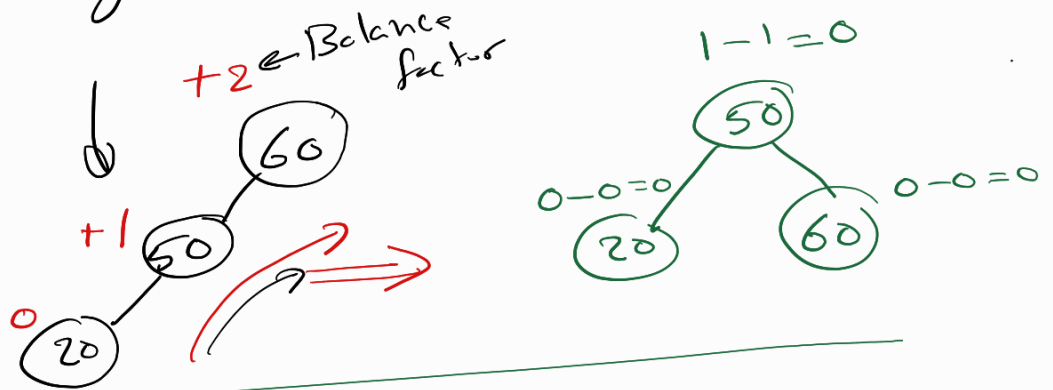
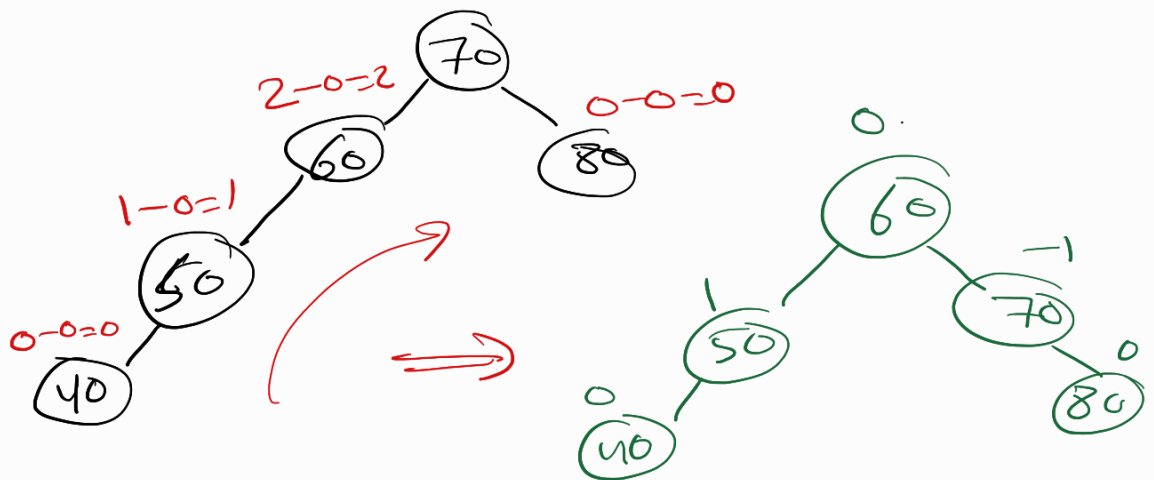


AVL Trees

Case 1 Single right rotation. (60 → 50 → 20)

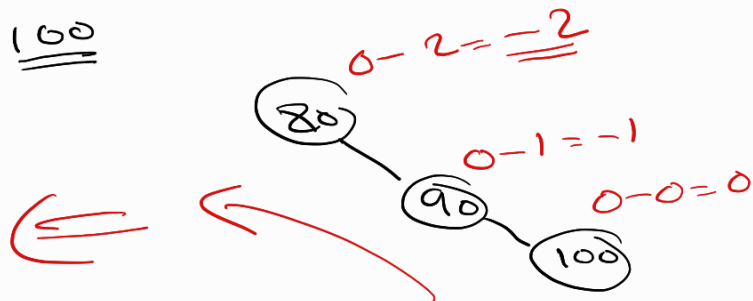
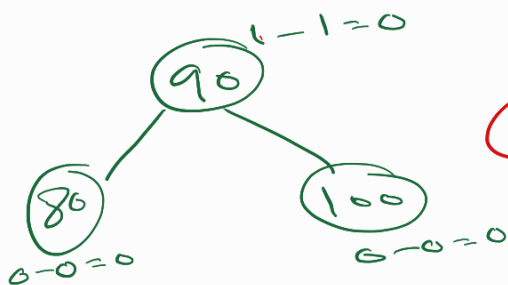


