

# Important Short Questions of DSA

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## Q1. What is data structure?

**Ans:** Data Structure is a way of collecting and organizing data in such a way that we can perform operations on the data in an effective way. General data structure types include arrays, linked lists, stacks, Queues etc.

## Q2. What is an algorithm?

**Ans:** An algorithm is a step-by-step procedure or method for solving a problem in a finite number of computer implementable instructions. Steps of an algorithm are written in human understandable language and independent of any programming language.

## Q3. What are asymptotic notations?

**Ans:** Asymptotic notations are the mathematical notations used to describe the running time of an algorithm when the input tends towards a particular value or a limiting value. We use three types of asymptotic notations

- i) Big – Oh( $O$ )
- ii) Big – Omega( $\Omega$ )
- iii) Big – Theta( $\Theta$ )

## Q4. What is divide and conquer approach?

**Ans:** In divide and conquer approach, the problem in hand, is divided into smaller sub-problems and then each problem is solved independently. The solution of all sub-problems is finally merged in order to obtain the solution of the original problem.

## Q5. What is the postfix notation of $(a+b)*(c+d)$ ?

**Ans:** The postfix notation of the above expression is  **$a\ b\ +\ c\ d\ +\ *$**

**Q6. Define an abstract data type (ADT)?**

**Ans:** Abstract data type is a data type, whose behavior is defined by a set of values and set of operations, independent of any particular implementation. Stacks and Queues are the examples of Abstract data type.

**Q7. What is difference between PUSH and POP?**

**Ans:**

<b>PUSH</b>	<b>POP</b>
PUSH function is used to insert an element at the top of the stack.	POP function is used to remove an element from the top of the stack.
The element is added to the stack container and the size of the stack is increased by 1.	The element is removed from the stack container and the size of the stack is decreased by 1.

**Q8. Why do we use Queues?**

**Ans:** Queue is used when things don't have to be processed immediately, but have to be processed in **First In First Out** order. This property of Queue makes it useful in following kind of scenario.

- When Serving requests on a single shared resource, like a printer or CPU task scheduling etc.

**Q9. List out the advantages of using a link list?**

**Ans:**

- Linked list is a dynamic data structure so it can grow and shrink at runtime.
- Insertion and deletion of nodes is easier.
- Data can be stored in non contiguous blocks of memory.
- Linked list offer an efficient use of memory.

#### Q10. What are doubly link lists?

**Ans:** Doubly linked list is a variation of linked list in which navigation is possible in both ways, either forward or backward easily as compared to single linked list. In doubly linked list a node consists of three parts:

- Node data.
- Pointer to the next node.
- Pointer to the previous node.

#### Q11. What is Recursion?

**Ans:** The process in which a function calls itself directly or indirectly is called recursion and the corresponding function is called as recursive function.

#### Q12. What is binary tree?

**Ans:** A **binary tree** is a tree data structure composed of nodes, each of which has at most, two children, referred to as *left* and *right* nodes. The tree starts off with a single node known as the **root**.

#### Q13. What is full, complete and perfect binary tree?

**Ans: Full Binary Tree:** A Binary Tree is a full binary tree if every node has 0 or 2 children. We can also say a full binary tree is a binary tree in which all nodes except leaf nodes have two children.

**Complete Binary Tree:** A Binary Tree is a Complete Binary Tree if all the levels are completely filled except possibly the last level and the last level has all keys as left as possible.

**Perfect Binary Tree:** A Binary tree is a Perfect Binary Tree in which all the internal nodes have two children and all leaf nodes are at the same level.

#### Q14. What is hashing?

**Ans:** Hashing is a technique or process of mapping keys, values into the hash table by using a hash function. It is done for faster access to elements. The efficiency of mapping depends on the efficiency of the hash function used.

**Q15. Which sorting algorithm is best if the list is already sorted? Why?**

**Ans:** Insertion sort algorithm is best if the list is already sorted. Because if the list is already sorted then insertion sort will give Big  $O(n)$  complexity.

