**UNIT III**

# NON LINEAR DATA STRUCTURES- TREES

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| **S.**  **No.** | **Question** |
| 1 | **Define non-linear data structure**  Data structure which is capable of expressing more complex relationship than that of physical adjacency is called non-linear data structure. |
| 2 | **Define tree?**  A tree is a data structure, which represents hierarchical relationship between individual data items. |
| 3 | **Define leaf?**  In a directed tree any node which has out degree o is called a terminal node or a leaf. |
| 4 | **Explain the representations of priority queue.**  Using Heap structure, Using Linked List |
| 5 | **List out the steps involved in deleting a node from a binary search tree.**   1. t has no right hand child node t->r == z 2. t has a right hand child but its right hand child node has no left sub tree   t->r->l == z  3.t has a right hand child node and the right hand child node has a left hand child node t->r->l != z |
| 6 | **Convert the infix expression (A-B/C)\*(D/E-F) into a postfix.**  Postfix: ABC/-DE/F-\* |
| 7 | **What are the steps to convert a general tree into binary tree?**  \* use the root of the general tree as the root of the binary tree |
|  | * determine the first child of the root. This is the leftmost node in the general tree at the next   level   * insert this node. The child reference of the parent node refers to this node * continue finding the first child of each parent node and insert it below the parent node with the   child reference of the parent to this node.   * when no more first children exist in the path just used, move back to the parent of the last node   entered and repeat the above process. In other words, determine the first sibling of the last  node entered.   * complete the tree for all nodes. In order to locate where the node fits you must search for the   first child at that level and then follow the sibling references to a nil where the next sibling can  be inserted. The children of any sibling node can be inserted by locating the parent and then  inserting the first child. Then the above process is repeated. |
| 8 ed | **What is meant by directed tree?**  tree is an acyclic diagraph which has one node called its root with in degree o while all other nodes have in degree I. |
| 9 | **What is a ordered tree?**  In a directed tree if the ordering of the nodes at each level is prescribed then such a tree is called ordered tree. |
| 10 | **What are the applications of binary tree?**   1. Binary tree is used in data processing. 2. File index schemes 3. Hierarchical database management system |
| 11 | **What is meant by traversing?**  Traversing a tree means processing it in such a way, that each node is visited only once. |
| 12 | **What are the different types of traversing?**  The different types of traversing are   1. Pre-order traversal-yields prefix form of expression. 2. In-order traversal-yields infix form of expression. 3. Post-order traversal-yields postfix form of expression. |
| 13 | **What are the two methods of binary tree implementation?**  Two methods to implement a binary tree are   1. Linear representation. 2. Linked representation |
| 14 | **What is a balance factor in AVL trees?**  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. |

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| 15 | **What is meant by pivot node?**  The node to be inserted travel down the appropriate branch track along the way of the deepest level node on the branch that has a balance factor of +1 or -1 is called pivot node. |
| 16 | **What is the length of the path in a tree?**  The length of the path is the number of edges on the path. In a tree there is exactly one path form the root to each node. |
| 17 | **Define expression trees?**  aves of an expression tree are operands such as constants or variable names and the other nodes contain operators. |
| 18 | **What is a threaded binary tree?**  A threaded [binary tree](http://en.wikipedia.org/wiki/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 meant by 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 | **Write the advantages of threaded binary tree.**  The difference between a binary tree and the threaded binary tree is that in the binary trees the nodes are null if there is no child associated with it and so there is no way to traverse back.  But in a threaded binary tree we have threads associated with the nodes i.e they either are linked to the predecessor or successor in the in order traversal of the nodes.  This helps us to traverse further or backward in the in order traversal fashion.  There can be two types of threaded binary tree :-   1. Single Threaded: - i.e. nodes are threaded either towards its in order predecessor or successor. 2. Double threaded: - i.e. nodes are threaded towards both the in order predecessor and successor. |
| 21 | **What is the various representation of a binary tree?**  Tree Representation Array representation Linked list representation |
| 22 | **List the application of tree.**  (i) Electrical Circuit  ii) Folder structure   1. Binary tree is used in data processing. 2. File index schemes 3. Hierarchical database management system |
| 23 | **Define binary tree and give the binary tree node structure.** |

