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source: <http://placement.freshersworld.com/data-structures/33121964113>

1.What is data structure?

A data structure is a way of organizing data that considers not only the items stored, but also their relationship to each other. Advance knowledge about the relationship between data items allows designing of efficient algorithms for the manipulation of data.

2.Minimum number of queues needed to implement the priority queue?

Two. One queue is used for actual storing of data and another for storing priorities.

3.What are the notations used in Evaluation of Arithmetic Expressions using prefix and postfix forms?

Polish and Reverse Polish notations.

4.List out few of the Application of tree data-structure?

- i)The manipulation of Arithmetic expression
- ii)Symbol Table construction
- iii)Syntax analysis.

5.What is the type of the algorithm used in solving the 8 Queens problem?

Backtracking

6.In RDBMS, what is the efficient data structure used in the internal storage representation? B+ tree. Because in B+ tree, all the data is stored only in leaf nodes, that makes searching easier. This corresponds to the records that shall be stored in leaf nodes.

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7. What is a spanning Tree?

A spanning tree is a tree associated with a network. All the nodes of the graph appear on the tree once. A minimum spanning tree is a spanning tree organized so that the total edge weight between nodes is minimized.

8. List out the areas in which data structures are applied extensively?

Compiler Design, Operating System, Database Management System, Statistical analysis package, Numerical Analysis, Graphics, Artificial Intelligence, Simulation

9. Translate infix expression into its equivalent post fix expression:  $(A-B)*(D/E)$

$(A-B)*(D/E) = [AB-]*[DE/] = AB-DE/*$

10. What are priority queues?

A priority queue is a collection of elements such that each element has been assigned a priority.

11. What is a string?

A sequential array of characters is called a string.

12. What is Brute Force algorithm?

Algorithm used to search the contents by comparing each element of array is called Brute

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Force algorithm.

13. What are the limitations of arrays?

- i) Arrays are of fixed size.
- ii) Data elements are stored in continuous memory locations which may not be available always.
- iii) Adding and removing of elements is problematic because of shifting the locations.

14. How can you overcome the limitations of arrays?

Limitations of arrays can be solved by using the linked list.

15. What is a linked list?

Linked list is a data structure which store same kind of data elements but not in continuous memory locations and size is not fixed. The linked lists are related logically.

16. What is a node?

The data element of a linked list is called a node.

17. What does node consist of?

Node consists of two fields: data field to store the element and link field to store the address of the next node.

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18. What is a queue ?

A Queue is a sequential organization of data. A queue is a first in first out type of data structure. An element is inserted at the last position and an element is always taken out from the first position.

19. What are the types of Collision Resolution Techniques and the methods used in each of the type?

Open addressing (closed hashing), The methods used include: Overflow block

Closed addressing (open hashing), The methods used include: Linked list, Binary tree

20. What are the methods available in storing sequential files ?

Straight merging, Natural merging, Polyphase sort, Distribution of Initial runs.

21. Mention some of the problem solving strategies?

The most widely strategies are listed below

i) Divide and conquer

ii) Binary doubling strategy

iii) Dynamic programming

22. What is divide and conquer method?

The basic idea is to divide the problem into several sub problems beyond which cannot be further subdivided. Then solve the sub problems efficiently and join them together to get the solution for the main problem.

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23. What is the need for the header?

Header of the linked list is the first element in the list and it stores the number of elements in the list. It points to the first data element of the list.

24. Define leaf?

In a directed tree any node which has out degree 0 is called a terminal node or a leaf.

25. What are the applications of binary tree?

Binary tree is used in data processing.

26. What are the different types of traversing?

The different types of traversing are

- i) Pre-order traversal-yields prefix form of expression.
- ii) In-order traversal-yields infix form of expression.
- iii) Post-order traversal-yields postfix form of expression.

27. Define pre-order traversal?

- i) Process the root node
- ii) Process the left subtree
- iii) Process the right subtree

28. Define post-order traversal?

- i) Process the left subtree

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ii)Process the right subtree

iii)Process the root node

29. Define in -order traversal?

i)Process the left subtree

ii)Process the root node

iii)Process the right subtree

30. What is meant by sorting?

Ordering the data in an increasing or decreasing fashion according to some relationship among the data item is called sorting.

31. What's the major distinction in between Storage structure and file structure and how?

The expression of an specific data structure inside memory of a computer system is termed storage structure in contrast to a storage structure expression in auxiliary memory is normally known as a file structure.

32. Stack can be described as a pointer. Explain?

Because stack will contain a head pointer which will always point to the top of the Stack.All Stack Operations are done using Head Pointer. Hence Stack ca be Described as a Pointer

33. What do you mean by: Syntax Error, Logical Error, Run time Error?

Syntax Error-Syntax Error is due to lack of knowledge in a specific language. It is due to

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somebody does not know how to use the features of a language. We can know the errors at the time of compilation.

logical Error-It is due to the poor understanding of the requirement or problem.

Run time Error-The exceptions like divide a number by 0, overflow and underflow comes under this.

34. What is mean by d-queue?

D-queue stands for double ended queue. It is a abstract data structure that implements a queue for which elements can be added to front or rear and the elements can be removed from the rear or front. It is also called head-tail linked list

35. What is AVL tree?

Avl tree is self binary tree in which balancing factor lie between the -1 to 1. It is also known as self balancing tree.

36. what is binary tree?

Binary tree is a tree which has maximum no. of childrens either 0 or 1 or 2. i.e., there is at the most 2 branches in every node.

37. What is the difference between a stack and a Queue?

Stack – Represents the collection of elements in Last In First Out order. Operations includes testing null stack, finding the top element in the stack, removal of top most element and adding elements on the top of the stack.

Queue - Represents the collection of elements in First In First Out order. Operations include testing null queue, finding the next element, removal of elements and inserting the elements from the queue.

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Insertion of elements is at the end of the queue. Deletion of elements is from the beginning of the queue

38. What actions are performed when a function is called?

- i) arguments are passed
- ii) local variables are allocated and initialized
- iii) transferring control to the function

39. What is precision?

Precision refers to the accuracy of the decimal portion of a value. Precision is the number of digits allowed after the decimal point.

40. What do you mean by overflow and underflow?

When new data is to be inserted into the data structure but there is no available space i.e. free storage list is empty this situation is called overflow. When we want to delete data from a data structure that is empty this situation is called underflow.

Data Structure Advanced updated on Sep 2019

1. Is it possible to find a loop in a Linked list ?

- a. Possible at  $O(n)$
- b. Not possible
- c. Possible at  $O(n^2)$  only
- d. Depends on the position of loop

Solution: a. Possible at  $O(n)$

Have two pointers say P1 and P2 pointing to the first node of the list.

Start a loop and increment P1 once and P2 twice in each iteration. At any point of time if  $P1 == P2$  then there is a loop in that linked list. If P2 reaches NULL (end of linked list) then no loop exists.

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2. Two linked lists L1 and L2 intersect at a particular node N1 and from there all other nodes till the end are common. The length of the lists are not same. What are the possibilities to find N1?.

- a. Solution exist for certain cases only
- b. No linear solution exist
- c. Linear solution is possible
- d Only Non-linear solution exist.

Solution: c. Linear solution is possible

Have two pointers say P1 pointing to the first node of L1 and P2 to that of L2. Traverse through both the lists. If P1 reaches L1's last node, point it to the first node of L2 and continue traversing. Do the same thing for P2 when it reaches L2's last node. (By doing this, we are balancing the difference in the length between the linked lists. The shorter one will get over soon and by redirecting to longer list's head, it will traverse the extra nodes also.) Finally they will Meet at the Intersection node.

3. void PrintTree (Tree T)

```
{  
if (T != NULL)  
{  
PrintTree (T-> Left);  
PrintElement (T-> Element);  
PrintTree (T->Right);  
}  
}
```

The above method 'PrintTree' results in which of the following traversal

- a Inorder
- b. Preorder
- c. Postorder
- d. None of the above

Solution: a. Inorder

Inorder:

void PrintTree (Tree T)

```
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if (T != NULL)  
{  
PrintTree (T-> Left);  
PrintElement (T-> Element);  
}
```

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```
PrintTree (T->Right);  
}  
}
```

For preorder use this order

```
PrintElement (T-> Element);  
PrintTree (T-> Left);  
PrintTree (T->Right);
```

For postorder use this order

```
PrintTree (T-> Left);  
PrintTree (T->Right);  
PrintElement (T-> Element);
```

4. Given a Binary Search Tree (BST), print its values in ascending order.

- a. Perform Depth first traversal
- b. Perform Breadth first traversal
- c. Perform Postorder traversal
- d. Perform Inorder traversal

Solution: d. Perform Inorder traversal

It is the property of BST and Inorder traversal.

5. Is it possible to implement a queue using Linked List ?. Enqueue & Dequeue should be  $O(1)$ .

- a. Not possible to implement.
- b Only Enqueue is possible at  $O(1)$ .
- c. Only Dequeue is possible at  $O(1)$ .
- d. Both Enqueue and Dequeue is possible at  $O(1)$

Solution: d. Both Enqueue and Dequeue is possible at  $O(1)$

Have two pointers H pointing to the Head and T pointing to the Tail of the linked list. Perform enqueue at T and perform dequeue at H. Update the pointers after each operations accordingly.

6. Given a Tree, is it possible to find the greatest and least among leaves in linear time?.

- a. Solution depends on the tree structure
- b.Linear solution exist

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c. Only Non-linear solution exist.

d. No linear solution exist

Solution: b. Linear solution exist

Have two variables Min and Max. Perform any tree traversal. Assign the first traversed leaf element to Min and Max for all other leaf elements check with these variables and update it accordingly. If a current element is  $< \text{Min}$  then update Min with that element. If it is  $> \text{Min}$  then check with Max.

Note: If you want to find the greatest and least among all nodes perform the checks for each node traversed.

7. Is it possible to find the greatest and least value among the nodes in a given BST without using any extra variables?

a. No solution exist.

b. Solution need 2 extra variables

c. Solution exist without any extra variables

d. Solution need 1 extra variable

Solution: c. Solution exist without any extra variables

As per BST property, the left most node should be the least one and the rightmost node should be the greatest. In other words, the first and last node of an Inorder traversal are the least and greatest among the nodes respectively.

8. Is it possible to implement 2 stack in an array?

Condition: None of the stack should indicate an overflow until every slot of an array is used.

a. Only 1 stack can be implemented for the given condition

b. Stacks can not be implemented in array

c. 2 stacks can be implemented for the given condition.

d. 2 stacks can be implemented if the given condition is applied only for 1 stack.

Solution: c. 2 stacks can be implemented for the given condition

Start 1st stack from left (1st position of an array) and 2nd from right (last position say n). Move 1st stack towards right (i.e 1,2,3 ...n) and 2nd towards left (i.e n,n-1,n-2...1).

9. Given two keys K1 & K2, write an algorithm to print all the elements between them with  $K1 \leq K2$  in a BST.

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- a. Solution need 2 extra spaces
- b. Linear solution is possible without using any extra space
- c No linear solution exist
- d Solution need 1 extra space

Solution:b. Linear solution is possible without using any extra space

Perform an inorder traversal. Once you find K1 print it and continue traversal now, print all other traversed elements until you reach K2.

Note: If  $K1 == K2$  stop once you find K1.

10. How many stacks are required to implement a Queue.

- a. One
- b. Two
- c. Three
- d. Two + one extra space.

Solution:b Two

Have two stacks S1 and S2.

For Enqueue, perform push on S1.

For Dequeue, if S2 is empty pop all the elements from S1 and push it to S2. The last element you popped from S1 is an element to be dequeued. If S2 is not empty, then pop the top element in it.

DATA STRUCTURES updated on Sep 2019

DATA STRUCTURES:

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Solution: a. Possible at  $O(n)$

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Start a loop and Increment P1 once and P2 twice in each iteration. At any point of time if  $P1 == P2$  then there is a loop in that linked list. If P2 reaches NULL (end of linked list) then no loop exists.

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```
}  
}
```

The above method `PrintTree` results in which of the following traversal

- a Inorder
- b. Preorder
- c. Postorder
- d. None of the above

Solution: a. Inorder

Inorder:

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void PrintTree (Tree T)
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}  
}
```

For preorder use this order

```
PrintElement (T-> Element);  
PrintTree (T-> Left);
```

```
PrintTree (T->Right);
```

For postorder use this order

```
PrintTree (T-> Left);
```

```
PrintTree (T->Right);
```

```
PrintElement (T-> Element);
```

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Solution:b. Linear solution is possible without using any extra space

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Note: If  $K1 == K2$  stop once you find K1.

10. How many stacks are required to implement a Queue.

a. One

b. Two

c. Three

d. Two + one extra space.

Solution:b Two

Have two stacks S1 and S2.

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For Enqueue, perform push on S1.

For Dequeue, if S2 is empty pop all the elements from S1 and push it to S2. The last element you popped from S1 is an element to be dequeued. If S2 is not empty, then pop the top element in it.

## Data Structures Interview Questions with Answers

Here are the 30+ most asked data structures interview questions. Data Structures & Algorithms is one of the most frequently tested subjects by a lot of companies. So make sure you have a quick look at these questions before the interview.

### 1) What do you mean by a Data structure?

Data structure is a format for storing data in a structured manner. For example, data like photos, videos are stored in gallery with the help of a data structure. It is not a separate programming language. It is just an implementation method and can be implemented using any one of the programming language like C, C++, Java, etc.

### 2) What are some of the applications of DS?

Some of the real-time applications of Data Structures are:

For representing a city region telephone network.

To implement back functionality in the internet web browser.

To store dynamically growing data which is accessed very frequently, based upon a key value.

To implement the undo function in a text editor.

To store information about the directories and files in a system.

For more applications of each of the data structures, check out the below links:

Applications of a Stack

Applications of Priority Queue

Applications of Depth First Search

Applications of Breadth-First Search

### 3) What are the advantages of a Linked list over an array?

Consider a scenario, where we need to store large amount of data in an array. But, the

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memory to store that data is not available contiguously. In this case we cannot use array. Hence, we go for a linked list. Since each node is connected using link, it is not necessary that memory has to be contiguous.

Also, some of the major differences between a Linked List and an array are given below. For more, click here.

#### Arrays Linked List

Array elements can be accessed randomly using the array index. Random accessing is not possible in linked lists. The elements will have to be accessed sequentially.

Data elements are stored in contiguous locations in memory. New elements can be stored anywhere and a reference is created for the new element using pointers.

4) Write the syntax in C to create a node in the singly linked list.

