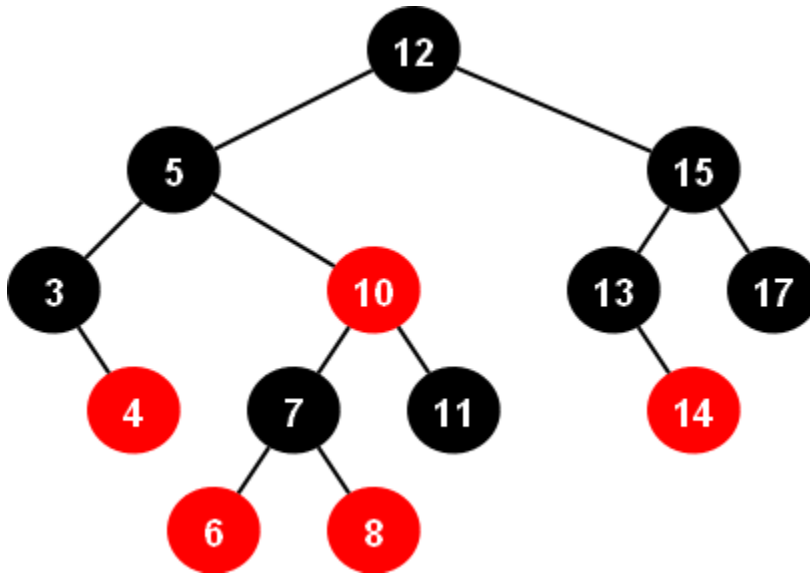


## Lab W3D1

### Problem 1

Consider the following initial configuration of a Red-Black Tree:



Draw the tree representation of the Red-Black tree after each of the following operations. Your operations are done in **sequence**, so your tree should have 17 values in it when you're done. Make sure to clearly indicate each of your final answers including rotations

Insert 1

Insert 13.5

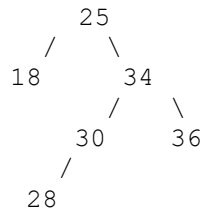
Insert 14.5

Insert 9

## Problem 2

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- (a) Given the following “Red-Black tree”, indicate the color of each node with letter R or B.



- (b) Insert the key 29.

## Problem 3 Exploration

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- (a) How many Red-Black trees are there if the number of nodes = 1, 2, 3, 4, 5, 6, 7, 8, 9 and so on.
- (b) What is the maximum value of the ratio of #Red nodes/#Black nodes.
- (c) What is the minimum value of the ratio of #Red nodes/#Black nodes.