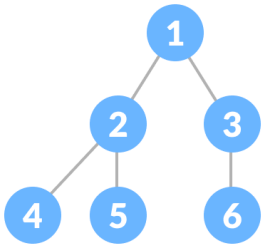
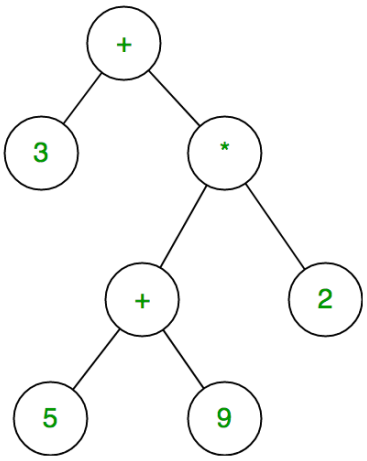
Trees

1. **Define depth and height of a node in a tree.**
   The depth of a node is the number of edges present in path from the root node of a tree to that node. The height of a node is the number of edges present in the longest path connecting that node to a leaf node.
2. **Define complete binary tree.**
   A complete binary tree is a binary tree in which all the levels are completely filled except possibly the lowest one, which is filled from the left. For example following is a complete binary tree.

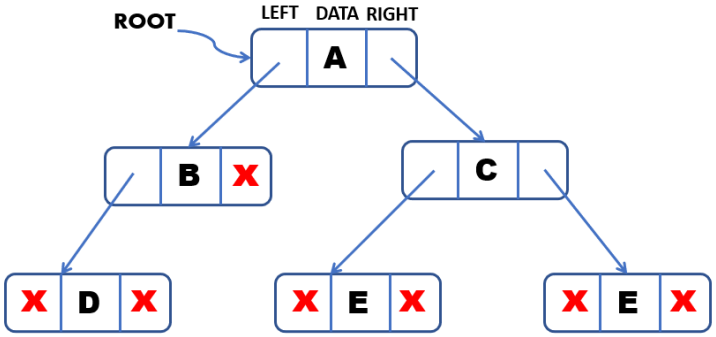


3. **List the operations that are specific to Binary Search Tree.**
   - Insert: insert a node in the tree.
   - Search: Searches for a node in the tree.
   - Delete: deletes a node from the tree.
   - Inorder: in-order traversal of the tree.
   - Preorder: pre-order traversal of the tree.
   - Postorder: post-order traversal of the tree.
4. **Define B trees.**
   B Tree is **a specialized m-way tree that can be widely used for disk access**. A B-Tree of order m can have at most m-1 keys and m children.
5. **Define BST.**
   Binary Search tree is a binary tree in which each internal node *x* stores an element such that the element stored in the left sub tree of *x* are less than *x* and elements stored in the right sub tree of *x* are greater than *x* .
6. **Define expression tree.**
   The expression tree is a binary tree in which each internal node corresponds to the operator and each leaf node corresponds to the operand. For example expression tree for 3 + ((5+9)*2) would be:

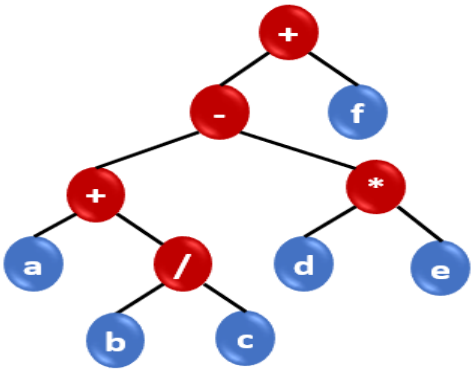


7. **Define balance factor of a node in AVL tree.**
   Balance factor of a node is defined to be the difference between the height of the node's left subtree and the height of the node's right subtree.

8. **What are the rotations used in AVL trees?**
   - Left-Left Rotation (LL Rotation) ...
   - Right-Right Rotation (RR Rotation) ...
   - Left-Right Rotation (LR Rotation) ...
   - Right-Left Rotation (RL Rotation)
9. **Write a procedure to delete the root node of a binary search tree.**
   - If root node is the ***only node*** in the tree, delete it directly.
   - ***If Root has only one child:*** Copy the child to the root and delete the child
   - ***If Root has two children,*** Find inorder successor of the node. Copy contents of the inorder successor to the node and delete the inorder successor
10. **What is the balance condition in AVL trees?**
    abs(height(left subtree) – height(right subtree)) <= 1
11. **Define and represent binary trees with an example.**
    A **binary tree** is a hierarchical data structure in which each node has at most two children generally referred as left child and right child.



