BALANCED RED BLACK TREE

In this assignment, you are expected to implement a modified red black tree named Balanced Red Black Tree in Java.

RULES

- **Input Type:**
  - V = Value of node. (Mehmet)
  - K = Key of node. (29)
- **Balancing Conditions:**
  - If *root* is not **BLACK**.
  - If two nodes in a row are **RED**.
  - If the difference of depth between any two subtrees is more than 1.
- **Balancing Transactions:**
  - If *root* = ***RED*** then *Recolor(root).*
  - If *node.uncle* = ***RED*** then *Recolor(node.parent, node.grandparent, node.uncle).* ○ If *node.uncle* = ***BLACK*** and node_positions = ***TRIANGLE*** then *Rotate(node.parent).* (Figure 1.A)
  - If *node.uncle* = ***BLACK*** and node_positions = ***LINE*** then *Rotate(node.grandparent)* and *Recolor(node.parent, node.grandparent).* (Figure 1.B)
  - If the height of the left and right subtrees of each node is more than 1 then *Rotate(node.grandgrandparent)* and *Recolor(node.grandparent, node.grandgrandparent).*
- Usage of Abstract Data Types (ADT) is required.
- Object Oriented Principles (OOP) and try-catch exception handling must be used when it is needed.
- After balancing process, difference between depth of the right and left tree at any part of the tree should be 0 or 1.
- All Red Black Tree and balance codes must be implemented by yourself.

- **Main Functionalities:**
    - **INSERT:** Insert the given inputs to the tree.
    - **SEARCH:** Search a user input (word) in the tree and return word, key, color, parent, grandparent, and uncle information of the node.