```
struct node
{
    int data;
    struct node *next;
};
struct node *head, *ptr;
ptr = (struct node *)malloc(sizeof(struct node));
```

5) What is the use of a doubly-linked list when compared to that of a singly linked list?

#### data structures interview questions

In a singly linked list, we have only forward links. Hence, we cannot traverse the linked list in a backward manner. In order to overcome this, we go for a doubly linked list. In a doubly linked list, each node has three fields such as previous, data and next field and has two links such as a forward and backward link. The previous field of the first node and the address field of the last node is NULL. The previous field of the second node has the address of the first node and so on.

Also, accessing of elements can be done more efficiently in case of a doubly linked list.

6) What is the difference between an Array and Stack?

Stack Data Structure:

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Size of the stack keeps on changing as we insert and delete the element

Stack can store elements of different data type

Array Data Structure:

Size of the array is fixed at the time of declaration itself

Array stores elements of similar data type

7) What are the minimum number of Queues needed to implement the priority queue?

Two queues are needed. One queue is used to store the data elements, and another is used for storing priorities. Check out the implementation of a Priority Queue.

8) What are the different types of traversal techniques in a tree?

There are three main traversals of a tree such as In-order, Pre-order, Post-order.

Algorithm of In-order traversal:

Traverse the left sub-tree

Visit the root

Traverse the right sub-tree

Algorithm of Pre-order traversal:

Visit the root

Traverse the left sub-tree

Traverse the right sub-tree

Algorithm of Post-order traversal:

Traverse the left sub-tree

Traverse the right sub-tree

Visit the root

9) Why it is said that searching a node in a binary search tree is efficient than that of a simple binary tree?

When searching any node in binary search tree, the value of the target node is compared with the parent node and accordingly either left sub tree or right sub tree is searched. So, one has to compare only particular branches. Thus searching becomes efficient.

10) What are the applications of Graph DS?

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Graphs are used in circuit networks where points of connection are drawn as vertices and component wires become the edges of the graph, in transport networks where stations are drawn as vertices and routes become the edges of the graph, in maps that draw cities/states/regions as vertices and adjacency relations as edges, in program flow analysis where procedures or modules are treated as vertices and calls to these procedures are drawn as edges of the graph.

11) Can we apply Binary search algorithm to a sorted Linked list?

No, we cannot apply the binary search algorithm to a sorted linked list because finding the index of the middle element is difficult.

12) When can you tell that a Memory Leak will occur?

A memory leak occurs when a program does not free a block of memory allocated dynamically.

13) How will you check if a given Binary Tree is a Binary Search Tree or not?

To know that you need to check the inorder traversal of a binary tree. If it is sorted, then the binary tree is BST. Click here to know how to perform inorder traversal.

14) Which data structure is ideal to perform Recursion operation and why?

Stack is the most ideal for recursion operation. This is mainly because of its LIFO (Last In First Out) property, it remembers the elements & their positions, so it exactly knows which one to return when a function is called.

15) What are some of the most important applications of a Stack?

Some of the important applications are given below. Check them out to know the detailed code & explanation.

Balanced parenthesis checker

Redundant braces

Infix to postfix using a stack

Infix to prefix using a stack

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16) Convert the below given expression to its equivalent Prefix And Postfix notations.

$((A + B) * C - (D - E) ^ (F + G))$

Prefix Notation:  $^ - * + ABC - DE + FG$

postfix Notation:  $AB + C * DE - - FG + ^$

Source: <https://www.faceprep.in/data-structures-interview-questions/>

Source: [https://java2blog.com/data-structure-and-algorithm-interview-questions-in-java/#Question\\_102\\_What\\_is\\_Memoization](https://java2blog.com/data-structure-and-algorithm-interview-questions-in-java/#Question_102_What_is_Memoization)

I have been posting **data structure** and algorithms interview questions on various topics such as Array, Queue, Stack, Binary tree, LinkedList, String, Number, ArrayList, etc. So I am consolidating a list of programs to create an index post. I will keep adding links to this post whenever I add new programs. These are frequently asked Data Structure and algorithm interview questions.

## Table of Contents

### Stack

**Question 1: Implement a stack using array.**

**Question 2: Implement a stack using Linked List :**

**Question 3: Implement a stack using two queues .**

**Question 4 : Sort an stack using another stack**

### Queue

**Question 5: Implement Queue using Array in java.**

**Question 6: Implement a stack using two queues .**

### Linked List

**Question 7 : Implement singly linked list in java.**

**Question 8: How to reverse linked list in java.**

**Question 9: How to find middle element of linked list.**

**Question 10 : How to find nth element from end of linked list .**

**Question 11 : How to detect a loop in linked list. If linked list has loop, find the start node for the loop.**

**Question 12: How to check if linked list is palindrome or not?**

**Question 13 : Find intersection of two linked lists?**

**Question 14 : How to reverse a linked list in pairs?**

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## Array

**Question 15 : Implement Doubly linked list in java?**

**Question 16 : Write java Program to Find Smallest and Largest Element in an Array.**

**Question 17 : Find missing number in the array.**

**Question 18 : Search an element in rotated and sorted array.**

**Question 19 : Find minimum element in a sorted and rotated array.**

**Question 20: Find second largest number in an array**

**Question 21 : Find the number occurring odd number of times in an array**

**Question 22 : Find minimum number of platforms required for railway station**

**Question 23 : Find a Pair Whose Sum is Closest to zero in Array**

**Question 24 : Given a sorted array and a number x, find the pair in array whose sum is closest to x**

**Question 25 : Find all pairs of elements from an array whose sum is equal to given number**

**Question 26: Given an array of 0's and 1's in random order, you need to separate 0's and 1's in an array.**

**Question 27 : Separate odd and even numbers in an array**

**Question 28 : Given an array containing zeroes, ones and twos only. Write a function to sort the given array in  $O(n)$  time complexity.**

**Question 29 : Find local minima in array**

**Question 30 : Sliding window maximum in java**

**Question 31 : Count number of occurrences (or frequency) of each element in a sorted array**

**Question 32 : Find subarrays with given sum in an array.**

**Question 33 : Find peak element in the array.**

**Question 34 : Find leaders in an array.**

**Question 35 : Count 1's in sorted Binary Array.**

**Question 36 : Find first repeating element in an array of integers.**

**Question 37 : Check if Array Elements are Consecutive.**

**Question 38 : Permutations of array in java.**

**Question 39 : Rotate an array by K positions.**

**Question 40 : Stock Buy Sell to Maximize Profit.**

**Question 41 : Find maximum difference between two elements such that larger element appears after the smaller number.**

**Question 42 : Search in a row wise and column wise sorted matrix.**

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**Question 43 : Largest sum contiguous subarray.**

**Question 44 : Find the Contiguous Subarray with Sum to a Given Value in an array.**

**Question 45 : Longest Common Prefix in an array of Strings in java.**

**Question 46 : Find all subsets of set (power set) in java.**

#### **String**

**Question 47 : How to reverse a String in java? Can you write a program without using any java inbuilt methods?**

**Question 48 : Write a java program to check if two Strings are anagram in java?**

**Question 49 : Write a program to check if String has all unique characters in java?**

**Question 50 : How to check if one String is rotation of another String in java?**

**Question 51 : How to find duplicate characters in String in java?**

**Question 52 : Find first non repeated character in String in java?**

**Question 53 : Find all substrings of String in java?**

**Question 54 : Find length of String without using any inbuilt method in java?**

**Question 55 : Write a program to print all permutations of String in java?**

#### **Binary Tree**

**Question 56 : How can you traverse binary tree?**

**Question 57 : Write an algorithm to do level order traversal of binary tree?**

**Question 58 : Write an algorithm to do spiral order traversal of binary tree?**

**Question 59 : How can you print leaf nodes of binary tree?**

**Question 60 : How to count leaf nodes of binary tree.**

**Question 61 : How to print all paths from root to leaf in binary tree.**

**Question 62 : How to find level of node in binary tree**

**Question 63 : How to find maximum element in binary tree.**

**Question 64 : How to find lowest common ancestor(LCA) in binary tree.**

**Question 65 : How to do boundary traversal of binary tree.**

**Question 66 : How to print vertical sum of binary tree?**

**Question 67 : Count subtrees with Sum equal to target in binary tree?**

#### **Binary Search tree**

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**Question 68 : What is binary search tree?**

**Question 69 : Can you write algorithm to insert a node in binary search tree.**

**Question 70 : Can you write algorithm to delete a node in binary search tree.**

**Question 71 : How can you find minimum and maximum elements in binary search tree?**

**Question 72 : How to find lowest common ancestor(LCA) in binary search tree.**

**Question 73 : Find inorder successor in a Binary search Tree**

**Question 74 : Convert sorted array to balanced BST**

**Question 75 : Convert sorted Linked List to balanced BST**

**Question 76 : Check if a binary tree is binary search tree or not in java**

### **Sorting**

**Question 77 : Write an algorithm to implement bubble sort?**

**Question 78 : Write an algorithm to implement insertion sort?**

**Question 79 : Write an algorithm to implement selection sort?**

**Question 80 : Can you write algorithm for merge sort and also do you know complexity of merge sort?**

**Question 81 : Do you know how to implement Heap sort?**

**Question 82 : Implement quick sort in java?**

**Question 83 : Implement shell sort in java?**

**Question 84 : Implement Counting sort in java?**

**Question 85 : What is binary search? Can you write an algorithm to find an element in sorted array using binary search?**

### **Graph**

**Question 86 : Write algorithm to do depth first search in a graph.**

**Question 87 : Write algorithm to do breadth first search in a graph.**

**Question 88 : Explain Dijkstra algorithm from source to all other vertices.**

**Question 89 : Explain Bellman Ford algorithm to find shortest distance**

**Question 90 : Explain Kruskal's algorithm for finding minimum spanning tree**

### **Dynamic Programming**

**Question 91 : Given two String, find longest common substring.**

**Question 92 : Given two Strings A and B. Find the length of the Longest Common Subsequence (LCS) of the given Strings.**

**Question 93 : Given a matrix, we need to count all paths from top left**

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to bottom right of MxN matrix. You can either move down or right.

Question 94 : Edit Distance Problem in java

Question 95: Coin change problem in java

Question 96 : Minimum number of jumps to reach last index

#### Miscellaneous

Question 97 : What is an algorithm and how to calculate complexity of algorithms.

Question 98 : Implement trie data structure in java.

Question 99 : Count Factorial Trailing Zeroes in java.

Question 100 : Largest Rectangular Area in a Histogram.

Question 101 : Check for balanced parentheses in an expression in java.

Question 102 : What is Memoization.

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If you want to practice and improve data structure and algorithm programs, this post will be very helpful to you. I will recommend you to try it yourself first and then check the solution.

**Stack**

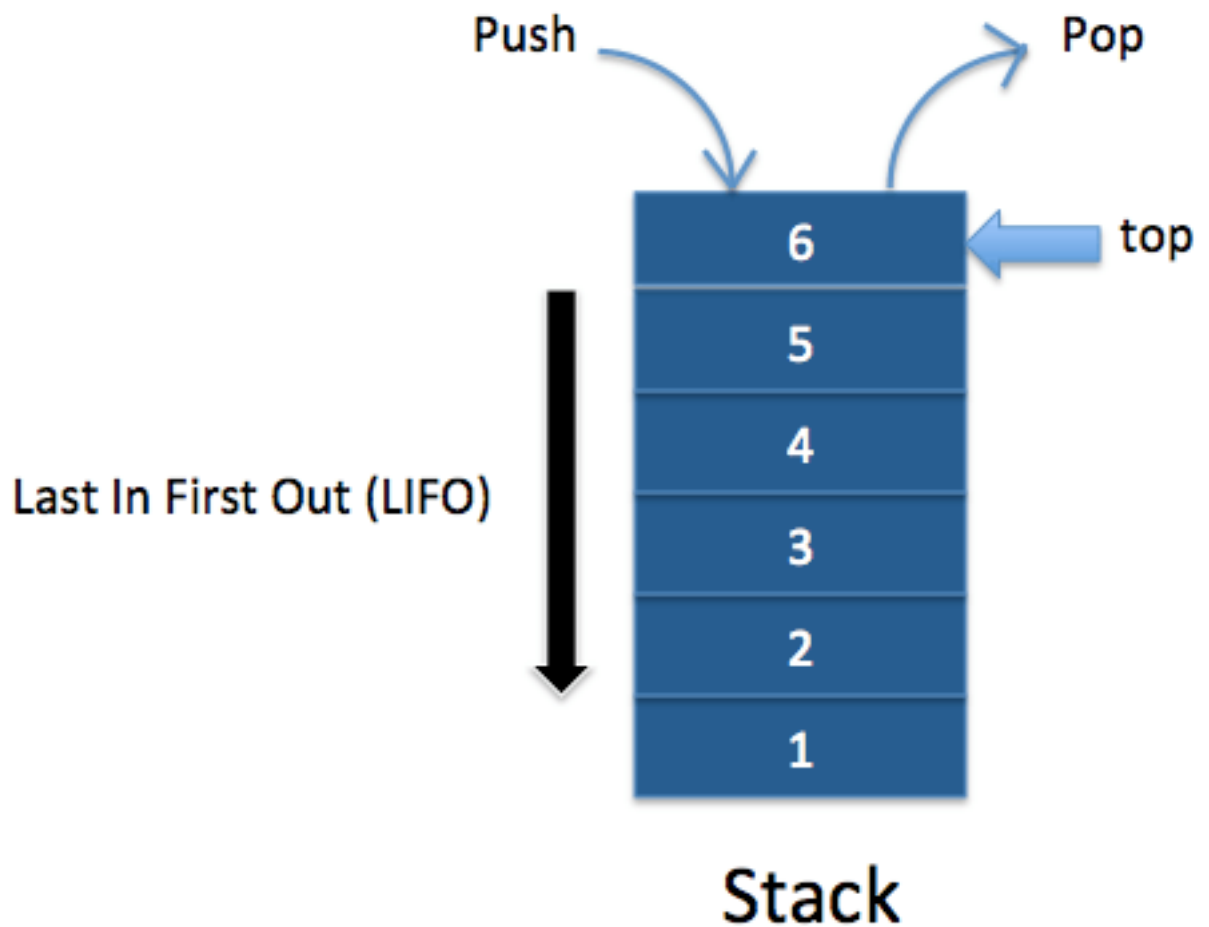
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**Question 1: Implement a stack using array.**

You need to implement Stack using array. You need to write push and pop methods to demonstrate Stack behavior(Last In First Out).

**Solution :** [Java Program to implement stack using array.](#)

**Question 2: Implement a stack using Linked List :**

You need to implement Stack using Linked List. You need to write push and pop methods to demonstrate Stack behavior(Last In First Out).

**Solution :** [Java Program to implement stack using Linked List](#)

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**Question 3: Implement a stack using two queues .**

You need to use two queues to implement stack behavior. You need to write push and pop methods to demonstrate Stack behavior (Last In First Out).

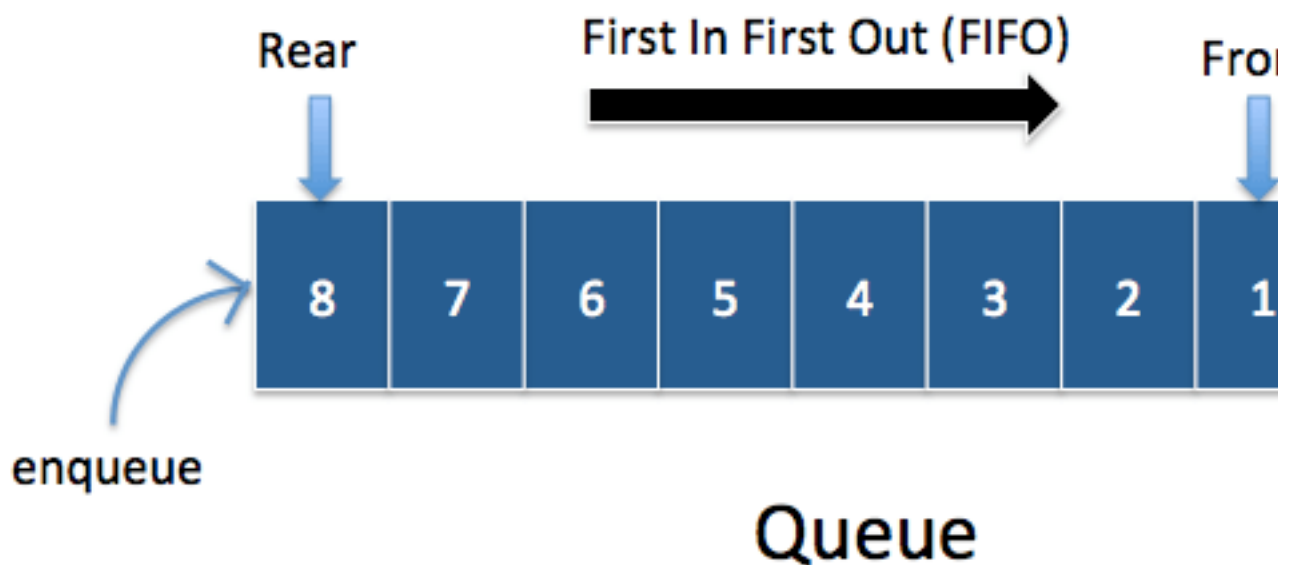
**Solution :** [Java Program to implement stack using two queues](#)

**Question 4 : Sort an stack using another stack**

You need to sort an stack using another stack. You can use push and pop operation of stack to do so,

**Solution :** [Sort a stack using another stack.](#)

**Queue**



**Question 5: Implement Queue using Array in java.**

You need to use array to implement queue.

**Solution :** [Implement Queue using Array in java](#)

**Question 6: Implement a stack using two queues .**

You need to use Linked list to implement queue.

**Solution :** [Java Program to implement queue using linked list](#)

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## Linked List

### Question 7 : Implement singly linked list in java.

You need to implement singly linked list data structures. You need to write simple program to demonstrate insert , delete operations.



**Solution :** [Java program to implement singly linked list in java.](#)

### Question 8: How to reverse linked list in java.

You need to write iterative and recursive solution to reverse linked list.

**Solution :** [Java program to reverse linked list in java.](#)

### Question 9: How to find middle element of linked list.

You need to write java program to find middle element of linked list in most optimize way.



**Solution :** [Java program to find middle element of linked list.](#)

### Question 10 : How to find nth element from end of linked list .

You need to write java program to find nth element of linked list in most optimize way.

In question 6, Node 7 is 3rd from last of linked list.

**Solution :** [How to find nth element from end of linked list.](#)

### Question 11 : How to detect a loop in linked list. If linked list has loop, find the start node for the loop.

You need to write a java program to detect whether any loop exists in linked list and if loop exists , you need to find start node for the linked list.

**Solution :** [How to detect loop in linked list.](#)

[How to find start node of loop in linked list.](#)

### Question 12: How to check if linked list is palindrome or not?

A palindrome is a word, phrase, number, or other sequence of symbols or elements that reads the same forward or reversed. For example: 12121 is palindrome as it reads same forward or reversed. madam is also a palindrome . So we need write java programs to check if linked list is palindrome or not.

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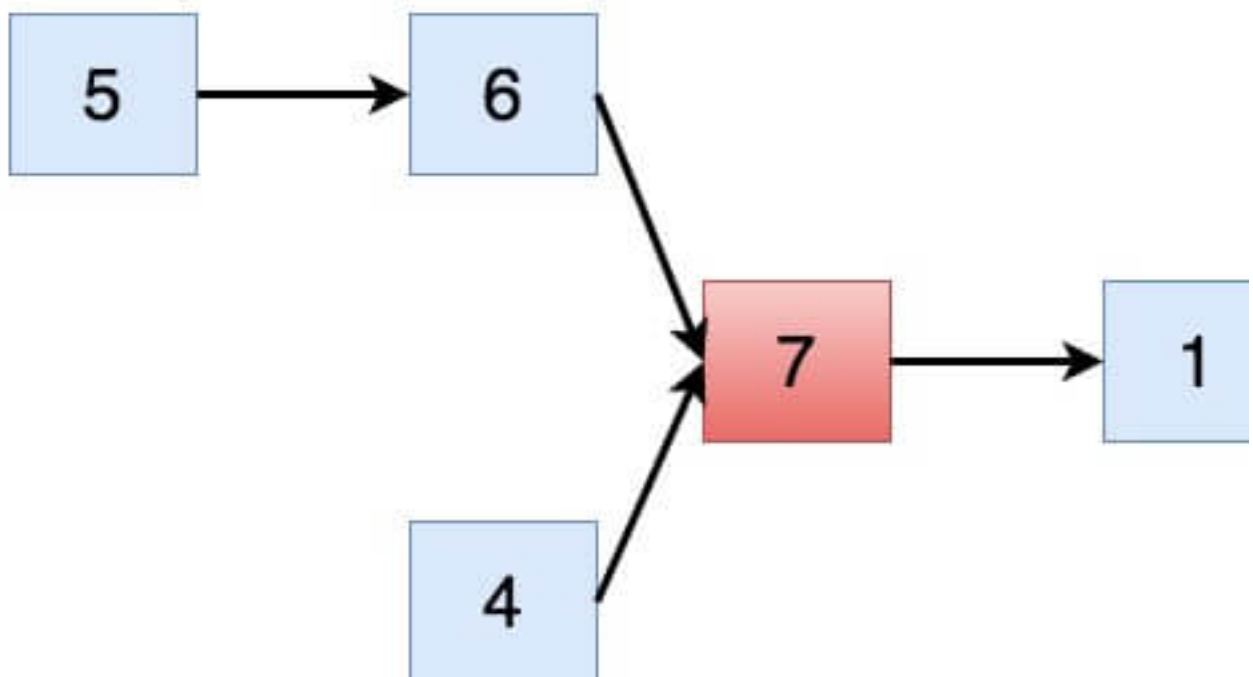
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**Solution :** Java program to check if linked list is palindrome.

**Question 13 :** Find intersection of two linked lists?

Given two **singly linked lists**, find if two linked lists intersect. If they intersect, find intersection point.



**Solution :** Intersection of two linked list

**Question 14 :** How to reverse a linked list in pairs?

You need to write a java program to reverse linked list in pairs.

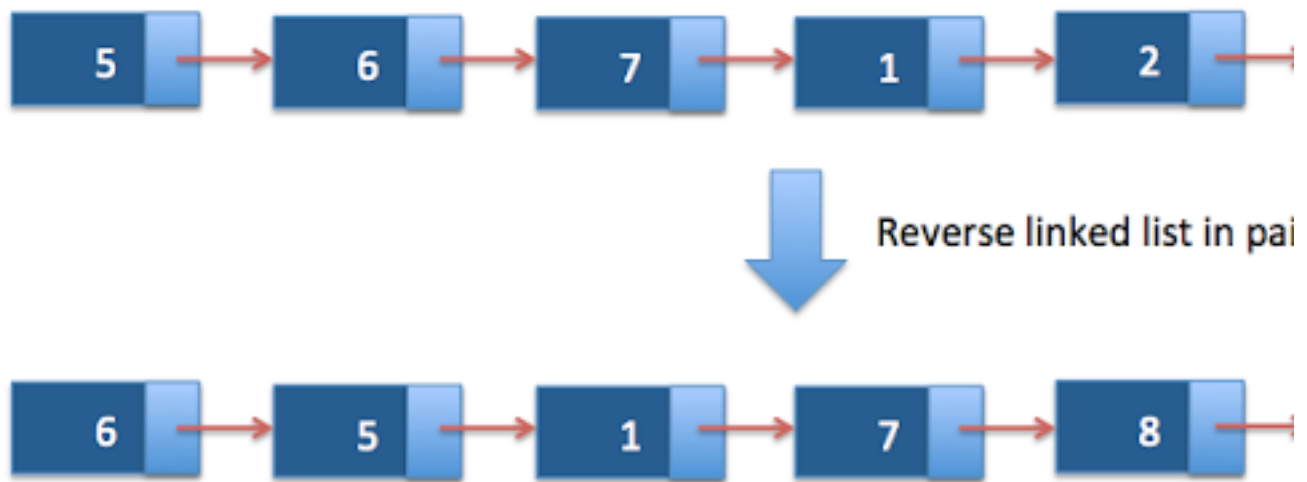
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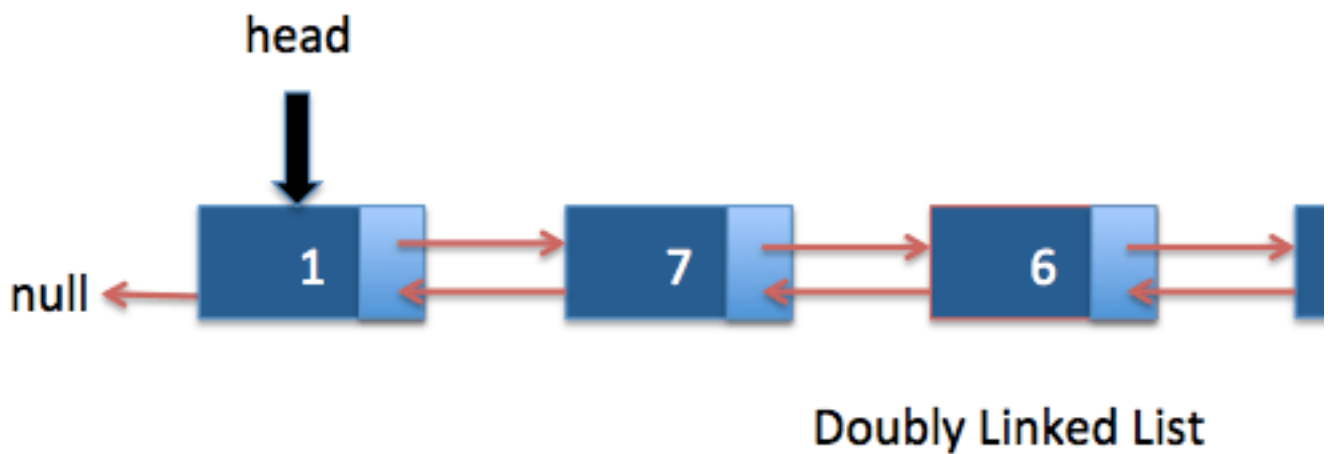
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Solution : **Java program to reverse linked list in pair.**

**Question 15 : Implement Doubly linked list in java?**

You need to write a java program to implement doubly linked list in java.



Solution : **Doubly Linked List in java**  
**Array**

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10	40	70	21	40	32	26	16
0	1	2	3	4	5	6	7



Array of length 8

**Question 16 : Write java Program to Find Smallest and Largest Element in an Array.**

You are given an integer array containing 1 to n but one of the number from 1 to n in the array is missing. You need to provide an optimum solution to find the missing number. Number can not be repeated in the array.

For example:

```
1  
2 int[] arr1={7,5,6,1,4,2};  
3 Missing numner : 3  
4 int[] arr2={5,3,1,2};  
5 Missing numner : 4  
6
```

**Solution : Java Program to Find Smallest and Largest Element in an Array**

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**Question 17 : Find missing number in the array.**

You are given an integer array containing 1 to n but one of the number from 1 to n in the array is missing. You need to provide optimum solution to find the missing number. Number cannot be repeated in the array.

For example:

```
1
2 int[] arr1={7,5,6,1,4,2};
3 Missing numner : 3
4 int[] arr2={5,3,1,2};
5 Missing numner : 4
6
```

**Solution : Find missing number in the array.**

**Question 18 : Search an element in rotated and sorted array.**

You are given an sorted and rotated array as below:

```
1
2 int arr[]={16,19,21,25,3,5,8,10};
3
```

If you note that array is sorted and rotated. You need to search an element in above array in  $O(\log n)$  time complexity.

**Solution : Search element in rotated and sorted array**

**Question 19 : Find minimum element in a sorted and rotated array.**

You are given an sorted and rotated array as below:

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```
1  
2 int arr[]={16,19,21,25,3,5,8,10};  
3 Minimum element in the array : 3  
4
```

If you note that array is sorted and rotated. You need to find an element in above array in  $O(\log n)$  time complexity.

**Solution :** Find minimum element in a sorted and rotated array

**Question 20: Find second largest number in an array**

You are given an sorted and rotated array as below:

**For example:**

```
1  
2 int[] arr1={7,5,6,1,4,2};  
3 Second largest element in the array : 6  
4
```

**Solution :** java program to find second largest number in an array.

**Question 21 : Find the number occurring odd number of times in an array**

You are given a array of integer. All numbers occur even number of times except one. You need to find the number which occurs odd number of time. You need to solve it with  $O(n)$  time complexity and  $O(1)$  space complexity.

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```
1
2 int array[] = new int[]{20, 40, 50, 40, 50, 20, 30, 30, 50, 20, 40, 40, 20};
3 Number which occurs odd number of times is : 50
4
```

**Solution : java program to find number occurring odd number of times in an array.**

### **Question 22 : Find minimum number of platforms required for railway station**

You are given arrival and departure time of trains reaching to a particular station. You need to find minimum number of platforms required to accommodate the trains at any point of time.

**For example:**

```
1
2 arrival[] = {1:00, 1:40, 1:50, 2:00, 2:15, 4:00}
3 departure[] = {1:10, 3:00, 2:20, 2:30, 3:15, 6:00}
4 No. of platforms required in above scenario = 4
5
```

Please note that arrival time is in chronological order.

**Solution : Find minimum number of platforms required for railway station.**

### **Question 23 : Find a Pair Whose Sum is Closest to zero in Array**

Given array of +ve and -ve integers ,we need to find a pair whose sum is closed to Zero in Array.

**For example:**

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```
1  
2 array[]={1,3,-5,7,8,20,-40,6};  
3 The pair whose sum is closest to zero : -5 and 6  
4
```

**Solution : Find a Pair Whose Sum is Closest to zero in Array in java.**

**Question 24 : Given a sorted array and a number x, find the pair in array whose sum is closest to x**

Given a sorted array, we need to find a pair whose sum is closed to number X in Array.