**Q16. What is Heap, Max heap and Min heap?**

**Ans:** Heap is a special case of complete binary tree data structure where the root-node key is compared with its children and arranged accordingly. If the value of the root node is less than or equal to either of its children then it is a min heap. If the value of the root node is greater than or equal to either of its children then it is a max heap.

**Q17. Why we need to do algorithm analysis?**

**Ans:** The most straightforward reason for analyzing an algorithm is to discover its characteristics in order to evaluate its suitability for various applications or compare it with other algorithms for the same application

**Q18. What are the criteria of algorithm analysis?**

**Ans:** Performance analysis of an algorithm is performed by using the following measures:

- Space required to complete the task of that algorithm (Space complexity).
- Time required to complete the task of that algorithm (Time complexity).

**Q19. Give some examples of greedy algorithms?**

**Ans:**

- Travelling Salesman Problem.
- Graph – Map coloring.
- Graph – Vertex Cover.
- Knapsack Problem.
- Huffman Coding.

**Q20. What is Stack? Why do we use stacks?**

**Ans:** Stack is an abstract data type and linear data structure that follows the LIFO (Last – IN – First - Out) principle. It can be defined as a container in which Insertion and deletion can be done from the one end known as the top of the stack. Usage of Stack is following.

- Stack is used to perform UNDO/REDO operations.
- Recursion is done by using stack.
- Stack is also used for reversing a string.
- It is also used for expression conversion (e.g infix to prefix).

**Q21. What is shell sort?**

**Ans:** Shell sort is a generalized version of the insertion sort algorithm. It first sorts elements that are far apart from each other and successively reduces the interval between the elements to be sorted. The interval between the elements is reduced based on the sequence used.

**Q22. How breadth first traversal works?**

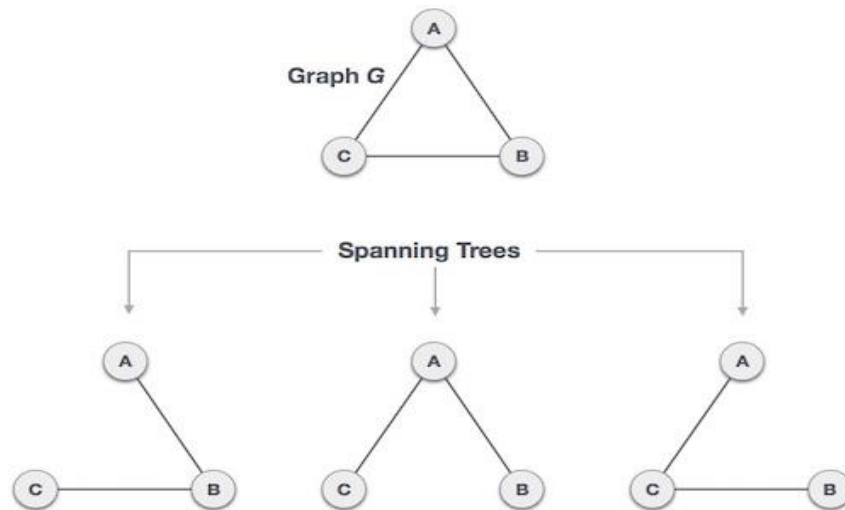
**Ans:** In Breadth First search (BFS) traversal, It starts at the tree root or some arbitrary node of a graph, sometimes referred to as a “search key”, and explores the neighbor nodes first, before moving to the next level neighbors.

**Q23. What is an AVL tree?**

**Ans:** An AVL tree is a balanced binary search tree in which balance factor of every node is either -1, 0 or +1. Balance factor of a node is the difference between the heights of left and right subtrees of that node.

**Q24. What is spanning tree?**

**Ans:** A spanning tree is a sub-graph of an undirected connected graph, which includes all the vertices of the graph with a minimum possible number of edges.