12. **Draw the binary tree for the following algebraic expression: a+b/c-d*e+f.**



13. **Define Min Heap**.
    A Min-Heap is a complete binary tree in which the value in each internal node is smaller than or equal to the values in the children of that node.
14. **Define tree.**
    A tree is a data structure, which represents hierarchical relationship between individual data items.
15. **Define leaf node.**
    In a tree any node which has no children is called a terminal node or a leaf.
16. **What are the applications of binary tree?**
    1. Binary tree is used in data processing.
    2. File index schemes
    3. Hierarchical database management system
17. **What is meant by tree traversal? Mention different types of tree traversals.**
    The different types of tree traversals are
    a. Pre-order traversal-yields prefix form of an expression.

b. In-order traversal-yields infix form of an expression.
c. Post-order traversal-yields postfix form of an expression .

18. What is a threaded binary tree?

A threaded binary tree may be defined as follows: "A binary tree is *threaded* by making all right child pointers that would normally be null point to the inorder successor of the node, and all left child pointers that would normally be null point to the inorder predecessor of the node

19. What is a binary search tree?

Binary Search tree is a binary tree in which each internal node *x* stores an element such that the element stored in the left sub tree of *x* are less than or equal to *x* and elements stored in the right sub tree of *x* are greater than or equal to *x* .

20. List out the representations of a binary tree.

- Array representation
- Linked representation

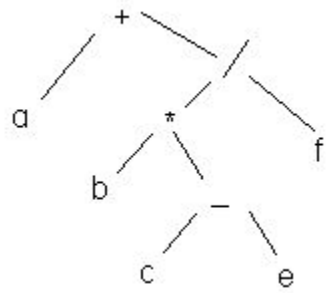
21. List the applications of tree.

- Electrical Circuit
- Folder structure
- Binary tree is used in data processing.
- File index schemes
- Hierarchical database management system

22. Mention the properties of a B-tree.

- In a B-tree of order m, each node can have a maximum of **m** children and m-1 keys
- In a B-tree of order m, each node must have at least $\lceil (p/2) \rceil$ successors and ($\lceil (p/2) \rceil$ -1) keys .
- All leaf nodes are at the same level.
- Within each node, the keys are arranged in ascending order

23. Give the expression tree for the expression (a +((b*(c-e))/f).



24. Define AVL Tree.

An AVL tree is a binary search tree with the additional property that for every node in the tree, the height of the left and right subtrees can differ by at most 1.

25. Differentiate between B-Tree and B+tree.

- In a B-tree, the keys and data can be stored in both the internal and leaf nodes, whereas in a B+ tree, the data and keys can only be stored in the leaf nodes.
- In B-Tree, the leaf nodes of the tree store pointers to records rather than actual records, whereas in B+ tree, The leaf nodes of the tree store the actual record rather than pointers to records
- In B+tree, leaf nodes are connected like linked list to facilitate sequential access of records. In B-Tree leaf nodes are not connected as in B+ tree.
- In B-tree keys are not repeated in the nodes, whereas in B+ Tree, keys in internal nodes are repeated in leaf nodes.

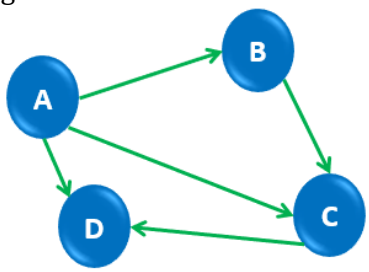
26. Define Balanced binary tree.

A balanced binary tree, also referred to as a height-balanced binary tree, is defined as a binary tree in which the height of the left and right subtree of any node differs by not more than 1.

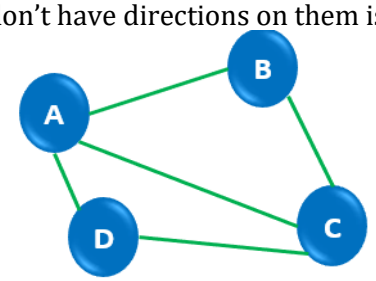
27. **What is the use of threaded binary tree?**
    The idea of threaded binary trees is to make inorder traversal faster and do it without stack and without recursion.

