Data Structures

Tree Rotation

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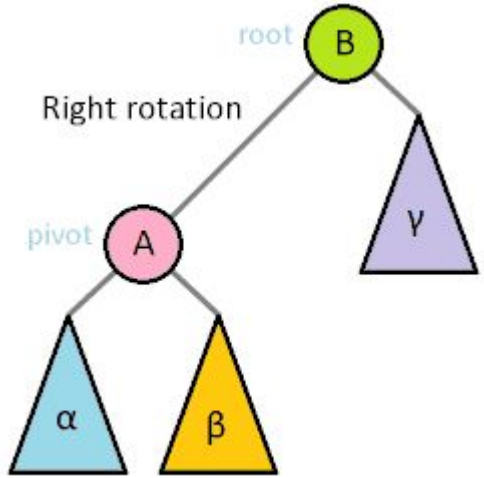
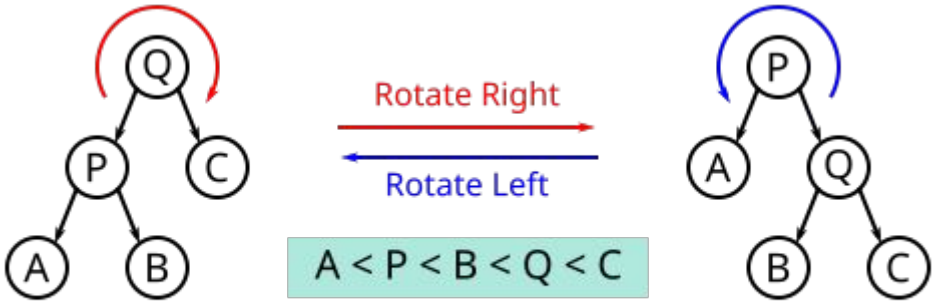
Left and Right Rotations

- Tree rotation **changes the structure** without affecting the order of the elements
  - One node moves **up** and one node moves **down**
  - This movement can change the height of A and B
  - We will use this height change for **rebalancing**
- We have 2 rotations
  - Right rotation (clockwise):
    - For memorization: the right node (B) goes down
  - Left rotation (counter-clockwise)
    - For memorization: the left node (A) goes down
- Observe β is the only child *changing its parent*



Left and Right Rotations



- Observe
  - Subtrees A, B, C: no change to their children ⇒ same BF
  - A < P < B < Q < C in both
    - Remain a BST
- Right rotation (*clockwise*)
  - P's height increased
  - Q's height decreased
- Left rotation (*counter-clockwise*)
  - P's height decreased
  - Q's height increased

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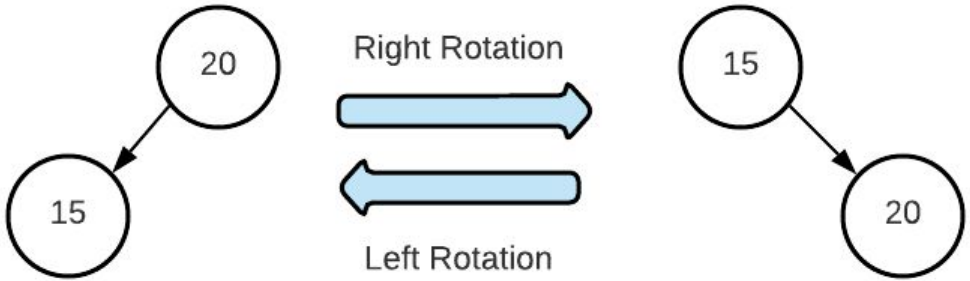
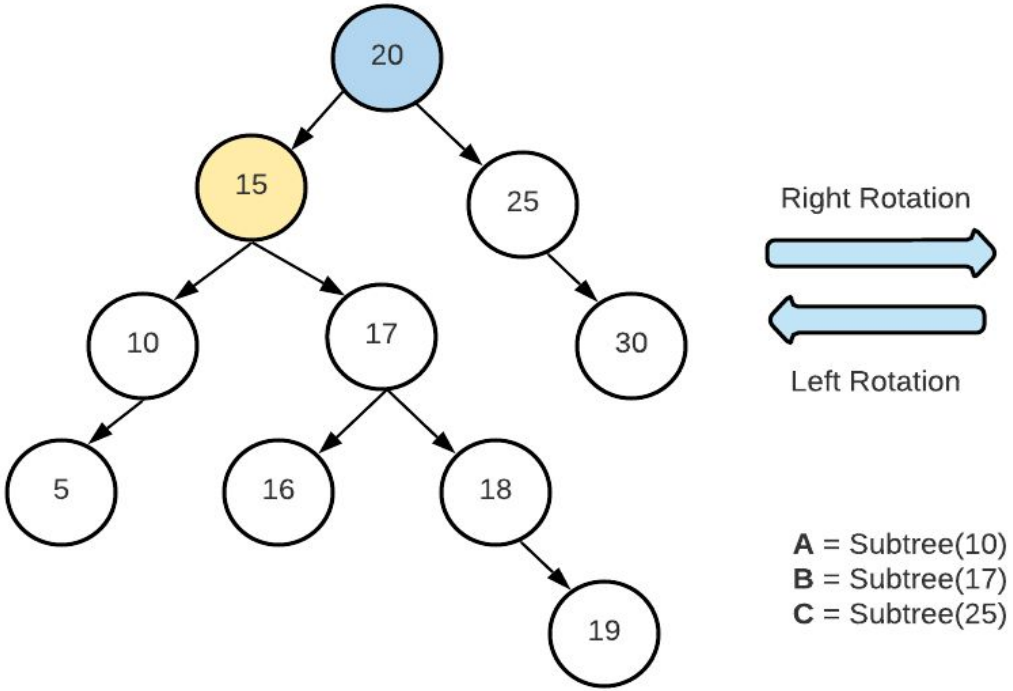
Rotation Example