**For example:**

```
1  
2 array[]={-40,-5,1,3,6,7,8,20};  
3 The pair whose sum is closest to 5 : 1 and 3  
4
```

**Solution : Find a Pair Whose Sum is Closest to X in Array in java.**

**Question 25 : Find all pairs of elements from an array whose sum is equal to given number**

Given a array,we need to find all pairs whose sum is equal to number X.

**For example:**

```
1
```

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```
2 array[]={ -40, -5, 1, 3, 6, 7, 8, 20 };
3 Pair of elements whose sum is equal to 15 : 7, 8 and -5, 20
4
```

**Solution : Find all pairs of elements from an array whose sum is equal to given number .**

**Question 26:** Given an array of 0's and 1's in random order, you need to separate 0's and 1's in an array.

**For example:**

```
1
2 arr[] = {0,1,0,0,1,1,1,0,1}
3 Array after separating 0 and 1 numbers :
4 {0,0,0,0,1,1,1,1,1}
5
```

**Solution : Separate 0s and 1s in array.**

**Question 27 : Separate odd and even numbers in an array**

Given an array of integers, you need to segregate odd and even numbers in an array.

Please note: Order of elements can be changed.

**For example:**

```
1
2 arr[] = {12, 17, 70, 15, 22, 65, 21, 90}
3 Array after separating odd and even numbers :
```

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```
4 {12, 90, 70, 22, 15, 65, 21, 17}
5
```

**Solution :** Separate 0s and 1s in array.

**Question 28 :** Given an array containing zeroes, ones and twos only. Write a function to sort the given array in  $O(n)$  time complexity.

**For example:**

```
1
2 Input :
3 [1, 2, 2, 0, 0, 1, 2, 2, 1]
4
5 Output :
6 [0, 0, 1, 1, 1, 2, 2, 2, 2]
7
```

**Solution :** Sort an array of 0s, 1s and 2s.

**Question 29 :** Find local minima in array

A local minima is less than its neighbours

**For example:**

```
1
2 Input :
3
```

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```
4  int [] arr = {10, 5, 3, 6, 13, 16, 7};
5  Output: 2
6
7  int []arr = {11,12,13,14};
8  Output: 11
9
10 int []arr = {10};
11 Output: 10
12
13 int []arr = {8,6};
14 Output: 6
15
```

### Question 30 : Sliding window maximum in java

Given an Array of integers and an Integer k, Find the maximum element of from all the contiguous subarrays of size K.

**For example:**

```
1
2 Input :
3 Input : int[] arr = {2,6,-1,2,4,1,-6,5}
4 int k = 3
5 output : 6,6,4,4,4,5
6
```

**Solution : Find the local minima in array.**

### Question 31 : Count number of occurrences (or frequency) of each element in a sorted array

Given a Sorted Array of integers containing duplicates. Find the frequency of every unique element present in the array.

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Frequency is defined as the number of occurrence of any element in the array.

**For example :**

```
1
2 Input :
3 Input:
4 int[] arr = {1, 1, 1, 3, 3, 4, 5, 5, 6, 6};
5 Output:
6 Frequency of 1 is : 3
7 Frequency of 3 is : 2
8 Frequency of 4 is : 1
9 Frequency of 5 is : 2
10 Frequency of 6 is : 2
11
```

**Solution : Count number of occurrences (or frequency) of each element in a sorted array.**

**Question 32 : Find subarrays with given sum in an array.**

Given an Array of non negative Integers and a number. You need to print all the starting and ending indices of Subarrays having their sum equal to the given integer.

**For example :**

```
1
2 Input :
3 Input-int[] arr = {2, 3, 6, 4, 9, 0, 11};
4 int num = 9
5 Output-
6 starting index : 1, Ending index : 2
```

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```
7 | starting index : 5, Ending index : 5
8 | starting index : 5, Ending index : 6
9 |
```

**Solution : Find subarrays with given sum in an array.**

**Question 33 : Find peak element in the array.**

Peak Element is the element of the array which is GREATER THAN / EQUAL TO its neighbours, that is, for an element at  $i$ th index, the neighbour elements at index  $i-1$  &  $i+1$  must be greater than equal to element at  $i$ th position.

**Solution : Find peak element in the array.**

**Question 34 : Find leaders in an array.**

We need to print all the leaders present in the array. Element is the leader if it is greater than right side of elements.

```
1 |
2 | arr[]={14, 12, 70, 15, 99, 65, 21, 90}
3 | Here 99 and 90 are leader elements
4 |
```

**For example:**

**Solution : Find leaders in an array.**

**Question 35 : Count 1's in sorted Binary Array.**

Print number of 1's in a given sorted Binary Array.

**For example :**

```
1 |
```

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```
2 | Input :  
3 | int[] arr = {0,0,0,1,1,1,1};  
4 | output : 4  
5 | int[] arr = {0,0,1};  
6 | output : 1  
7 |
```

**Solution : Count 1's in sorted Binary Array.**

**Question 36 : Find first repeating element in an array of integers.**

Find the first repeating element in array of integers.

**For example :**

```
1 |  
2 | Input :  
3 | Input: array[] = {10, 7, 8, 1, 8, 7, 6}  
4 | Output: 7 [7 is the first element actually repeats]  
5 |
```

**Solution : Find first repeating element in an array of integers.**

**Question 37 : Check if Array Elements are Consecutive.**

Given an array, we need to check if array contains consecutive elements.

**For example :**

```
1 |  
2 | Input: array[] = {5, 3, 4, 1, 2}  
3 | Output: true
```

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```
4 | As array contains consecutive elements from 1 to 5Input: array[] = {47, 43, 45, 44, 46}
5 | Output: true
6 | As array contains consecutive elements from 43 to 47Input: array[] = {6, 7, 5, 6}
7 | Output: false
8 | As array does not contain consecutive elements.
9 |
```

**Solution : Check if Array Elements are Consecutive.**

**Question 38 : Permutations of array in java.**

Given array of distinct integers, print all permutations of the array.

**For example :**

```
1 |
2 | array : [10, 20, 30]
3 |
4 | Permuations are :
5 |
6 | [10, 20, 30]
7 | [10, 30, 20]
8 | [20, 10, 30]
9 | [20, 30, 10]
10 | [30, 10, 20]
11 | [30, 20, 10]
12 |
```

**Solution : Permutations of array in java.**

**Question 39 : Rotate an array by K positions.**

**For example :**

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```
1
2 N=6 and k=2
3 If Arr[] = {1, 2, 3, 4, 5, 6} and k=2
4 then rotated array will be {5, 6, 1, 2, 3, 4}
5
```

**Solution : Rotate an array by K positions.**

**Question 40 : Stock Buy Sell to Maximize Profit.**

Given an array of integers representing stock price on single day, find max profit that can be earned by 1 transaction.

So you need to find pair (buyDay,sellDay) where buyDay <= sellDay and it should maximise the profit.

**For example :**

```
1
2 int arr[]={14, 12, 70, 15, 99, 65, 21, 90};
3 Max profit can be gain by buying at 1th day(0 based indexing) and sell at 4th day.
4 Max profit = 99-12 =87
5
```

**Solution : Stock Buy Sell to Maximize Profit.**

**Question 41 : Find maximum difference between two elements such that larger element appears after the smaller number.**

Given array of integers, find Maximum difference between two elements such that larger element appears after the smaller number

**For example :**

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```
1  
2 int arr[]={14, 12, 70, 15, 95, 65, 22, 30};  
3 Max Difference =95-12 = 83  
4
```

**Solution :** Maximum difference between two elements such that larger element appears after the smaller number.

**Question 42 :** Search in a row wise and column wise sorted matrix.

Given row wise and column wise sorted matrix ,we need to search element with minimum time complexity.

**Solution :** Search in a row wise and column wise sorted matrix.

**Question 43 :** Largest sum contiguous subarray.

Largest sum contiguous subarray is the task of finding the contiguous subarray within a one-dimensional array of numbers which has the largest sum.

**For example :**

```
1  
2 for the sequence of values -2, 1, -3, 4, -1, 2, 1, -5, 4; the contiguous subarray with the largest sum i  
3
```

**Solution :** Largest sum contiguous subarray.

**Question 44 :** Find the Contiguous Subarray with Sum to a Given Value in an array.

Given an array of positive integer and given value X, find Contiguous sub array whose sum is equal to X.

**For example :**

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```
1
2 arr[]={14, 12, 70, 15, 99, 65, 21, 90};
3 X =97.
4 Sum found between index 1 to 3
5 Elements are 12, 17 and 15
6
```

**Solution : Find the Contiguous Subarray with Sum to a Given Value in an array.**

**Question 45 : Longest Common Prefix in an array of Strings in java.**

Given an array of positive integer and given value X, find Contiguous sub array whose sum is equal to X.

**For example :**

```
1
2 String[] strArr={"java2blog","javaworld","javabean","javatemp"};
3 So Longest common prefix in above String array will be "java" as all above string starts with "java".
4
```

**Solution : Longest Common Prefix in an array of Strings in java.**

**Question 46 : Find all subsets of set (power set) in java.**

Given a set of distinct integers, arr, return all possible subsets (the power set).

**For example :**

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```
1
2   Input: nums = [1,2,3]
3   Output:
4   [
5   [3],
6   [1],
7   [2],
8   [1,2,3],
9   [1,3],
10  [2,3],
11  [1,2],
12  []
13  ]
14
```

**Solution :** Find all subsets of set in java.

**String**

**Question 47 :** How to reverse a String in java? Can you write a program without using any java inbuilt methods?

**Solution:** There are many ways to do it, some of them are:

- Using for loop
- Using recursion
- Using StringBuffer

Please refer to the solution at [reverse a String in java](#)

**Question 48 :** Write a java program to check if two Strings are anagram in java?

**Solution:** Two string are anagrams if they have same characters but in different order. For example: Angel and Angle are anagrams

There are few ways to check if Strings are anagrams. Some of them are:

- 1 Using String methods
- 2 Using array.sort

Check solution at [check if two Strings are anagram in java.](#)

**Question 49 :** Write a program to check if String has all unique characters in java?

**Solution:** Here are some ways to check if String contains all unique characters

- By using HashSet

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- Using indexOf and lastIndexOf methods of String
- By Using ascii value of characters.

Please refer to complete solution at [check if String has all unique characters](#).

**Question 50 : How to check if one String is rotation of another String in java?**

**Solution:** Let's say you want to check whether str1 and str2 is rotation of one another or not.

- 1 Create a new String with str3= str1 + str1
- 2 Check if str3 **contains** str2 or not.
- 3 if str3 **contains** str2 then str2 is rotation of str1 else it is not

You can find complete solution at [check if one String is rotation of another in java](#).

**Question 51 : How to find duplicate characters in String in java?**

**Solution:** Here is a solution to find duplicate characters in String.

- 1 Create a **HashMap** and character of String will be inserted as key and its count as value.
- 2 If **Hashamap** already contains char, increase its count by 1, else put char in HashMap.
- 3 If value of Char is more than 1, that means it is duplicate character in that String.

Please refer to solution at [program to find duplicate characters in a String](#).

**Question 52 : Find first non repeated character in String in java?**

**Solution:** There are many ways to find it.

Some of them are:

- Using **LinkedHashMap**
- Using indexOf and lastIndexOf methods.

Please find complete solution at [find first non repeated character in a String](#).

**Question 53 : Find all substrings of String in java?**

**Solution:** Java program to find all **substrings** of a String.

For example: If input is "abb" then output should be "a", "b", "b", "ab", "bb", "abb"

We will use String class's subString method to find all subString.

Please refer to complete solution at [find all subStrings of String](#).

**Question 54 : Find length of String without using any inbuilt method in java?**

**Solution:** You can use try catch block for catching StringIndexOutOfBoundsException and when this exception arises, you can simply return i (Index at which you will get the exception)

Please refer to complete solution at [find length of String without inbuilt methods](#).

**Question 55 : Write a program to print all permutations of String in java?**

**Solution:** Take out first character of String and insert into different places of permutations of

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remaining String recursively. Please find complete solution at [how to find all permutations of String in java](#).

### Binary Tree

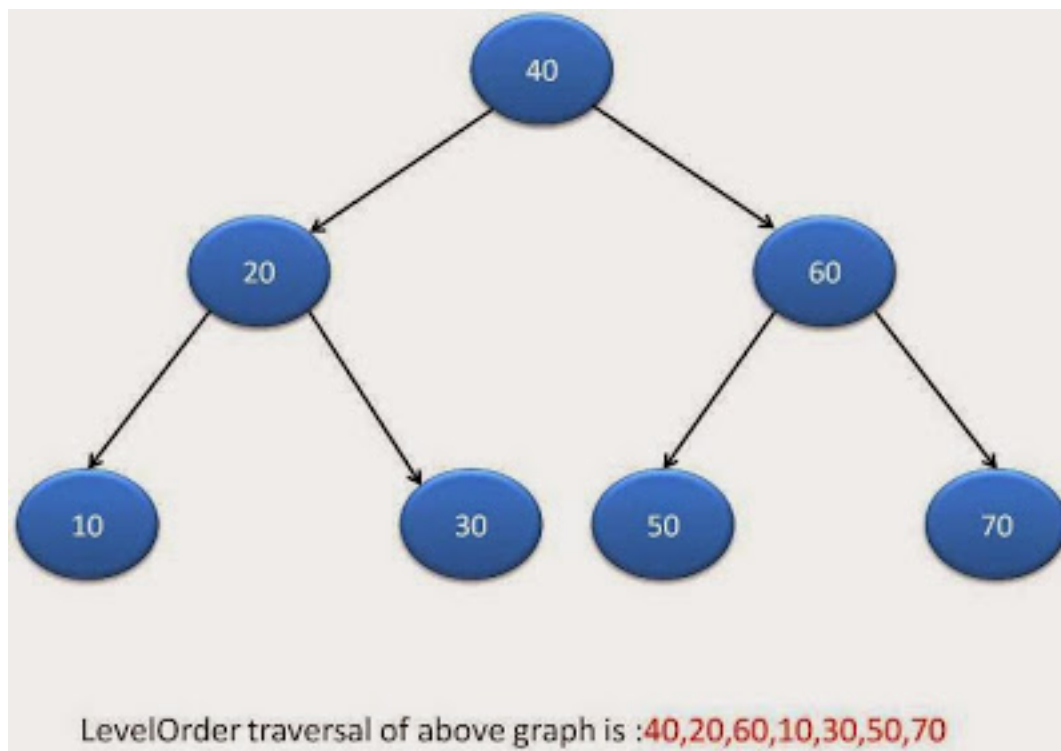
#### Question 56 : How can you traverse binary tree?

There are three ways to traverse binary tree.

- **PreOrder**
- **InOrder**
- **PostOrder**.

#### Question 57 : Write an algorithm to do level order traversal of binary tree?

You need to write java program to do level order traversal of binary tree. You can use queue data structure to do level order traversal.



**Solution :** **Level order traversal of binary tree.**

#### Question 58 : Write an algorithm to do spiral order traversal of binary tree?

You need to write java program to do spiral level order traversal of binary tree

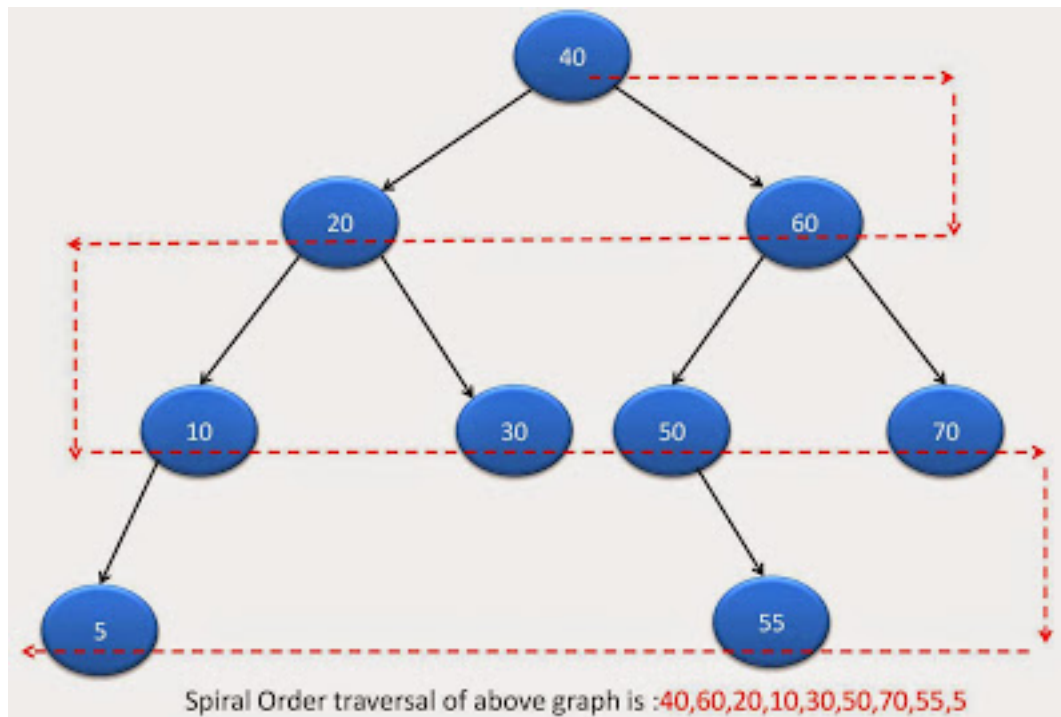
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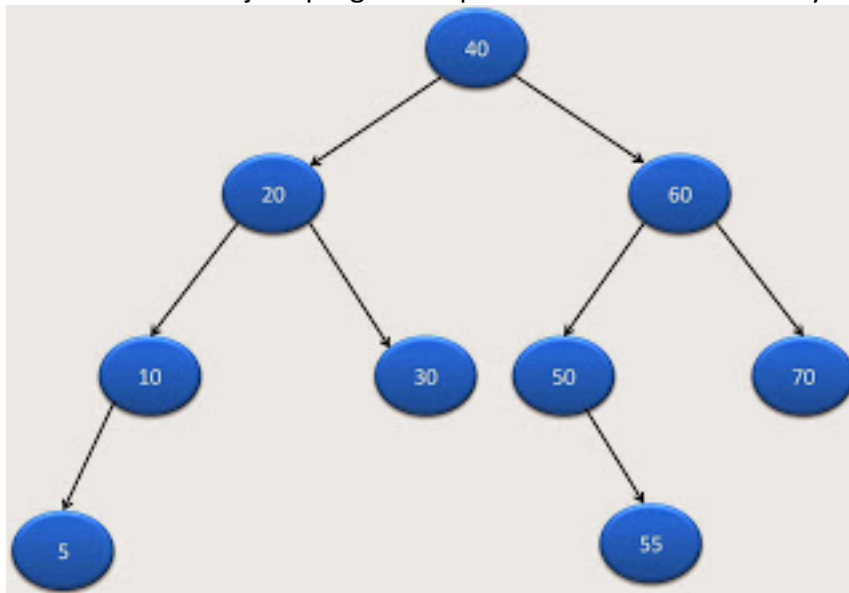
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**Solution :** Spiral order or zigzag traversal of binary tree.

**Question 59 :** How can you print leaf nodes of binary tree?

You need to write java program to print all leaf nodes of binary tree.



Leaf nodes for above binary tree will be 5 , 30 , 55 ,70

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**Solution : Print leaf nodes of binary tree.**

**Question 60 : How to count leaf nodes of binary tree.**

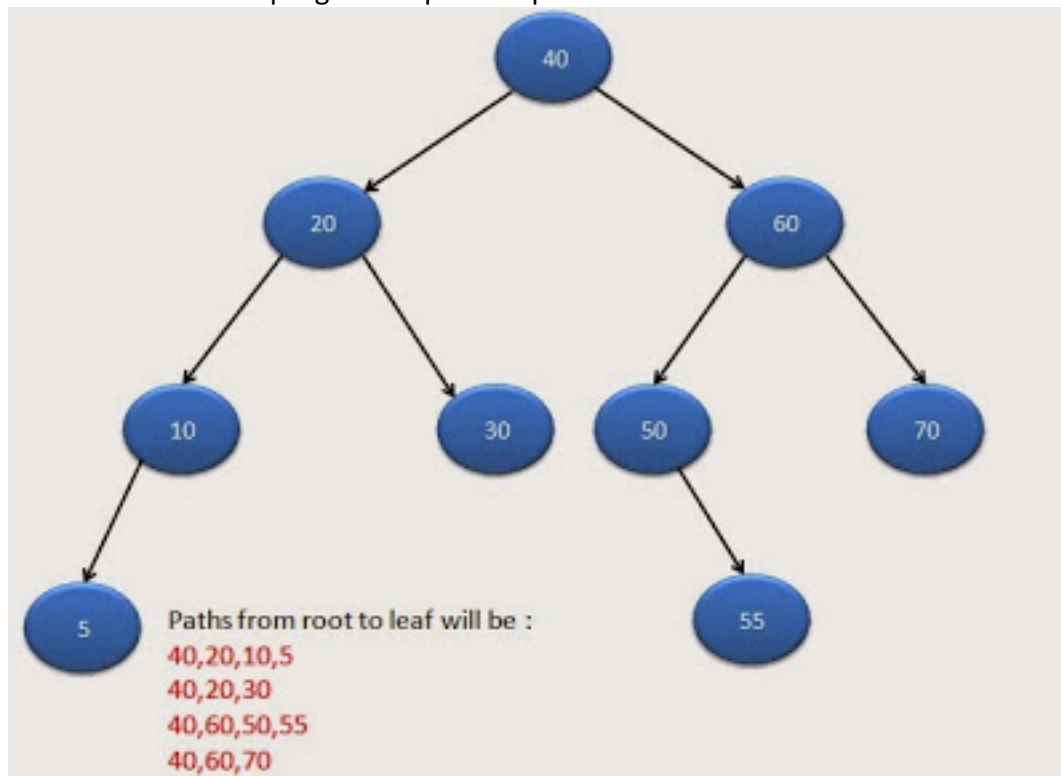
You need to write java program to count leaf nodes of binary tree.

Count of Leaf nodes for binary tree used in Question 15 are 5.

**Solution : Count leaf nodes of binary tree.**

**Question 61 : How to print all paths from root to leaf in binary tree.**

You need to write a program to print all paths from root to leaf.



