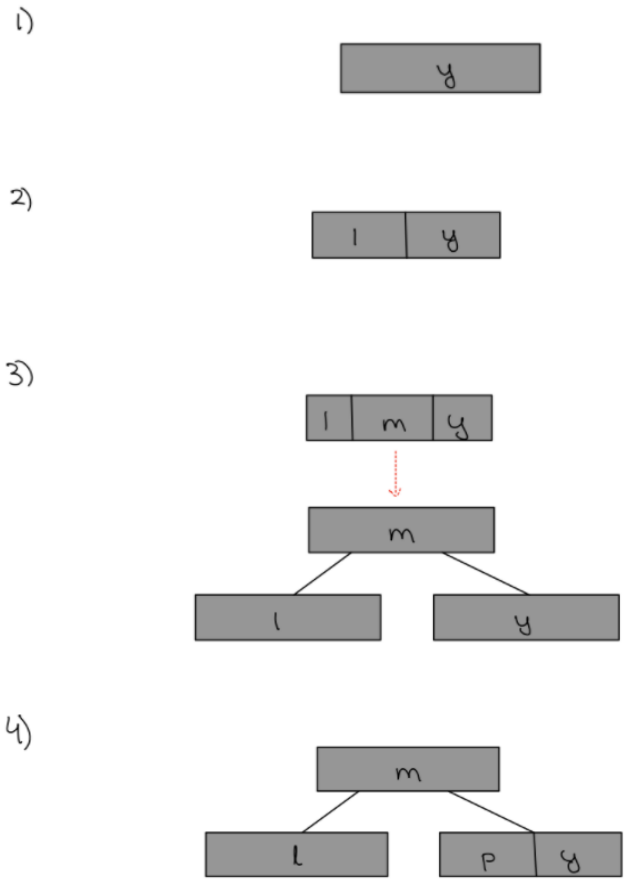
Keshav Narang

Data Structures and Algorithms in Java

November 22nd, 2021

**Assignment 10 - Red Black Trees**

1. Draw the 2-3 trees that result when you insert the keys Y L P M X H C R A E S T B C A in that order into an initially empty tree. Show all intermediate and final trees after each insertion.



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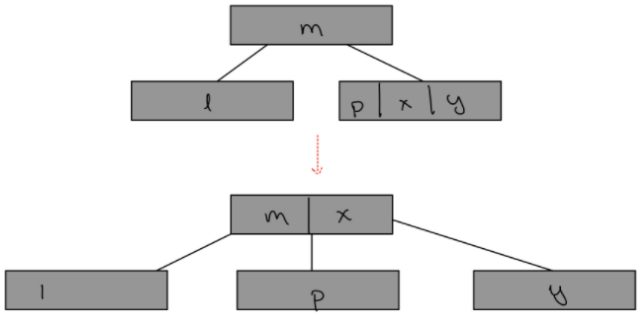


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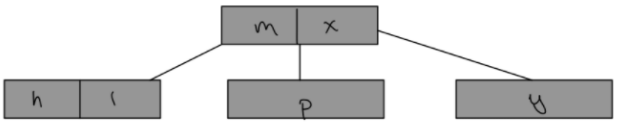


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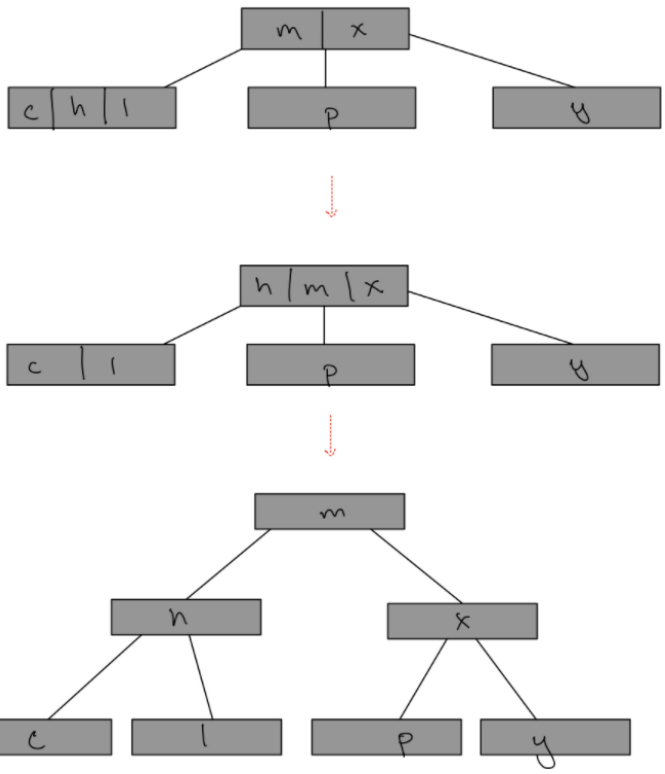