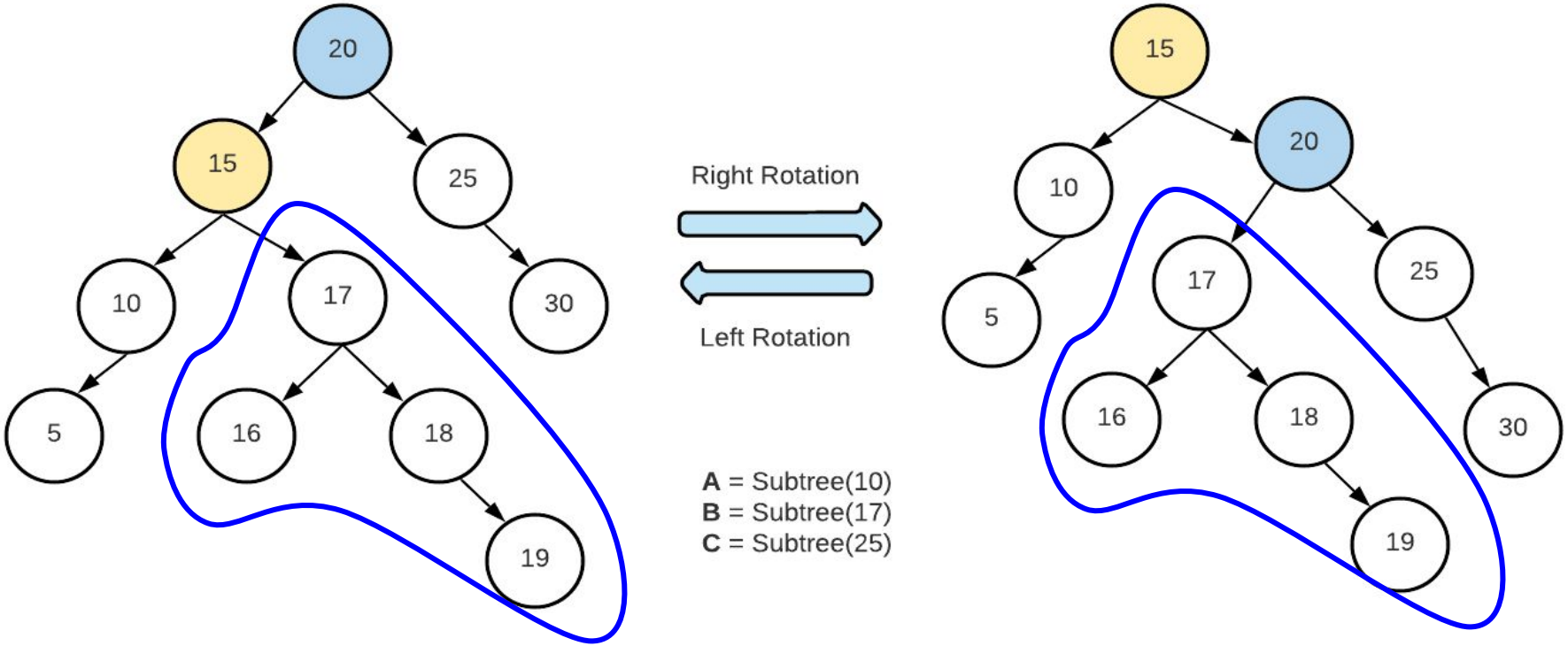


Your turn: Right rotation for subtree(20)



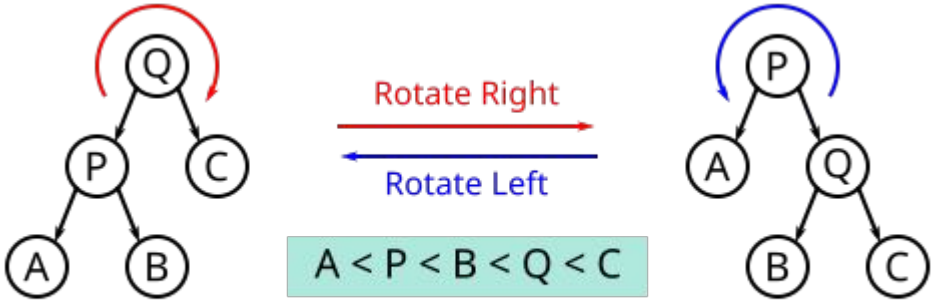
A = Subtree(10)
B = Subtree(17)
C = Subtree(25)

Rotation Example

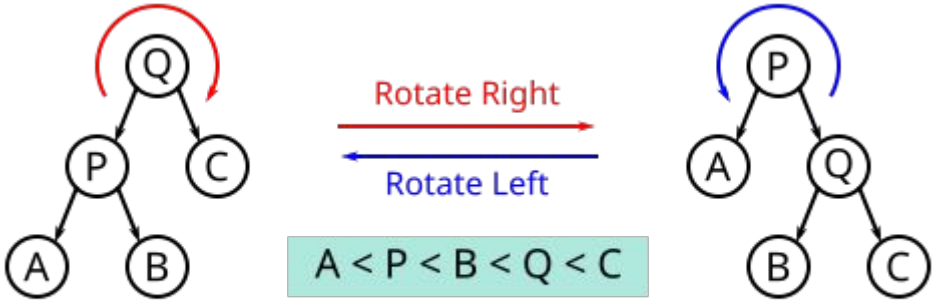


Your turn: Code rotations

- AVLTree* right_rotation(AVLTree* Q)
- AVLTree* left_rotation(AVLTree* P)
- Tip: A few simple lines of code (sketch out your work on paper)



Right Rotation code




```
def _right_rotation(self, Q):
    print("right_rotation", Q.val)
    P = Q.left
    Q.left = P.right