**Solution : Print all paths from root to leaf in binary tree.**

**Question 62 : How to find level of node in binary tree**

Given a node, you need to find level of a node. For example : Level of node will 3 for node 70 used in Question 14.

**Solution: Find level of node in binary tree.**

**Question 63 : How to find maximum element in binary tree.**

You need to write a java program to find maximum element in binary tree.

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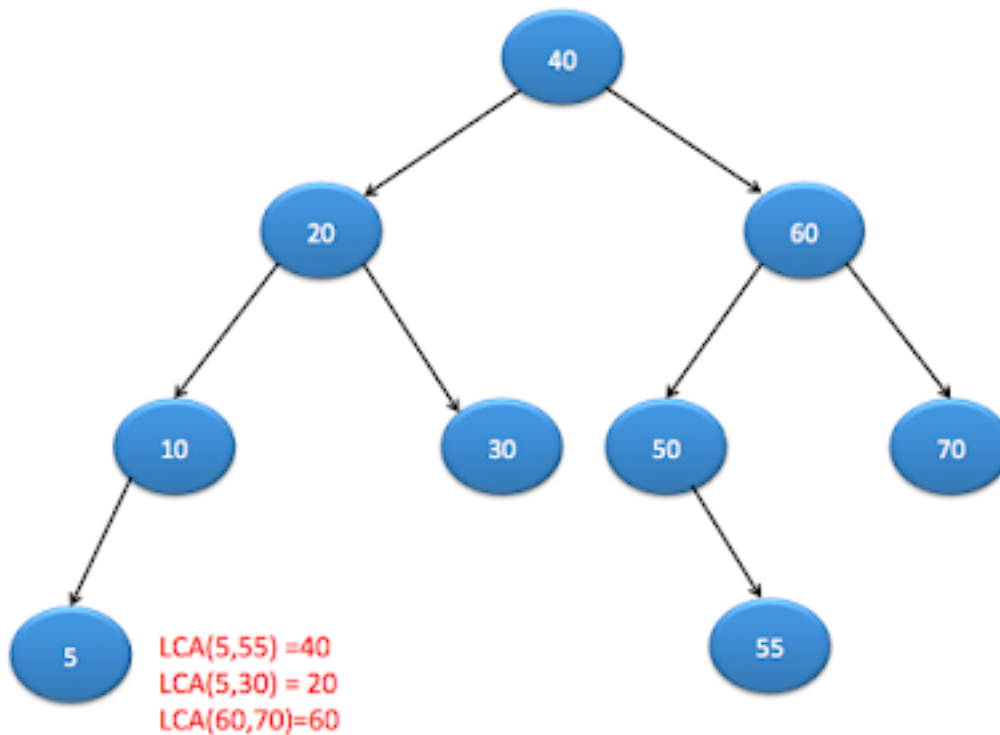
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**Solution : Find maximum element in binary tree.**

**Question 64 : How to find lowest common ancestor(LCA) in binary tree.**

You need to write a program to find LCA in binary tree.



**Solution: Program to find LCA in binary tree.**

**Question 65 : How to do boundary traversal of binary tree.**

Write a java program to do boundary traversal of binary tree as shown in below image.

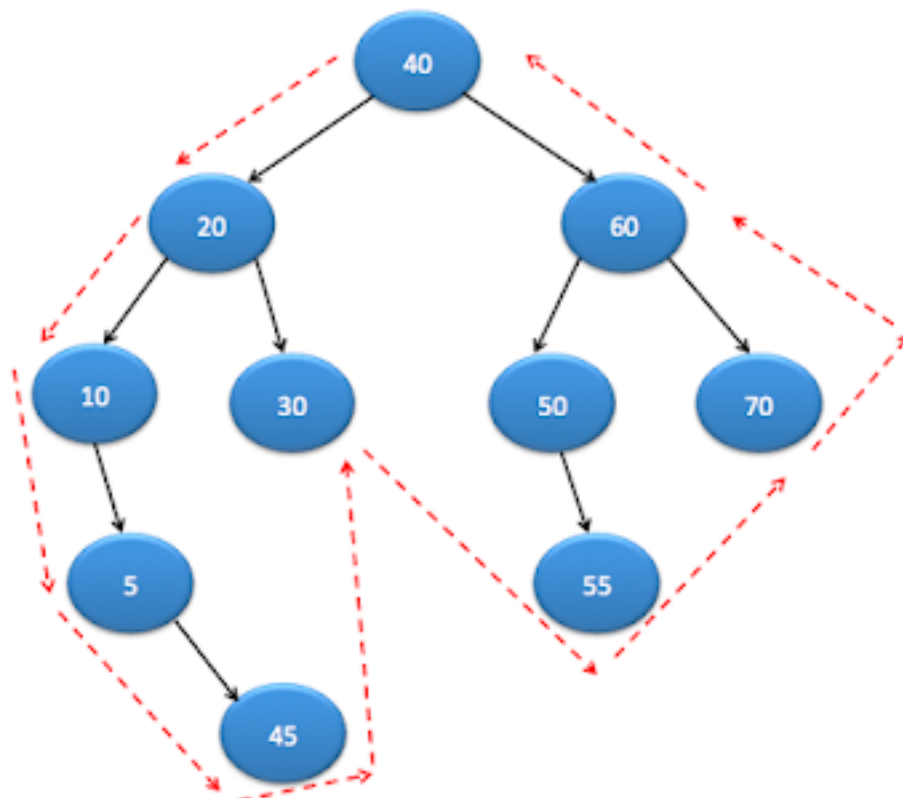
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Boundary traversal of above binary tree is :40,20,10,5,45,30,55,70,60

Solution : **Boundary traversal of binary tree.**

**Question 66 : How to print vertical sum of binary tree?**

You need to find sum of nodes which lies in same column.

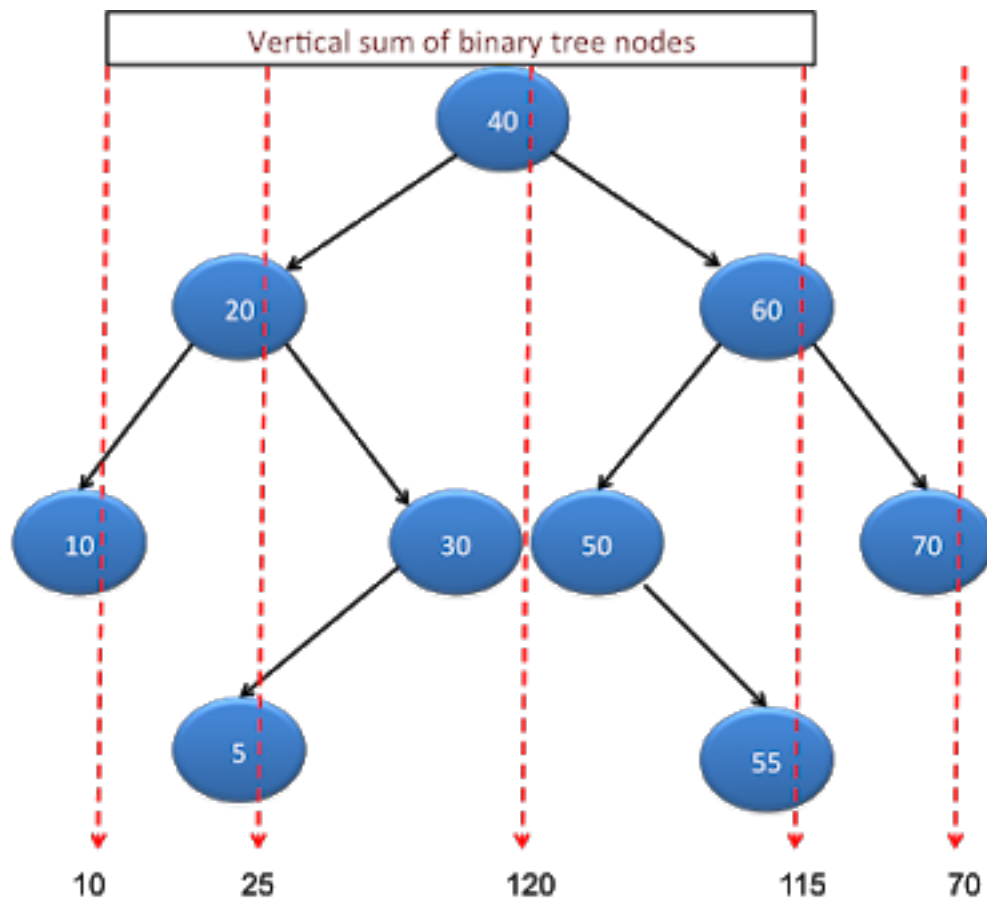
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Solution : **How to print vertical sum of binary tree.**

**Question 67 : Count subtrees with Sum equal to target in binary tree?**

Given a **Binary tree** and an integer. You need to find the number of subtrees having the sum of all of its nodes equal to given Integer, that is, Target sum.

Solution : **Count subtrees with Sum equal to target in binary tree.**

**Binary Search tree**

**Question 68 : What is binary search tree?**

Binary search tree is a special type of **binary tree** which have following properties.

- Nodes which are smaller than root will be in left subtree.
- Nodes which are greater than root will be right subtree.
- It should not have duplicate nodes
- Both left and right subtree also should be binary search tree.

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**Question 69 :** Can you write algorithm to insert a node in binary search tree.

**Solution :** [Insert node in binary search tree](#)

**Question 70 :** Can you write algorithm to delete a node in binary search tree.

**Solution :** [Delete node in binary search tree](#)

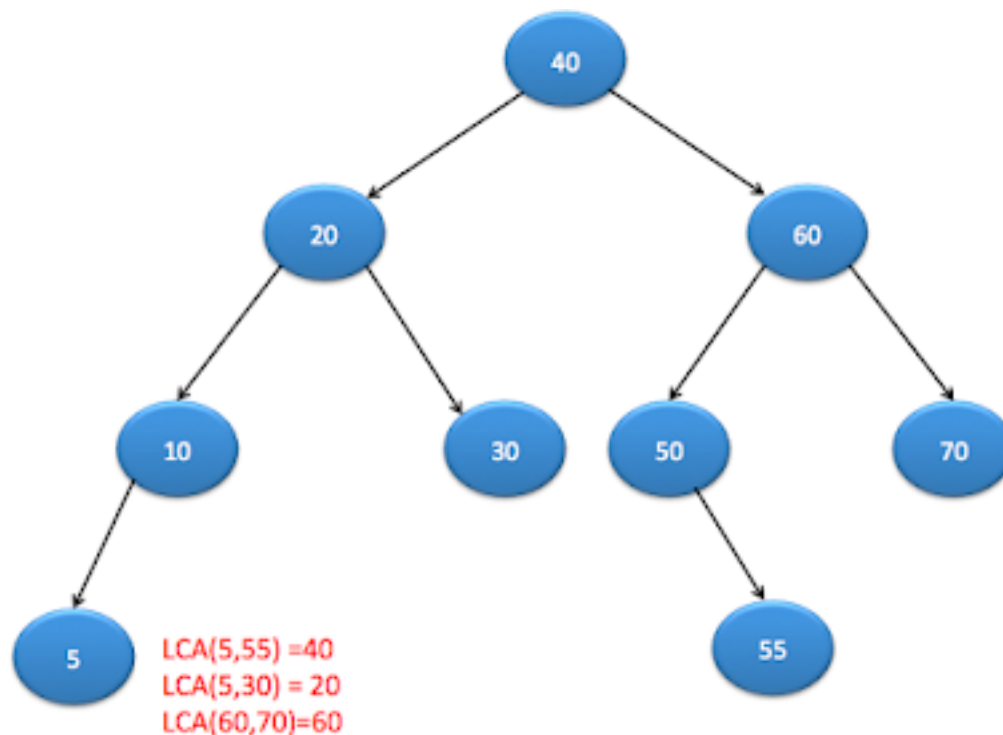
**Question 71 :** How can you find minimum and maximum elements in binary search tree?

**Solution :** Leftmost and rightmost nodes of binary search tree are minimum and maximum nodes respectively

**Minimum and maximum elements in binary search tree.**

**Question 72 :** How to find lowest common ancestor(LCA) in binary search tree.

You need to write a program to find LCA in binary search tree.



**Solution:** [Program to find LCA in binary search tree.](#)

**Question 73 :** Find inorder successor in a Binary search Tree

You need to write a program to find inorder successor in a Binary search tree.

**Solution:** [Inorder Successor in a Binary Search Tree](#)

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**Question 74 : Convert sorted array to balanced BST**

**Solution:** [Convert sorted sorted array to balanced BST](#)

**Question 75 : Convert sorted Linked List to balanced BST**

**Solution:** [Convert sorted Linked List to balanced BST](#)

**Question 76 : Check if a binary tree is binary search tree or not in java**

**Solution:** [Check if a binary tree is binary search tree or not in java](#)

**Sorting**

**Question 77 : Write an algorithm to implement bubble sort?**

**Solution :** [Bubble sort in java](#)

**Question 78 : Write an algorithm to implement insertion sort sort?**

**Solution :** [Insertion sort in java](#)

**Question 79 : Write an algorithm to implement selection sort sort?**

**Solution :** [Selection sort in java](#)

**Question 80 : Can you write algorithm for merge sort and also do you know complexity of merge sort?**

**Solution :** [Merge sort in java](#)

**Question 81 : Do you know how to implement Heap sort?**

**Solution :** [implement Heap sort in java](#)

**Question 82 : Implement quick sort in java?**

**Solution :** [implement Quick sort in java](#)

**Question 83 : Implement shell sort in java?**

**Solution :** [implement Shell sort in java](#)

**Question 84 : Implement Counting sort in java?**

**Solution :** [implement Counting sort in java](#)

**Question 85 : What is binary search? Can you write an algorithm to find an element in sorted array using binary search?**

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**Solution :Binary search algorithm in java  
Graph**

**Question 86 : Write algorithm to do depth first search in a graph.**

**Solution : Depth first search in java**

**Question 87 : Write algorithm to do breadth first search in a graph.**

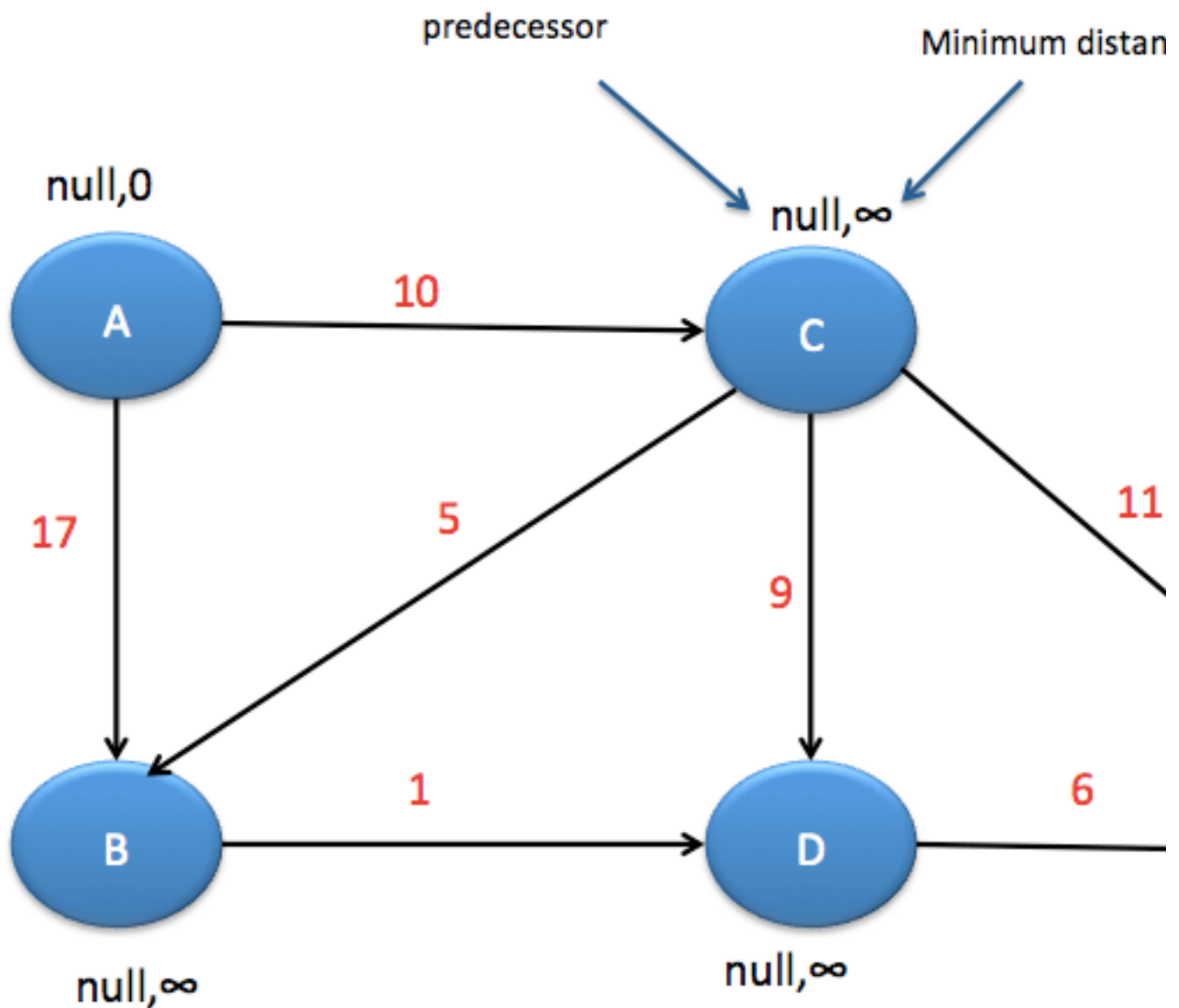
**Solution : breadth first search in java**

**Question 88 : Explain Dijkstra algorithm from source to all other vertices.**

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Solution : **Dijkstra's algorithm in java**

**Question 89 : Explain Bellman Ford algorithm to find shortest distance**

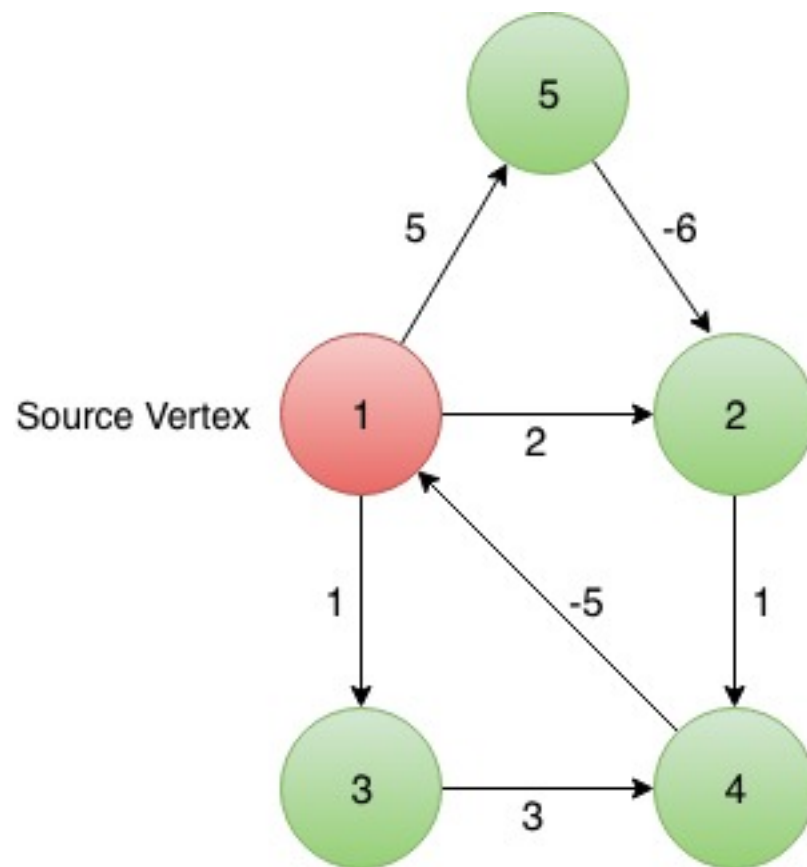
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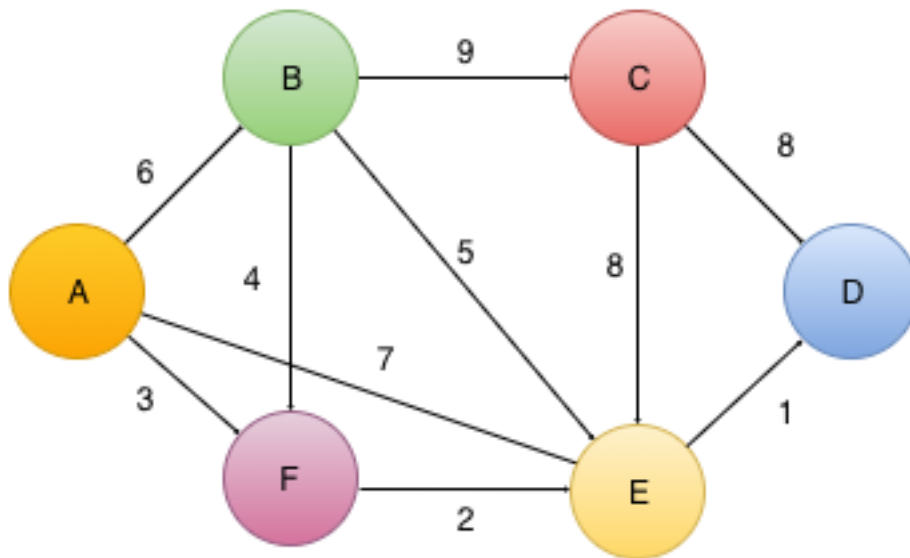
Solution : [Bellman ford algorithm in java](#)

Question 90 : Explain Kruskal's algorithm for finding minimum spanning tree

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Solution : **Kruskal's algorithm**  
**Dynamic Programming**

**Question 91 : Given two String, find longest common substring.**

Solution: **Longest common substring in java.**

**Question 92 : Given two Strings A and B. Find the length of the Longest Common Subsequence (LCS) of the given Strings.**

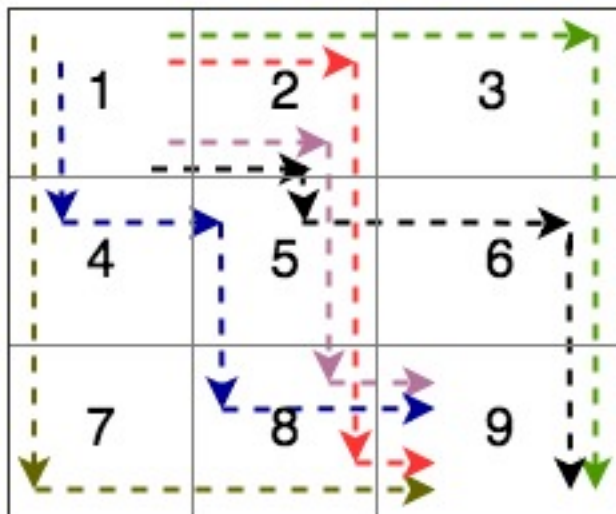
Solution: **Longest common subsequence in java**

**Question 93 : Given a matrix, we need to count all paths from top left to bottom right of MxN matrix. You can either move down or right.**

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No. of paths from top left to  
bottom right : 6

Solution: **Count all paths in matrix**

#### Question 94 : Edit Distance Problem in java

Given two strings string1 and string2, String1 is to be converted into String2 with the given operations available in the minimum number of steps. Using any one of the given operations contributes to the increment of steps by one.