70 → 60 → 80 → 50 → 40
3-1=2

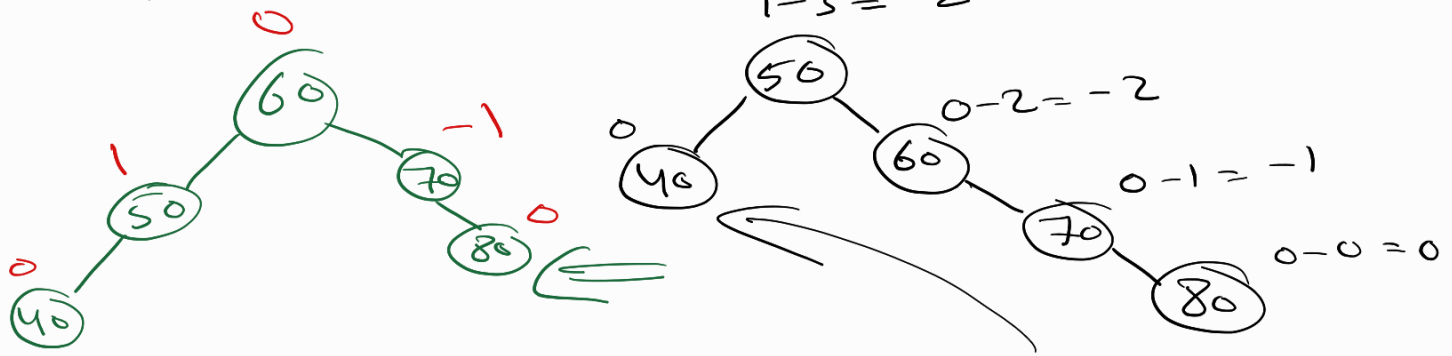


Case 2 Single left rotation.

80 → 90 → 100

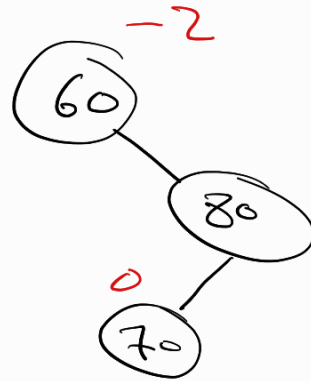
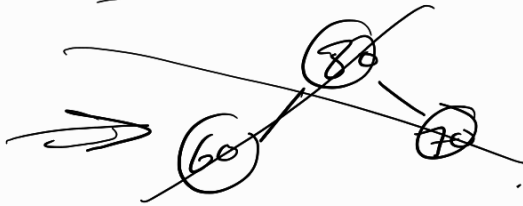


50 → 60 → 40 → 70 → 80
 $1 - 3 = -2$

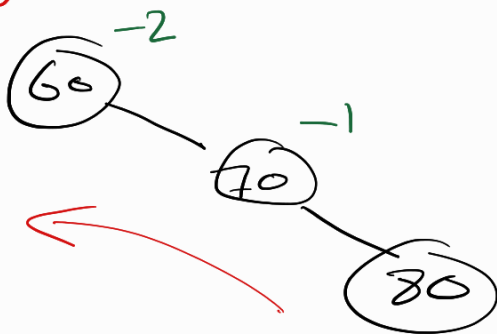


Case 3, Double Rotation (Right left)

