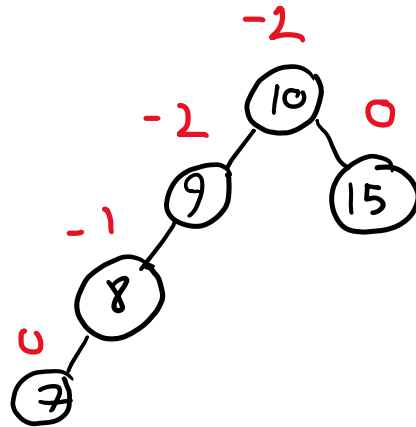


*Each leaf node's height is 0*

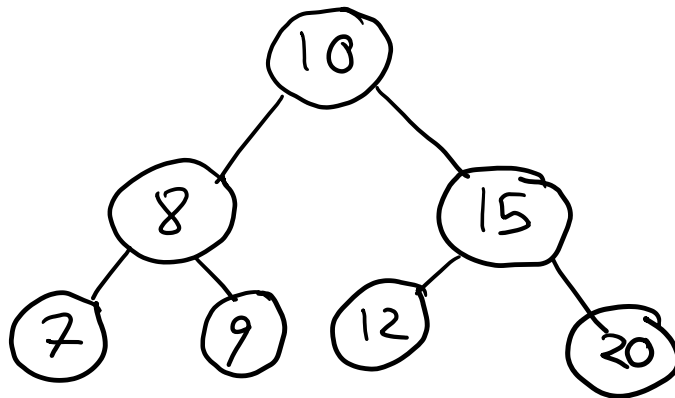
*Balance factor calculation formula: rightSubTree's height – leftSubTree's height*

- i. Write the balance factors of each node in the tree shown below.

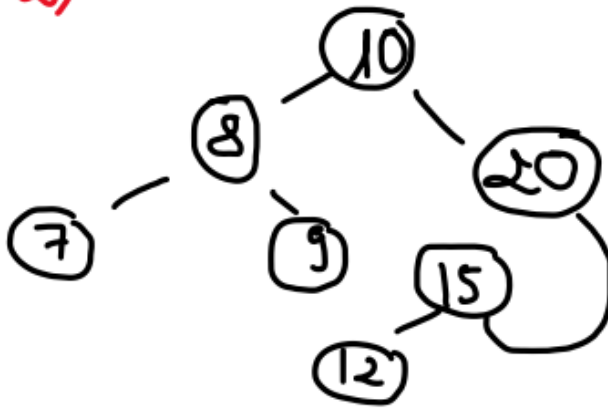


- ii. Rotate the sub-tree rooted at node containing 15 to the left by 1 in the tree shown below. Draw trees to show intermediate steps.

1)

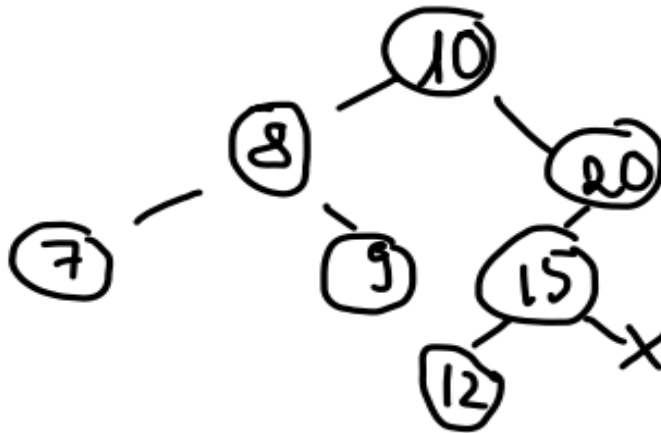


2)



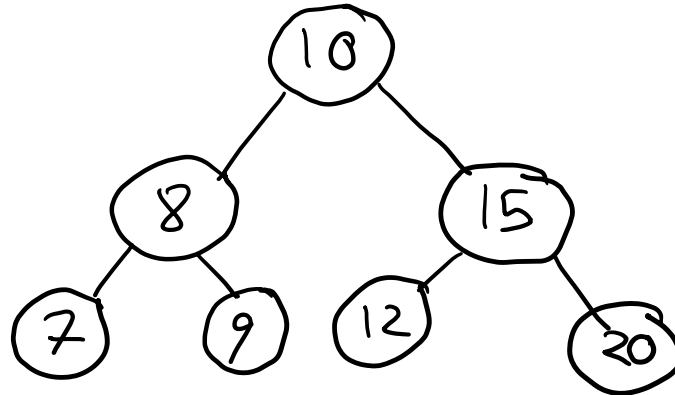
15->right is still 20.