Allowed Operations are :

- (i) **Remove** : This operation allows the Removal any one character from String.
- (ii) **Insert** : This operation allows the Insertion of one character at any spot in the String.
- (iii) **Replace** : This operation allows the replacement of any one character in the string with any other character.

Solution: **Edit distance problem in java.**

#### Question 95: Coin change problem in java

Given an Amount to be paid and the currencies to pay with. There is infinite supply of every currency using combination of which, the given amount is to be paid. Print the number of ways by which the amount can be paid.

Solution: **Coin change problem in java**

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**Question 96 : Minimum number of jumps to reach last index**

Solution: **Minimum number of jumps to reach last index.**

**Miscellaneous**

**Question 97 : What is an algorithm and how to calculate complexity of algorithms.**

Solution : **How to calculate Complexity of algorithm**

**Question 98 : Implement trie data structure in java.**

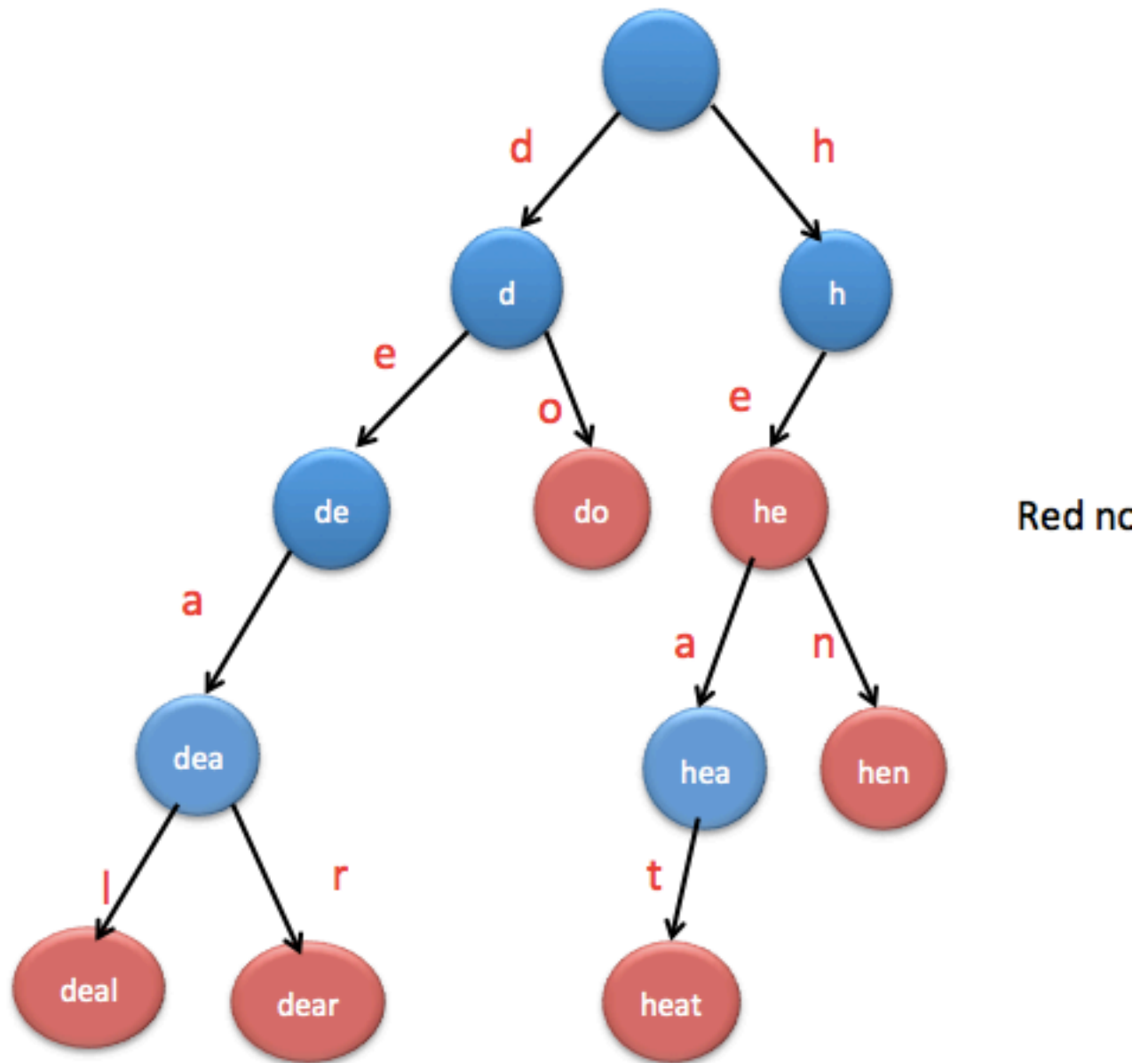
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## Trie Data structure

Solution : **Implement trie data structure in java.**

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**Question 99 : Count Factorial Trailing Zeroes in java.**

Solution : [Count Factorial Trailing Zeroes in java](#)

**Question 100 : Largest Rectangular Area in a Histogram.**

Solution : [Count Largest Rectangular Area in a Histogram](#)

**Question 101 : Check for balanced parentheses in an expression in java.**

Solution : [check for balanced parentheses in an expression in java.](#)

**Question 102 : What is Memoization.**

Solution :

Memoization ensures that method does not execute more than once for same inputs by storing the results in the data structure(Usually Hashtable or HashMap or Array).

**Memoization example in java**

This is all about questions on data structure and algorithm interview questions. Please do comment if you want to add any new questions to above list.

You may also like:

<https://career.guru99.com/top-50-data-structure-interview-questions/>

### **1) What is data structure?**

Data structure refers to the way data is organized and manipulated. It seeks to find ways to make data access more efficient. When dealing with the data structure, we not only focus on one piece of data but the different set of data and how they can relate to one another in an organized manner.

### **2) Differentiate between file and structure storage structure.**

The key difference between both the data structure is the memory area that is being accessed. When dealing with the structure that resides the main memory of the computer system, this is referred to as storage structure. When dealing with an auxiliary structure, we refer to it as file structures.

### **3) When is a binary search best applied?**

A binary search is an algorithm that is best applied to search a list when the elements are already in order or sorted. The list is searched starting in the middle, such that if that middle value is not the target search key, it will check to see if it will continue the search on the lower half of the list or the higher half. The split and search will then continue in the same manner.

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#### **4) What is a linked list?**

A linked list is a sequence of nodes in which each node is connected to the node following it. This forms a chain-like link for data storage.

#### **5) How do you reference all the elements in a one-dimension array?**

To reference all the elements in a one -dimension array, you need to use an indexed loop, So that, the counter runs from 0 to the array size minus one. In this manner, You can reference all the elements in sequence by using the loop counter as the array subscript.

#### **6) In what areas do data structures are applied?**

Data structures are essential 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, to name a few.

#### **7) What is LIFO?**

LIFO is a short form of Last In First Out. It refers how data is accessed, stored and retrieved. Using this scheme, data that was stored last should be the one to be extracted first. This also means that in order to gain access to the first data, all the other data that was stored before this first data must first be retrieved and extracted.

#### **8 ) What is a queue?**

A queue is a data structure that can simulate a list or stream of data. In this structure, new elements are inserted at one end, and existing elements are removed from the other end.

#### **9) What are binary trees?**

A binary tree is one type of data structure that has two nodes, a left node, and a right node. In programming, binary trees are an extension of the linked list structures.

#### **10) Which data structures are applied when dealing with a recursive function?**

Recursion, is 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.

#### **11) What is a stack?**

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A stack is a data structure in which only the top element can be accessed. As data is stored in the stack, each data is pushed downward, leaving the most recently added data on top.

### **12) Explain Binary Search Tree**

A binary search tree stores data in such a way that they can be retrieved very efficiently. The left subtree contains nodes whose keys are less than the node's key value, while the right subtree contains nodes whose keys are greater than or equal to the node's key value. Moreover, both subtrees are also binary search trees.

### **13) What are multidimensional arrays?**

Multidimensional arrays make use of multiple indexes to store data. It is useful when storing data that cannot be represented using single dimensional indexing, such as data representation in a board game, tables with data stored in more than one column.

### **14) Are linked lists considered linear or non-linear data structures?**

It depends on where you intend to apply linked lists. If you based it on storage, a linked list is considered non-linear. On the other hand, if you based it on access strategies, then a linked list is considered linear.

### **15) How does dynamic memory allocation help in managing data?**

Apart from being able to store simple structured data types, dynamic memory allocation can combine separately allocated structured blocks to form composite structures that expand and contract as needed.

### **16) What is FIFO?**

FIFO stands for First-in, First-out, and is used to represent how data is accessed in a queue. Data has been inserted into the queue list the longest is the one that is removed first.

### **17) What is an ordered list?**

An ordered list is a list in which each node's position in the list is determined by the value of its key component, so that the key values form an increasing sequence, as the list is traversed.

### **18) What is merge sort?**

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Merge sort, is a divide-and-conquer approach for sorting the data. In a sequence of data, adjacent ones are merged and sorted to create bigger sorted lists. These sorted lists are then merged again to form an even bigger sorted list, which continues until you have one single sorted list.

### **19) Differentiate NULL and VOID**

Null is a value, whereas Void is a data type identifier. A variable that is given a Null value indicates an empty value. The void is used to identify pointers as having no initial size.

### **20) What is the primary advantage of a linked list?**

A linked list is an ideal data structure because it can be modified easily. This means that editing a linked list works regardless of how many elements are in the list.

### **21) What is the difference between a PUSH and a POP?**

Pushing and popping applies to the way data is stored and retrieved in a stack. A push denotes data being added to it, meaning data is being “pushed” into the stack. On the other hand, a pop denotes data retrieval, and in particular, refers to the topmost data being accessed.

### **22) What is a linear search?**

A linear search refers to the way a target key is being searched in a sequential data structure. In this method, each element in the list is checked and compared against the target key. The process is repeated until found or if the end of the file has been reached.

### **23) How does variable declaration affect memory allocation?**

The amount of memory to be allocated or reserved would depend on the data type of the variable being declared. For example, if a variable is declared to be of integer type, then 32 bits of memory storage will be reserved for that variable.

### **24) What is the advantage of the heap over a stack?**

The heap is more flexible than the stack. That’s because memory space for the heap can be dynamically allocated and de-allocated as needed. However, the memory of the heap can at times be slower when compared to that stack.

### **25) What is a postfix expression?**

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A postfix expression is an expression in which each operator follows its operands. The advantage of this form is that there is no need to group sub-expressions in parentheses or to consider operator precedence.

### **26) What is Data abstraction?**

Data abstraction is a powerful tool for breaking down complex data problems into manageable chunks. This is applied by initially specifying the data objects involved and the operations to be performed on these data objects without being overly concerned with how the data objects will be represented and stored in memory.

### **27) How do you insert a new item in a binary search tree?**

Assuming that the data to be inserted is a unique value (that is, not an existing entry in the tree), check first if the tree is empty. If it's empty, just insert the new item in the root node. If it's not empty, refer to the new item's key. If it's smaller than the root's key, insert it into the root's left subtree, otherwise, insert it into the root's right subtree.

### **28) How does a selection sort work for an array?**

The selection sort is a fairly intuitive sorting algorithm, though not necessarily efficient. In this process, the smallest element is first located and switched with the element at subscript zero, thereby placing the smallest element in the first position.

The smallest element remaining in the subarray is then located next to subscripts 1 through n-1 and switched with the element at subscript 1, thereby placing the second smallest element in the second position. The steps are repeated in the same manner till the last element.

### **29) How do signed and unsigned numbers affect memory?**

In the case of signed numbers, the first bit is used to indicate whether positive or negative, which leaves you with one bit short. With unsigned numbers, you have all bits available for that number. The effect is best seen in the number range (an unsigned 8-bit number has a range 0-255, while the 8-bit signed number has a range -128 to +127).

### **30) What is the minimum number of nodes that a binary tree can have?**

A binary tree can have a minimum of zero nodes, which occurs when the nodes have NULL values. Furthermore, a binary tree can also have 1 or 2 nodes.

### **31) What are dynamic data structures?**

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Dynamic data structures are structures that expand and contract as a program runs. It provides a flexible means of manipulating data because it can adjust according to the size of the data.

### **32) In what data structures are pointers applied?**

Pointers that are used in linked list have various applications in the data structure. Data structures that make use of this concept include the Stack, Queue, Linked List and Binary Tree.

### **33) Do all declaration statements result in a fixed reservation in memory?**

Most declarations do, with the exemption of pointers. Pointer declaration does not allocate memory for data, but for the address of the pointer variable. Actual memory allocation for the data comes during run-time.

### **34) What are ARRAYS?**

When dealing with arrays, data is stored and retrieved using an index that refers to the element number in the data sequence. This means that data can be accessed in any order. In programming, an array is declared as a variable having a number of indexed elements.

### **35) What is the minimum number of queues needed when implementing a priority queue?**

The minimum number of queues needed in this case is two. One queue is intended for sorting priorities while the other queue is used for actual storage of data.

### **36) Which sorting algorithm is considered the fastest?**

There are many types of sorting algorithms: quick sort, bubble sort, balloon sort, radix sort, merge sort, etc. Not one can be considered the fastest because each algorithm is designed for a particular data structure and data set. It would depend on the data set that you would want to sort.

### **37) Differentiate STACK from ARRAY.**

Stack follows a LIFO pattern. It means that data access follows a sequence wherein the last data to be stored when the first one to be extracted. Arrays, on the other hand, does not follow a particular order and instead can be accessed by referring to the indexed element within the array.

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**38) Give a basic algorithm for searching a binary search tree.**

1. if the tree is empty, then the target is not in the tree, end search
2. if the tree is not empty, the target is in the tree
3. check if the target is in the root item
4. if a target is not in the root item, check if a target is smaller than the root's value
5. if a target is smaller than the root's value, search the left subtree
6. else, search the right subtree

**39) What is a dequeue?**

A dequeue is a double-ended queue. This is a structure wherein elements can be inserted or removed from either end.

**40) What is a bubble sort and how do you perform it?**

A bubble sort is one sorting technique that can be applied to data structures such as an array. It works by comparing adjacent elements and exchanges their values if they are out of order. This method lets the smaller values "bubble" to the top of the list, while the larger value sinks to the bottom.

**41) What are the parts of a linked list?**

A linked list typically has two parts: the head and the tail. Between the head and tail lie the actual nodes. All these nodes are linked sequentially.

**42) How does selection sort work?**

Selection sort works by picking the smallest number from the list and placing it at the front. This process is repeated for the second position towards the end of the list. It is the simplest sort algorithm.

**43) What is a graph?**

A graph is one type of data structure that contains a set of ordered pairs. These ordered pairs are also referred to as edges or arcs and are used to connect nodes where data can be stored and retrieved.

**44) Differentiate linear from a nonlinear data structure.**

The linear data structure is a structure wherein data elements are adjacent to each other. Examples of linear data structure include arrays, linked lists, stacks, and queues. On the other hand, a non-linear data structure is a structure wherein each data element can

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connect to more than two adjacent data elements. Examples of nonlinear data structure include trees and graphs.

#### **45) What is an AVL tree?**

An AVL tree is a type of binary search tree that is always in a state of partially balanced. The balance is measured as a difference between the heights of the subtrees from the root. This self-balancing tree was known to be the first data structure to be designed as such.

#### **46) What are doubly linked lists?**

Doubly linked lists are a special type of linked list wherein traversal across the data elements can be done in both directions. This is made possible by having two links in every node, one that links to the next node and another one that connects to the previous node.

#### **47) What is Huffman's algorithm?**

Huffman's algorithm is used for creating extended binary trees that have minimum weighted path lengths from the given weights. It makes use of a table that contains the frequency of occurrence for each data element.

#### **48) What is Fibonacci search?**

Fibonacci search is a search algorithm that applies to a sorted array. It makes use of a divide-and-conquer approach that can significantly reduce the time needed in order to reach the target element.

#### **49) Briefly explain recursive algorithm.**

Recursive algorithm targets a problem by dividing it into smaller, manageable sub-problems. The output of one recursion after processing one sub-problem becomes the input to the next recursive process.

#### **50) How do you search for a target key in a linked list?**

To find the target key in a linked list, you have to apply sequential search. Each node is traversed and compared with the target key, and if it is different, then it follows the link to the next node. This traversal continues until either the target key is found or if the last node is reached.

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**Question 1: How to find middle element of linked list in one pass?**

One of the most popular question from data structures and algorithm mostly asked on a telephonic interview. Since many programmers know that, in order to find the length of a linked list we need to first traverse through the linked list till we find the last node, which is pointing to null, and then in second pass we can find a middle element by traversing only half of length.

They get confused when the interviewer asks him to do the same job in one pass i.e. without traversing the linked list again.

In order to find middle element of linked list in one pass, you need to maintain two-pointer, one increment at each node while other increments after two nodes at a time, by having this arrangement, when the first pointer reaches the end, the second pointer will point to a middle element of the linked list. See this trick to [find middle element of linked list in a single pass](#) for more details.

**Question 2: How to find if a linked list has a loop?**

This question has a bit of similarity with the earlier algorithm and data structure interview question. I mean we can use two pointer approach to solve this problem.

If we maintain two pointers, and we increment one pointer after processing two nodes and other after processing every node, we are likely to find a situation where both the pointers will be pointing to the same node.

This will only happen if a linked list has a loop or cycle. You can check my article [linked list with cycles](#) for more details.

**Question 3: How to find the third element from the end in a linked list in one pass?**

This is another frequently asked linked list interview question. This question is exactly similar to [find middle element of linked list in a single pass](#).

If we apply the same trick of maintaining two pointers and increment another pointer, when

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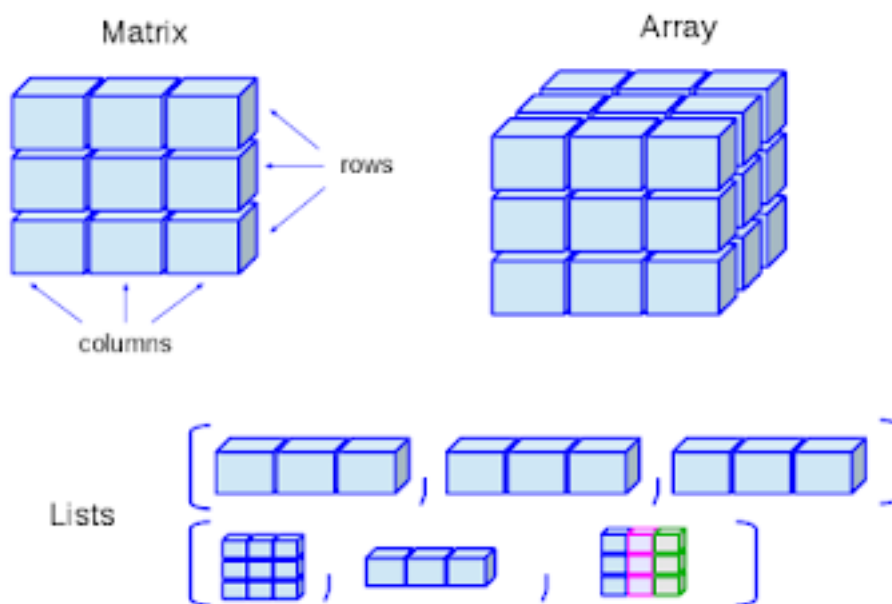


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first has moved up to the 3rd element, then when the first pointer reaches to the end of the linked list, the second pointer will be pointing to the 3rd element from last in a linked list.

Sometimes, interviewers can also generalize this problem and ask him to find the kth element from the tail, end or last. Just use the same logic, replace 3 with k and you can solve the problem.

If you want to learn more about linked list, you can also check out [Algorithms and Data Structures - Part 1 and 2](#) courses on Pluralsight.



Btw, you would need a Pluralsight membership to access this course, which costs around \$29 monthly or \$299 annually. I have one and I also suggest all developers have that plan because Pluralsight is like Netflix for Software developers.

It has more than 5000+ good quality courses on all latest topics. Since we programmers have to learn new things every day, an investment of \$299 USD is not bad.

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**Question 4: In an integer array, there is 1 to 100 number, out of one is duplicate, how to find?**

This is a rather simple data structures question, especially for this kind of. In this case, you can simply add all numbers stored in an array, and the total sum should be equal to  $n(n+1)/2$ . Now just subtract actual sum to expected sum, and that is your duplicate number.

Of course, there is a brute force way of checking each number against all other numbers, but that will result in the performance of  $O(n^2)$  which is not good.

By the way, this trick will not work if an array has multiple duplicates or its not numbers forming an arithmetic progression. Here is an example of one way to [find the duplicate number in the array](#).

**Question 6: How to reverse String in Java?**

This is one of my favorite questions. Since String is one of the most important types of programming, you expect a lot of question-related to String any data structure interview.

There are many ways to reverse Sting in Java or any other programming language, and the interviewer will force you to solve this problem by using without API i.e. without using `reverse()` method of `StringBuffer`.

