Relationship between number of nodes and height of binary
.

Prerequisite – Binary Tree Data Structure

In this article, we will discuss various cases for relationship between number of nodes and height of binary tree.

Before understanding this article, you should have basic idea about binary trees and their properties.

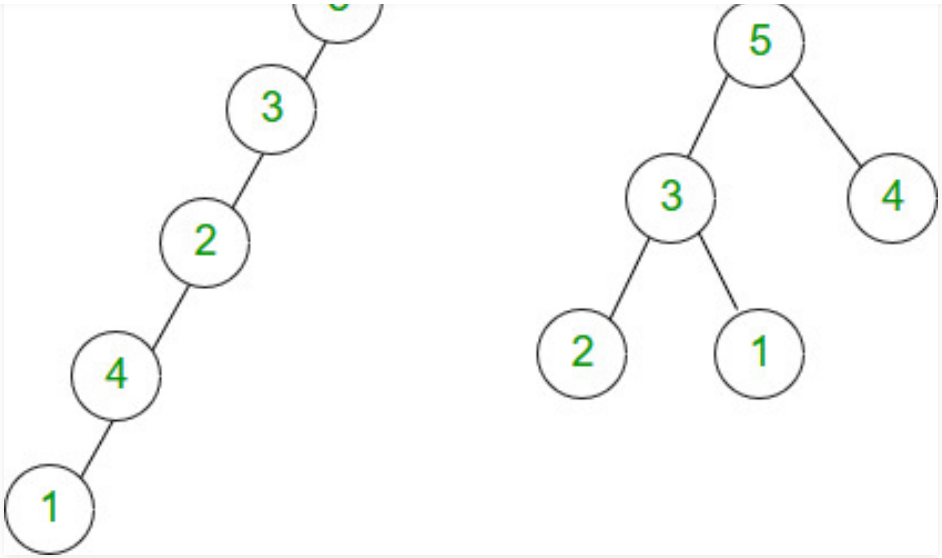
The **height** of the binary tree is the longest path from root **node to any leaf** node in the tree. For example, the height of binary tree shown in Figure 1(b) is 2 as longest path from root node to node 2 is 2. Also, the height of binary tree shown in Figure 1(a) is 4.

Binary Tree –

In a binary tree, a node can have maximum two children.

Calculating minimum and maximum height from number of nodes –

If there are n nodes in binary tree, **maximum height** of the binary tree is **n-1** and **minimum height** is **floor(log2n)**.



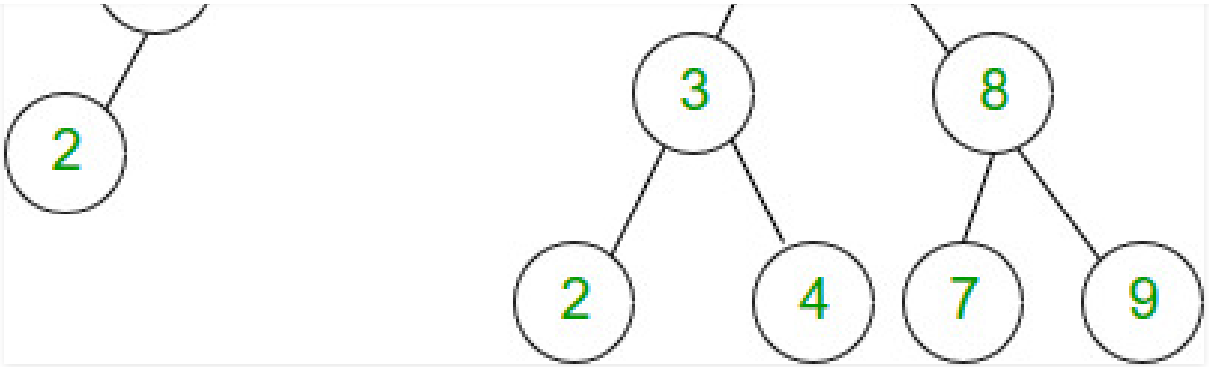
Calculating minimum and maximum number of nodes from height –

If binary tree has **height h**, minimum number of **nodes is h+1** (in case of left skewed and right skewed binary tree).

For example, the binary tree shown in Figure 2(a) with height 2 has 3 nodes.

If binary tree has height h, maximum number of nodes will be when all levels are completely full. Total number of nodes will be 2^0 + 2^1 + ... 2^h = 2^(h+1)-1.

For example, the binary tree shown in Figure 2(b) with height 2 has 2^(2+1)-1 = 7 nodes.



Binary Search Tree –

In a binary search tree, left child of a node has value less than the parent and right child has value greater than parent.

Calculating minimum and maximum height from the number of nodes –

If there are n nodes in a binary search tree, maximum height of the binary search tree is n-1 and minimum height is ceil(log2n).

Calculating minimum and maximum number of nodes from height –

If binary search tree has **height h**, minimum number of **nodes is h+1** (in case of left skewed and right skewed binary search tree).

If binary search tree has **height h**, maximum number of nodes will be when all levels are completely full. Total number of nodes will be 2^0 + 2^1 + ... 2^h = 2^(h+1)-1.

All the rules in BST are same as in binary tree and can b ialized in the same way.

(C) 32 and 6, respectively
(D) 31 and 5, respectively

Solution: According to formula discussed,
max number of nodes = 2^(h+1)-1 = 2^6-1 =63.
min number of nodes = h+1 = 5+1 = 6.

Que-2. Which of the following height is not possible for a binary tree with 50 nodes?
(A) 4
(B) 5
(C) 6
(D) None

Solution: According to formula discussed,
Minimum height with 50 nodes = floor(log250) = 5. Therefore, height 4 is not possible.

Like 33

Previous

Graph measurements: length, distance, diameter, eccentricity, radius, center

Next

Mathematics | Matrix Introduction

RECOMMENDED ARTICLES

02 Find height of a special binary tree whose leaf nodes are connected
17, Aug 16

03 Height of a complete binary tree (or Heap) with N nodes
01, Apr 18

04 Query for ancestor-descendant relationship in a tree
10, Jul 17

06 Relationship between user level thread and Kernel level thread
29, Apr 20

07 Relationship between grammar and Language
03, Jul 21

08 Traversal of tree with k jumps allowed between nodes of same height
20, May 18

Article Contributed By :

GeeksforGeeks

Vote for difficulty

Current difficulty : Easy

Easy | Normal | Medium | Hard | Expert

Improved By : cssd1983, SohamDas78, gursevaks2001

GeeksforGeeks
5th Floor, A-118,
Sector-136, Noida, Uttar Pradesh - 201305

feedback@geeksforgeeks.org