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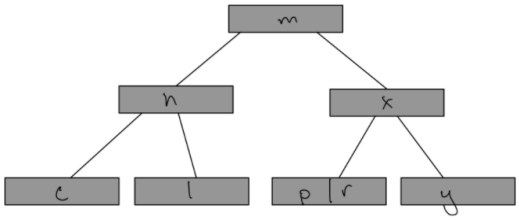
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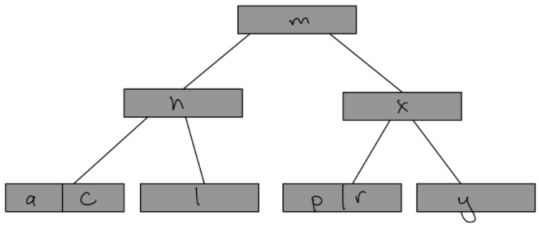
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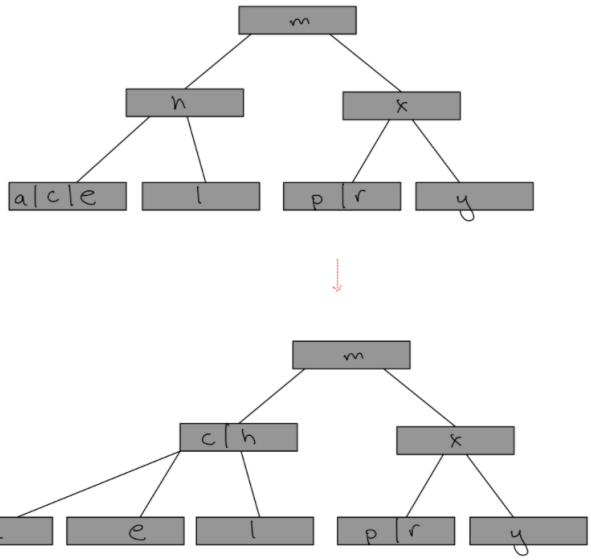
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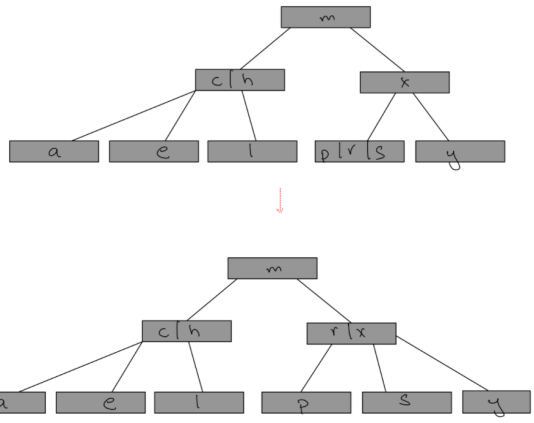
11)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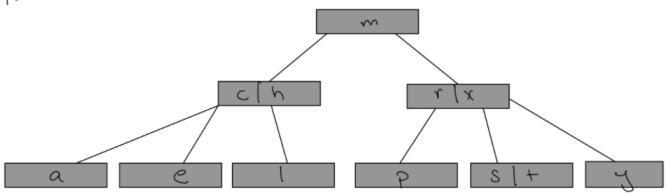


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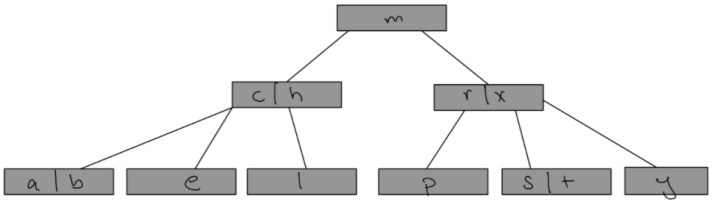