**Q25. What is minimum spanning tree?**

**Ans:** A minimum spanning tree is a spanning tree in which the sum of the weight of the edges is as minimum as possible.

**Q26. What is adjacency list?**

**Ans:** An adjacency list represents a graph as an array of linked lists. The index of the array represents a vertex and each element in its linked list represents the other vertices that form an edge with the vertex.

**Q27. What is a graph?**

**Ans:** A Graph is a non-linear data structure consisting of nodes and edges. The nodes are sometimes also referred to as vertices and the edges are lines or arcs that connect any two nodes in the graph.

**Q28. Define O-notation?**

**Ans:** Big O – notation is one of asymptotic notations that describe the performance or complexity of an algorithm. Big O specifically describes the worst-case scenario, and can be used to describe the execution time required or the space used by an algorithm.

**Q29. What is B Tree?**

**Ans:** B-tree is a special type of self-balancing search tree in which each node can contain more than one key and can have more than two children. It is a

generalized form of the binary search tree. It is also known as a height-balanced m-way tree.

**Q30. Differentiate linear from non-linear data structure?**

**Ans:**

<b>Linear Data Structure</b>	<b>Non – linear Data Structure</b>
A type of data structure that arranges data elements sequentially or linearly where the elements attached adjacently. <b>For Example:</b> Array, Stack, Queue, linked list.	Data structures where data elements are not arranged sequentially or linearly are called non-linear data structures. <b>For Example:</b> Graph, Tree.
In linear data structure, single level is involved. Therefore, we can traverse all the elements in single run only.	In a non-linear data structure, single level is not involved. Therefore, we can't traverse all the elements in single run only.
Linear data structures are easy to implement	Non-linear data structures are not easy to implement in comparison to linear data structure.

**Q31. What is FIFO?**

**Ans:** FIFO is the acronym of First IN First Out. It means whatever the data is entered first, it will be the first to be removed also. Queue data structure works on this method.

**Q32. What is the postfix of  $(a+b/c*(d*e))$ ?**

**Ans:** The postfix notation of the above expression is **ab+cde \*\*/**.

**Q33. What is merge sort?**

**Ans:** Merge sort is one of the most efficient sorting algorithms. It works on the principle of Divide and Conquer. Merge sort repeatedly breaks down a problem into several sub-problems until each sub-problem consists of a single element and merging those sub-problems in a manner that results into a sorted list.

**Q34. Define leaves node in a tree?**

**Ans:** In a tree data structure, the **node which does not have a child** is called as LEAF Node. In simple words, a leaf is a node with no child. In a tree data structure, the leaf nodes are also called as External Nodes.

**Q35. What is interpolation search technique?**

**Ans:** The Interpolation Search is an improvement over Binary Search for scenarios, where the values in a sorted array are uniformly distributed. Binary Search always goes to the middle element to check. On the other hand, interpolation search may go to different locations according to the value of the key being searched.

**Q36. What is the minimum number of queues needed when implementing a priority queue?**

**Ans:** The minimum number of queue required for implementing priority queue is 2. One for storing the actual data and another one for storing the priorities.

**Q37. What is a DEQUEUE?**

**Ans:** De-queue or Double Ended Queue is a type of queue in which insertion and removal of elements can either be performed from the front or the rear. Thus, it does not follow FIFO rule (First In First Out).

**Q38. What are dynamic data structures?**

**Ans:** A dynamic data structure (DDS) refers to an organization or collection of data in memory that has the flexibility to grow or shrink in size at run time, enabling a programmer to control exactly how much memory is utilized.

**Q39. Why to use PREFIX and POSTFIX notations when we have simple INFIX notation?**

**Ans:** Infix notation is easy to read for *humans*, whereas pre-/postfix notation is easier to parse for a machine. The big advantage in pre-/postfix notation is that there never arise any questions like operator precedence.



**Q40. There are 8, 15, 13 and 14 nodes in 4 different trees. Which one of them can form a full binary tree? Why?**

**Ans:** A full binary tree with N leaves contains  $2N - 1$  nodes. It means that the number of nodes in a full binary tree is always odd, so you can't create a full binary tree with 8 and 14 but you can create with 13 and 15.