In the follow-up, he may ask to reverse String using recursion as well. See [3 ways to reverse String in Java](#) to learn to reverse String using both loops and [recursion in Java](#).

**Question 7: Write a Java program to sort an array using Bubble Sort algorithm?**

I have always sent a couple of questions from searching and sorting in data structure interviews. Bubble sort is one of the simplest sorting algorithms but if you ask anyone to implement on the spot it gives you an opportunity to gauge the programming skills of a

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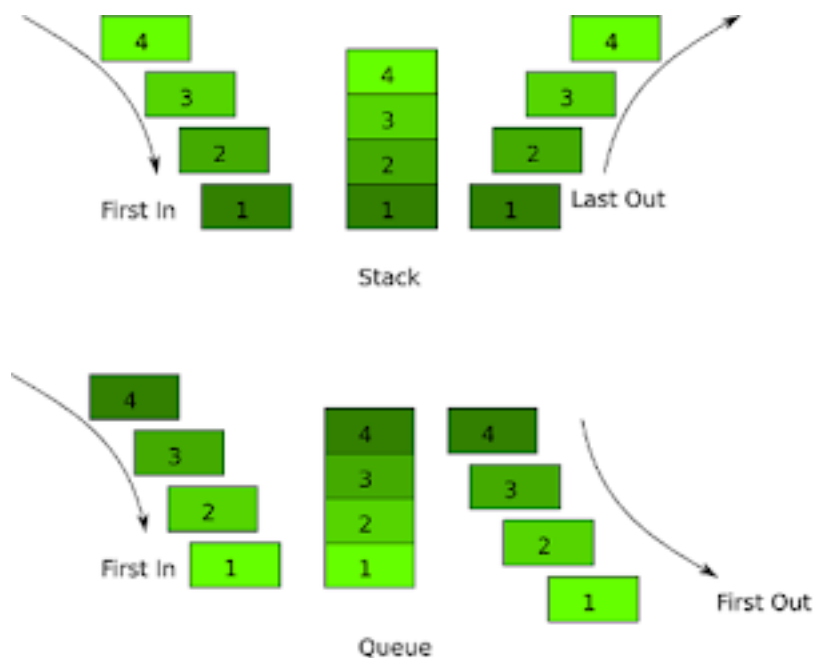
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candidate. See [How to sort an array using Bubble Sort in Java](#) for complete solution of this data structure interview question.

#### Question 8: What is the difference between Stack and Queue data structure?

One of the classical data structure interviews question. I guess everyone knows, No? Anyway, the main difference is that Stack is LIFO (Last In First Out) data structure while Queue is a FIFO (First In First Out) data structure. You can further see my article [stack vs queue](#) in Java for more details.



#### Question 9: How do you find duplicates in an array if there is more than one duplicate? (solution)

Sometimes this is asked a follow-up question of earlier data structure interview question, related to finding duplicates in Array. One way of solving this problem is using a [Hashtable or HashMap](#) data structure.

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You can traverse through the array, and store each number as key and number of occurrence as value. At the end of traversal, you can find all duplicate numbers, for which occurrence is more than one.

In Java if a number already exists in [HashMap](#) then calling `get(index)` will return number otherwise it returns null. this property can be used to insert or update numbers in HashMap.

**Question 10: What is the difference between the Singly Linked List and Doubly Linked List data structure?**

This is another classical interview question on the data structure, mostly asked on telephonic rounds. The main difference between the singly linked list and the doubly linked list is the ability to traverse.

In a singly linked list, a node only points towards the next node, and there is no pointer to the previous node, which means you can not traverse back on a singly linked list.

On the other hand, the doubly linked list maintains two pointers, towards the next and previous node, which allows you to navigate in both directions in any linked list.

If you want to learn more about essential data structure, you can also check out JavaScript [Algorithms and Data Structures Masterclass](#) By Colt Steele.

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**Question 11: Write Java program to print Fibonacci series?**

This is not a data structures question, but a programming one, which many times appear during data structure interview. Fibonacci series is a mathematical series, where each number is the sum of the previous two numbers e.g. 1, 1, 2, 3, 5, 8, 13, 21.

An interviewer is often interested in two things, a function which returns an nth number in Fibonacci series and solving this problem using recursion in Java.

Though, its easy question, recursion part often confuses beginners. See this link to [find the nth Fibonacci number in Java](#).

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**Question 12: Write Java program to check if a number is a palindrome or not? (solution)**

This is similar to the previous question, not directly related to data structures, but quite popular along with other questions. A number is called palindrome if the reverse of number is equal to the number itself.

An interviewer asks to solve this problem without taking help from Java API or any open source library. Anyway, it's a simple question, you can use the division operator (/) and remainder operator (%) to solve this question.

Just remember, division operator can be used to get rid of the last digit e.g.  $1234/10$  will give you 123, and modulus operator can give you last digit e.g.  $1234\%10$  will return 4. By the way, here is a [Java program check if the number is palindrome or not](#).

**Question 13: What is a binary search tree? (solution)**

This is a data structure question from Tree data structures. Binary Search Tree has some special properties e.g. left nodes contains items whose value is less than root, right subtree contains keys with higher node value than root, and there should not be any duplicates in the tree.

Apart from the definition, an interview can ask you to implement a binary search tree in Java and questions on tree traversal e.g. [in order](#), [preorder](#), and [postorder](#) traversals are quite popular data structure question.

**Question 14: How to reverse a linked list using recursion and iteration? (solution)**

This is another good question on data structures. There are many algorithms to reverse linked list and you can search for them using google. I am thinking of writing another blog post to explain linked list reversal and will share with you later.

As one of my readers mentioned, I have already written about it and linked into the [solution](#) link, you can check out my solution but I strongly suggest you try it yourself before looking at the solution.

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**Question 15: Write a Java program to implement Stack in Java? (solution)**

You can implement Stack by using an array or linked list. This question expects you to implement standard method provided by stack data structure e.g. push() and pop(). Both push() and pop() should be happening at top of the stack, which you need to keep track. It's also good if you can implement utility methods like contains(), isEmpty() etc.

By the way, JDK has a java.util.Stack class and you can check it's code to get an idea. You can also check [Effective Java book](#), where Josh Bloch has explains how an incorrect implementation of the stack can cause a memory leak in Java.

I also suggest looking on data structure and algorithm questions on [Cracking the Coding Interview](#) book, as this book contains some good questions with proper explanation. That will certainly help you to do better on programming job interviews.

Source: <https://www.java67.com/2018/06/data-structure-and-algorithm-interview-questions-programmers.html>

**Answer:**

A data structure is a way of defining, storing & retrieving data in a structural & systematic way. A data structure may contain a different type of data item. Different kinds of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks.

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**Answer:**

Data structure availability may vary by [programming languages](#). Commonly available data structures are the list, arrays, stack, queues, graph, tree etc.

**Answer:**

An algorithm is a step by step procedure, which defines a set of instructions to be executed in certain order to get the desired output. A computer program can be viewed as an [elaborate algorithm](#). In mathematics and [computer science](#), an algorithm usually means a small procedure that solves a recurrent problem.

Let us move to the next Data Structures And Algorithms Interview Questions

**Answer:**

Actually, the key difference is the memory area that is being accessed. When dealing with the structure that resides the main memory of the computer system, this is referred to as storage structure. When dealing with an auxiliary structure, we refer to it as file structures.

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**Answer:**

A linked-list is a list of data-items connected with links i.e. pointers or references. Most modern high-level programming language does not provide the feature of directly accessing a memory location, therefore, linked-list is not supported in them or available in the form of inbuilt functions. In computer science, a linked list is a linear collection of data elements, in which linear order is not given by their physical placement in memory. Instead, each element points to the next. It is a data structure consisting of a group of nodes that together represent a sequence.

**Answer:**

In data-structure, a stack is an Abstract Data Type (ADT) used to store and retrieve values in the Last In First Out method. The stack is the memory set aside as scratch space for a thread of execution.

**Answer:**

A stack structure restricts dramatically how elements are inserted, retrieved, and removed: The most recently inserted element in the stack is the only one that can be retrieved or removed. Stacks follow the LIFO method and the addition and retrieval of a data item take

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only  $O(n)$  time. Stacks are used where we need to access data in the reverse order of their arrival. Stacks are used commonly in recursive function calls, expression parsing, depth-first traversal of graphs, etc.

Let us now have a look at the advanced Data Structures And Algorithms Interview Questions.

**Answer:**

The below operations can be performed on a stack –

- push() – adds an item to stack – Insertion
- pop() – removes the top stack item -Deletion
- peek() – gives a value of a top item without removing it -Traversal
- isempty() – checks if a stack is empty –Null check
- isfull() – checks if a stack is full –No space

**Answer:**

The queue is an abstract data structure, somewhat similar to stack. In contrast to stack, a

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queue is opened at both ends. One end is always used to insert data (enqueue) and the other is used to remove data (dequeue). Queue follows First-In-First-Out methodology, i.e., the data item stored first will be accessed first.

**Answer:**

Linear search tries to find an item in a sequentially arranged data type. These sequentially arranged data items known as array or list, are accessible in incrementing memory location. Linear search compares expected data item with each of the data items in list or array. The average case time complexity of the linear search is  $O(n)$  and worst-case complexity is  $O(n^2)$ . Data in target arrays/lists need not be sorted.

Let us move to the next Data Structures And Algorithms Interview Questions

**Answer:**

A binary search works only on sorted lists or arrays. This search selects the middle which splits the entire list into two parts. First, the middle is compared.

This search first compares the target value to the mid of the list. If it is not found, then it takes a decision on the weather. In computer science, binary search, also known as half-

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interval search, logarithmic search, or binary chop, is a search algorithm that finds the position of a target value within a sorted array.

**Answer:**

A graph is a pictorial representation of a set of objects where some pairs of objects are connected by links. The interconnected objects are represented by points termed as vertices, and the links that connect the vertices are called edges. A graph data structure consists of a finite (and possibly mutable) set of vertices or nodes or points, together with a set of unordered pairs of these vertices for an undirected graph or a set of ordered pairs for a directed graph.

**Answer:**

A recursive function is one which calls itself, directly or calls a function that in turn calls it. Every recursive function follows the recursive properties – base criteria where functions stop calling itself and progressive approach where the functions try to meet the base criteria in each iteration. An important application of recursion in computer science is in defining dynamic data structures such as Lists and Trees.

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**Answer:**

Tower of Hanoi, is a mathematical puzzle which consists of three towers (pegs) and more than one ring. All rings are of different sizes and stacked upon each other where the large disk is always below the small disk. The aim is to move the tower of a disk from one peg to another, without breaking its properties. The objective of this game is to move the disks one by one from the first peg to the last peg. And there is only ONE condition, we cannot place a bigger disk on top of a smaller disk.

**Answer:**

The below-given problems find their solution using [a greedy algorithm](#) approach –

- Travelling Salesman Problem
- Prim's Minimal Spanning Tree Algorithm
- Kruskal's Minimal Spanning Tree Algorithm
- Dijkstra's Minimal Spanning Tree Algorithm
- Graph – Map Coloring
- Graph – Vertex Cover

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- Knapsack Problem

- Job Scheduling Problem

#### Data Structure Interview Questions

Any programming language interview can have a few or many questions based around data structures. Here are the most important data structure interview questions with their respective answers for you:

**Question: What do you understand by a data structure?**

**Answer:** A data structure offers a convenient way of organizing as well as manipulating the data. Simply put, it allows the data to be used in an effective manner. There is a galore of data structures and each of them is suitable for a distinct set of applications.

For instance, compiler implementations use hash tables for looking up identifiers. Similarly, B-trees are suitable for the implementation of databases. Data structures are virtually applied to all areas relying on data. Some of the most important ones are:

- Artificial intelligence
- Compiler design
- Database management
- [Graphics](#)
- Numerical analysis
- Operating system
- Statistical analysis

**Question: How does a linear data structure differ from a non-linear data structure?**

**Answer:** If the elements of a data structure form a sequence or a linear list then it is called a linear data structure. On the other hand, non-linear data structures are those in which the traversal of nodes is done in a non-linear way.

Arrays, linked lists, stacks, and queues are examples of linear data structures, while graphs and trees are those of non-linear data structures.

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**Question: Please enumerate the various operations that can be performed on a data structure.**

**Answer:** Following are the various operations that can be performed on a data structure:

- **Deletion** – Deleting an existing element from the data structure
- **Insertion** – Adding a new element to the data structure
- **Searching** – Find the location of an element, if it exists, in the data structure
- **Sorting** – Arranging elements of the data structure in:
  - Ascending or descending order for numerical data
  - Dictionary order for alphanumeric data
- **Traversal** – Accessing each element of the data structure once for processing

**Question: Can you tell which data structures are used for BFS and DFS of a graph?**

**Answer:** BFS (Breadth First Search) of a graph uses a queue. Although DFS (Depth First Search) of a graph makes use of a stack, it can also be implemented using recursion that uses function call stack.

**Question: Please explain stack and also mention some of its important applications.**

**Answer:** Stack is a linear data structure that follows either LIFO (Last In First Out) or FILO (First In Last Out) approach for accessing elements. Push, pop, and peek are the basic operations of a stack.

Some notable applications of a stack are:

- Check for balanced parentheses in an expression
- Evaluation of a postfix expression
- Implement two stacks in an array
- Infix to postfix conversion
- Reverse a string

**Question: What is a queue? How is it different from a stack?**

**Answer:** A queue is a form of linear structure that follows the FIFO (First In First Out) approach for accessing elements. Dequeue, enqueue, front, and rear are basic operations on a queue. Like a stack, a queue can be implemented using arrays and linked lists.

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In a stack, the item that is most recently added is removed first. Contrary to this, the item least recently added is removed first in case of a queue.

**Question: What do you understand by a binary search? What is the best scenario of using it?**

**Answer:** A binary search is an algorithm that starts with searching in the middle element. If the middle element is not the target element then it further checks whether to continue searching the lower half or the higher half. The process continues until the target element is found.

The binary search works best when applied to a list with sorted or ordered elements.

**Question: Could you explain how to reference all the elements in a one-dimension array?**

**A:** We can reference all the elements in a one-dimension array using an indexed loop. The counter runs from 0 to the maximum array size, say n, minus one. All elements of the one-dimension array are referenced in sequence by using the loop counter as the array subscript.

**Question: Please explain what do you understand by FIFO and LIFO?**

**Answer:** Both FIFO and LIFO are approaches to accessing, storing, and retrieving elements from a data structure. LIFO stands for Last In First Out. In this approach, recently stored data is the one to be extracted first.

FIFO is a contraction for First In First Out. Following this approach, the data that is stored the least recently will be extracted first.

**Question: Do you know how does dynamic memory allocation help in managing data?**

**Answer:** Dynamic memory allocation helps in storing simple structured data types. Moreover, it can combine separately allocated structured blocks for forming composite structures that contract and expand as required.

**Question: What is the difference between NULL and VOID?**

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**Answer:** While NULL is a value, VOID is a data type identifier. A variable assigned with a NULL value represents an empty value. The VOID is used for identifying pointers having no initial size.

**Question: How does a POP operation differ from a PUSH operation?**

**Answer:** Both PUSH and POP operations pertain to a stack. Data is added to the stack using the PUSH operation, while it is retrieved using the POP operation.

**Question: Could you explain how does variable declaration affect memory allocation?**

**Answer:** The total amount of memory to be allocated or reserved in the case of a variable declaration depends on the data type used. For instance, declaring an integer type variable reserves 4 bytes of memory space while declaring a double variable reserve 8 bytes of the available memory.

**Question: Please explain the concept of data abstraction.**

**Answer:** Data abstraction helps in dividing complex data problems into smaller, easy-to-manage parts. It starts with specifying all the involved data objects and the various operations to be performed on the same without stressing too much on the way data is stored.

**Question: How will you insert a new item in a binary search tree?**

**Answer:** As a binary search tree doesn't allow for duplicates, the new item to be inserted must be unique. Assuming it is, we will proceed with checking whether the tree is empty or not. If it is empty, then the new item will be inserted in the root node.

However, if the tree is non-empty then we will refer to the key of the new item. When it is smaller than the root item's key, the new item will be added to the left subtree. If the new item's key is bigger than the root item's key, then the new item is inserted into the right subtree.

**Question: Could you explain how does the selection sort work on an array?**

**Answer:** The selection sort begins with finding the smallest element. It is switched with the element present at subscript 0. Next, the smallest element in the remaining subarray is located and switched with the element residing in the subscript 1.

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The aforementioned process is repeated until the biggest element is placed at the subscript  $n-1$ , where  $n$  represents the size of the given array.

**Question: Do you know how the memory is affected by signed and unsigned numbers?**

**Answer:** For signed numbers, the first bit is reserved for indicating whether the number is positive or negative. Hence, it has one bit less for storing the value. Unlike signed numbers, unsigned numbers have all the bits available for storing the number.

The effect of the aforementioned can be seen in the value range available to signed and unsigned numbers. While an unsigned 8-bit number can have a range of 0 to 255, an 8-bit signed number has a range varying from -128 to 127.

**Question: Does all declaration statements result in a fixed memory reservation?**

**Answer:** Except for pointers, all declaration statements result in a fixed memory reservation. Instead of allocating memory for storing data, a pointer declaration results into allocating memory for storing the address of the pointer variable.

For pointers, actual memory allocation for the data happens during the runtime.

**Question: How does an array differ from a stack?**

**Answer:** A stack follows the LIFO approach. This means that data manipulation follows a specific sequence where the latest data element is the one to be retrieved first.

Unlike a stack, an array doesn't follow any particular sequence for adding or retrieving data. Adding or retrieving an element in an array is done by referring to the array index.

**Question: What do you understand by an AVL tree?**

**Answer:** An AVL tree is a type of BST (Binary Search Tree), which is always in a partially-balanced state. The measure of the balance is given by the difference of the heights of the subtrees from the root node of the AVL tree.

**Question: Please explain how does an Array differ from a Linked List?**

**Answer:** Following are the various differences between an array and a linked list:

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- **Additional Memory** – For each element belonging to a linked list, extra memory space is required for storing the pointer. Arrays have no such requirement
- **Cache** – In comparison to linked lists, arrays have better cache locality, which can significantly enhance the performance in various scenarios
- **Insertion and Deletion** – It is easy to add or delete elements in a linked list. Inserting and deleting elements for an array is comparatively expensive
  - **Random Access** – Linked lists do not allow random access, while arrays do
  - **Size** – While the size of an array is fixed, the size of a linked list is dynamic

**Question: What do you understand by Infix, Prefix, and Postfix notations?**

**Answer:**

- **Infix Notation** – Operators are written between the operands. This is the standard way of writing expressions. For example,  $A * (B + C) / D$
- **Postfix Notation/Reverse Polish Notation** – Operators are written after the operands, hence the name. For instance,  $A B C + * D /$
- **Prefix Notation/Polish Notation** – Operators are written before the operands.  $/ * A + B C D$  is the prefix notation equivalent of the aforementioned postfix notation example

**Question: Please explain the Linked List and its various types.**

**Answer:** In a linked list, each element is a distinct object. Like arrays, linked lists are a linear type of [data structures](#). In addition to data, every element of a linked list comprises a reference to the next element. Various types of linked lists are:

- **Singly Linked List** – Each node stores the address or reference of the next node in the linked list, leave for the last node that stores NULL
- **Doubly Linked List** – Each node keeps two references. One point to the next node and the other points to the previous node
- **Circular Linked List** – In this type of linked list, all nodes are connected to form a circle. Hence, there is no NULL at the end. A circular linked list can either be a single circular linked list or a double circular linked list

**Question: How will you implement a stack using queue and vice-versa?**

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**Answer:** It is possible to implement a stack using two queues. Further, there are two options; either to make the push operation costly or the pop operation costly.

A queue can also be implemented with two stacks. Moreover, there are two options; either to make the enqueue operation costly or the dequeue operation costly.

**Question: Which data structures are used for implementing LRU cache?**

**Answer:** By organizing items in order of use, a Least Recently Used or LRU cache allows quick identification of an item that hasn't been put to use for the longest time. Two data structures are used for implementing an LRU cache:

- **Queue** – Implemented using a doubly linked list. The maximum size of the queue is determined by the total number of frames available i.e. the cache size. While the most recently used pages will be near the rear end of the queue, the least recently pages will be near the queue's front end
- **Hashmap** – Having page number as the key along with the address of the corresponding queue node as the value

**Question: Could you give a brief explanation of the various approaches for developing algorithms?**

**Answer:** There are 3 main approaches to developing algorithms:

- **Divide and Conquer** – Involves dividing the entire problem into a number of subproblems and then solving each of them independently
- **Dynamic Programming** – Identical to the divide and conquer approach with the exception that all sub-problems are solved together
- **Greedy Approach** – Finds a solution by choosing the next best option

**Question: Please enumerate some examples of greedy and divide and conquer algorithms.**

**Answer:** Some examples of algorithms that follow greedy approach are:

- Dijkstra's Minimal Spanning Tree
  - Graph – Map Coloring
  - Graph – Vertex Cover
  - Job Scheduling Problem

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- Knapsack Problem
- Kruskal's Minimal Spanning Tree
- Prim's Minimal Spanning Tree
- Travelling Salesman

Following are some notable instances of the divide and conquer approach:

- Binary Search
- Closest Pair (or Points)
  - [Merge Sort](#)
  - Quick Sort
- Strassen's Matrix Multiplication

**Question: How does insertion sort differ from selection sort?**

**Answer:** Both insertion and selection approaches maintain two sub-lists, sorted and unsorted. Each takes one element from the unsorted sub-list and place it into the sorted sub-list. The distinction between the two sorting processes lies in the treatment of the current element.

Insertion sort takes the current element and places it in the sorted sublist at the appropriate location. Selection sort, on the other hand, searches for the minimum value in the unsorted sub-list and replaces the same with the present element.

**Question: What do you understand by shell sort?**

**Answer:** The shell sort can be understood as a variant of the insertion sort. The approach divides the entire list into smaller sub-lists based on some gap variable. Each sub-list is then sorted using insertion sort.

**Question: Can you explain tree traversal?**

**Answer:** The process for visiting all the nodes of a tree is called tree traversal. It always starts from the root node and there are three ways of doing it:

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

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**Question: Please explain a spanning tree. What is the maximum number of spanning trees a graph can have?**

**Answer:** A spanning tree is a subset of a graph that has all the vertices but with the minimum possible number of edges. Neither a spanning tree can be disconnected and nor does it have cycles.