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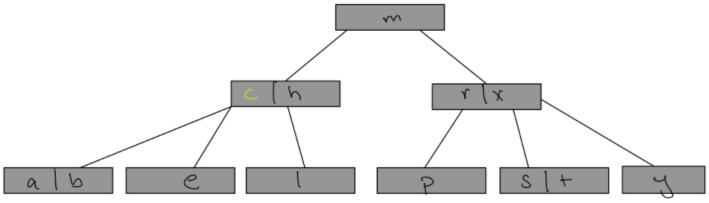


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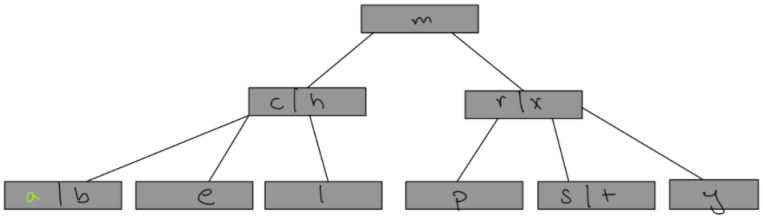
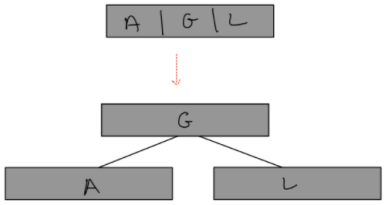



2. Draw the 2-3 trees that result when you insert the keys A L G O R I T H M S X Y Z in that order into an initially empty tree. Show all intermediate and final trees after each insertion.

1)


2)

3)

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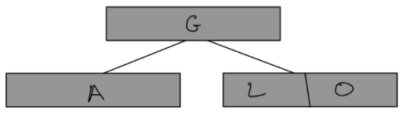


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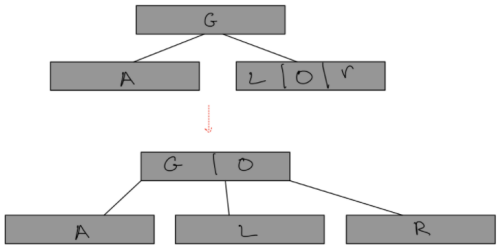


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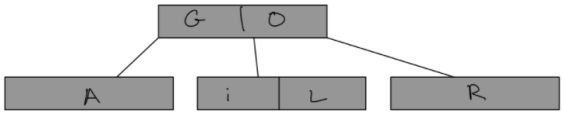


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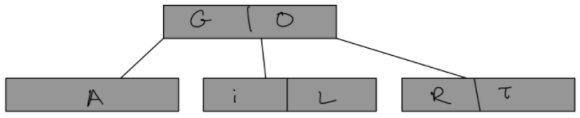

