

CLRS Problem 13.3-2: insert nodes into an empty red-black tree.

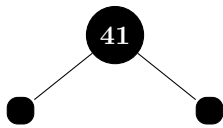
Note: NIL nodes shown as black rounded-corner rectangles.

Insert: 41

Always insert new nodes as red.

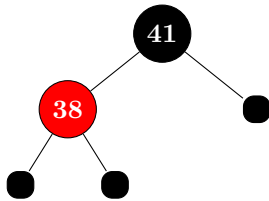


Inserting into an empty tree, the root must be black.

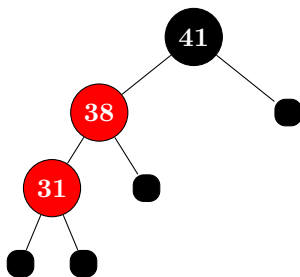


Insert: 38

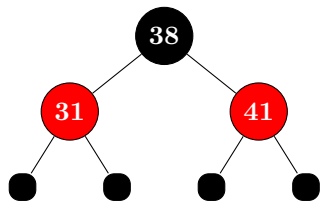
Simply insert 38 as a red node.



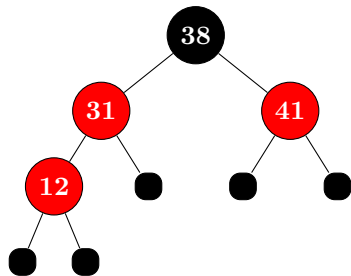
Insert: 31



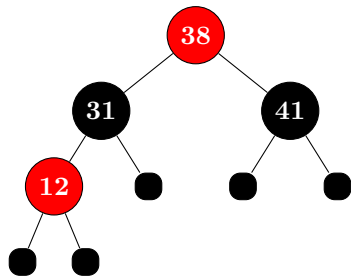
Uncle (NIL) is black, rotate grandparent in opposite direction of node inserted, in this case, rotate right on node with key 41.



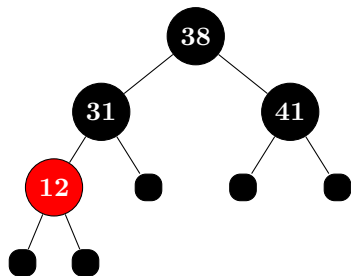
Insert: 12



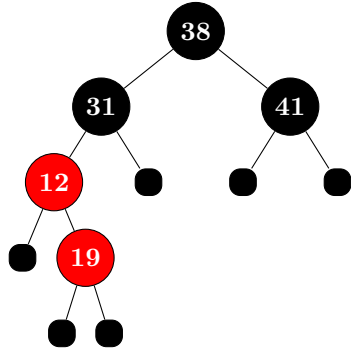
Uncle is red, recolor parent, uncle, and grandparent.



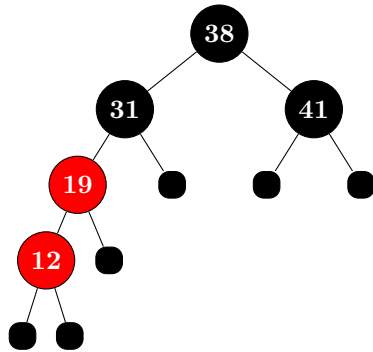
The root must be black, recolor it black.



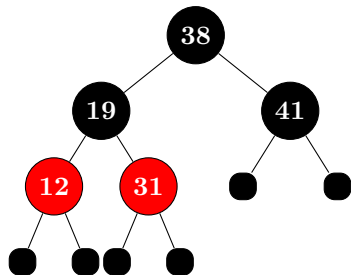
Insert: 19



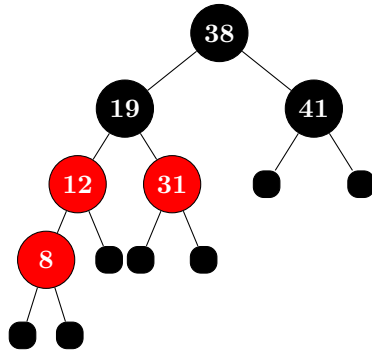
Uncle (NIL) is black, “triangle” case, thus, rotate 19’s parent (node with key 12).



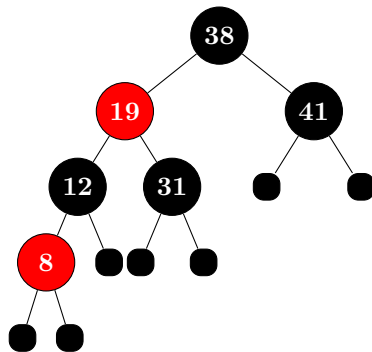
Uncle (NIL) is black, “line” case, thus, rotate right on 12’s grandfather.



Insert: 8



Uncle is red, recolor parent, uncle, and grandparent.



Done!