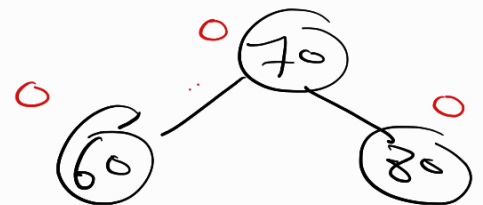
60 → 80 → 70



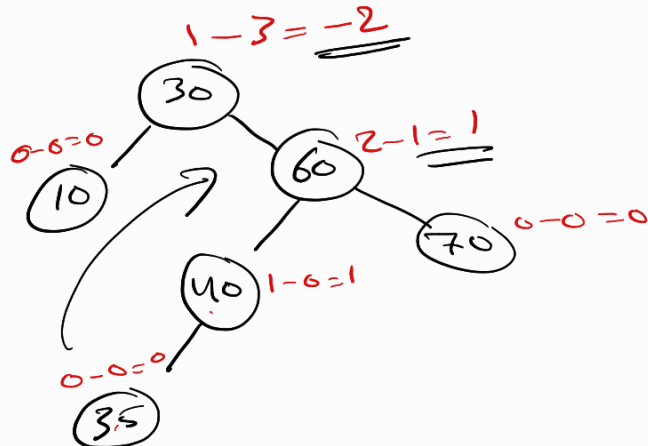
① Right Rotation

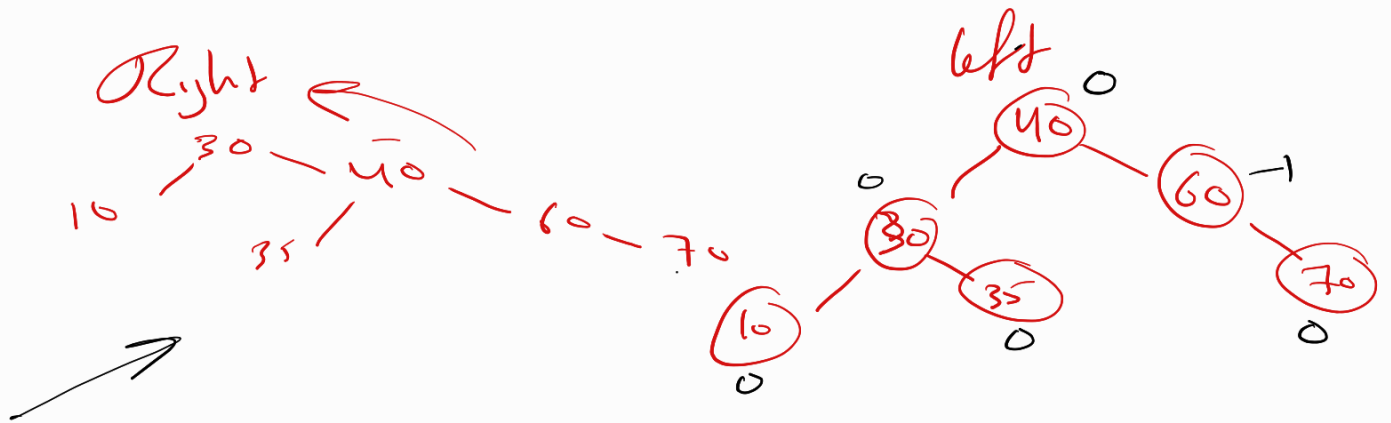


② Left Rotation