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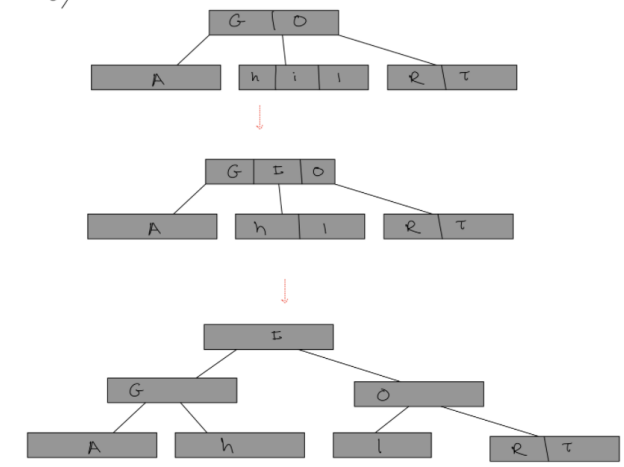
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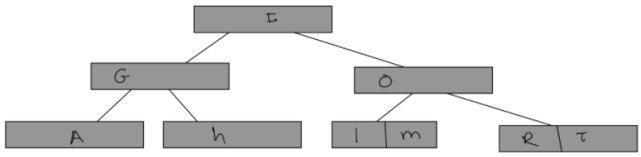
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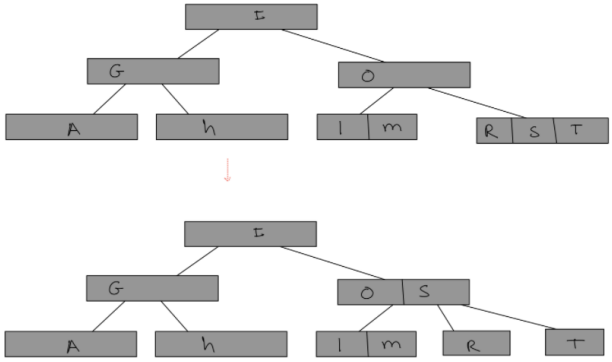
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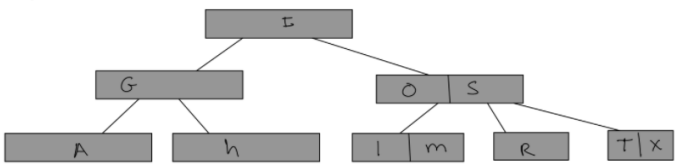
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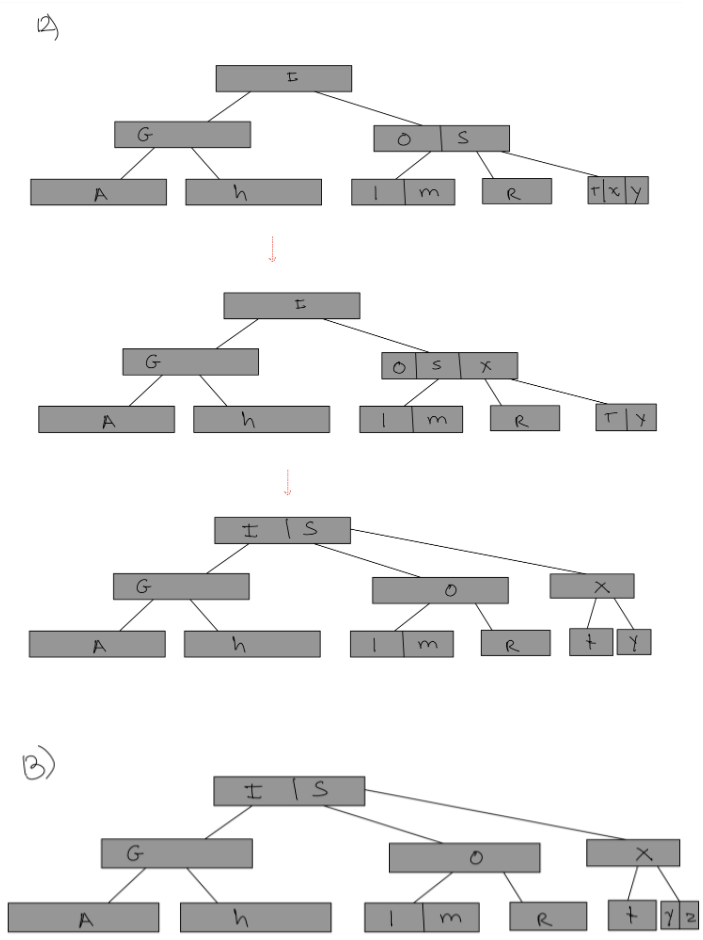
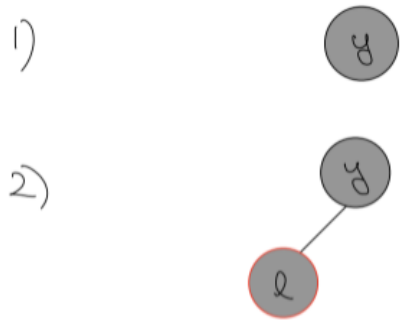



3. Draw the red-black trees that result when you insert the keys Y L P M X H C R A E S T B C A in that order into an initially empty tree. Show all intermediate and final trees after each insertion.



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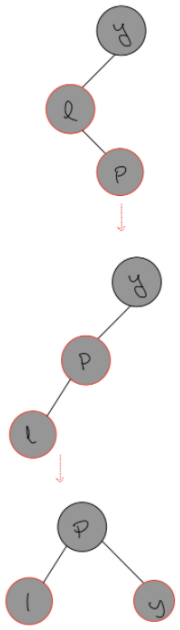


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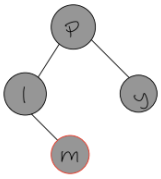


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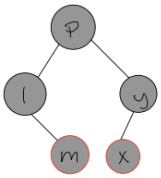


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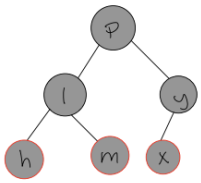


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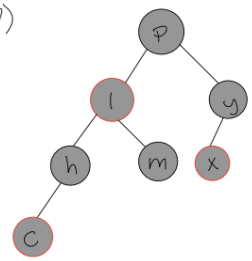