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| 24 | **What are the different ways of representing a Binary Tree?**   * Linear Representation using Arrays. * Linked Representation using Pointers. |
| 25 | **Give the pre & postfix form of the expression (a + ((b\*(c-e))/f).** |
| 26 | **Define a heap. How can it be used to represent a priority queue?**  A priority queue is a different kind of queue, in which the next element to be removed is defined by (possibly) some other criterion. The most common way to implement a priority queue is to use a different kind of binary tree, called a heap. A heap avoids the long paths that can arise with binary search trees. |
| 27 | **What is binary heap?**  It is a complete binary tree of height h has between 2h and 2h+1 -1 node. The value of the root node is higher than their child nodes |
| 28 | **Define Strictly binary tree?**  If every nonleaf node in a binary tree has nonempty left and right subtrees ,the tree is termed  as a strictly binary tree. |
| 29 | **Define complete binary tree?**  A complete binary tree of depth d is the strictly binary tree all of whose are at level d. |
| 30 | **What is an almost complete binary tree?**  A binary tree of depth d is an almost complete binary tree if :  \_ Each leaf in the tree is either at level d or at level d-1  \_ For any node nd in the tree with a right descendant at level d,all the left descendants of nd that are leaves are at level d. |
| 31 | **Define AVL Tree.**  A AVL tree is a binary search tree except that for every node in the tree,the height of the  left and right subtrees can differ by atmost 1. |

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| 1 | Define Tree. Explain the tree traversals with algorithms and examples. |
| 2 | Construct an expression tree for the expression (a + b \* c)  +((d \* e + 1) \* g). Give the outputs when you apply preorder, inorder and postorder traversals. |
| 3 | Explain binary search tree ADT in detail. |
| 4 | Explain AVL tree ADT in detail. |
| 5 | Explain b tree and B+ tree ADT in detail. |
| 6 | Explain Heap tree ADT in detail. |
| 7 | Explain threaded binary tree ADT in detail. |