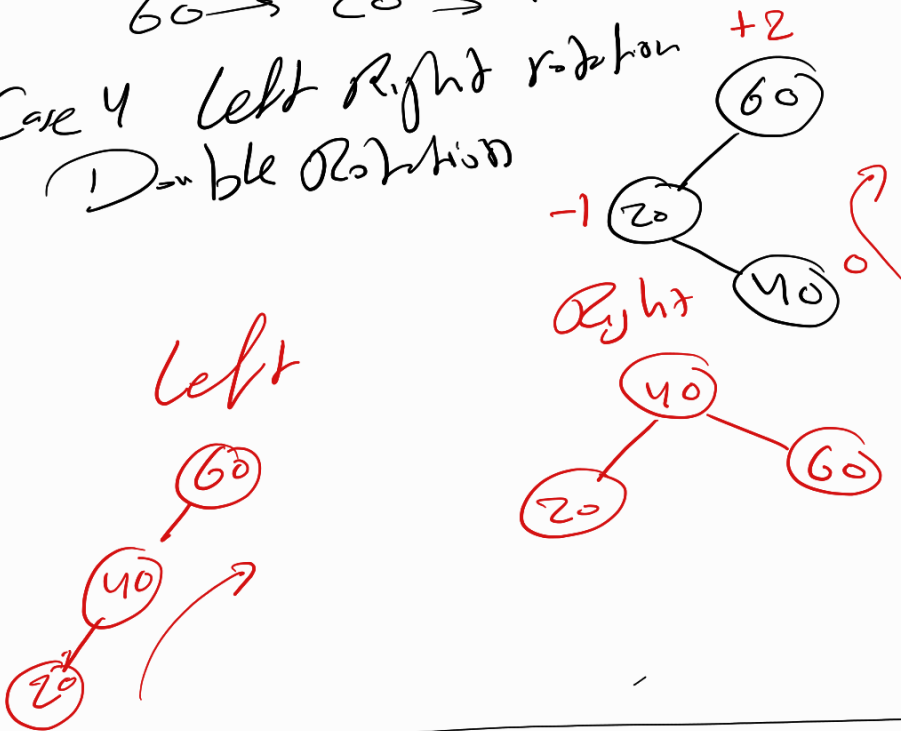
30 → 10 → 60 → 40 → 70 → 35





60 → 20 → 40

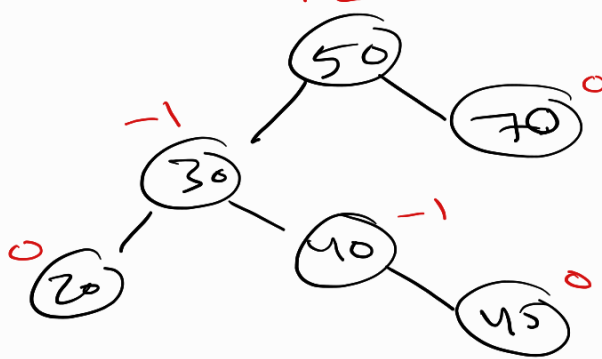
Case 4 Left Right rotation
Double Rotation