3)

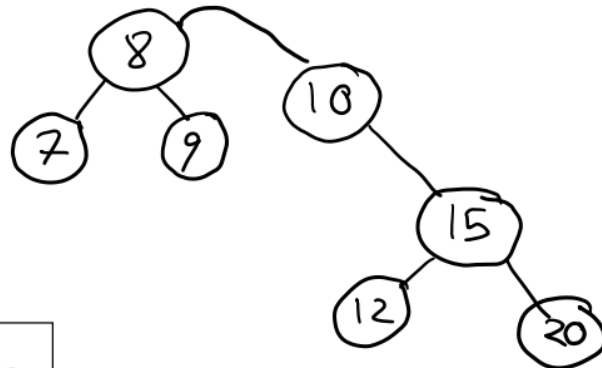


- iii. Rotate the sub-tree rooted at node containing 10 to the right by 1 in the tree shown below. Draw trees to show intermediate steps.

1)

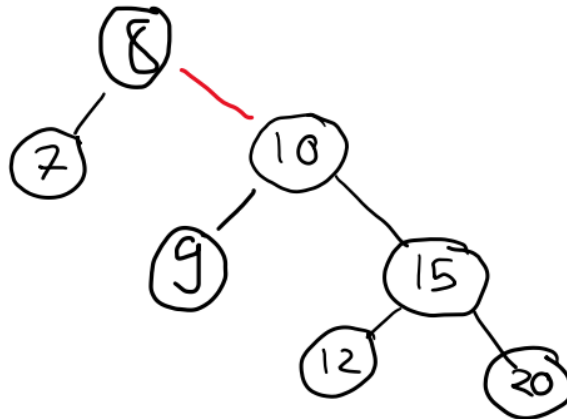


2)



Node 8 is the root now.  
Node 10-left at the moment is still 8

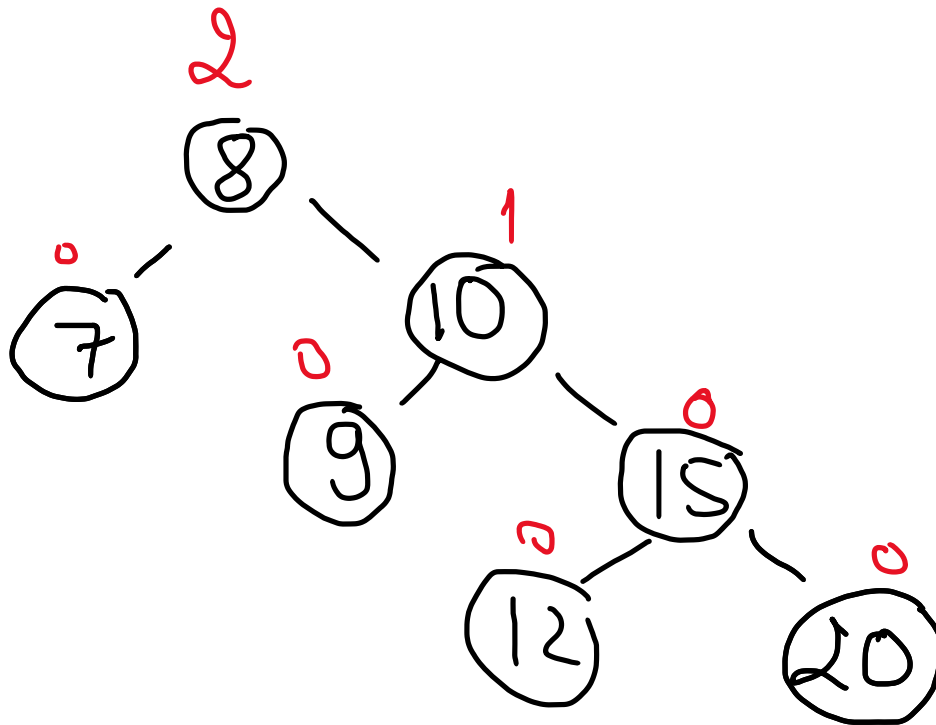
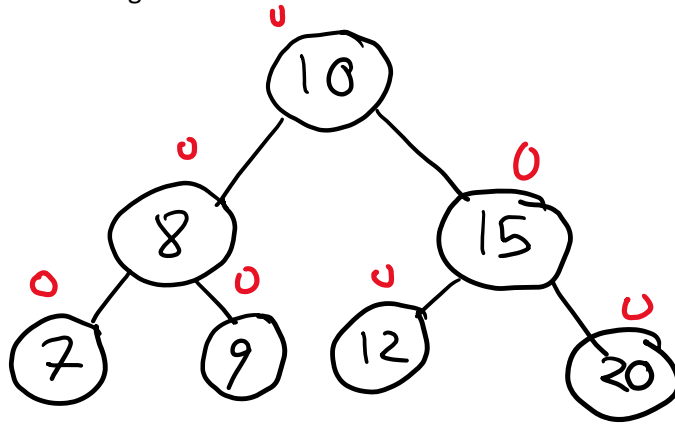
3)



