CS/CPE590: Algorithms
Spring 2023
Assignment (Extra Credit)

Advanced Search Trees

1. (50 Points) Red-black tree (RBT) is a special version of BST that allows faster retrieval operations. Answer the followings about RBT based on the assigned reading:

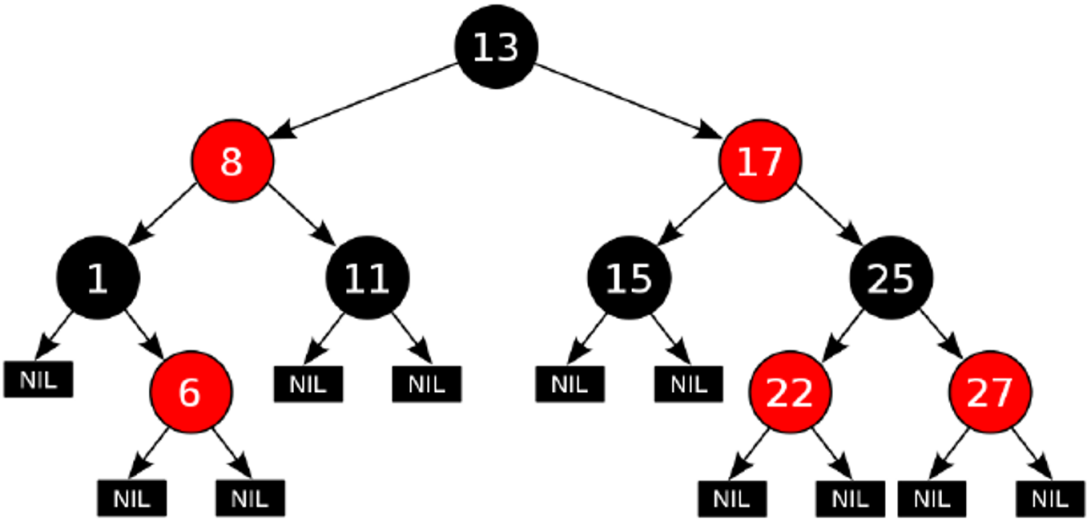
a. Mention the properties of an RBT?

b. What is the maximum height of an RBT with n nodes? If every path from the root to a null/NIL node contains b black nodes, the tree will have at least how many black nodes? Is it possible to insert a black node into an RBT? Explain your answer.

c. Demonstrate all the cases of insertion of a node in RBT? Provide the pseudocode of the insertion that covers all the cases.

d. Demonstrate all the cases of deletion of a node from RBT? Provide the pseudocode of the deletion that covers all the cases.

e. Insert the nodes with key/value 14, 7, 23 into the following RBT in the given order. Redraw the tree for each of the steps. (Make sure to mention the color of the nodes)



Remarks:

- The assignment has to be completed individually. No collaboration is allowed between students. No code from online resources is allowed to be used. Any sign of collaboration or use of online materials will result in a 0 and be reported to the Stevens Honor Board. You have to strictly follow the provided template. **No late submission is allowed**.
- You have to submit a report containing your solutions to the set of problems in Question-1 as a **pdf** file.