Agenda:

- Construct a Binary Tree, given its Preorder and Inorder traversals (discuss also for Postorder and Inorder).
- Iterative inorder traversal
- Introduction to Binary Search Trees
    - Discuss properties
    - Inorder traversal always sorted
- Searching a node in a BST
- Inserting a node in a BST
- Deleting a node from a BST
- How to check whether a given tree is a BST or not?
- Sorted array to BST

Construct Tree from Inorder & Preorder

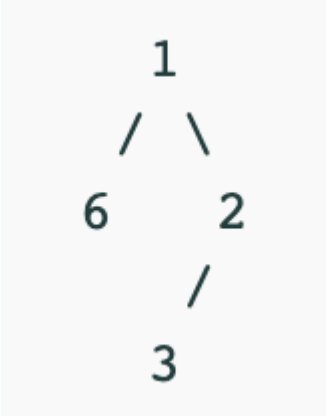
Given 2 Arrays of Inorder and preorder traversal. Construct a tree and print the Postorder traversal.

```
Input:
N = 6
inorder[] = {3 1 4 0 5 2}
preorder[] = {0 1 3 4 2 5}
Output: 3 4 1 5 2 0
Explanation: The tree will look like
        0
     /     \
   1        2
 /   \     /
3     4   5
```

Iterative inorder traversal

Given a binary tree, return the inorder traversal of its nodes values.

NOTE: Using recursion is not allowed.




```
[6, 1, 3, 2]
```

Introduction to Binary Search Trees

Binary Search Tree is a node-based binary tree data structure that has the following properties:

- The left subtree of a node contains only nodes with keys lesser than the node's key.
- The right subtree of a node contains only nodes with keys greater than the node's key.
- The left and right subtree each must also be a binary search tree.

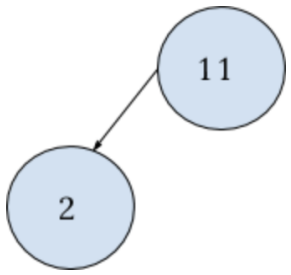
There must be no duplicate nodes.

The basic purpose and idea behind such a data structure are to have a storing mechanism that provides a way for efficient sorting and searching operations.

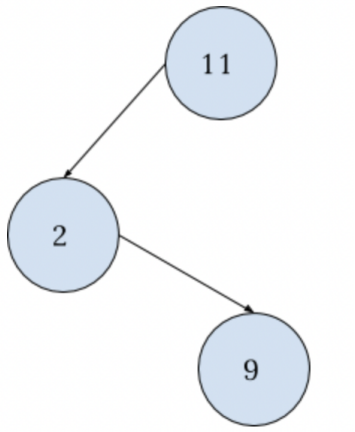
Inserting a Node into BST

Any newly inserted node in a BST is always a leaf node.

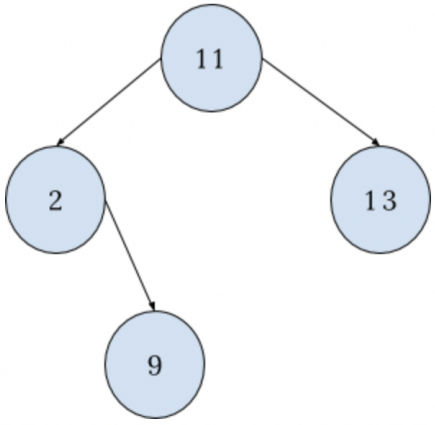
For example:



Insert 9:



Insert 13:

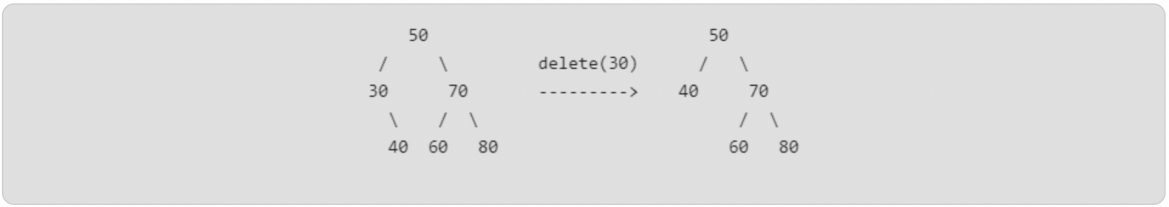


Deleting a Node from BST

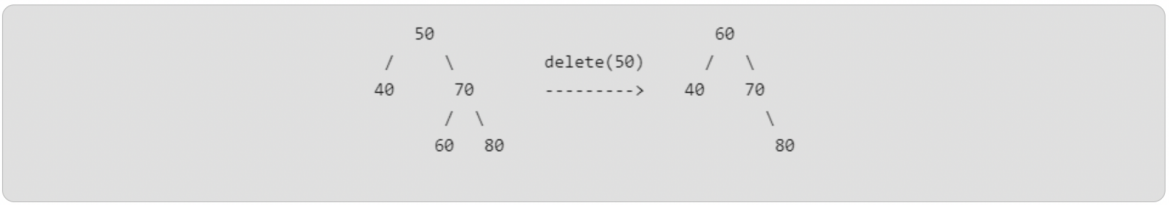
There are 3 possible cases:

1. *Node to be deleted is leaf:* Simply remove from the tree.

2. *Node to be deleted has only one child:* Copy the child to the node and delete the child.



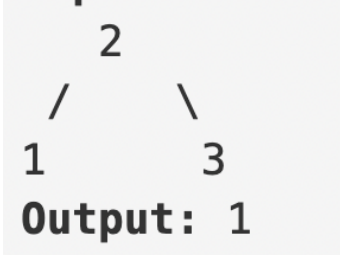
3. *Node to be deleted has two children:* Find inorder successor of the node. Copy contents of the inorder successor to the node and delete the inorder successor. Note that inorder predecessor can also be used.



How to check whether a given tree is a BST or not?

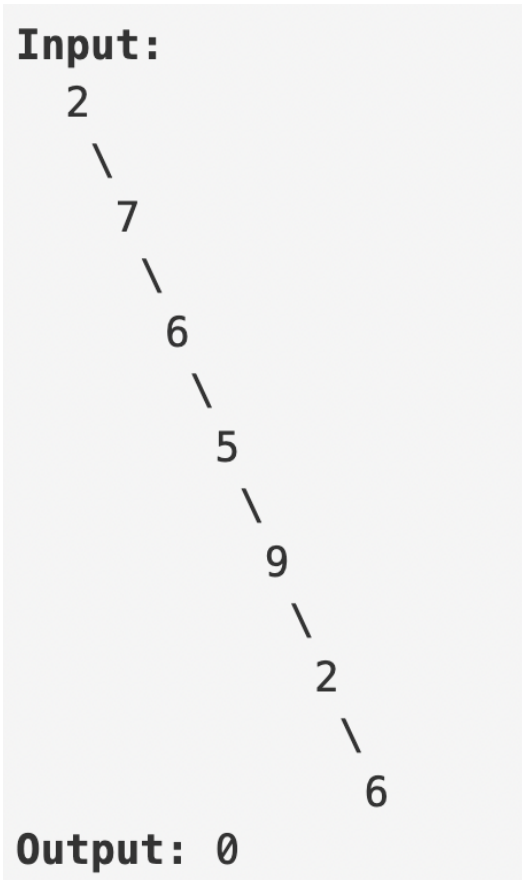
Given the root of a binary tree. Check whether it is a BST or not.
Note: We are considering that BSTs can not contain duplicate Nodes.

Input:



Output: 1

Input:



Output: 0

Sorted array to Height Balanced BST

Given an integer array `nums` where the elements are sorted in **ascending order**, convert *it to a **height-balanced** binary search tree*.

A **height-balanced** binary tree is a binary tree in which the depth of the two subtrees of every node never differs by more than one.

Output: Preorder traversal of the returned BST

```
Input: nums = {1,2,3,4,5,6,7}
Ouput: {4,2,1,3,6,5,7}
Explanation:
The preorder traversal of the following
BST formed is {4,2,1,3,6,5,7} :
        4
      / \
     2   6
    / \  / \
   1   3 5  7
```