    P.right = Q
    Q.update_height()
    P.update_height()
    return P
```

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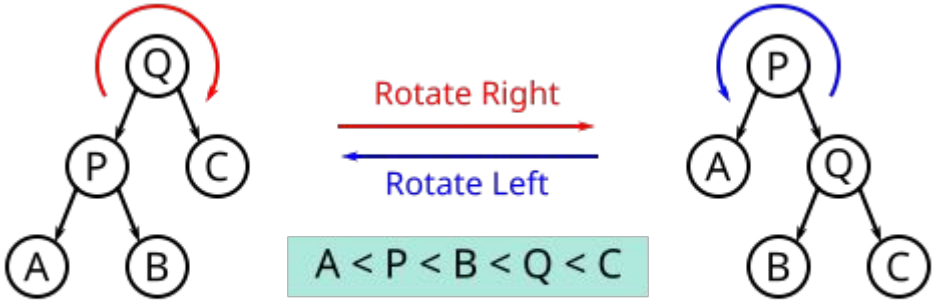
Left Rotation code




```
def _left_rotation(self, P):
    print("left_rotation", P.val)
    Q = P.right
    P.right = Q.left
    Q.left = P
    P.update_height()
    Q.update_height()
    return Q
```

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"Acquire knowledge and impart it to the people."

"Seek knowledge from the Cradle to the Grave."