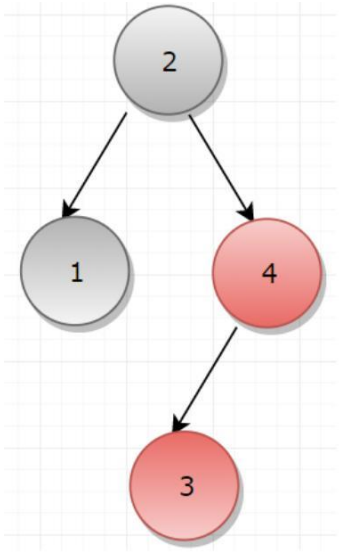


Figure 1.A – node_position = **TRIANGLE**

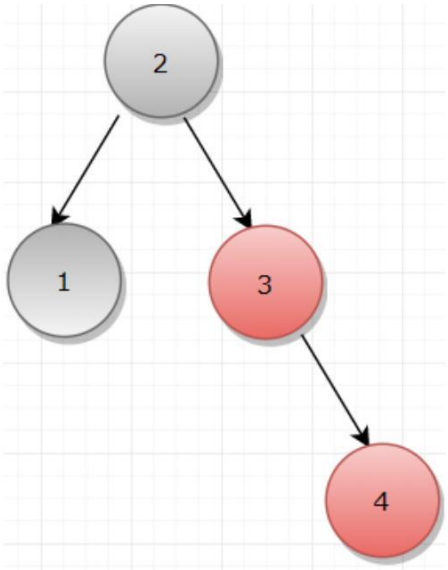


Figure 1.B – node_position = **LINE**

SEARCHING EXAMPLE

Search: Mehmet

Key: 6

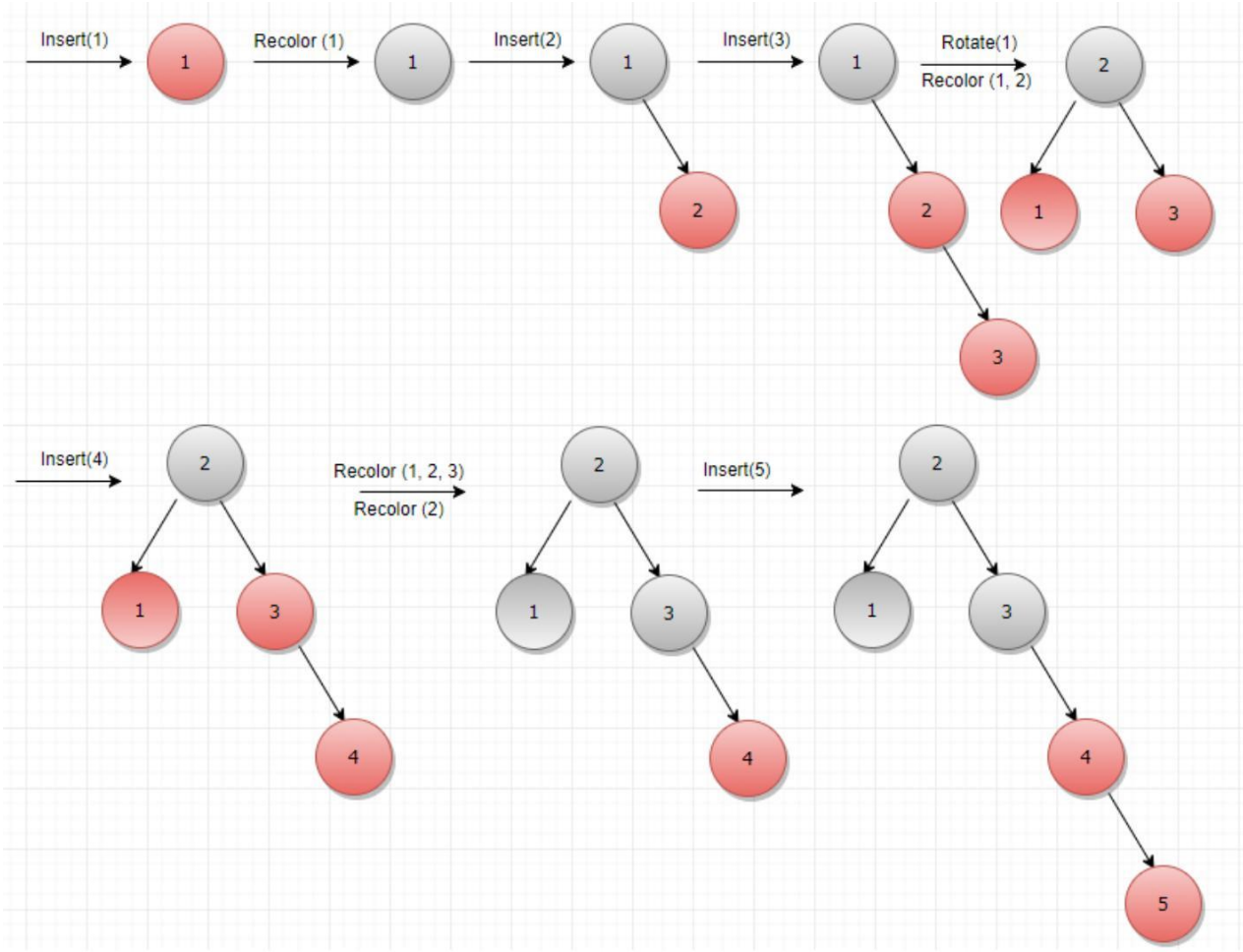
Color: RED

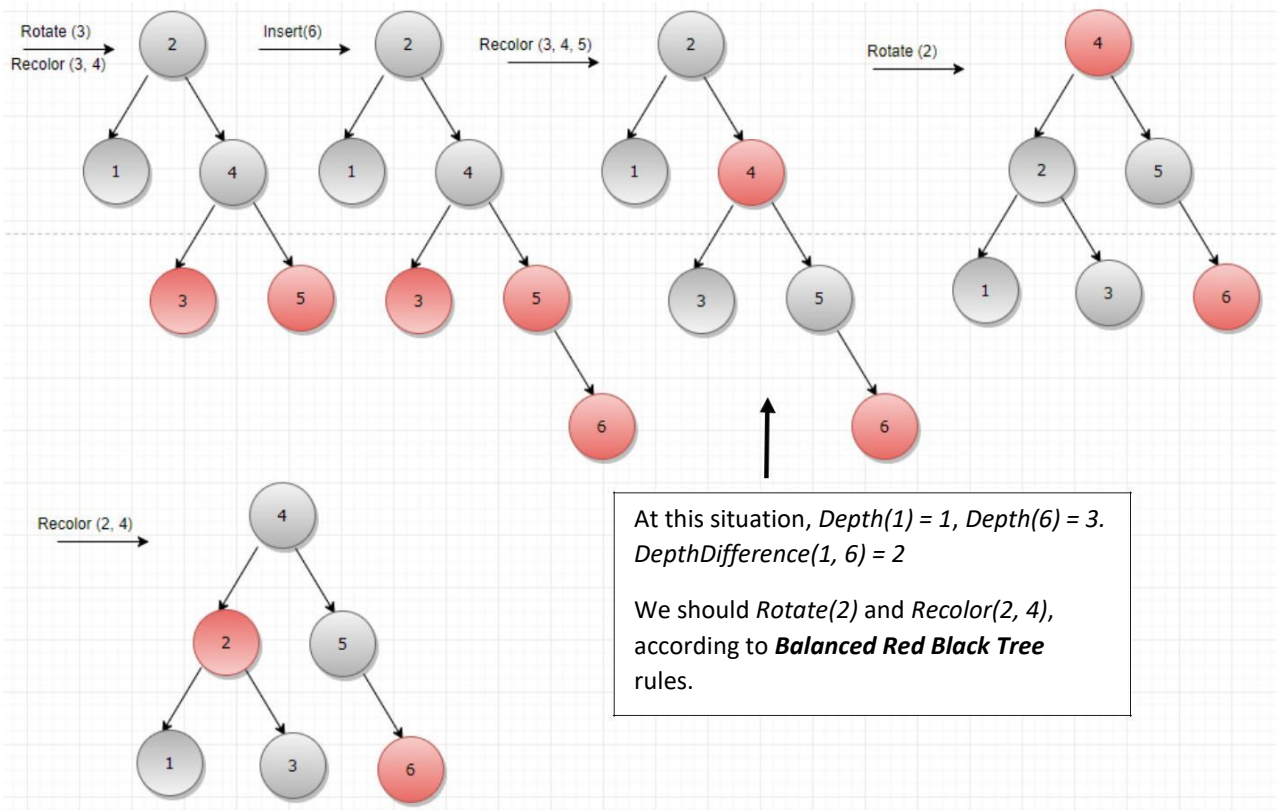
Parent.Key: 5 -> Parent.Color: BLACK

Grandparent.Key: 4 -> Parent.Color: BLACK

Uncle.Key: 2 -> Parent.RED

INSERTION EXAMPLES





At this situation, *Depth(1) = 1*, *Depth(6) = 3*. *DepthDifference(1, 6) = 2*

We should *Rotate(2)* and *Recolor(2, 4)*, according to ***Balanced Red Black Tree*** rules.