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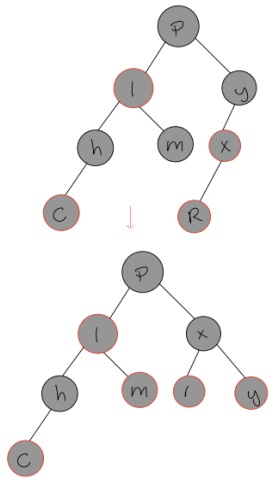
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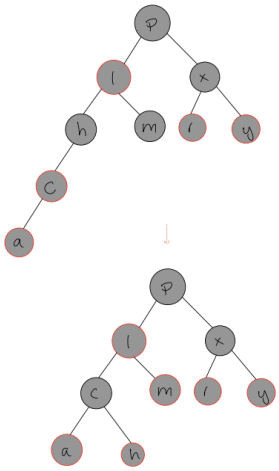
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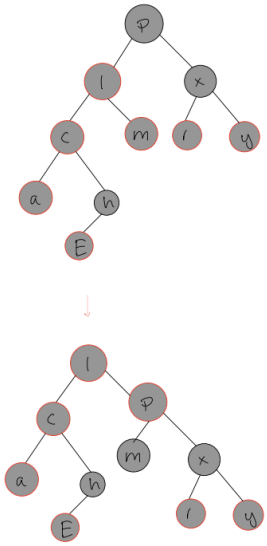
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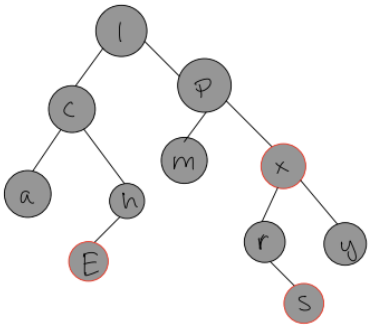


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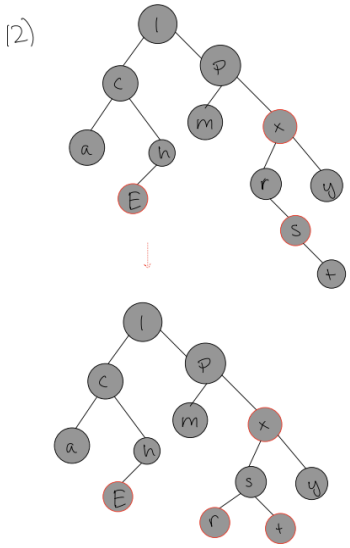
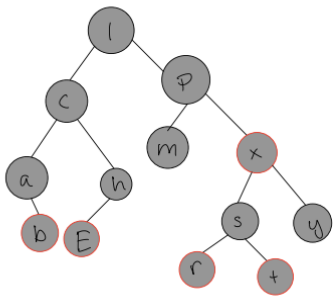






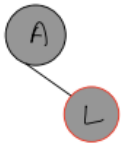
13)



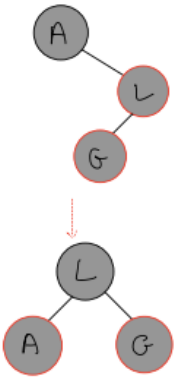

4. Draw the red-black trees that result when you insert the keys A L G O R I T H M S X Y Z in that order into an initially empty tree. Show all intermediate and final trees after each insertion.

1)

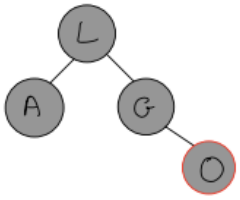

2)




3)




4)



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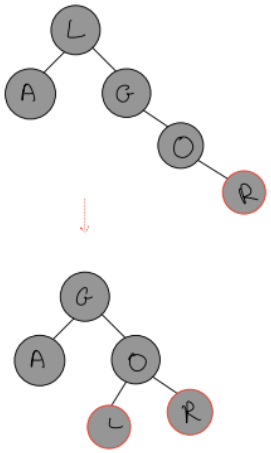
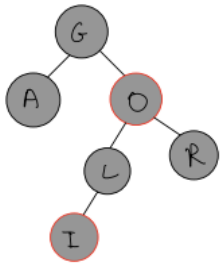
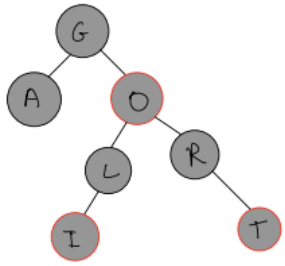