**Q41. What is binary search tree?**

**Ans:** Binary Search Tree is a node-based binary tree data structure which has the following properties:

- The left subtree of a node contains only nodes with keys lesser than the node's key.
- The right subtree of a node contains only nodes with keys greater than the node's key.
- The left and right subtree each must also be a binary search tree.

**Q42. How do you insert a new item in a binary search tree?**

**Ans:** A new item is always inserted at the leaf node. Start searching from the root till a leaf node is hit, while searching if new value is greater than current node move to right child else to left child. Once a leaf node is found, the new node is added as a child of the leaf node.

**Q43. When is a binary search best applied?**

**Ans:** A binary search is an algorithm that is best applied to search a list or array when the elements are already in sorted order.

**Q44. Differentiate file structure from storage structure?**

**Ans:** The main difference between file structure and storage structure is based on memory area that is being accessed.

- **Storage structure:** It is the representation of the data structure in the computer memory.

- **File structure:** It is the representation of the storage structure in the auxiliary memory.

**Q45. Which data structure is applied when dealing with a recursive function?**

**Ans:** Recursion, which is basically a function that calls itself based on a terminating condition, makes use of the stack. Using LIFO, a call to a recursive function saves the return address so that it knows how to return to the calling function after the call terminates.

**Q46. What is an ordered list?**

**Ans:** An ordered list is a collection of items where each item holds a relative position that is based upon some underlying characteristic of the item. The ordering is typically either ascending or descending and we assume that list items have a meaningful comparison operation that is already defined.

**Q47. What is Data abstraction?**

**Ans:** Data abstraction refers to providing only essential information about the data to the outside world, hiding the background details or implementation. It is one of the most essential feature of Object Oriented programming.

**Q48. In what areas do data structures applied?**

**Ans:** Data structure is important in almost every aspect where data is involved. In general, algorithms that involve efficient data structure is applied in the following areas: numerical analysis, operating system, A.I., compiler design, database management, graphics, and statistical analysis etc.

**Q49. What is the minimum number of nodes that a binary tree can have?**

**Ans:** A binary tree can have a minimum of zero nodes, which occurs when the nodes have NULL values. A binary tree can have maximum of two nodes.

**Q50. What is a cycle in a graph, also define cyclic graph, acyclic, uni-cyclic?**

**Ans:** In graph theory, a path that starts from a given vertex and ends at the same vertex is called a cycle. A cyclic graph is a graph containing at least one graph cycle. A graph that is not cyclic is said to be acyclic. A cyclic graph possessing exactly one cycle is called a uni-cyclic graph.

**Q51. List the benefits of ADT's?**

**Ans:**

- Increase ease of maintenance and reuse of code.
- Encapsulation: internal complexity, data and operation details are hidden.
- Higher Modularity
- Domain concepts are reflected in the code.

**Q52. What are pointers?**

**Ans:** The pointer is a variable which stores the address of another variable i.e., direct address of the memory location. The general form of a pointer variable declaration is.

type \*var-name;

**Q53. How do you understand hash tables?**

**Ans:** A hash table is a data structure that stores key value pairs. Each value is assigned a unique key that is generated using a hash function. The name of the key is used to access its associated value. This makes searching for values in a hash table very fast, irrespective of the number of items in the hash table.

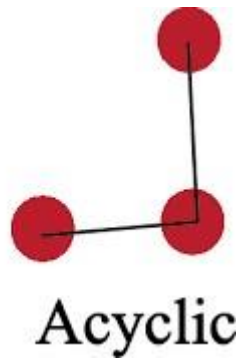
**Q54. Write the different categories of strings?**

**Ans:**

Fixed-length strings	Variable-length strings
Fixed-length strings, have a fixed maximum length to be determined at compile-time and which use the same amount of memory whether this maximum is needed or not.	variable-length strings, whose length is not arbitrarily fixed and which can use varying amounts of memory depending on the actual requirements at run time.

