**Fundamentals of Algorithm Question Bank Answers**

1. **What is an algo?**

**Answer:** An algorithm is a finite sequence of well-defined, computer-implementable instructions.

1. **Types of analysis?**

**Answer:** There are 3 types of analysis we perform:

1. **Worst Case**

Best case performance used in computer science to describe an algorithm’s behaviour under optimal conditions.

1. **Best Case**

Average case performance measured using the average optimal conditions to solve the problem.

1. **Average Case**

Worst case performance used to analyse the algorithm's behaviour under worst case input and least possible to solve the problem.

1. **Divide and Conquer theorem.**

**Answer:** A divide-and-conquer algorithm recursively breaks down a problem into two or more sub-problems of the same or related type, until these become simple enough to be solved directly.

Master Theorem is used to determine running time of algorithms (divide and conquer algorithms) in terms of asymptotic notations.

1. **Define method of guessing & confirming.**

**Answer:** The basic idea behind this method is to guess the answer, and then prove it correct by induction.

This method can be used to solve any recurrence. If a solution is guessed and then try to verify our guess inductively, usually either the proof will succeed (in that case we are done), or the proof will fail (in that case the failure will help us refine our guess).

1. **What is Tree?**

**Answer:** A tree is a nonlinear data structure, arranged in hierarchical order. compared to arrays, linked lists, stacks and queues which are linear data structures.

1. **What is a Binary Tree? & types of binary tree.**

**Answer:** A binary tree is a tree-type non-linear data structure with a maximum of two children for each parent node.

Types of Binary Tree:

1. Full Binary Tree.
2. Complete Binary Tree.
3. Perfect Binary Tree.
4. Balanced Binary Tree.
5. Degenerate Binary Tree.
6. **Properties of Binary Tree.**

**Answer:** Five properties of Binary Trees:

1. The maximum number of nodes at level ‘l’ of a binary tree is 2l.
2. The Maximum number of nodes in a binary tree of height ‘h’ is 2h – 1.
3. In a Binary Tree with N nodes, minimum possible height or the minimum number of levels is? Log2(N+1)?
4. A Binary Tree with L leaves has at least | Log2L? |+ 1 levels
5. In Binary tree where every node has 0 or 2 children, the number of leaf nodes is always one more than nodes with two children.
6. **Define Generic Trees.**

**Answer:** Generic trees are a collection of nodes where each node is a data structure that consists of records and a list of references to its children (duplicate references are not allowed). Unlike the linked list, each node stores the address of multiple nodes.

1. **What is BST?**

**Answer:** Binary search tree (BST), also called an ordered or sorted binary tree, is a rooted binary tree whose internal nodes each store a key greater than all the keys in the node's left subtree and less than those in its right subtree.

1. **Explain AVL tree.**

**Answer:** AVL tree is a self-balancing Binary Search Tree (BST) where the difference between heights of left and right subtrees cannot be more than one for all nodes.

AVL is named after its inventors **A**delson-**V**elsky and **L**andis.

1. **Applications of graphs.**

**Answer:** A graph is a non-linear data structure, which consists of vertices (or nodes) connected by edges (or arcs) where edges may be directed or undirected.

Graphs can be used to:

1. Represent the flow of computation.
2. Google maps uses graphs for building transportation systems
3. In World Wide Web, web pages are considered to be the vertices.
4. Resource Allocation Graph in Operating Systems.
5. **Explain Prims, Kruskal’s, Dijkstra’s algorithm.**

**Answer: Prims:**

Prim’s algorithm is a Greedy algorithm. It starts with an empty spanning tree. The idea is to maintain two sets of vertices. The first set contains the vertices already included in the MST; the other set contains the vertices not yet included. At every step, it considers all the edges that connect the two sets, and picks the minimum weight edge from these edges. After picking the edge, it moves the other endpoint of the edge to the set containing MST.

**Kruskal’s:**

Kruskal's algorithm to find the minimum cost spanning tree uses the greedy approach. This algorithm treats the graph as a forest and every node it has as an individual tree. A tree connects to another only and only if, it has the least cost among all available options and does not violate MST properties.

**Dijkstra’s:**

Dijkstra’s algorithm is very similar to Prim’s algorithm for minimum spanning tree. Like Prim’s MST, we generate a SPT (shortest path tree) with given source as root. We maintain two sets, one set contains vertices included in shortest path tree, other set includes vertices not yet included in shortest path tree. At every step of the algorithm, we find a vertex which is in the other set (set of not yet included) and has a minimum distance from the source.

1. **What is Greedy Algorithm?**

**Answer:** Greedy is an algorithmic paradigm that builds up a solution piece by piece, always choosing the next piece that offers the most obvious and immediate benefit. So, the problems where choosing locally optimal also leads to global solution are best fit for Greedy.

1. **Explain Dynamic Programming.**

**Answer:** Dynamic Programming is mainly an optimization over plain recursion.

Wherever we see a recursive solution that has repeated calls for same inputs, we can optimize it using Dynamic Programming. The idea is to simply store the results of subproblems, so that we do not have to re-compute them when needed later.

1. **Examples of Dynamic Programming.**

**Answer:** Insertion sort and finding Fibonacci numbers are some applications of Dynamic programming.

1. **Advantages & disadvantages of greedy method.**

**Answer:** Advantages:

1. Greedy approach is easy to implement.
2. Typically have less time complexities.
3. Greedy algorithms can be used for optimization purposes or finding close to optimization in case of NP Hard problems**.**

Disadvantages:

1. The local optimal solution may not always be global optimal.
2. **Define Threaded Binary Tree.**

**Answer:** The idea of threaded binary trees is to make inorder traversal faster and do it without stack and without recursion.

A binary tree is made threaded by making all right child pointers that would normally be NULL point to the inorder successor of the node (if it exists).