1. Give the preorder, inorder, postorder, and level-order traversals of the following binary trees.
   1. A picture containing sketch, circle, drawing, white

      Description automatically generated

Pre-order: D B A C F E G

In-order: A B C D E F G

Post-order: A C B E G F D

Level-order: D B F A C E G

* 1. A picture containing sketch, circle, drawing, diagram

     Description automatically generated

Pre-order: C B A D E

In-order: A B C D E

Post-order: A B E D C

Level-order: C B D A E

c. A picture containing sketch, circle, drawing, white

Description automatically generated

Pre-order: E C B A D H F G I

In-order: A B C D E F G H I

Post-order: A B D C G F I H E

Level-order: E C H B D F I A G

1. For each of the following key sequences create the binary search tree obtained when the keys are inserted one-by-one in the order given into an initially empty tree:

(1) 4, 3, 1, 11, 5, 9, 2, 6, 15, 12.

(2) 12, 7, 1, 3, 2, 5, 10, 8, 6, 9.



Give the preorder, inorder, postorder,and level-order traversals of the created binary trees.

In (1) delete keys 2, 3 and 11. In (2) delete keys 5, 6 and 7. After each time of deleting, give the above traversals.

* (1) 4, 3, 1, 11, 5, 9, 2, 6, 15, 12.



Pre-order: 4 3 1 2 11 5 9 6 15 12

In-order: 1 2 3 4 5 6 9 11 12 15

Post-order: 2 1 3 6 9 5 12 15 11 4

Level-order: 4 3 11 1 5 15 2 9 12 6

Delete keys 2, 3, 11: 4, 1, 5, 9, 6, 15, 12.



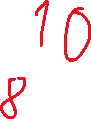
Pre-order: 4 1 5 9 6 15 12

In-order: 1 4 5 6 9 12 15

Post-order: 1 6 12 15 9 5 4

Level-order: 4 1 5 9 6 15 12

* (2) 12, 7, 1, 3, 2, 5, 10, 8, 6, 9.



Pre-order: 12 7 1 3 2 5 6 10 8 9

In-order: 1 2 3 5 6 7 8 9 10 12

Post-order: 2 6 5 3 1 9 8 10 7 12

Level-order: 12 7 1 10 3 8 2 5 9 6

* Delete keys 5, 6,7: 12, 1, 3, 2, 10, 8, 9.



Pre-order: 12 1 3 2 10 8 9

In-order: 1 2 3 8 9 10 12

Post-order: 2 9 8 10 3 1 12

Level-order: 12 1 3 2 10 8 9

1. For each of the key sequences in question 2 create the AVL tree obtained when the keys are inserted one-by-one in the order given into an initially empty tree. Give the preorder, inorder, postorder, and level-order traversals of the created binary trees.

* (1) 4, 3, 1, 11, 5, 9, 2, 6, 15, 12



Pre-order: 5 3 1 2 4 11 9 6 15 12

In-order: 1 2 3 4 5 6 9 11 12 15

Post-order: 2 1 4 3 6 9 12 15 11 5

Level-order: 5 3 11 1 4 9 15 2 6 12

* (2) 12, 7, 1, 3, 2, 5, 10, 8, 6, 9.



Pre-order: 7 3 1 2 5 6 10 8 9 12

In-order: 1 2 3 5 6 7 8 9 10 12

Post-order: 2 1 6 5 3 9 8 12 10 7

Level-order: 7 3 10 1 5 8 12 2 6 9

1. The tree (c) in question 1 is height balanced (AVL). Delete the node D and perform necessary operations so that the tree is still AVL after deletion.

* A picture containing sketch, circle, drawing, white

  Description automatically generated



1. Consider a nearly complete binary tree with n nodes.
   1. For what values of n is a nearly complete binary tree a full binary tree?
      * n is odd
   2. For what values of n is a nearly complete binary a complete (perfect) binary tree?
      * n = 2^h – 1 (h: height of the tree)
2. Suppose we have numbers between 1 and 100 in a binary search tree and we want to search for the number 57 in the tree. Could the following sequence be the sequence of nodes to be examined? 2, 90, 63, 70, 68, 72, 57

* No. In BST, on right child of parent should be greater than parent and left child should be smaller than the parent, but in C after 63, 70 goes on the right side because it greater than parent, now everything below this point should be greater than 63 but 57 appears that does not satisfy the BST property.