**Q55. Define acyclic graph with an example?**

**Ans:** An acyclic graph is a graph having no graph cycles.



**Q56. What is circular queue? Why we use it?**

**Ans:** Circular Queue is a linear data structure in which the operations are performed based on FIFO (First In First Out) principle and the last position is connected back to the first position to make a circle. It is also called '**Ring Buffer**'. Circular queue is used in Computer controlled Traffic Signal System. It is also used for CPU scheduling and Memory management.

**Q57. Define array?**

**Ans:** An array is a collection of elements of the same type placed in contiguous memory locations that can be individually referenced by using an index to a unique identifier.

**Q58. Are linked lists considered linear or non-linear data structures? give reason?**

**Ans:** Linked list is a linear data structure because in linked list data elements are stored sequentially and attached adjacently.

**Q59. What are tree traversals? How many traversals of binary tree are possible?**

**Ans:** Traversal is a process to visit all the nodes of a tree and may print their values too. There are three ways which we use to traverse a tree,

- In-order Traversal
- Pre-order Traversal
- Post-order Traversal

**Q60. When we should not use sequential search?**

**Ans:** We should not use sequential search when list or array is already in sorted order. The *sequential search* is *used* whenever the list is *not* ordered.

**Q61. What are the different methods to represent a graph?**

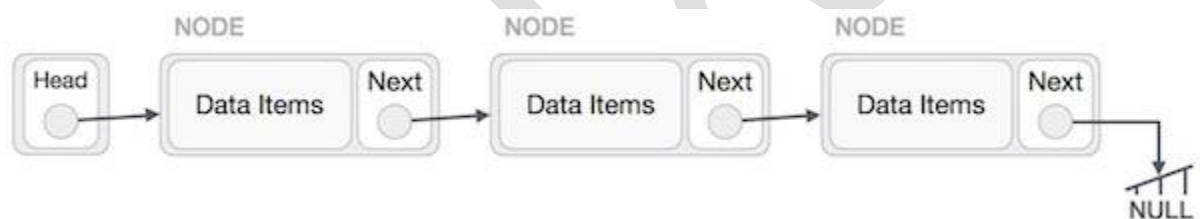
**Ans:** The following two are the most commonly used representations of a graph.

1. Adjacency Matrix
2. Adjacency List

**Q62. What is a linked list?**

**Ans:** A linked list is a linear data structure that includes a series of connected nodes. Here, each node store the **data** and the **address** of the next node.

**For Example:**



**Q63. What are asymptotic analysis?**

**Ans:** Asymptotic analysis of an algorithm refers to defining the mathematical boundation/framing of its run-time performance. Using asymptotic analysis, we can very well conclude the best case, average case, and worst case scenario of an algorithm.

**Q64. What operations can be performed on Queues?**

**Ans:** Following are the basic operations performed on a Queue.

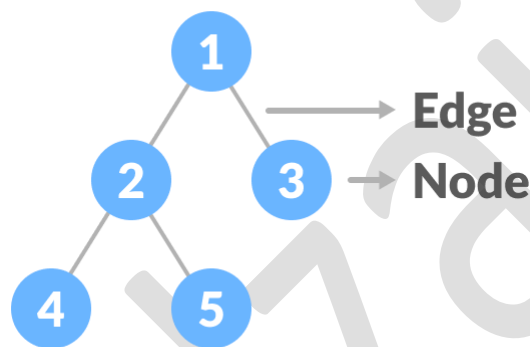
- **Enqueue:** Add an element to the end of the queue
- **Dequeue:** Remove an element from the front of the queue
- **IsEmpty:** Check if the queue is empty
- **IsFull:** Check if the queue is full
- **Peek:** Get the value of the front of the queue without removing it

**Q65. What is selection sort?**

**Ans:** The selection sort algorithm sorts an array by repeatedly finding the minimum element from unsorted part and putting it at the beginning. The algorithm maintains two subarrays in a given array.