# UNIT IV

**NON LINEAR DATA STRUCTURES- GRAPHS**

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| **S. N**  **o.** | **Question** |
| 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 | **Explain the topological sort.**  It is an Ordering of vertices in a directed acyclic graph such that if there is a path from vi to vj, then vj appears after vi in the ordering. |
| 3 | **Define NP**  NP is the class of decision problems for which a given proposed solution for a given input can be checked quickly to see if it is really a solution. |
| 4 | **Define biconnected graph.**  A connected undirected graph is biconnected if there are no vertices whose removal disconnects the rest of the graph. |
| 5 | **Define shortest path problem?**  For a given graph G=(V, E), with weights assigned to the edges of G, we have to find the shortest path (path length is |
|  | defined as sum of the weights of the edges) from any given source vertex to all the remaining vertices of G. |
| 6 | **Mention any two decision problems which are NP-Complete.**  NP is the class of decision problems for which a given proposed solution for a given input can be checked quickly to see if it is really a solution |
| 7 | **Define adjacent nodes?**  Any two nodes which are connected by an edge in a graph are called adjacent nodes. For E is associated with a pair of nodes∈example, if and edge x (u,v) where u, v V, then we say that the edge x connects the nodes u and v. ∈ |
| 8 | **What is a directed graph?**  A graph in which every edge is directed is called a directed graph. |
| 9 | **What is a undirected graph?**  A graph in which every edge is undirected is called a directed graph. |
| 10 | **What is a loop?**  An edge of a graph which connects to itself is called a loop or sling. |
| 11 | **What is a simple graph?**  A simple graph is a graph, which has not more than one edge between a pair of nodes than such a graph is called a simple graph. |
| 12 | **What is a weighted graph?**  A graph in which weights are assigned to every edge is called a weighted graph. |
| 13 | **Define out degree of a graph?**  In a directed graph, for any node v, the number of edges which have v as their initial node is called the out degree of the node v. |
| 14 | **Define indegree of a graph?**  In a directed graph, for any node v, the number of edges which have v as their terminal node is called the indegree of the node v. |
| 15 | **Define path in a graph?**  The path in a graph is the route taken to reach terminal node from a starting node. |
| 16 | **What is a simple path?**  A path in a diagram in which the edges are distinct is called a simple path. It is also called as edge simple. |
| 17 | **What is a cycle or a circuit?**  A path which originates and ends in the same node is called a cycle or circuit. |
| 18 | **What is an acyclic graph?**  A simple diagram which does not have any cycles is called an acyclic graph. |
| 19 | **What is meant by strongly connected in a graph?**  An undirected graph is connected, if there is a path from every vertex to every other vertex. A directed graph with this property is called strongly connected. |
| 20 | **When is a graph said to be weakly connected?**  When a directed graph is not strongly connected but the underlying graph is connected, then the graph is said to be weakly connected. |
| 21 | **Name the different ways of representing a graph?**   1. Adjacency matrix 2. Adjacency list |
| 22 | **What is an undirected acyclic graph?**  When every edge in an acyclic graph is undirected, it is called an undirected acyclic graph. It is also called as undirected forest. |
| 23 | **What are the two traversal strategies used in traversing a graph?**   1. Breadth first search 2. Depth first search |
| 24 | **What is a minimum spanning tree?**  A minimum spanning tree of an undirected graph G is a tree formed from graph edges that connects all the vertices of G at the lowest total cost. |
| 25 | **Define topological sort?**  A topological sort is an ordering of vertices in a directed acyclic graph, such that if there is a path from vi to vj appears after vi in the ordering. |
| 26 | **What is the use of Kruskal’s algorithm and who discovered it?** Kruskal’s algorithm is one of the greedy techniques to solve the minimum spanning tree problem. It was discovered by Joseph Kruskal when he was a second-year graduate student. |
| 27 | **What is the use of Dijksra’s algorithm?**  Dijkstra’s algorithm is used to solve the single-source shortest-paths problem: for a given vertex called the source in a weighted connected graph, find the shortest path to all its other vertices. The single-source shortest-paths problem asks for a family of paths, each leading from the source to a different vertex in the graph, though some paths may have edges in common. |
| 28 | **Prove that the maximum number of edges that a graph with n Vertices is n\*(n-1)/2.**  Choose a vertex and draw edges from this vertex to the remaining n-1 vertices. Then, from these n-1 vertices, choose a vertex and draw edges to the rest of the n-2 Vertices. Continue this process till it ends with a single Vertex. Hence, the total number of edges added in graph is  (n-1)+(n-2)+(n-3)+…+1 =n\*(n-1)/2. |
| 29 | **Define minimum cost spanning tree?**  A spanning tree of a connected graph G, is a tree consisting of edges and all the vertices of G. In minimum spanning tree T, for a given graph G, the total weights of the edges of the spanning tree must be minimum compared to all other spanning trees generated from G. -Prim’s and Kruskal is the algorithm for finding Minimum Cost Spanning Tree. |
| 30 | **Define Adjacency in graph.**  Two node or vertices are adjacent if they are connected to each other through an edge. In the following example, B is adjacent to A, C is adjacent to B, and so on. |
| 31 | **Define Basic Operations of Graph.**  Following are basic primary operations of a Graph   * **Add Vertex** − Adds a vertex to the graph. * **Add Edge** − Adds an edge between the two vertices of the graph. * **Display Vertex** − Displays a vertex of the graph. |
| 32 | **What is Levels in graph?**  Level of a node represents the generation of a node. If the root node is at level 0, then its next child node is at level 1, its grandchild is at level 2, and so on. |
| 33 | **What is visiting and traversing in graph.**   * Visiting refers to checking the value of a node when control is on the node. * Traversing means passing through nodes in a specific order. |
| 1 | Explain the various representation of graph with example in detail? |
| 2 | Define topological sort? Explain with an example? |
| 3 | Explain Dijkstra's algorithm with an example? |
| 4 | Explain Prim's algorithm with an example? |
| 5 | Explain Krushal's algorithm with an example? |
| 6 | Write and explain the prim’s algorithm and depth first search algorithm. |
| 7 | For the graph given below, construct Prims algorithm 2  4 2 1 7  8 4  5 1 6  1 2 |
| 8 | Explain the breadth first search algorithm |
| 9 | the algorithm to compute lengths of shortest path |
| 10 | n the depth first search algorithm. |