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Semester 2 Session 2023/2024

Binary Tree Tutorial

Learning Outcomes:

- Understand the binary tree concept and labels
- Use information provided to traverse a tree in multiple order
- Building a binary tree by analysising different set of traversal order
- Differentiating simple binary tree and binary search tree

Short Questions

1. Mark the following statements as true or false.
   a. A binary tree must be nonempty.

   b. The level of the root node is 0.

   c. If a tree has only one node, the height of the tree is 0 because the number of levels is 0.

   d. The level of a node in a binary tree is the number of branches on the path from the root to the node.

   e. The inorder traversal of a binary tree always outputs the data in ascending order.

   f. In preorder traversal of a binary tree, the node is visited before visiting the left and right subtrees.

   g. In a binary search tree, the data in a node is larger than the data in its left child, if any.

   h. In a binary search tree, the left and right subtrees of a node are binary search trees.

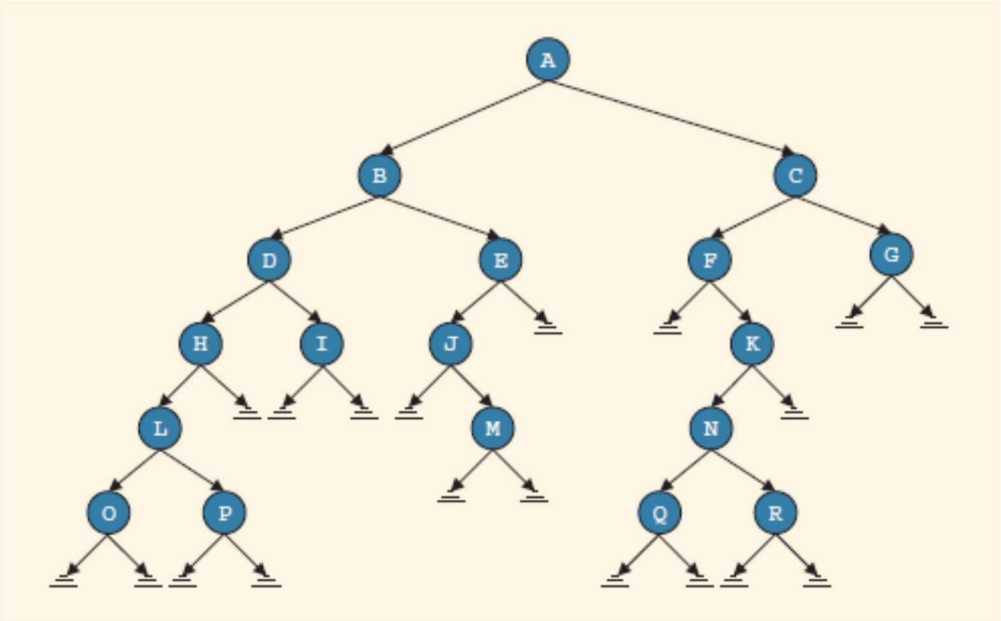
   i. To insert a new item in a binary search tree, first we search the binary search tree and find the place where the new item is to be inserted.

   j. Typically, a stack is used to implement a nonrecursive traversal algorithm in a binary tree.

   k. In C++, a function name without any parentheses is considered a pointer to the function.

2. There are 14 different binary trees with four nodes (do you remember the formula?). Draw all of them.

3. Given the following tree:



Answer the following:

a. Find L_A, the node in the left subtree of A.

b. Find R_A, the node in the right subtree of A.

c. Find L_B, the node in the left subtree of B.

d. Find R_B, the node in the right subtree of B.

e. Find L_E, the node in the left subtree of E.

f. Find the height of the tree with root A.

g. Find the height of the tree with root D.

h. Find the level of the node M.

i. Find the height of the tree with root C.

j. Find the level of the node K.

k. Find the level of the node F.

l. Find the number of leaves in the binary tree with root A.

m. Find the number of leaves in the binary tree with root C.

n. List the leaves in the binary tree with root E.

o. List the nodes in the path from node A to node P.

p. List the nodes of this binary tree in an inorder sequence.

q. List the nodes of this binary tree in a preorder sequence.

r. List the nodes of this binary tree in a postorder sequence.

