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Topic:

AVL Trees Rotations & operations

AVL Trees & Balance Factor

In AVL trees, the difference between the heights of left and right subtree, known as the balance factor. It must be atmost one. Once the difference exceeds one, the tree automatically executes the balancing algorithm until the difference becomes one again.

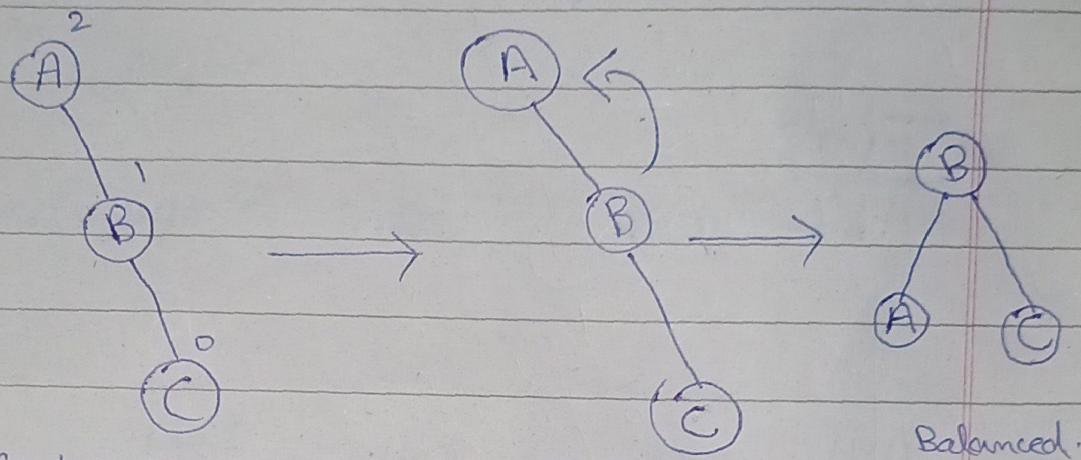
$$\text{Balance Factor} = \text{height}(\text{left subtree}) - \text{height}(\text{right subtree})$$

→ There are usually four cases of rotation in the balancing algorithm of AVL trees.

- 1) LL Rotation
- 2) RR Rotation
- 3) LR Rotation
- 4) RL Rotation.

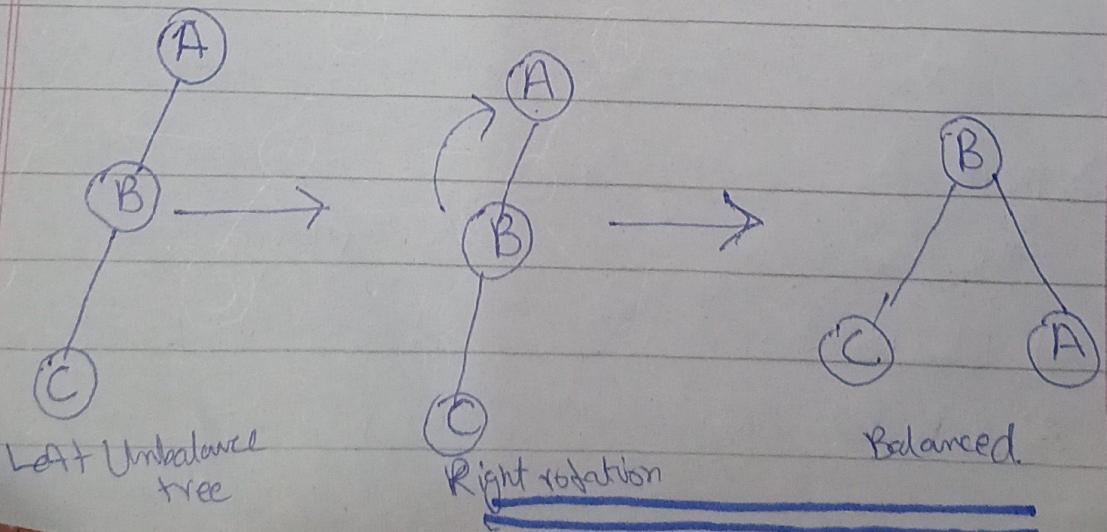
a) Left-Left Rotation

→ It is performed when the node is inserted into the right subtree leading to an unbalance tree.