Graphs

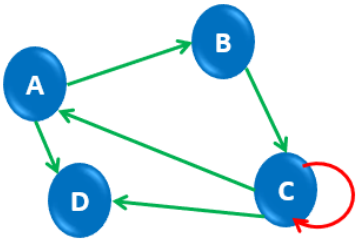
1. **Define Graph?**
   A graph G consist of a nonempty set V which is a set of nodes of the graph, a set E which is the set of edges of the graph, and a mapping from the set for edge E to a set of pairs of elements of V. It can also be represented as G= (V, E).
2. **What is a directed graph?**
   A graph in which every edge has direction on it is called a directed graph.



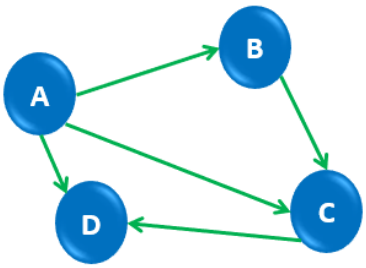
3. **What is an undirected graph?**
   A graph in which edges don't have directions on them is called an undirected graph.



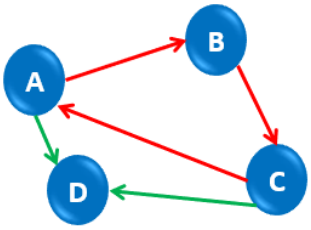
4. **What is a loop?**
   An edge of a graph which connects a node to itself is called a loop or sling.



5. **What is a weighted graph?**
   A graph in which weights are assigned to edges is called a weighted graph.
6. **Define out-degree and in-degree of a node.**
   In a directed graph, for any node v, the number of edges which have node v as their source vertex is called the out-degree of the node v and the number of edges which have v as their terminal/destination vertex is called the in-degree of the node v. For example, in the following graph, In-degree of node A is 0, while its out-degree is 3.

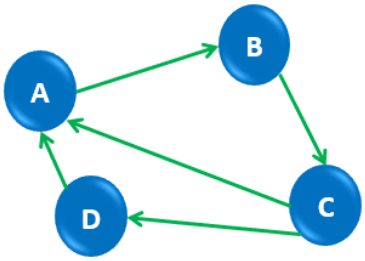


7. **What is a cycle or a circuit in a graph?**
   A path which originates and ends with the same node is called a cycle or circuit.



   A directed graph is acyclic if it has no cycles. A directed acyclic graph is sometimes referred to by its abbreviation, DAG

8. **What is meant by strongly connected graph?**
   A graph is connected if there is a path from every vertex to every other vertex In the graph. A directed graph which is connected is called strongly connected.



9. **Name the different ways of representing a graph.**
   a. Adjacency matrix
   b. Adjacency list
10. **Mention the graph traversal techniques**
    - Breadth First Search (BFS)
    - Depth First Search (DFS)
11. **What are the advantages and disadvantages of BFS over DFS?**
    Advantages of BFS:
    1.The solution will be definitely found out by BFS If there is some solution.
    2. BFS will never get trapped in a blind alley,
    3. If there is more than one solution then it will find a solution with minimal steps.
    Disadvantages of BFS:
    1. Requires more memory as it stores all the nodes of the present level to go for the next level.
    2. If a solution is far away then it consumes time.
12. **What are the advantages and disadvantages of DFS over BFS?**
    Advantages of Depth First Search:
    1. Consumes less memory
    2. Finds the larger distant element(from source vertex) in less time.
    Disadvantages of BFS:
    1. May not find optimal solution to the problem.
    2. May get trapped in searching useless path.

13. Mention applications of graphs.

- **Google maps** uses graphs for building transportation systems, where intersection of two(or more) roads are considered to be a vertex and the road connecting two vertices is considered to be an edge, thus their navigation system is based on the algorithm to calculate the shortest path between two vertices.
- In **Facebook**, users are considered to be the vertices and if they are friends then there is an edge running between them. Facebook's Friend suggestion algorithm uses graph theory. Facebook is an example of **undirected graph**.

14. List any two differences between graphs and trees.

1. In a tree, there will be only one path between a pair of nodes, where as in graph there can be more than one path between a pair of nodes.
2. A graph can have cycles, whereas in tree, cycles are not possible.

15. What is a connected component? Give an example.

A connected component is a maximal subgraph of a given graph such that there is a path between every pair of nodes. For example, in the following graph, nodes V7, V8 and V9 makes a connected component. nodes V10, V11 and V12 forms another component. all the remaining vertices make another connected component.