The maximum number of spanning trees that a graph can have depended on how connected the graph is. A complete undirected graph with n number of nodes can have a maximum of  $n^{n-1}$  number of spanning trees.

**Question: How does the Kruskal's Algorithm work?**

**Answer:** Kruskal's algorithm treats a graph as a forest and each node in it as an individual tree. A tree connects to another tree only if it:

- Has the least cost among all the available options
  - Does not violate the [MST properties](#)

**Question: What do you understand by Heap in data structure?**

**Answer:** A Heap data structure is a special balanced binary tree in which the root node key is compared with its children and accordingly arranged. A Heap data structure can be of two types:

- **Min-Heap** – The parent node has a key value less than its children
- **Max-Heap** – The parent node has a key value greater than its children

**Question: Please explain recursion.**

**Answer:** The ability to allow a function or module to call itself is called recursion. Either a function f calls itself directly or calls another function 'g' that in turn calls the function 'f'. The function f is known as the recursive function and it follows the recursive properties:

- **Base criteria** – Where the recursive function stops calling itself
- **Progressive approach** – Where the recursive function tries to meet the base criteria in each iteration

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**Question: Can you explain the Tower of Hanoi problem?**

**Answer:** The Tower of Hanoi is a mathematical puzzle that comprises of three tower (or pegs) and more than one ring. Each ring is of varying size and stacked upon one another such that the larger one is beneath the smaller one.

The goal of the Tower of Hanoi problem is to move the tower of the disk from one peg to another without breaking the properties.

**Question: How do the BFS (Breadth First Search) and DFS (Depth First Search) algorithms work?**

**Answer:** The BFS algorithm traverses a graph in the breadthwards motion. It uses a queue to remember the next vertex for starting a search when a dead end occurs in any iteration.

A DFS algorithm traverses a graph in the depthward motion. It uses a stack for remembering the next vertex to start a search when coming across a dead end in an iteration.

**Question: What do you understand by hashing?**

**Answer:** The technique of converting a range of key values into a range of indexes of an array is known as hashing. It is possible to create associative data storage using hash tables where data indices can be found by providing the corresponding key values.

**Question: Please explain an MST (Minimum Spanning Tree). Also, explain how does Prim's algorithm find a minimum spanning tree.**

**Answer:** An MST or Minimum Spanning Tree is a spanning tree in a weighted graph that has the minimum weight of all the possible spanning trees. Each node is treated as a single tree by [Prim's algorithm](#) while adding new nodes to the spanning tree from the available graph.

**Question: Can you explain the interpolation search technique?**

**Answer:** The interpolation search technique is an enhanced variant of [binary search](#). It works on the probing position of the required value.

**Question: How will you check whether the given Binary Tree is BST or not?**

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**Answer:** Simply do inorder traversal of the given binary tree while keeping track of the previous key value. If the current key value is greater, then continue, otherwise return false. The binary tree is BST if the inorder traversal of the binary tree is sorted.

The data structure, algorithms, string, array are a core part of any Programming Language job interview. It doesn't matter whether you are a **C++ developer, a Java developer or a Web developer working in JavaScript, Angular, React, or Query.**

There are a lot of computer science graduates and programmers applying for programming, coding, and software development roles at startups like **Uber and Netflix; big organizations like Amazon, Microsoft, and Google; and service-based companies like Infosys or Luxsoft**, but many of them have no idea of **what kind of programming interview questions to expect** when you're applying for a job with these companies.

In this article, I'll share some frequently asked programming interview questions from different interviews for programmers at different levels of experience, **from people who have just graduated from college to programmers with one to two years of experience.**

As a computer science graduate, its expected from a programmer to have strong knowledge of both basic data structures e.g. array, linked list, binary tree, hash table, stack, queue and advanced data structures like the binary heap, trie, self-balanced tree, circular buffer etc. I have taken a lot of Java interviews for both junior and senior positions in the past, and I have been also involved in interviewing C++ developer. One difference which I have clearly noticed between a C++ and a Java developer is their understanding and command of Data structure and algorithms.

On average, a C or C++ developer showed a better understanding and application of data structure and their coding skill was also better than Java developers. This is not a coincidence though. As per my experience, there is a direct correlation between a programmer having a good command of the algorithm also happens to be a good developer and coder.

I firmly believe that interview teaches you a lot in very short time and that's why I am sharing some frequently asked Data structure and algorithm questions from various Java interviews.

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If you are familiar with them then try to solve them by hand and if you do not then learn about them first, and then solve them. If you need to refresh your knowledge of data structure and algorithms then you can also take help from a good book or our course like Data Structures and Algorithms: Deep Dive Using Java for quick reference.

### **Data Structures, Algorithm and Programming Language Interview Questions**

For the sake of clarity and focus, I have categorized these data structure and algorithmic questions into various sub-category e.g. String questions, array-based questions, linked list questions, binary tree-related questions, searching and sorting based questions and bit manipulation questions.

This way you can start with the topic you feel most comfortable and slowly progressing to the topic which you want to improve.

#### **1. String Interview Questions**

The string is probably the most used data structure. You will see it right from your programming course and you will use it throughout your professional project. There is hardly an application written in Java and C++ who doesn't use String.

They are everywhere. From a C++ perspective, String is nothing but a null-terminated character array, but from Java perspective, String is a full-fledged object backed by character array.

In this category, you will find questions which require String manipulations e.g. substring, reversing, searching, sorting, slicing and dicing etc.

**Here is a list of some of the frequently asked String Interview Questions from Coding Interviews:**

- Print duplicate characters from String? ([solution](#))
  - Check if two Strings are anagrams of each other? ([solution](#))
  - Print first non repeated character from String? ([solution](#))
- Reverse a given String using recursion? ([solution](#))
  - Check if a String contains only digits? ([solution](#))
  - Find duplicate characters in a String? ([solution](#))

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- Count a number of vowels and consonants in a given String? ([solution](#))
  - Count the occurrence of a given character in String? ([solution](#))
  - Find all permutations of String? ([solution](#))
- Reverse words in a given sentence without using any library method? ([solution](#))
  - Check if two String is a rotation of each other? ([solution](#))
  - Check if given String is Palindrome? ([solution](#))

If you can solve all these String questions without any help then you are in good shape. For more advanced questions, I suggest you solve problems given on [Algorithm Design Manual by Steven Skiena](#), a book with toughest algorithm questions.

## 2. Array and Matrix Interview Questions

Next to String is array, the second most frequently used data structure. Array stores element in a contiguous memory location and in C++ you can access array elements using pointer arithmetic as well, but in Java array is again an object, which provides just length method.

You can only access the array using index and Java also doesn't valid index check and if you try to access an array with an invalid index, you will

get `java.lang.ArrayIndexOutOfBoundsException`, so beware of that.

**Here is a list of some of the frequently asked Array and Matrix-based Programming questions:**

- Find a missing number in given integer array of 1 to 100? ([solution](#))
  - Find the duplicate number on a given integer array? ([solution](#))
  - Largest and smallest number in an unsorted integer array? ([solution](#))
- Find all pairs of integer array whose sum is equal to a given number? ([solution](#))
  - Find duplicate numbers in an array if it contains multiple duplicates? ([solution](#))
  - Remove duplicates from given array in Java? ([solution](#))
- Sort an integer array in place using QuickSort algorithm? ([solution](#))
  - Remove duplicates from an array in place? ([solution](#))

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- Reverse an array in place in Java? ([solution](#))
- Find multiple missing numbers in given integer array with duplicates? ([solution](#))
  - Perform a binary search in given array? ([solution](#))
  - Transpose a Matrix? ([solution](#))
- Add or subtract two Matrices? ([solution](#))
  - Multiply two Matrices in Java? ([solution](#))
  - Calculate the average of all numbers in given array? ([solution](#))

If you need more advanced questions based upon array then you can see also see The Coding Interview Bootcamp: Algorithms + Data Structures, a boot camp style course on algorithms, especially designed for interview preparation to get a job on technical giants like Google, Microsoft, Apple, Facebook etc.

### 3. Linked List Interview Questions

A linked list is another important data structure from interview point of view, here are some of the frequently asked linked list questions from programming interviews:

**Here is a list of some of the common linked list data structure questions from interviews:**

- Find the middle element of a singly linked list in one pass? ([solution](#))
  - Find the 3rd node from the end in a singly linked list? ([solution](#))
  - Check if a given linked list contains cycle? How to find the starting node of the cycle? ([solution](#))
- Find the length of a singly linked list? ([solution](#))
  - Reverse a linked list? ([solution](#))
  - Reverse a singly linked list without recursion? ([solution](#))
- Remove duplicate nodes in an unsorted linked list?
  - Find the sum of two linked list using Stack? ([program](#))

If you need more interview questions based upon linked list then you can also refer to this list of [30 linked list questions](#).

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#### 4. Binary Tree Interview Questions

tree data structure is another popular data structure in programming interviews. It has several variants e.g. binary tree, binary search tree and even binary heaps. It's almost guaranteed to see a couple of binary tree questions in programming job interviews.

**Here is a list of some of the popular binary tree interview questions from programming job interviews:**

- Implement a binary search tree? ([solution](#))
  - Pre-order traversal in given binary tree? ([solution](#))
  - Traverse a given binary tree in Pre-order without recursion ([solution](#))
- Implement Post-order traversal algorithm? ([solution](#))
  - Traverse a binary tree in Post order traversal without recursion ([solution](#))
  - Print all leaves of a binary search tree? ([solution](#))
- Count a number of leaf nodes in the given binary tree? ([solution](#))
  - In order traversal in given binary tree? ([solution](#))
  - Print all nodes of given binary tree using inorder traversal without recursion ([solution](#))
- Check if a given binary tree is a binary search tree?
  - Check if a binary tree is balanced or not?
  - Given a binary search tree, how do you check whether there are two nodes in it whose sum equals a given value?
- convert a binary search tree to a sorted double-linked list.you are only allowed to change the target of pointers, but cannot create any new nodes.
  - Given a binary search tree and a value k, How do you find a node in the binary search tree whose value is closest to k.

#### 5. Stack and Queue Interview Questions

Stack and Queue are derived data structure i.e. they are implemented either using an array or linked list, but they have unique features.

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A queue is also known as FIFO data structure, which means First In First Out i.e. the element which will be added first will also be retrieved first.

Queue allows you to add an element at the tail and retrieve an element from the head, thus giving FIFO ordering.

On the other hand, Stack is a LIFO data structure, Last In First out i.e. the element which will be added first will be the last one to go.

This property is often used to convert a recursive algorithm into an iterative one. To learn more about Stack and Queue, I just you to join a good course on Data Structure and Algorithms e.g. Deep Dive into Data Structure in Java.

**For now, let's see some coding problems based on Stack and Queue data structure in Java.**

1. How do you implement a Queue using two Stacks?
2. Write a Java program to implement Stack using an array and linked list?
3. How do you implement Stack using Queues?
4. Given a binary tree, return the postorder traversal of its nodes' values, using Stack?
5. Difference between Stack and Queue data structure ([answer](#))

If you need more such coding questions you can take help from books like [Cracking Code Interview](#), which presents 189+ Programming questions and solution. A good book to prepare for programming job interviews in a short time.

## **6. Search and Sort Algorithmic Interview Questions**

Search and Sort based questions are the most popular algorithmic questions on any programming job interview. Interviewer often asks to implement various sorting algorithms e.g. Bubble sort, Quick sort, merge sort and asking to implement binary search etc.

**Other algorithms questions e.g. collision detection are not so popular but they are very interesting to solve and develop your grasp on creating your algorithms.**

- Implement the Bubble Sort algorithm? ([solution](#))
  - Implement Iterative QuickSort Algorithm? ([solution](#))

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- Implement the Bucket Sort Algorithm? ([solution](#))
- Implement Counting Sort Algorithm? ([solution](#))
  - Implement the Insertion Sort Algorithm? ([solution](#))
  - Implement a Merge Sort Algorithm? ([solution](#))
- Implement a Radix Sort Algorithm? ([solution](#))
  - Implement Sieve of Eratosthenes Algorithm to find Prime numbers? ([solution](#))
  - Find GCD of two numbers using Euclid's Algorithm? ([solution](#))

If you want to learn more about other algorithms, apart from search and sort e.g. advanced String algorithms then I suggest you check out the Data Structure and Algorithm MasterClass Part 1 - 2 on Pluarlsight.

## 7. Bit Manipulation Interview Questions

Last but not the least, we will see some bit manipulation based questions. There is a popular saying that, there are two kinds of programmers, one who knows binary and other's who don't.

Yes, understand binary and playing with bits is an important skill for good programmers. Every major programming language e.g. Java and C++ provide both bitwise and bit shift operators, which you can use to manipulate bits and solve problems.

- Check if a number is the power of two? ([solution](#))
  - Check if a number is even or odd without using modulo operator? ([solution](#))
  - Subtract two binary numbers? ([solution](#))
- Find the number of 1s (the Set bit) in a given Bit Sequence? ([solution](#))

## 8. Problem Solving Coding Questions

So far we have seen most of the programming questions based upon data structure and algorithms but sometime you will also find questions from [software design](#), [Dynamic Programming](#), and other logical and [tricky](#) questions.

Here is a collection of some of those questions for your practice:

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- Swap two numbers without using the third variable? ([solution](#))
  - Check if two rectangles overlap with each other? ([solution](#))
  - Design a Vending Machine? ([solution](#))
- Implement an LRU Cache in your favorite programming language? ([solution](#))
  - Check if a given number is a Palindrome? ([solution](#))
  - Check if a given number is an Armstrong number? ([solution](#))
- Find all prime factors of a given number? ([solution](#))
  - Check if a given number is a positive or negative in Java? ([solution](#))
  - Find the largest prime factor of a given integral number? ([solution](#))
- Print all prime numbers up to a given number? ([solution](#))
  - Print Floyd's triangle? ([solution](#))
  - Print Pascal's triangle? ([solution](#))
- Calculate the square root of a given number? ([solution](#))
  - Check if given number is a prime number? ([solution](#))
  - Add two numbers without using plus operator in Java? ([solution](#))
- Check if a given number is even/odd without using Arithmetic operator? ([solution](#))
  - Print a given Pyramid structure? ([solution](#))
  - Find the highest repeating word from a given file in Java? ([solution](#))
- The reverse is given Integer in Java? ([solution](#))
  - Convert a decimal number to binary in Java? ([solution](#))
  - Check if a given year is a leap year in Java? ([solution](#))

That's all about some data structure and algorithm interview questions for programmers.

Remember, its one of the most important topic for all levels of programmers, but its even more important for freshers, computer science graduates and junior programmers with 1 to 2 years of experience.

As you get more experienced, you started seeing less number of data structure and algorithm questions e.g. a Java developer with 3 to 4 years of experience will see the lot less

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DS and also questions then freshers and a more senior Java developer e.g. someone with 5 to 6 years of experience will see even less.

Nonetheless, its an important topic and programmer should not overlook it. I have found good companies like Google, Microsoft, Amazon they use Data structure and algorithm questions all the times.

On the algorithmic front, there are more e.g. interview questions based on Dynamic Programming and backtracking, which I have not shared here, but I'll add it sometime later. If you come across any good data structure and algorithm question, don't feel shy to share with us.

Thanks a lot for reading this article so far. If you like these Data Structure and Algorithm Interview questions then please share with your friends and colleagues. If you have any questions or feedback then please drop a note.

Source: HOB

### **Data Structures Job Interview Questions**

These are questions that are reported to have been asked during various job inter- views. We may not have covered everything that was asked, but you should try to answer them anyway and look up what you do not know.<sup>1</sup>

1. What is a data structure?
2. Suppose you are implementing the address book feature for a cellphone. The address book needs to be kept sorted by person's last name and support fast access when queried by last name. Which of the following data structures would be a good choice to use for storing the address book? Explain why. Which would be the bad choice and why?

(a) unsorted linked list (b) sorted linked list

(c) binary search tree (d) hash table

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3. Suppose you are a member of a team of programmers implementing a new text editor. You are in charge of the "UNDO" feature of the editor. What data structure would you use for storing the list of recent changes made to the document?
4. The linked lists that we discussed had a last node whose next\_node link was set to null. In circular linked lists, the next\_node link of the last node points to the first node. How would you write C++ code for a method
5.       boolean isCircular( linkedList)

which, given a linked list, returns true if the list is circular and false if it is not?

6. Given a singly linked list, how would you find a node that is n nodes away from the last node? Think of iterative and recursive solutions. You can make only a single pass through the list.
7. Given two sorted linked lists, write code that merges them into a single sorted linked list without copying the lists into a new list; i.e., just merge the two into one.
8. How can you simulate queue behavior using two stacks?

1Thanks to Joanna Klukowska for collecting many of these questions.

1

*CSci 235 Software Design and Analysis II Prof. Stewart Weiss Data Structures Job Interview Questions*

8. Write a method of a binary (search) tree class that returns the sum of all of the numbers stored in the nodes.  
Write another method that returns the sum of the numbers stored in the leaf-nodes.

Write another method that returns the sum of the numbers stored at even numbered levels (assume that the root is at level 0, which is even).

9. Given the binary tree below show the inorder, preorder and postorder traversals of the tree.

A

B

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C

DSME

FGVRH

T

10. Write a method of a binary search tree class that converts the tree to its mirror image (i.e., swaps left and right child for each node). Is the resulting tree a binary search tree?
11. Write a method of a binary tree class that determines if a given tree is a binary search tree or not.
12. Write a method of a binary tree
13. String printAllPathsFromRoot ()  
  
that returns a multi-line String containing one per line all paths from root to the leaves (there should be as many lines as there are leaves in the tree).
14. Write a method of a binary (search) tree that returns the largest depth of any node.
15. Given a sorted array (increasing order) of integers, write an algorithm that creates a binary search tree of minimal height.
16. Write an algorithm that when given a link to a node in a binary search tree returns the successor value of that node in the tree (the "successor" being the value that would follow the value in the given node in an inorder traversal of the tree). Do not use the inorder traversal.

2

*CSci 235 Software Design and Analysis II Prof. Stewart Weiss Data Structures Job Interview Questions*

16. Complexity (or Big-O notation)  
  
(a) What is the complexity (average or worst case) of inserting a new element into:  
  
i. an unsorted singly linked list (at the end) ii. an unsorted doubly linked list (at the end)

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iii. a stack (assume array based) iv. a queue (assume array based)

v. a binary search tree

vi. a hash table ( we did not cover this)

(b) What is the complexity (average or worst case) of finding a specific element in:

i. an unsorted singly linked list ii. an unsorted doubly linked list

iii. a sorted singly linked list iv. a binary search tree

v. a hash table ( we did not cover this)

17. What is the relationship between a queue and a priority queue? ( we did not cover this)

18. What data structure can "simulate" recursion?

19. How would you design a stack that, in addition to traditional push() and pop() operations, also provides a max() function? Your push(), pop() and max() functions should be  $O(1)$ .

Which sort algorithm guarantees performance better than  $O(N^2)$ ?

20. Is it possible to implement a binary tree using an array? How?

21. Given a binary search tree how do you find a predecessor/successor of a node?

Additional webpages with resources:

### **What is data structure?**

The logical and mathematical model of a particular organization of data is called data structure. There are two types of data structure

Linear

Nonlinear

### **2. What is a linked list?**

A linked list is a linear collection of data elements, called nodes, where the linear order is given by pointers.

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Each node has two parts first part contain the information of the element  
second part contains the address of the next node in the list.

**3. What is a queue?**

A queue is an ordered collection of items from which items may be deleted at one end (front end) and items inserted at the other end (rear end).

It obeys FIFO rule there is no limit to the number of elements a queue contains.

**4. What is a spanning Tree?**

A spanning tree is a tree associated with a network.

All the nodes of the graph appear on the tree once.

A minimum spanning tree is a spanning tree organized so that the total edge weight between nodes is minimized.

**5. What is precision?**

Precision refers the accuracy of the decimal portion of a value.

Precision is the number of digits allowed after the decimal point.

**6. What are the goals of Data Structure?**

It must rich enough in structure to reflect the actual relationship of data in real world.

The structure should be simple enough for efficient processing of data.

**7. What is the difference between a Stack and an Array?**

**Stack**

Stack is a dynamic object whose size is constantly changing as items are pushed and popped .

Stack may contain different data types.

Stack is declared as a structure containing an array to hold the element of the stack, and an integer to indicate the current stack top within the array.

Stack is a ordered collection of items.

**Array**

Array is an ordered collection of items.

Array is a static object.

It contains same data types.

Array can be home of a stack i.e. array can be declared large enough for maximum size of the stack.

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**8. What is sequential search?**

In sequential search each item in the array is compared with the item being searched until a match occurs.

It is applicable to a table organized either as an array or as a linked list.

**9. What are the disadvantages array implementations of linked list?**

The no of nodes needed can't be predicted when the program is written.

The no of nodes declared must remain allocated throughout its execution.

**10. What is a priority queue?**

The priority queue is a data structure in which the intrinsic ordering of the elements.

**11. What are the disadvantages of sequential storage?**

Fixed amount of storage remains allocated to the data structure even if it contains less element.

No more than fixed amount of storage is allocated causing overflow.

**12. Define circular list?**

In linear list the next field of the last node contain a null pointer, when a next field in the last node contain a pointer back to the first node it is called circular list.

**13. What does abstract Data Type Mean?**

Data type is a collection of values and a set of operations on these values.

Abstract data type refer to the mathematical concept that define the data type.

**14. What do you mean by recursive definition?**

The definition which defines an object in terms of simpler cases of itself is called recursive definition.

**15. What actions are performed when a function is called?**

When a function is called

arguments are passed

local variables are allocated and initialized

transferring control to the function

**16. Define double linked list?**

It is a collection of data elements called nodes, where each node is divided into three parts

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An info field that contains the information stored in the node.

Left field that contain pointer to node on left side.

Right field that contain pointer to node on right side.

**17. What do you mean by overflow and underflow?**

When new data is to be inserted into the data structure but there is no available space i.e. free storage list is empty this situation is called overflow.

When we want to delete data from a data structure that is empty this situation is called underflow.

**18. Whether Linked List is linear or Non-linear data structure?**

According to Access strategies Linked list is a linear one.