b) Right-Right Rotation

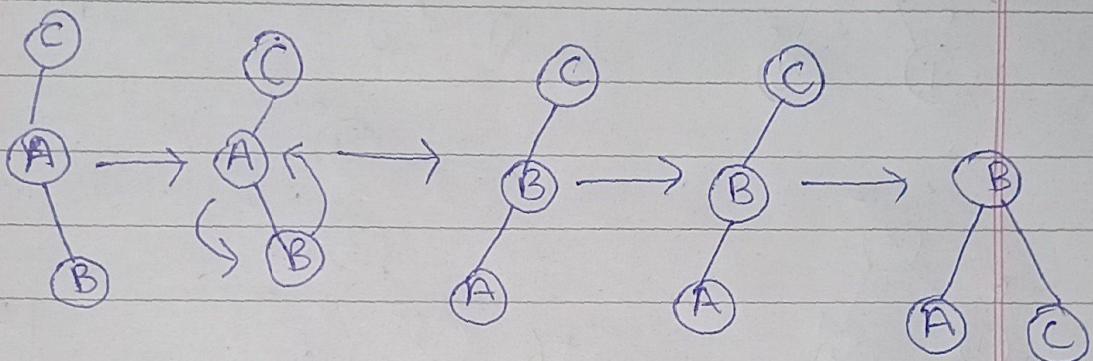
→ It is performed when the node is inserted into the left subtree leading to an unbalance tree.



c) Left-right rotation.

→ It is performed when a node is inserted into the right subtree of the left subtree.

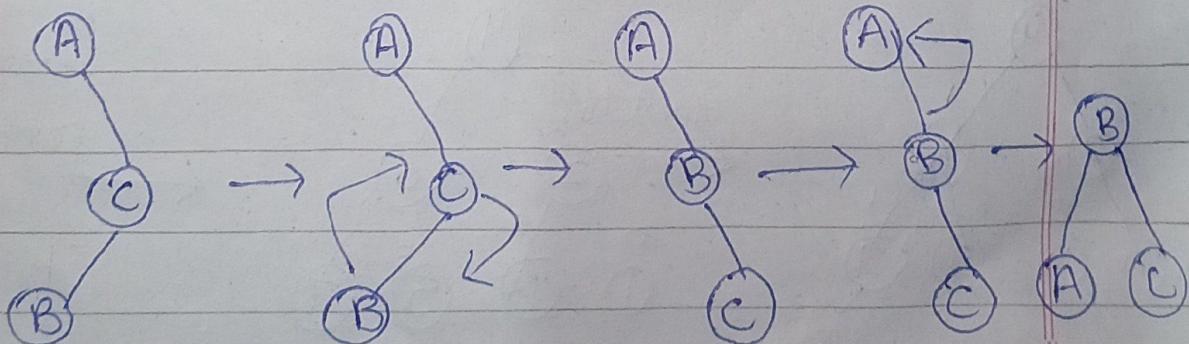
→ It is a combination of left rotation followed by the right rotation.



