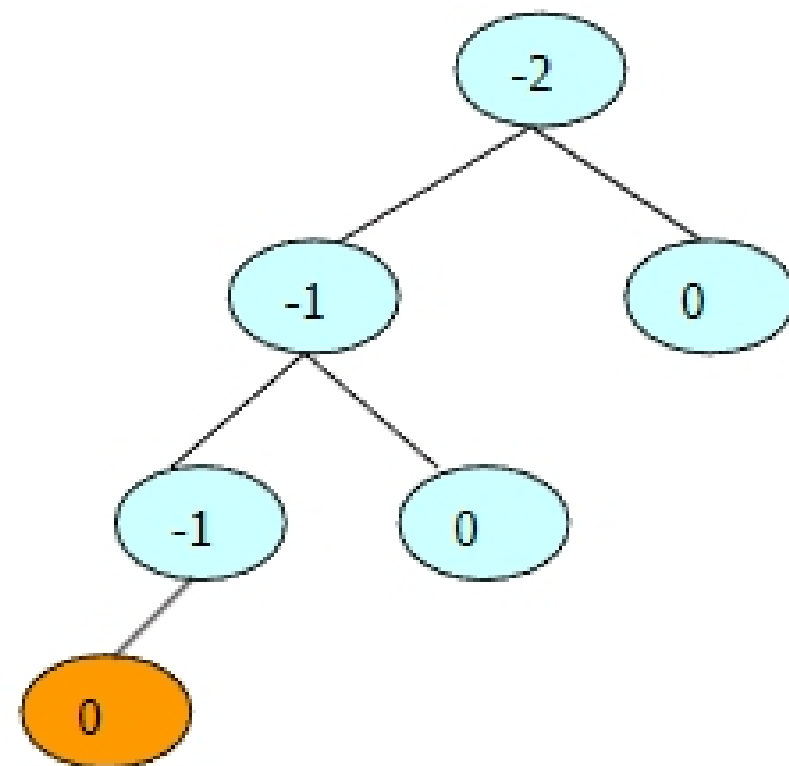
initial AVL tree



initial balance factors

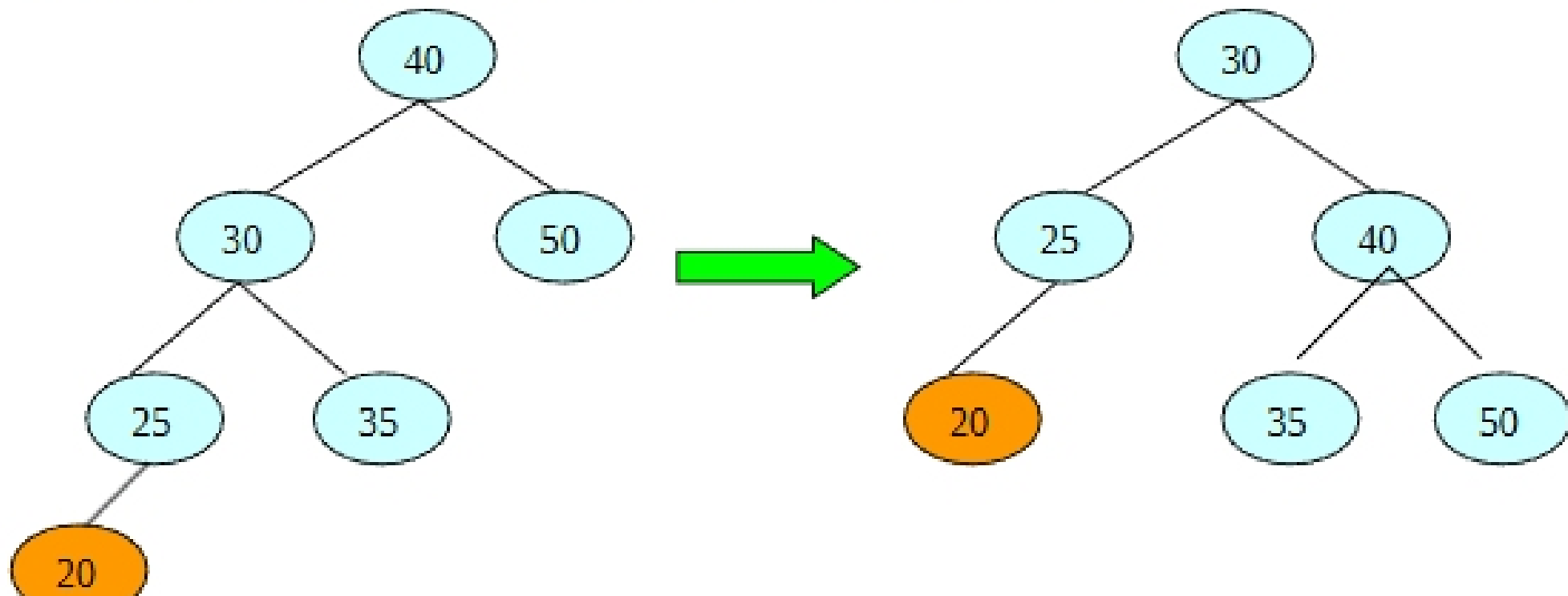


AVL tree after insertion of 20



balance factors after insertion

Perform right rotation of 30 about 40 (40 is the unbalanced node).



The steps in the right rotation are: