Data structure
Workshop 4

I. Exercise

1.1 How many distinct binary trees can be constructed with 3 nodes?

1.2 How many leaf nodes are there in a complete binary tree with 1001 nodes?

1.3 The height h of a binary tree with 1025 nodes is ().
A. 11 B. 10 C. Between 11 and 1025 D. Between 10 and 1024

1.4 Nodes in a binary tree are numbered consecutively starting from 1, with the requirement that the number of each node is greater than the numbers of its left and right children. Among the left and right children of the same node, the number of the left child is smaller than that of the right child. Such numbering can be implemented by means of ( ) traversal.
A. Pre-order B. In-order C. Post-order D. Level traversal starting from the root

1.5 For a non-empty binary tree, if its pre-order traversal sequence is exactly the reverse of its post-order traversal sequence, then the binary tree must satisfy ().
A. All nodes have no left children B. All nodes have no right children
C. There is only one leaf node D. It is any binary tree

1.6 Try to find the binary trees that satisfy the following conditions:
① The pre-order sequence is the same as the post-order sequence.
② The in-order sequence is the same as the post-order sequence.
③ The pre-order sequence is the same as the in-order sequence.
④ The in-order sequence is the same as the level traversal sequence.

1.7 Given the pre-order traversal sequence of a binary tree: A B D F C E G H, and the in-order traversal sequence: B F D A G E H C. Draw this binary tree.

II. Experiment

Problem Description:

Establish the binary linked list storage structure of a binary tree according to the extended pre-order traversal sequence.

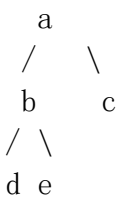
(1) Implement recursive algorithms for pre-order, in-order, and post-order traversals of the binary tree;

(2) Implement the algorithm calculating the number of nodes in the binary tree

(3) Implement the algorithm finding the depth of the binary tree.

Input Format:

The input is the extended pre-order traversal sequence of the binary tree, where the value of each node is a lowercase letter from a-z, and the null pointer is represented by "#". For example, for a binary tree as follows:



Its extended pre-order sequence is: abd##e##c##

Output Format:

The first line is the output result of the recursive pre-order traversal algorithm of the binary tree;

The second line is the output result of the recursive in-order traversal algorithm of the binary tree;

The third line is the output result of the recursive post-order traversal algorithm of the binary tree;

The fourth line is the number of nodes in the binary tree;

The last line is the depth of the binary tree.