d) Right-left rotation

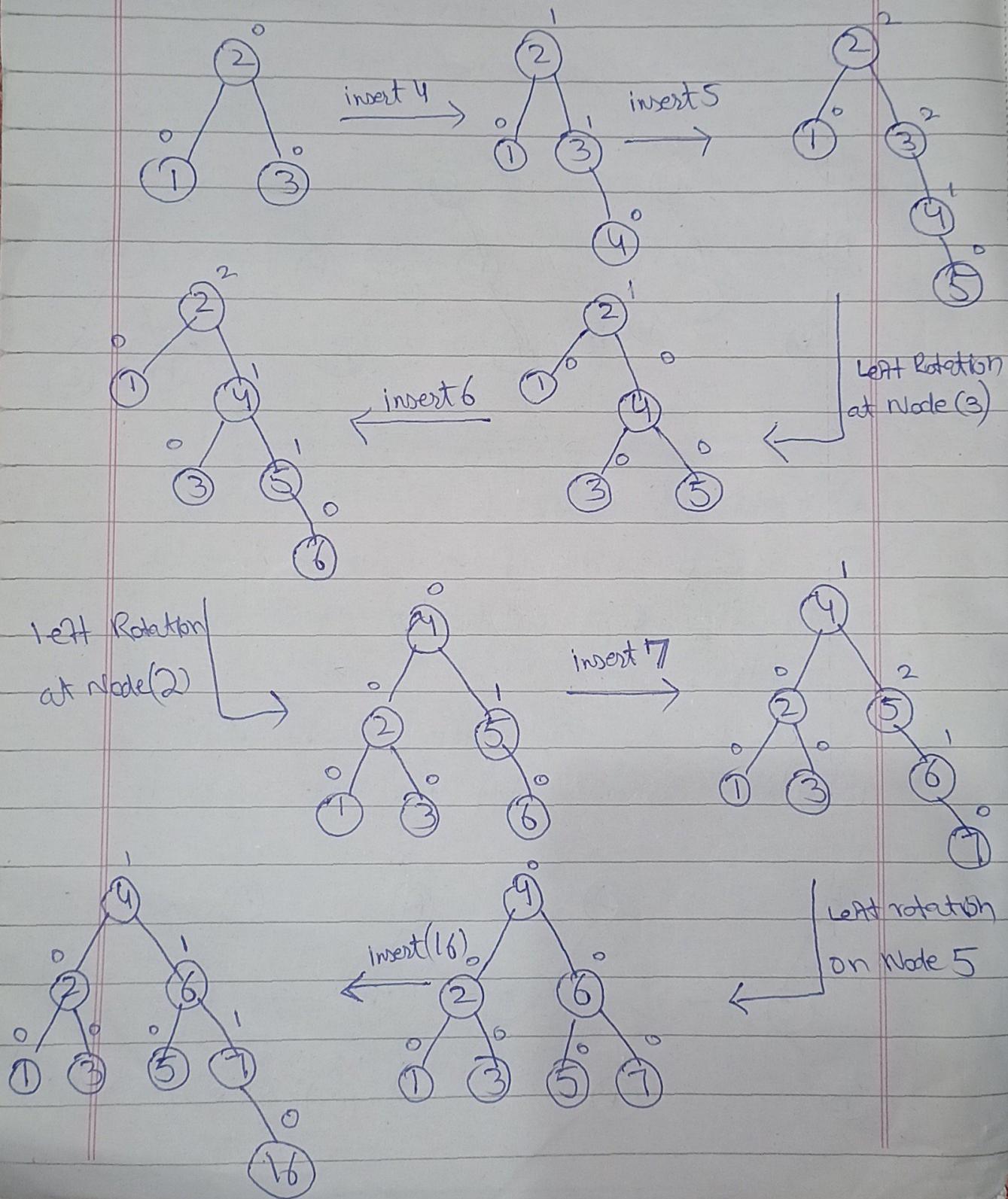
→ It is performed if a node is inserted into the left subtree of the right subtree.

→ It is a combination of the right rotation followed by the left rotation.