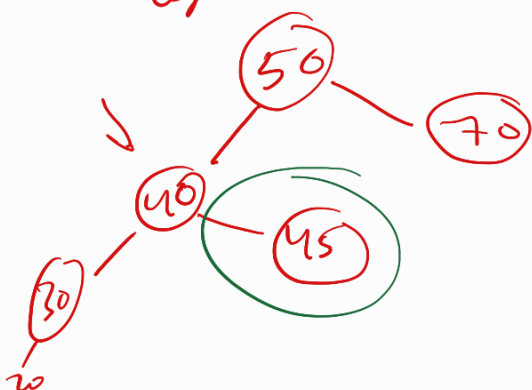
50 → 70 → 30 → 20 → 40 → 45

+2

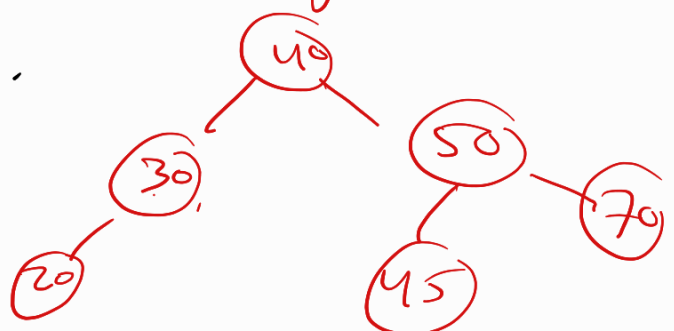
Successor
Min - offset



Left



Right

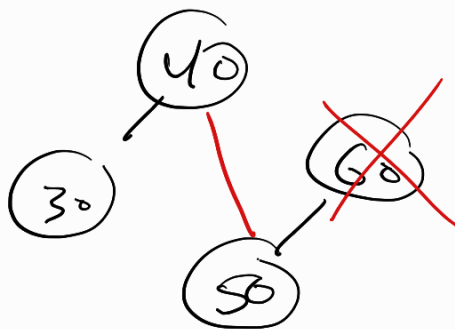


Delete

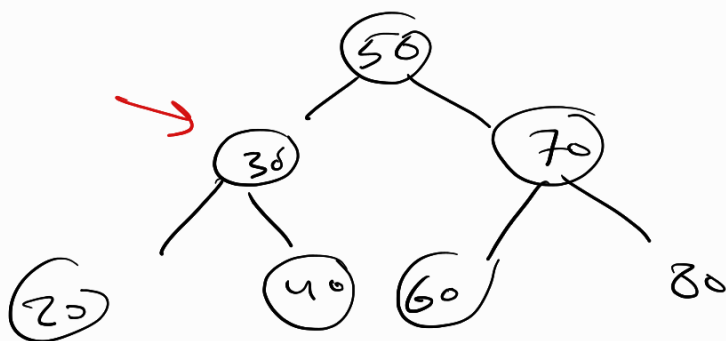
① leaf node



② has one child



③ more than one child

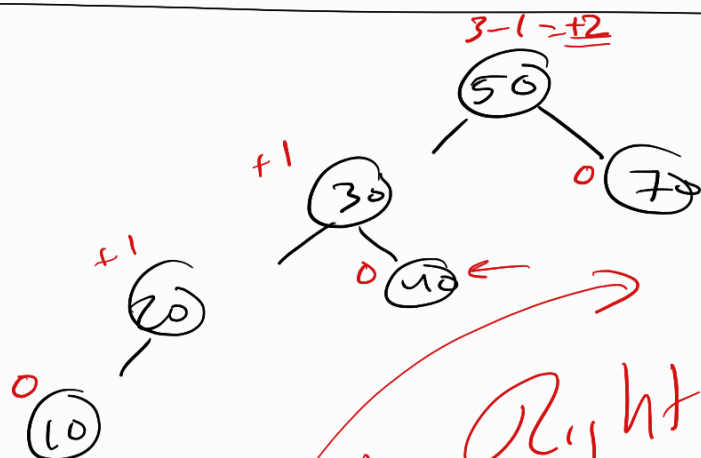
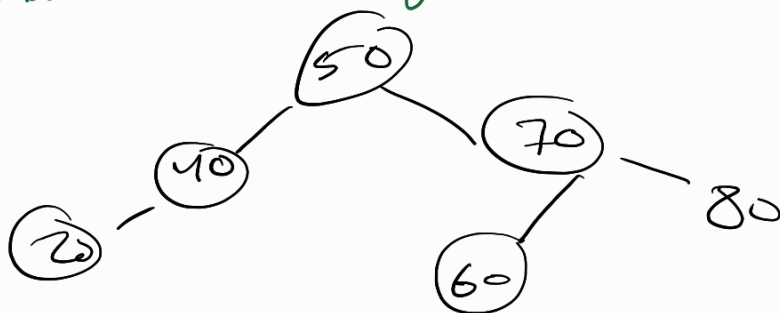


