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.

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?

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?

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?

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?

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.

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 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.

51) What are linear and non-linear data Structures?

- **Linear:** A data structure is said to be linear if its elements form a sequence or a linear list. Examples: Array. Linked List, Stacks and Queues
- **Non-Linear:** A data structure is said to be non-linear if the traversal of nodes is nonlinear in nature. Example: Graph and Trees.

52) What are the various operations that can be performed on different Data Structures?

- **Insertion** ? Add a new data item in the given collection of data items.
- **Deletion** ? Delete an existing data item from the given collection of data items.
- **Traversal** ? Access each data item exactly once so that it can be processed.
- **Searching** ? Find out the location of the data item if it exists in the given collection of data items.

- **Sorting** ? Arranging the data items in some order i.e. in ascending or descending order in case of numerical data and in dictionary order in case of alphanumeric data.

53) **How is an Array different from Linked List?**

- The size of the arrays is fixed, Linked Lists are Dynamic in size.
- Inserting and deleting a new element in an array of elements is expensive, Whereas both insertion and deletion can easily be done in Linked Lists.
- Random access is not allowed in Linked Listed.
- Extra memory space for a pointer is required with each element of the Linked list.
- Arrays have better cache locality that can make a pretty big difference in performance.

54) What is Stack and where it can be used?

Stack is a linear data structure which the order LIFO(Last In First Out) or FILO(First In Last Out) for accessing elements. Basic operations of the stack are: **Push, Pop, Peek**

Applications of Stack:

1. Infix to Postfix Conversion using Stack
2. Evaluation of Postfix Expression
3. Reverse a String using Stack
4. Implement two stacks in an array
5. Check for balanced parentheses in an expression

55) What is a Queue, how it is different from the stack and how is it implemented?

Queue is a linear structure that follows the order is **F**irst **I**n **F**irst **O**ut (FIFO) to access elements. Mainly the following are basic operations on queue: **Enqueue, Dequeue**, **Front, Rear**

The difference between stacks and queues is in removing. In a stack we remove the item the most recently added; in a queue, we remove the item the least recently added. Both Queues and Stacks can be implemented using Arrays and Linked Lists.

56) **What are Infix, prefix, Postfix notations?**

- **Infix notation:** X **+** Y – Operators are written in-between their operands. This is the usual way we write expressions. An expression such as
  `A * ( B + C ) / D`

- **Postfix notation (also known as “Reverse Polish notation”):** X Y **+** Operators are written after their operands. The infix expression given above is equivalent to
  `A B C + * D/`
- **Prefix notation (also known as “Polish notation”):** + X Y Operators are written before their operands. The expressions given above are equivalent to
  `/ * A + B C D`

57) What is a Linked List and What are its types?
A linked list is a linear data structure (like arrays) where each element is a separate object. Each element (that is node) of a list is comprising of two items – the data and a reference to the next node. Types of Linked List :

1. **Singly Linked List :** In this type of linked list, every node stores address or reference of next node in list and the last node has next address or reference as NULL. For example 1->2->3->4->NULL
2. **Doubly Linked List :** Here, here are two references associated with each node, One of the reference points to the next node and one to the previous node. Eg. NULL<-1<->2<->3->NULL
3. **Circular Linked List :** Circular linked list is a linked list where all nodes are connected to form a circle. There is no NULL at the end. A circular linked list can be a singly circular linked list or doubly circular linked list. Eg. 1->2->3->1 [The next pointer of last node is pointing to the first]

58) Which data structures are used for BFS and DFS of a graph?
- Queue is used for BFS
- Stack is used for DFS. DFS can also be implemented using recursion (Note that recursion also uses function call stack).

59) Can doubly linked be implemented using a single pointer variable in every node?
Doubly linked list can be implemented using a single pointer. See XOR Linked List – A Memory Efficient Doubly Linked List

60) How to implement a stack using queue?
A stack can be implemented using two queues. Let stack to be implemented be ‘s’ and queues used to implement be ‘q1’ and ‘q2’. Stack ‘s’ can be implemented in two ways:
- Method 1 (By making push operation costly)
- Method 2 (By making pop operation costly)

61) How to implement a queue using stack?
A queue can be implemented using two stacks. Let queue to be implemented be q and stacks used to implement q be stack1 and stack2. q can be implemented in two ways:

- Method 1 (By making enQueue operation costly)
- Method 2 (By making deQueue operation costly)

62) Which Data Structure Should be used for implementing LRU cache?

We use two data structures to implement an LRU Cache.

1. **Queue** which is implemented using a doubly linked list. The maximum size of the queue will be equal to the total number of frames available (cache size). The most recently used pages will be near rear end and least recently pages will be near front end.
2. **A Hash** with page number as key and address of the corresponding queue node as value.
3.

63) How to check if a given Binary Tree is BST or not?
If inorder traversal of a binary tree is sorted, then the binary tree is BST. The idea is to simply do inorder traversal and while traversing keep track of previous key value. If current key value is greater, then continue, else return false.

64 Linked List Questions

- Linked List Insertion
- Linked List Deletion
- middle of a given linked list
- Nth node from the end of a Linked List

65 Tree Traversal Questions

- Inorder
- Preorder and Postoder Traversals
- Level order traversal
- Height of Binary Tree

1. What is data-structure? What are various data-structures available?
2. What is linear data structure?
3. What are common operations that can be performed on a data-structure?
4. What is a linked-list?
5. What is stack?
6. Why do we use stacks?
7. What operations can be performed on stacks?
8. What is a queue in data-structure?
9. Why do we use queues?
10. What operations can be performed on Queues?
11. What is linear searching?
12. What is binary search?
13. What is bubble sort and how bubble sort works?
14. Tell me something about 'insertion sort'?
15. What is selection sort?
16. How insertion sort and selection sorts are different?
17. What is a graph?
18. What is a tree?
19. What is a binary tree?
20. What is a binary search tree?
21. What is tree traversal?
22. What is an AVL Tree?
23. What is a spanning tree?
24. How many spanning trees can a graph has?
25. What is a minimum spanning tree (MST)?
26. What is a recursive function?
27. What is fibonacci series?