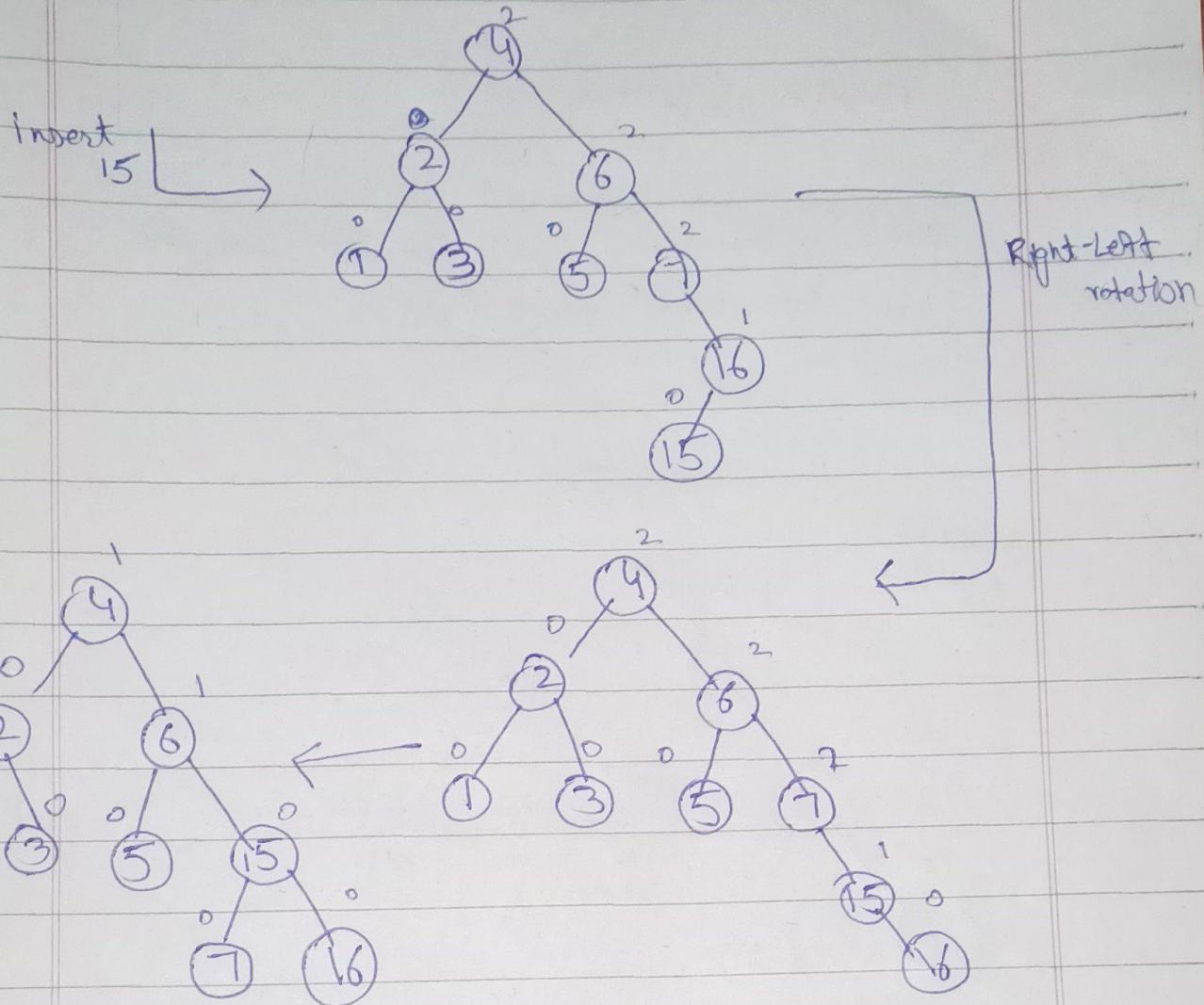
Operations of AVL Trees

⇒ Insertion



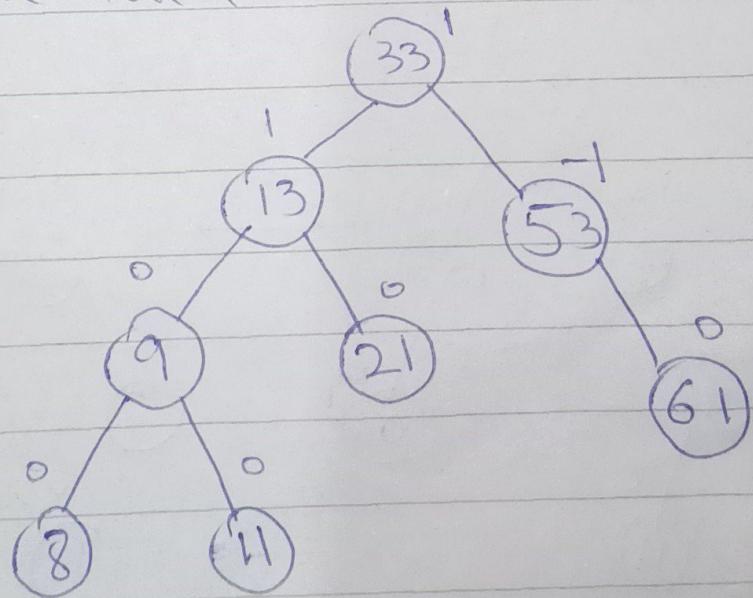
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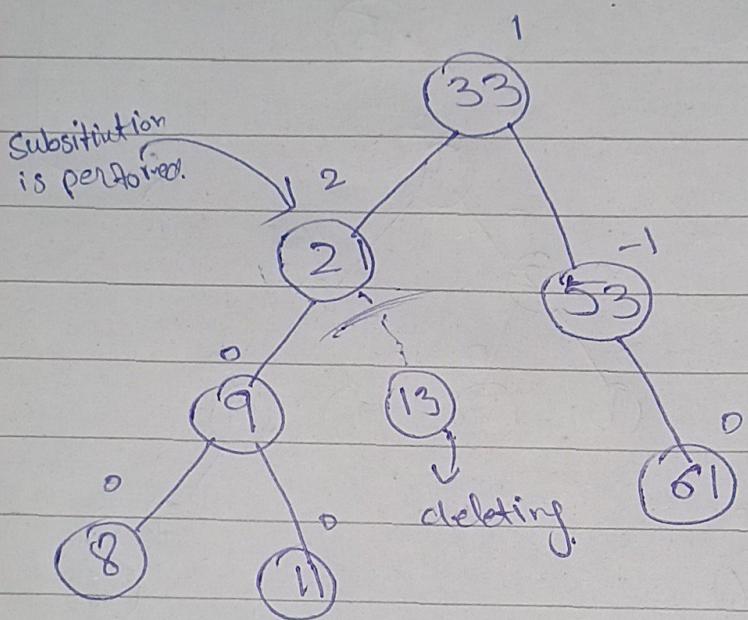
⇒ Deletion

