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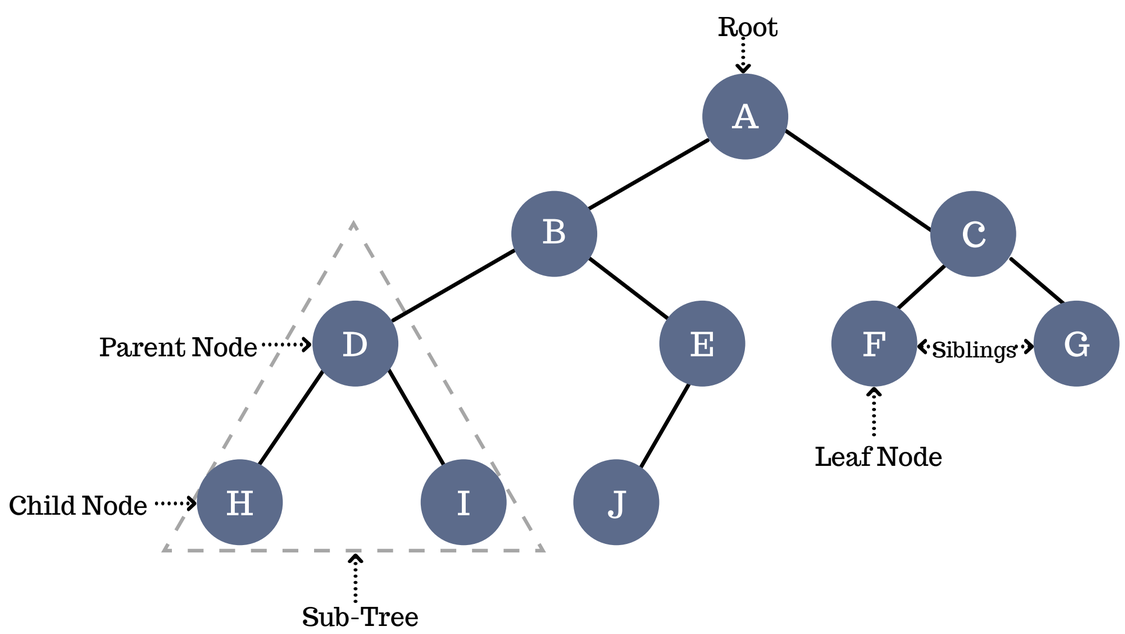
TAE 2

Data Structure and Algorithms

Binary Trees

A binary Tree is a hierarchal data structure used for data storage purposes. A binary tree has a special condition that each node can have a maximum of two children. A binary tree has the benefits of both an ordered array and a linked list as search is as quick as in a sorted array and insertion or deletion operations are as fast as in the linked list.



Properties

1. A binary tree can have a maximum of 2^l nodes at level l if the level of the root is zero.
2. When each node of a binary tree has one or two children, the number of leaf nodes (nodes with no children) is one more than the number of nodes that have two children.
3. There exists a maximum of $(2^h - 1)$ nodes in a binary tree if its height is h, and the height of a leaf node is one.
4. If there exist L leaf nodes in a binary tree, then it has at least L+1 levels.

Representation of a Binary Tree

A binary tree node is represented by a structure with two pointers to other structures of the same type and a data part.

```
struct node
{
 int data;
 struct node *leftChild;
 struct node *rightChild;
};
```

Types of Binary Tree

Full Binary Tree Each internal node has zero or two children.	**Perfect Binary Tree** All the leaf nodes are at the same level, and each internal node has two children.	**Degenerate or Pathological Tree** Each internal node has a single child, either the left child or the right child.
Balanced Binary Tree In this difference of height between the left and the right subtrees for each node is at most one.	**Complete Binary Tree** All of its levels are completely filled. The only exception is possibly the lowest level in which the nodes must lean as left as possible.	**Skewed Binary Tree** A skewed binary tree is a type of binary tree in which all the nodes have only one child or no child. Two types: left-skewed, right-skewed binary tree.

Applications

Binary trees are used to represent a nonlinear data structure. There are various forms of Binary trees. Binary trees play a vital role in a software application. One of the most important applications of the Binary tree is in the searching algorithm.

Other real-life applications of a binary tree include binary space partition, heap sort, Huffman coding, virtual memory management, and indexing.

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