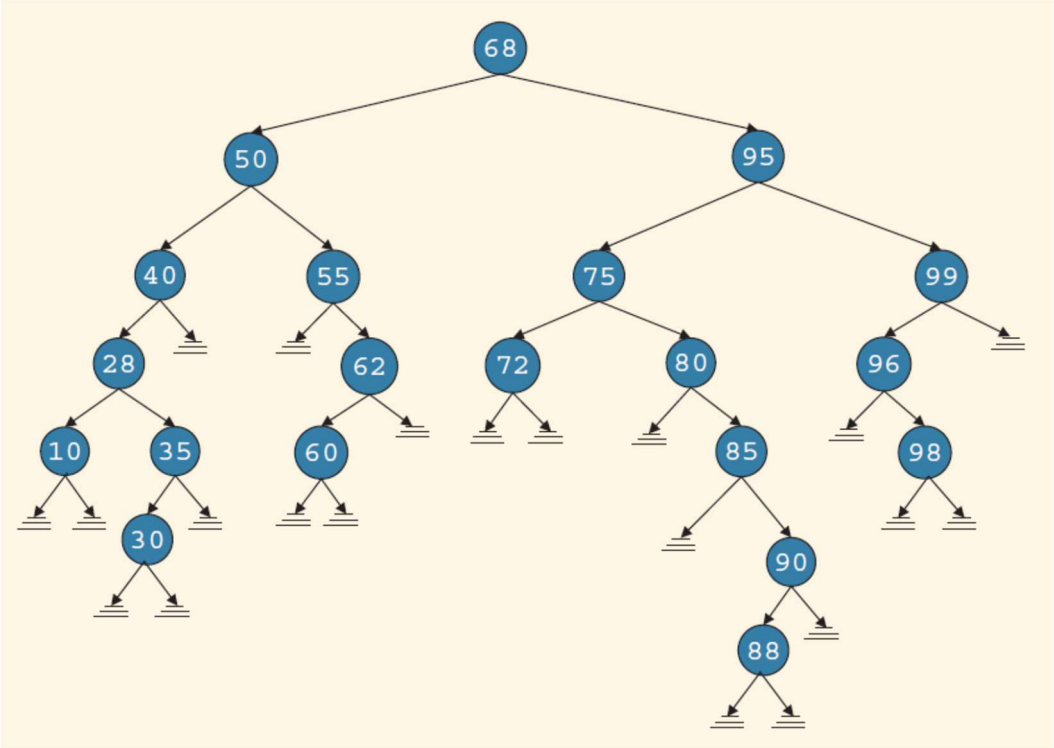
4. The following lists the nodes in a binary tree in two different orders:
   preorder: ABCDEFGHIJKLM
   inorder: CEDFBAHJIKGML

   Draw the binary tree.

5. Suppose that you are given two sequences of elements corresponding to the inorder sequence and the preorder sequence. Prove that it is possible to reconstruct a unique binary tree.

6. Given the nodes of a binary tree in the preorder sequence and the postorder sequence, show that it may not be possible to reconstruct a unique binary tree.

7. The following questions are independent of each other



a. List the path from the node with info 68 to the node with info 90.

b. A node with info 58 is to be inserted in the tree. List the nodes that are visited by the function insert to insert 58. Redraw the tree after inserting 58.

c. Delete node 60 and redraw the binary tree.

d. Delete nodes 50 and 95 in that order. Redraw the binary tree after each deletion.

e. Delete node 75 and redraw the binary tree.

f. Insert 28, 25, 26, 42, 47, 30, 45, 29, 5 into an initially empty binary search tree. Draw the final binary search tree.

8. How many different types of trees are there for 6 nodes?

Final Exam 2019/2020

9. The following lists the nodes in a binary tree in two different orders:

   Preorder: d u c v h a e o n g r a i e k b e
   Inorder: h v a c e u o d r g a n e i b k e

(a). Construct the binary tree above.
(b). Based on the constructed tree, give the postorder traversal.

10. The following three are the traversal sequence for preorder, inorder and postorder of a binary tree. Identify which one is preorder, inorder and postorder. Explain and show your work.
    I. 77 66 67 65 70 72 80 89 75
    II. 75 65 77 67 66 89 80 70 72
    III. 77 65 66 67 75 89 70 80 72

11. Given a binary search tree which contains the values 1, 2, 3, 4, 5, 6, 7, 8. Which of the following is/are possible preorder traversal. Show your work.

    (A) 5 3 1 2 4 7 8 6
    (B) 5 3 1 2 6 4 8 7
    (C) 5 3 2 4 1 6 7 8
    (D) 5 3 1 2 4 7

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12. Analyse the following lists of nodes for a binary tree:

    Preorder: srseponrsudennodomia
    Inorder: pnoerssru**s**ednnodoima

    Bold alphabet marks the root node of the tree.

    (a) Construct the binary tree above.
    (b) Show the postorder traversal based on the constructed tree.