Let we have a AVL tree



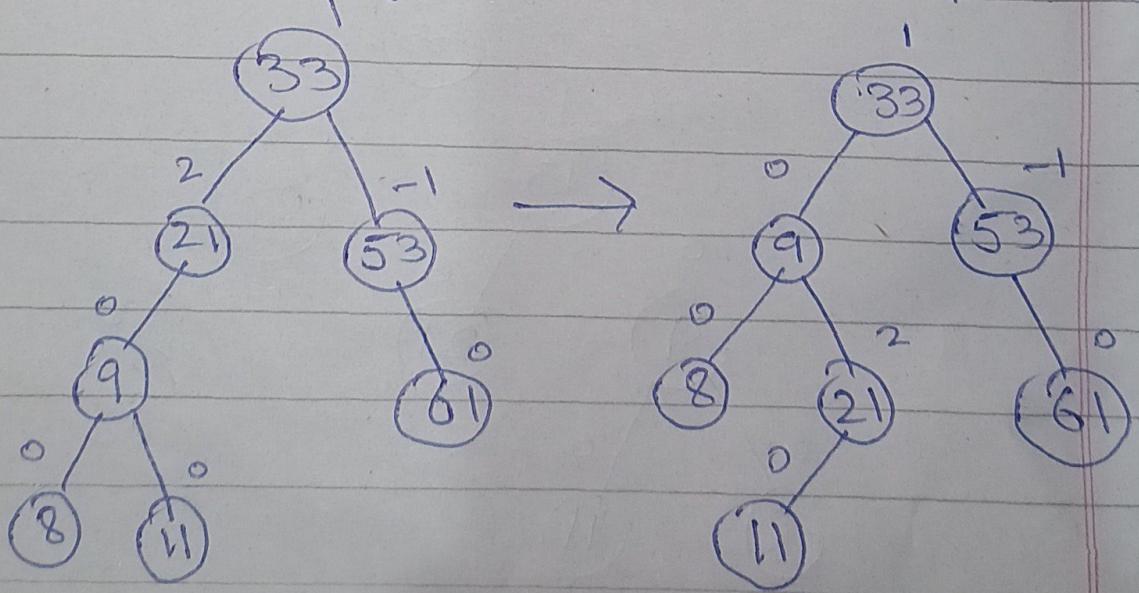
Delete node 13

Here substitution will be performed
as 13 has two child.



Now balancing factor for 21 is 2

Now -right rotation will be performed



The final tree is balanced.