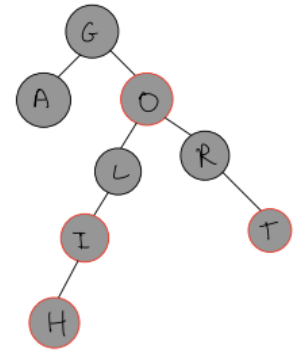

6)

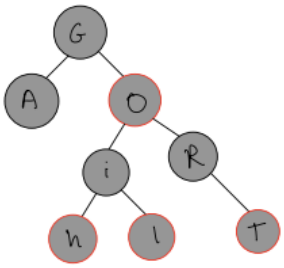



7)

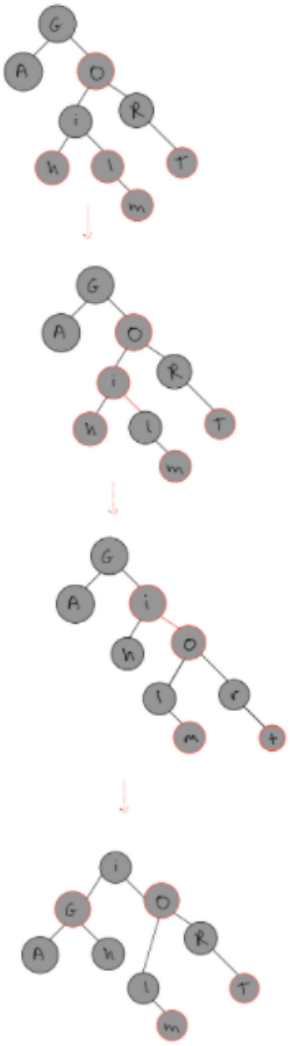


8)

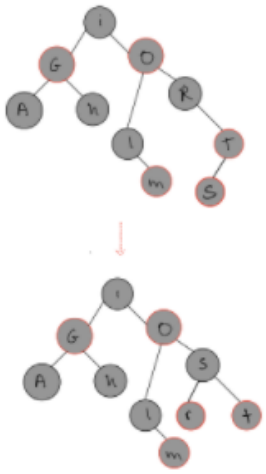


9)



b)




c)

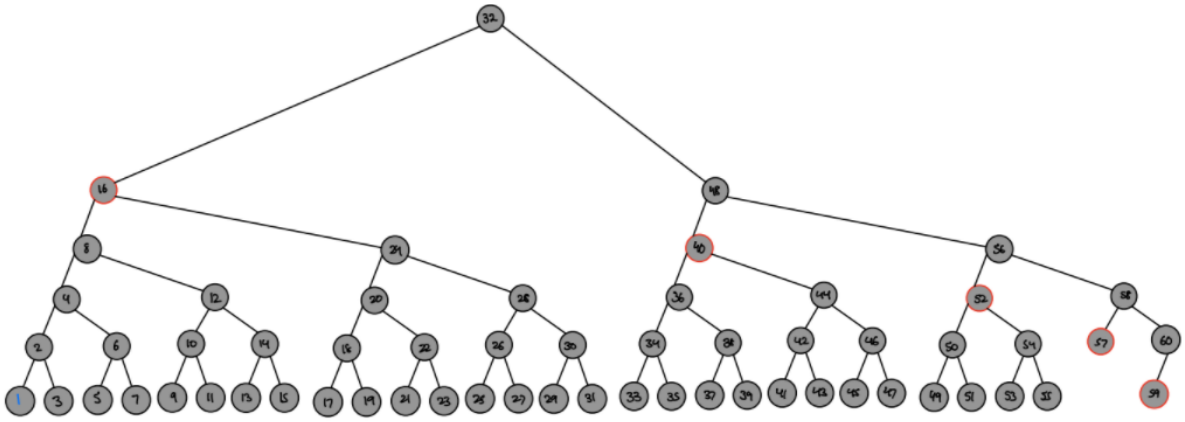
12.



13.



5. Implement a Red-Black tree using the code provided in section 3.3 and problems 3.39 – 3.41.
    a. Insert the keys 1 to 60 in increasing order into an empty tree. Draw the resulting tree by hand.



b. Then delete keys 1 to 20 in increasing order. Draw the resulting tree after deleting the first 20 numbers (i.e., after deleting 1-20). You can draw the tree by hand.