



Homework Assignment II

CS 202-002

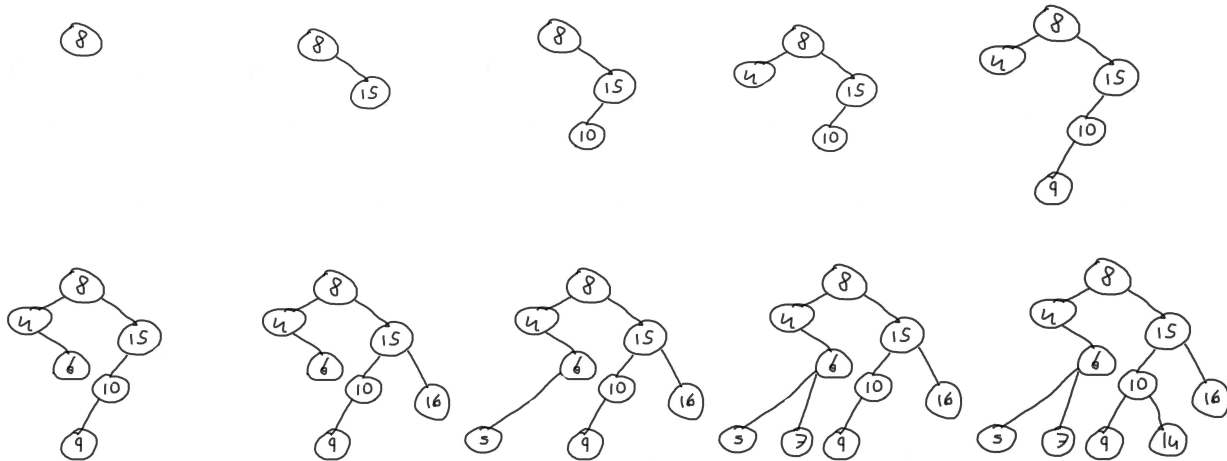
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CS

a) Insert 8, 15, 10, 4, 9, 6, 16, 5, 7, 14 into an empty binary search tree in the given order. Show the resulting BST after every insertion.



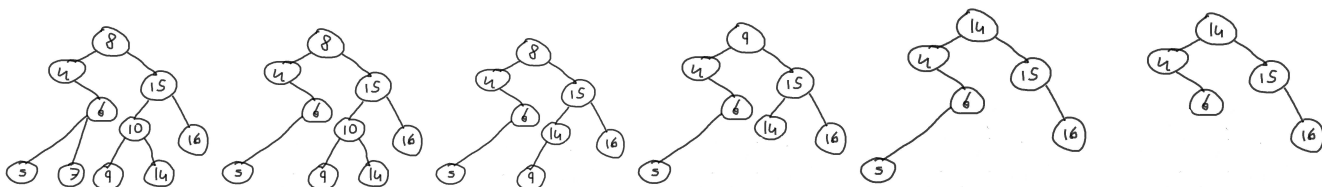
b) What are the preorder, inorder, and postorder traversals of the BST you have after (a)?

i) Preorder: **8, 4, 6, 5, 7, 15, 10, 9, 14, 16**

ii) Inorder: **4, 5, 6, 7, 8, 9, 10, 14, 15, 16**

iii) Postorder: **5, 7, 6, 4, 9, 14, 10, 16, 15, 8**

c) Delete 7, 10, 8, 9, 5 from the BST you have after (a) in the given order. Show the resulting BST after every deletion.



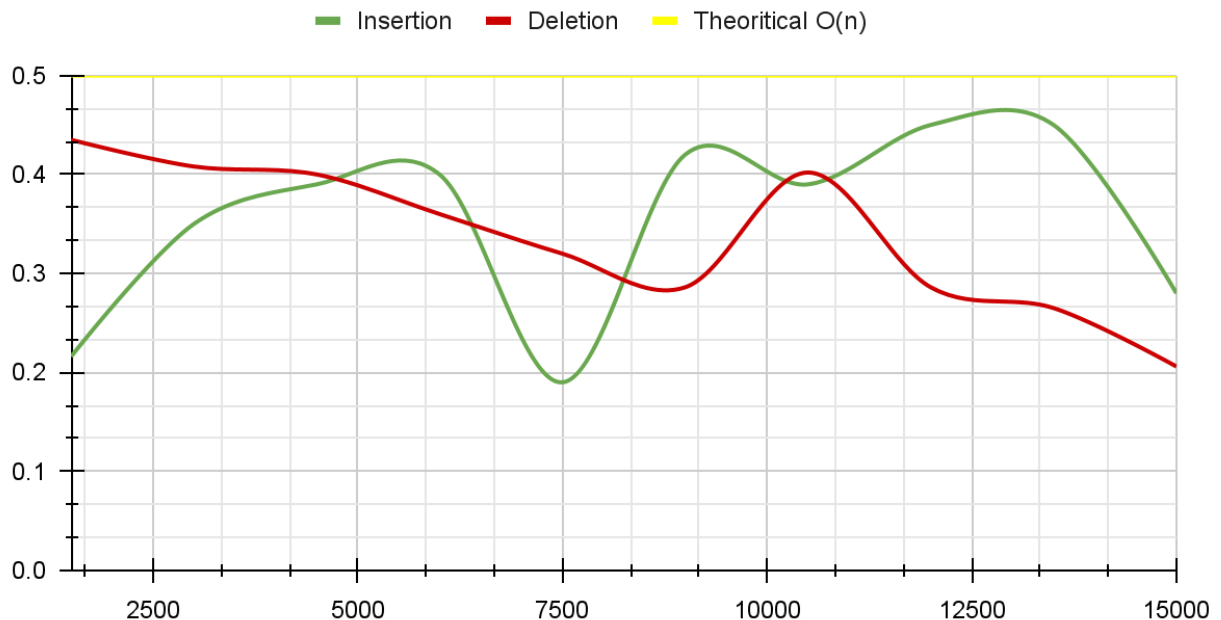
d) Write a recursive pseudocode implementation for finding the minimum element in a binary search tree.

```
def findMin(Node headNode)
    while(headNode.leftChild != NULL) {
        headNode = headNode.leftChild
    }
    return headNode.value
```

(e) What is the maximum and minimum height of a binary search tree that contains n items ?

Maximum will be when elements are chained one after the other or $n - 1$ height. Minimum will occur when tree is evenly distributed or $\log_2(n)$.

BST Performance Analysis (ms)



Final Comments:

Upon analyzing the results, it is evident that the insertion and deletion algorithms outperform their theoretical worst-case scenario due to the balancing effect of the average case, which is of $\log(n)$. There are multiple deviations and inconsistencies. These occurrences could be explained by a sequence of unfavorable/favorable deletions/insertions that took place at a different heights in the tree, which was caused by an imbalanced tree structure. Using a sorted array for insertion instead of a randomly sorted array would result in a significant decrease in performance. This is because it would always trigger the worst-case scenario of $O(n)$, causing the binary tree to resemble a linked list. Such a scenario would undermine the purpose of having a binary tree in the first place. I was pleasantly surprised by the effectiveness of binary search trees as a data storage (deletion and insertion) and retrieval method.

Relevant specifications for device used to conduct these tests:

Processor: Intel(R) Core(TM) i7-10750H CPU @ 2.60GHz 2.59 GHz

Installed RAM: 16.0 GB (15.8 GB usable)

Operating System: Windows 11 Pro 21H2 Build 22000.1219

System Type: 64-bit operating system, x64-based processor