According to Storage Linked List is a Non linear one.

**19.**

**What do you mean by free pool?**

Pool is a list consisting of unused memory cells which has its own pointer.

**20.**

**What are the methods available in storing sequential files ?**

- Straight merging
- Natural merging
- Polyphase sort
- Distribution of Initial runs

**1) What is Data Structure? Explain.**

The data structure is a way that specifies how to organize and manipulate the data. It also defines the relationship between them. Some examples of Data Structures are arrays, Linked List, Stack, Queue, etc. Data Structures are the central part of many computer science algorithms as they enable the programmers to handle the data in an efficient way

**2) Describe the types of Data Structures?**

Data Structures are mainly classified into two types:

**Linear Data Structure:** A data structure is called linear if all of its elements are arranged in the sequential order. In linear data structures, the elements are stored in a non-hierarchical way where each item has the successors and predecessors except the first and last element.

**Non-Linear Data Structure:** The Non-linear data structure does not form a sequence i.e.

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each item or element is connected with two or more other items in a non-linear arrangement. The data elements are not arranged in the sequential structure.

### 3) List the area of applications of Data Structure.

Data structures are applied extensively in the following areas of computer science:

Compiler Design,  
Operating System,  
Database Management System,  
Statistical analysis package,  
Numerical Analysis,  
Graphics,  
Artificial Intelligence,  
Simulation

### 4) What is the difference between file structure and storage structure?

Difference between file structure and storage structure:

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.

### 5) List the data structures which are used in RDBMS, Network Data Model, and Hierarchical Data Model.

- RDBMS uses Array data structure
- Network data model uses Graph
- Hierarchical data model uses Trees

### 6) Which data structure is used to perform recursion?

Stack data structure is used in recursion due to its last in first out nature. Operating system maintains the stack in order to save the iteration variables at each function call

### 7) What is a Stack?

Stack is an ordered list in which, insertion and deletion can be performed only at one end that is called the top. It is a recursive data structure having pointer to its top element. The stack is sometimes called as Last-In-First-Out (LIFO) list i.e. the element which is inserted first in the stack will be deleted last from the stack.

### 8) List the area of applications where stack data structure can be used?

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- 3 Expression evaluation
- 4 Backtracking
- 5 Memory Management
- 6 Function calling and return

9) What are the operations that can be performed on a stack?

- Push Operations
- Pop Operations
- Peek Operations

10) Write the stack overflow condition.

Overflow occurs when **top = Maxsize - 1**

11) What is the difference between PUSH and POP?

PUSH and POP operations specify how data is stored and retrieved in a stack.

**PUSH:** PUSH specifies that data is being "inserted" into the stack.

**POP:** POP specifies data retrieval. It means that data is being deleted from the stack.

12) Write the steps involved in the insertion and deletion of an element in the stack.

**Push:**

- 4 Increment the variable top so that it can refer to the next memory allocation
- 5 Copy the item to the at the array index value equal to the top
- 6 Repeat step 1 and 2 until stack overflows

**Pop:**

- 4 Store the topmost element into the an another variable
- 5 Decrement the value of the top
- 6 Return the topmost element

13) What is a postfix expression?

An expression in which operators follow the operands is known as postfix expression. The main benefit of this form is that there is no need to group sub-expressions in parentheses or to consider operator precedence.

The expression "a + b" will be represented as "ab+" in postfix notation.

14) Write the postfix form of the expression:  $(A + B) * (C - D)$

AB+CD-\*

15) Which notations are used in Evaluation of Arithmetic Expressions using prefix and

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postfix forms?

Polish and Reverse Polish notations.

16) What is an array?

Arrays are defined as the collection of similar types of data items stored at contiguous memory locations. It is the simplest data structure in which each data element can be randomly accessed by using its index number.

17) How to reference all the elements in a one-dimension array?

It can be done by using an indexed loop such that the counter runs from 0 to the array size minus one. In this manner, you can reference all the elements in sequence by using the loop counter as the array subscript.

18) What is a multidimensional array?

The multidimensional array can be defined as the array of arrays in which, the data is stored in tabular form consists of rows and columns. 2D arrays are created to implement a relational database lookalike data structure. It provides ease of holding the bulk of data at once which can be passed to any number of functions wherever required.

19) How are the elements of a 2D array are stored in the memory?

There are two techniques by using which, the elements of a 2D array can be stored in the memory.

- **Row-Major Order:** In row-major ordering, all the rows of the 2D array are stored into the memory contiguously. First, the 1st row of the array is stored into the memory completely, then the 2nd row of the array is stored into the memory completely and so on till the last row.
- **Column-Major Order:** In column-major ordering, all the columns of the 2D array are stored into the memory contiguously. first, the 1st column of the array is stored into the memory completely, then the 2nd row of the array is stored into the memory completely and so on till the last column of the array.

20) Calculate the address of a random element present in a 2D array, given base address as BA.

**Row-Major Order:** If array is declared as  $a[m][n]$  where  $m$  is the number of rows while  $n$  is the number of columns, then address of an element  $a[i][j]$  of the array stored in row major order is calculated as,

$$\text{Address}(a[i][j]) = B. A. + (i * n + j) * \text{size}$$

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**Column-Major Order:** If array is declared as  $a[m][n]$  where  $m$  is the number of rows while  $n$  is the number of columns, then address of an element  $a[i][j]$  of the array stored in column major order is calculated as

**$\text{Address}(a[i][j]) = ((j * m) + i) * \text{Size} + \text{BA}$ .**

#### 21) Define Linked List Data structure.

Linked List is the collection of randomly stored data objects called nodes. In Linked List, each node is linked to its adjacent node through a pointer. A node contains two fields, i.e. Data Field and Link Field.

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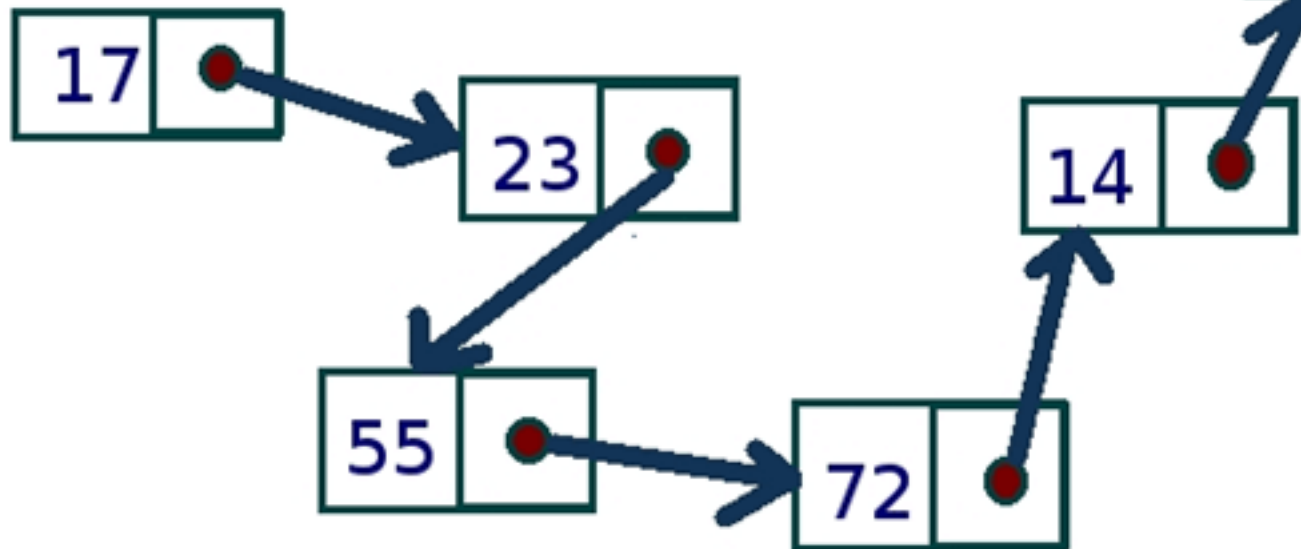
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## Linked list



## data format

22) Are linked lists considered linear or non-linear data structures?

A linked list is considered both linear and non-linear data structure depending upon the situation.

- On the basis of data storage, it is considered as a non-linear data structure.
- On the basis of the access strategy, it is considered as a linear data-structure.

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**23) What are the advantages of Linked List over an array?**

- The size of a linked list can be incremented at runtime which is impossible in the case of the array.
- The List is not required to be contiguously present in the main memory, if the contiguous space is not available, the nodes can be stored anywhere in the memory connected through the links.
- The List is dynamically stored in the main memory and grows as per the program demand while the array is statically stored in the main memory, size of which must be declared at compile time.
- The number of elements in the linked list are limited to the available memory space while the number of elements in the array is limited to the size of an array.

**24) Write the syntax in C to create a node in the singly linked list.**

```
1 struct node
2 {
3     int data;
4     struct node *next;
5 };
6 struct node *head, *ptr;
7 ptr = (struct node *)malloc(sizeof(struct node));
```

**25) If you are using C language to implement the heterogeneous linked list, what pointer type should be used?**

The heterogeneous linked list contains different data types, so it is not possible to use ordinary pointers for this. For this purpose, you have to use a generic pointer type like void pointer because the void pointer is capable of storing a pointer to any type.

**26) What is doubly linked list?**

The doubly linked list is a complex type of linked list in which a node contains a pointer to the previous as well as the next node in the sequence. In a doubly linked list, a node consists of three parts:

- node data
- pointer to the next node in sequence (next pointer)
- pointer to the previous node (previous pointer).

**27) Write the C program to insert a node in circular singly list at the beginning.**

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```
1 #include<stdio.h>
2 #include<stdlib.h>
3 void beg_insert(int);
4 struct node
5 {
6     int data;
7     struct node *next;
8 };
9 struct node *head;
10 void main ()
11 {
12     int choice,item;
13     do
14     {
15         printf("\nEnter the item which you want to insert?\n");
16         scanf("%d",&item);
17         beg_insert(item);
18         printf("\nPress 0 to insert more ?\n");
19         scanf("%d",&choice);
20     }while(choice == 0);
21 }
22 void beg_insert(int item)
23 {
24
25     struct node *ptr = (struct node *)malloc(sizeof(struct node));
26     struct node *temp;
27     if(ptr == NULL)
28     {
29         printf("\nOVERFLOW");
30     }
31     else
32     {
33         ptr -> data = item;
34         if(head == NULL)
35         {
36             head = ptr;
37             ptr -> next = head;
```

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```
38     }
39     else
40     {
41         temp = head;
42         while(temp->next != head)
43             temp = temp->next;
44         ptr->next = head;
45         temp -> next = ptr;
46         head = ptr;
47     }
48     printf("\nNode Inserted\n");
49 }
50
51 }
52
```

### 28) Define the queue data structure.

A queue can be defined as an ordered list which enables insert operations to be performed at one end called REAR and delete operations to be performed at another end called FRONT.

### 29) List some applications of queue data structure.

The Applications of the queue is given as follows:

- Queues are widely used as waiting lists for a single shared resource like a printer, disk, CPU.
- Queues are used in the asynchronous transfer of data (where data is not being transferred at the same rate between two processes) for eg. pipes, file IO, sockets.
- Queues are used as buffers in most of the applications like MP3 media player, CD player, etc.
- Queues are used to maintain the playlist in media players to add and remove the songs from the play-list.
- Queues are used in operating systems for handling interrupts.

### 30) What are the drawbacks of array implementation of Queue?

- **Memory Wastage:** The space of the array, which is used to store queue elements, can never be reused to store the elements of that queue because the elements can only be inserted at front end and the value of front might be so high so that, all the space before that, can never be filled.

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- **Array Size:** There might be situations in which, we may need to extend the queue to insert more elements if we use an array to implement queue, It will almost be impossible to extend the array size, therefore deciding the correct array size is always a problem in array implementation of queue.

31) What are the scenarios in which an element can be inserted into the circular queue?

- If  $(\text{rear} + 1) \% \text{maxsize} = \text{front}$ , the queue is full. In that case, overflow occurs and therefore, insertion can not be performed in the queue.
- If  $\text{rear} \neq \text{max} - 1$ , the rear will be incremented to the  $\text{mod}(\text{maxsize})$  and the new value will be inserted at the rear end of the queue.
- If  $\text{front} \neq 0$  and  $\text{rear} = \text{max} - 1$ , it means that queue is not full therefore, set the value of rear to 0 and insert the new element there.

32) What is a dequeue?

Deque (also known as double-ended queue) can be defined as an ordered set of elements in which the insertion and deletion can be performed at both the ends, i.e. front and rear.

33) What is the minimum number of queues that can be used to implement a priority queue?

Two queues are needed. One queue is used to store the data elements, and another is used for storing priorities.

34) Define the tree data structure.

The Tree is a recursive data structure containing the set of one or more data nodes where one node is designated as the root of the tree while the remaining nodes are called as the children of the root. The nodes other than the root node are partitioned into the nonempty sets where each one of them is to be called sub-tree.

35) List the types of tree.

There are six types of tree given as follows.

- General Tree
- Forests
- Binary Tree
- Binary Search Tree
- Expression Tree
- Tournament Tree

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### 36) What are Binary trees?

A binary Tree is a special type of generic tree in which, each node can have at most two children. Binary tree is generally partitioned into three disjoint subsets, i.e. the root of the node, left sub-tree and Right binary sub-tree.

### 37) Write the C code to perform in-order traversal on a binary tree.

```
1 void in-order(struct treenode *tree)
2 {
3     if(tree != NULL)
4     {
5         in-order(tree-> left);
6         printf("%d", tree-> root);
7         in-order(tree-> right);
8     }
9 }
```

### 38) What is the maximum number of nodes in a binary tree of height k?

$2^{k+1}-1$  where  $k \geq 1$

### 39) Which data structure suits the most in the tree construction?

Queue data structure

### 40) Which data structure suits the most in the tree construction?

Queue data structure

### 41) Write the recursive C function to count the number of nodes present in a binary tree.

```
1 int count (struct node* t)
2 {
3     if(t)
4     {
5         int l, r;
6         l = count(t->left);
7         r=count(t->right);
8         return (1+l+r);
9     }
10     else
```

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```
11     {
12         return 0;
13     }
14 }
```

42) Write a recursive C function to calculate the height of a binary tree.

```
1 int countHeight(struct node* t)
2 {
3     int l,r;
4     if(!t)
5         return 0;
6     if((!(t->left)) && !(t->right))
7         return 0;
8     l=countHeight(t->left);
9     r=countHeight(t->right);
10    return (1+((l>r)?l:r));
11 }
```

43) How can AVL Tree be useful in all the operations as compared to Binary search tree?

AVL tree controls the height of the binary search tree by not letting it be skewed. The time taken for all operations in a binary search tree of height  $h$  is  $O(h)$ . However, it can be extended to  $O(n)$  if the BST becomes skewed (i.e. worst case). By limiting this height to  $\log n$ , AVL tree imposes an upper bound on each operation to be  $O(\log n)$  where  $n$  is the number of nodes.

44) State the properties of B Tree.

A B tree of order  $m$  contains all the properties of an  $M$  way tree. In addition, it contains the following properties.

- Every node in a B-Tree contains at most  $m$  children.
- Every node in a B-Tree except the root node and the leaf node contain at least  $m/2$  children.
- The root nodes must have at least 2 nodes.
- All leaf nodes must be at the same level.

45) What are the differences between B tree and B+ tree?

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SN	B Tree	B+ Tree
1	Search keys cannot repeatedly be stored.	Redundant search keys
2	Data can be stored in leaf nodes as well as internal nodes	Data can only be stored in leaf nodes
3	Searching for some data is a slower process since data can be found on internal nodes as well as on the leaf nodes.	Searching is comparatively faster as it only searches on the leaf nodes.
4	Deletion of internal nodes is so complicated and time-consuming.	Deletion will never be complicated as it will always be deleted from the leaf nodes.
5	Leaf nodes cannot be linked together.	Leaf nodes are linked together, making the search more efficient.

**46) List some applications of Tree-data structure?**

Applications of Tree- data structure:

- The manipulation of Arithmetic expression,
- Symbol Table construction,
- Syntax analysis
- Hierarchical data model

**47) Define the graph data structure?**

A graph  $G$  can be defined as an ordered set  $G(V, E)$  where  $V(G)$  represents the set of vertices and  $E(G)$  represents the set of edges which are used to connect these vertices. A graph can be seen as a cyclic tree, where the vertices (Nodes) maintain any complex relationship among them instead of having parent-child relations.

**48) Differentiate among cycle, path, and circuit?**

- **Path:** A Path is the sequence of adjacent vertices connected by the edges with no restrictions.
- **Cycle:** A Cycle can be defined as the closed path where the initial vertex is identical to the end vertex. Any vertex in the path can not be visited twice
- **Circuit:** A Circuit can be defined as the closed path where the initial vertex is identical to the end vertex. Any vertex may be repeated.

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49) Mention the data structures which are used in graph implementation.

For the graph implementation, following data structures are used.

- In sequential representation, Adjacency matrix is used.
- In Linked representation, Adjacency list is used.

50) Which data structures are used in BFS and DFS algorithm?

- In BFS algorithm, Queue data structure is used.
- In DFS algorithm, Stack data structure is used.

51) What are the applications of Graph data structure?

The graph has the following applications:

- Graphs are used in circuit networks where points of connection are drawn as vertices and component wires become the edges of the graph.
- Graphs are used in transport networks where stations are drawn as vertices and routes become the edges of the graph.
- Graphs are used in maps that draw cities/states/regions as vertices and adjacency relations as edges.
- Graphs are used in program flow analysis where procedures or modules are treated as vertices and calls to these procedures are drawn as edges of the graph.

54) In what scenario, Binary Search can be used?

Binary Search algorithm is used to search an already sorted list. The algorithm follows divide and conquer approach

**Example:**

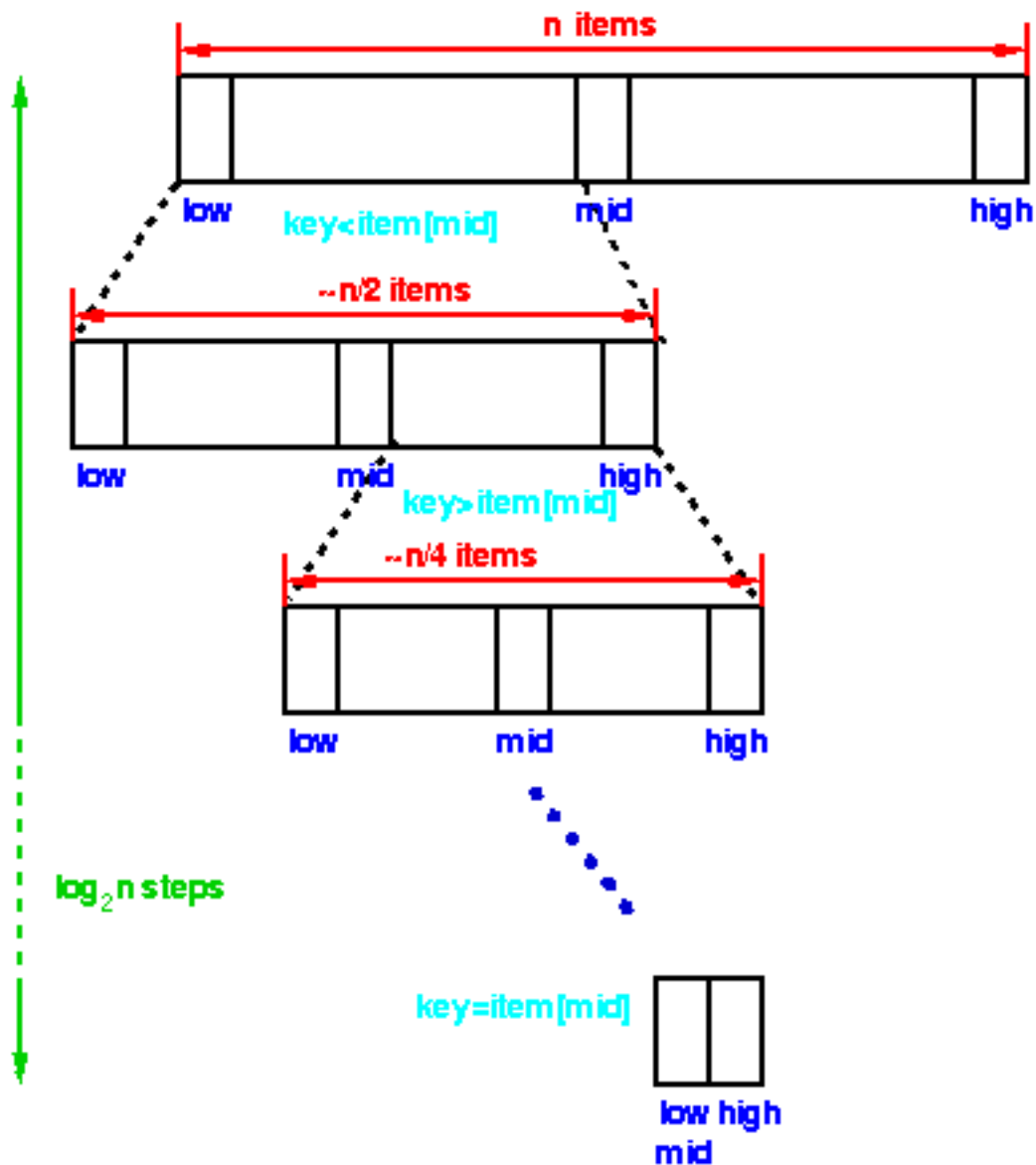
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52) What are the advantages of Binary search over linear search?

There are relatively less number of comparisons in binary search than that in linear search. In average case, linear search takes  $O(n)$  time to search a list of  $n$  elements while Binary search takes  $O(\log n)$  time to search a list of  $n$  elements.

53) What are the advantages of Selection Sort?

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- It is simple and easy to implement.
- It can be used for small data sets.
- It is 60 per cent more efficient than bubble sort.

**55) List Some Applications of Multilinked Structures?**

- Sparse matrix,
- Index generation.

**56) What is the difference between NULL and VOID?**

- Null is actually a value, whereas Void is a data type identifier.
- A null variable simply indicates an empty value, whereas void is used to identify pointers as having no initial size.

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