Node 10-left links to node8-right.  
node8-right now links to 10.

2. AVL Tree analysis

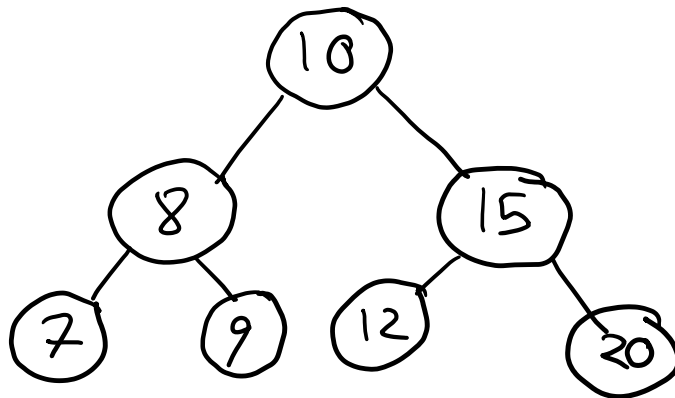
- a. Convert the following bst into one that has an RR imbalance.



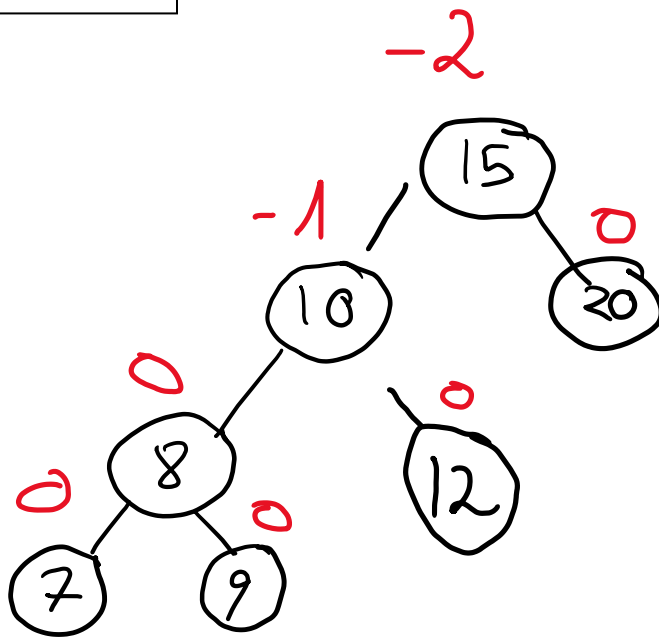
Right rotate node 10

→ RR imbalance at 8

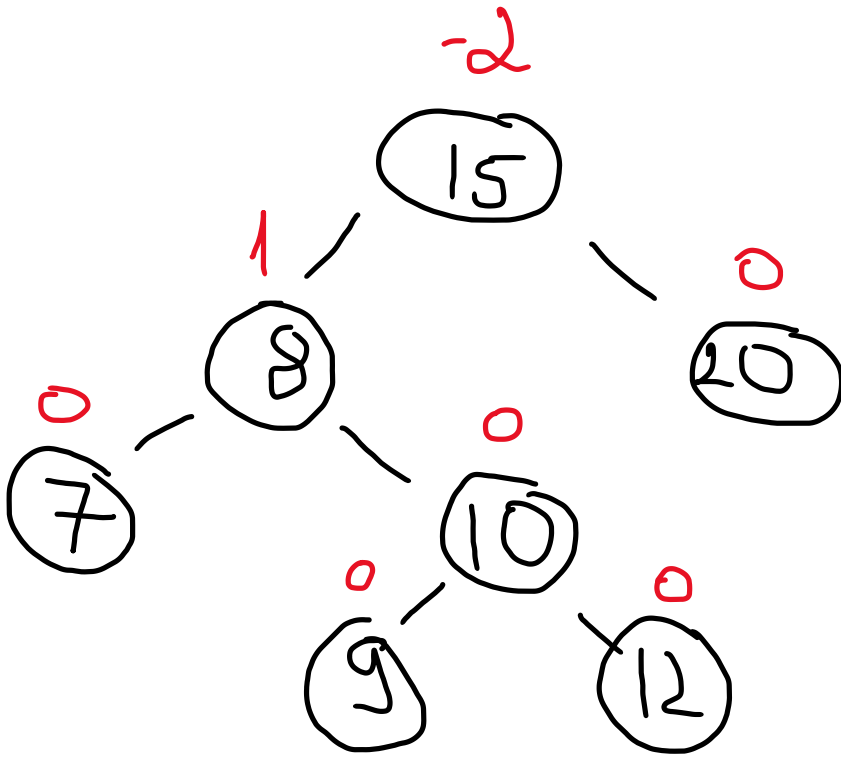
b. Convert the following bst into one that has an LR imbalance.