**Q66. What is a tree?**

**Ans:** A tree is a nonlinear hierarchical data structure that consists of nodes connected by edges.



**Q67. What is tower of Hanoi?**

**Ans:** Tower of Hanoi is a mathematical puzzle where we have three rods and n disks. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:

1. Only one disk can be moved at a time.
2. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack
3. No disk may be placed on top of a smaller disk.

**Q68. What is Fibonacci series?**

**Ans:** The Fibonacci sequence is a series of numbers where a number is the addition of the last two numbers, starting with 0, and 1.

**The Fibonacci Sequence: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55...**

Written as a rule, the expression is:

$$X_n = X_{n-1} + X_{n-2}$$

**Q69. What is data type?**

**Ans:** A data type, in programming, is a classification that specifies which type of value a variable has and what type of mathematical, relational or logical operations can be applied to it without causing an error. For example, integer, float, character.

**Q70. What is recursive function? List the four fundamental rules of recursion?**

**Ans:** A recursive function is a function that calls itself during its execution. The process may repeat several times.

- **Base Case:** You must always have at least one case that can be solved without recursion.
- **Make Progress:** Any recursive call must make progress toward a base case.
- **Design Rule:** Always assume that the recursive call works.
- **Compound Interest:** Never duplicate work by solving the same instance of a problem in separate recursive calls.

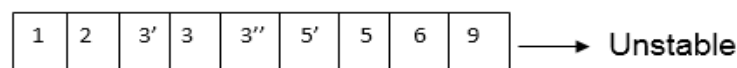
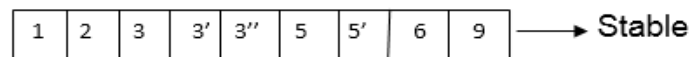
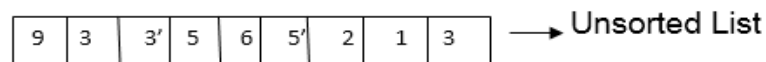
**Q71. How insertion sort and selection sort are different?**

**Ans:**

<b>Insertion Sort</b>	<b>Selection sort</b>
Insertion sort performs sorting by exchanging an element at a time with the partially sorted array.	Selection sort performs sorting by selecting the smallest element from the remaining elements and exchanging it with the element in the correct location.
More efficient than selection sort.	Less efficient than insertion sort.
Complex than selection sort.	Simpler than insertion sort.
Best case time complexity $O(n)$	Best case time complexity $O(n^2)$

### Q72. What is meant by a sorting algorithm is stable?

**Ans:** A sorting algorithm is said to be stable if two objects with equal keys appear in the same order in sorted output as they appear in the input unsorted array.



1.

### Q73. What is Queue?

**Ans:** A Queue is an abstract data type and linear data structure which follows the First In First Out (FIFO) rule - the item that goes in first is the item that comes out first.



### Q74. Differentiate between Stack and Array?

**Ans:**

Array	Stack
Array contains elements of the same data type.	Stack can contain elements of different data types
Any element can be accessed using the array index.	Only the topmost element can be read or removed at a time.
Basic operations include insert, delete, modify, traverse, sort, search.	Basic operations are push, pop and peek.



**Q75. When are linked lists best suited?**

**Ans:** linked lists are best suited if the size of the structure and the data in the structure are constantly changing

**Q76. What is time complexity of bubble sort algorithm?**

**Ans:** Bubble sort has a worst-case and average-case complexity of  $O(n^2)$  and the best-case complexity of bubble sort is only  $O(n)$ .

**Q77. What do you mean by space complexity?**

**Ans:** Space complexity is an amount of memory used by the algorithm (including the input values of the algorithm), to execute it completely and produce the result.

**Q78. What is index number of the middle element of an array of size 11?**

**Ans:** The index number of the middle element of an array of size 11 is 5.

**Compiled by: M.Uzair**