Predecessor

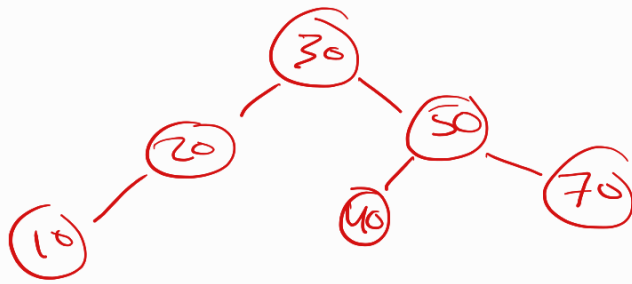
→ largest number from left

✓ Successor

→ smallest number from right



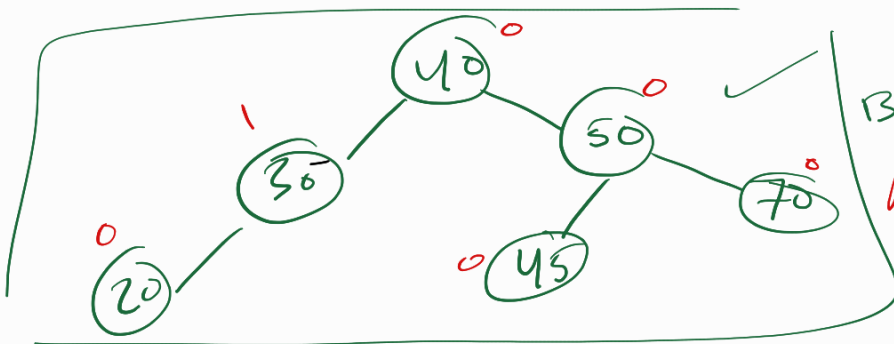
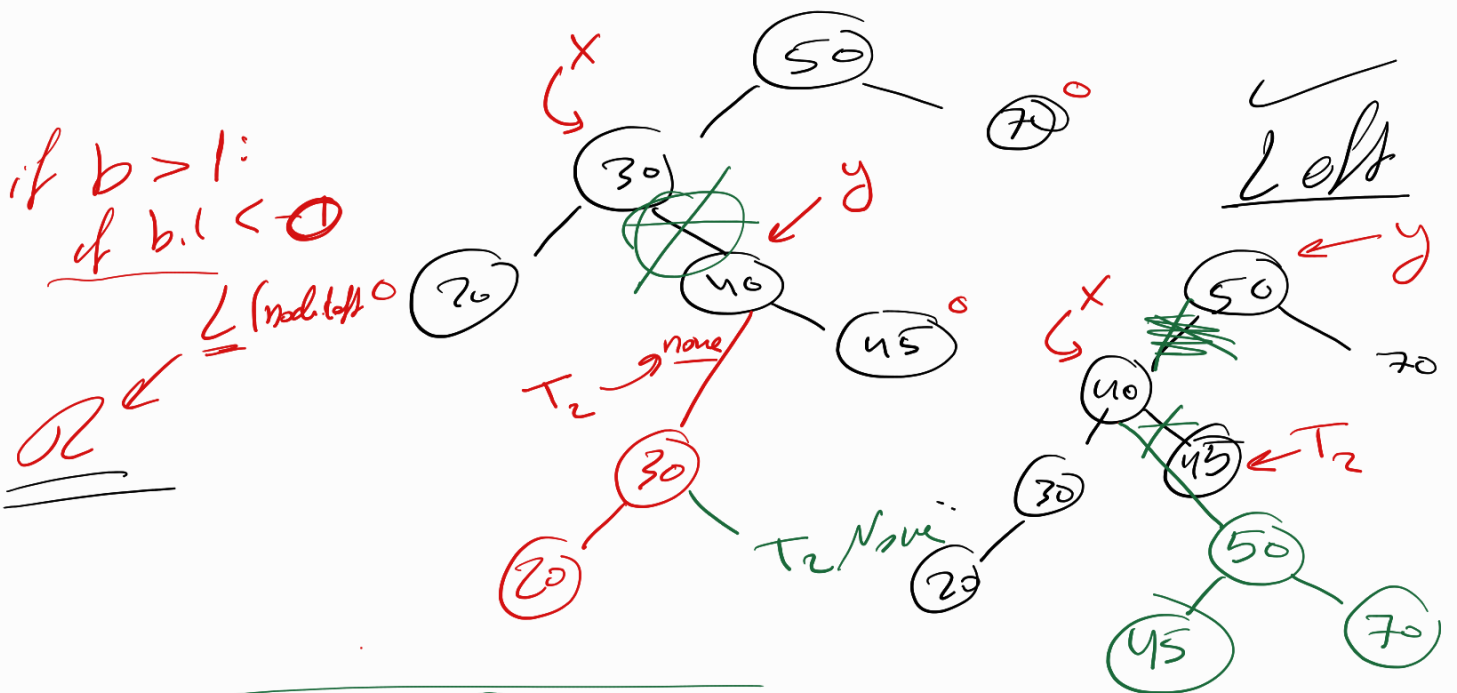
Single Right Rotation



BST? ✓

نقطه لیس ✓ +2	+1 → -1	Single Right
-2	+1 → -1	Double → R L
نقطه لیس ✓ -2	-1 → +1	Double → L R
		Single Left

50 → 70 → 30 → 20 → 40 → 45



BST ✓
Balanced ✓