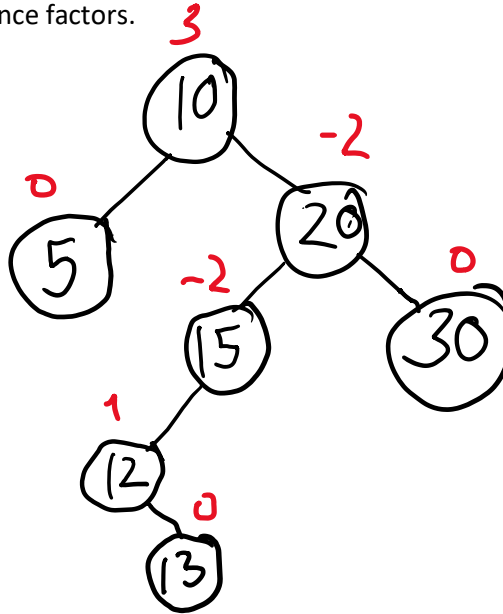
Left rotate at 10, then a right rotate  
at 10  
→ LR imbalance at 15



$\Rightarrow$



- c. What type of imbalance does the bst shown below have at node containing 15? Give reasoning using balance factors.

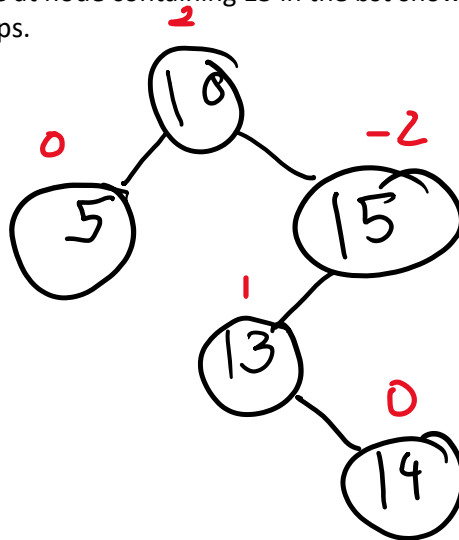


At 15, it's LR imbalance since:

$$BF(15) == -2$$

$$BF(15 \rightarrow \text{left}) = BF(12) = 1$$

- d. Fix the imbalance at node containing 15 in the bst shown below. Draw trees to show intermediate steps.



At 15 → LR imbalance.

- 1 left rotation at 13
- 1 right rotation at 15

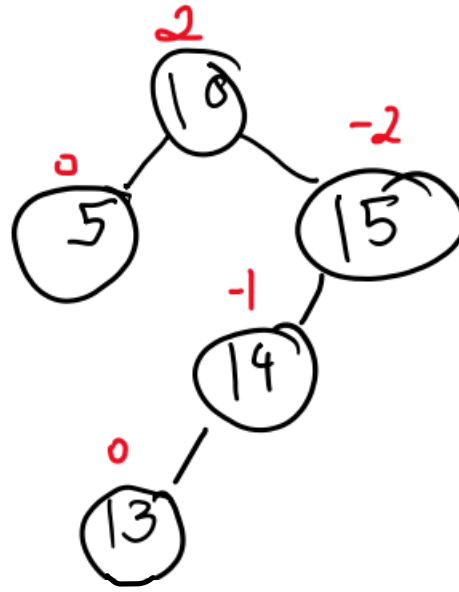
1)

Left rotation at 13:

15->left to 13->right which is 14

13->right to 14->left which is nullptr

14->left to 13



Right rotation at 15:

10->right now links to 14

15->left links to 14->right (nullptr)

14->right links to 15

2)

