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. **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

3. **What are the major data structures used in the following areas**: RDBMS, Network data model & Hierarchical data model.
   - RDBMS – Array (i.e. Array of structures)
   - Network data model – Graph
   - Hierarchical data model – Trees

4. **If you are using C language to implement the heterogeneous linked list, what pointer type will you use?**
   The heterogeneous linked list contains different data types in its nodes and we need a link, pointer to connect them. It is not possible to use ordinary pointers for this. So we go for void pointer. Void pointer is capable of storing pointer to any type as it is a generic pointer type.

5. **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.

6. **What is the data structures used to perform recursion?**
   Stack. Because of its LIFO (Last In First Out) property it remembers its ‘caller’ so knows whom to return when the function has to return. Recursion makes use of system stack for storing the return addresses of the function calls. *Every recursive function has its equivalent iterative (non-recursive) function.* Even when such equivalent iterative procedures are written, explicit stack is to be used.

7. **What are the notations used in Evaluation of Arithmetic Expressions using prefix and postfix forms?**
   Polish and Reverse Polish notations.

8. **Convert the expression ((A + B) * C – (D – E) ^ (F + G)) to equivalent Prefix and Postfix notations.**
Prefix Notation:  ^ - * +ABC - DE + FG
Postfix Notation:  AB + C * DE - - FG + ^

9. Sorting is not possible by using which of the following methods?
   (a) Insertion      (b) Selection      (c) Exchange       (d) Deletion
   (d) Deletion.
   Using insertion we can perform insertion sort, using selection we can perform selection sort, using exchange we can perform the bubble sort (and other similar sorting methods). But no sorting method can be done just using deletion.

10. A binary tree with 20 nodes has _____ null branches?
    21
    Let us take a tree with 5 nodes (n=5)

It will have only 6 (ie,5+1) null branches. In general,
   A binary tree with $n$ nodes has exactly $n+1$ null nodes.

11. What are the methods available in storing sequential files?
   ➢ Straight merging,       Natural merging,
   ➢ Polyphase sort,         Distribution of Initial runs.

12. How many different trees are possible with 10 nodes?
    1014
    For example, consider a tree with 3 nodes(n=3), it will have the maximum combination of 5 different (ie, $2^3 - 3 = 5$) trees.
In general:
If there are \( n \) nodes, there exist \( 2^n - n \) different trees.

13. List out few of the Application of tree data-structure?
- The manipulation of Arithmetic expression,
- Symbol Table construction,
- Syntax analysis.

14. List out few of the applications that make use of Multilinked Structures?
- Sparse matrix, Index generation.

15. In tree construction which is the suitable efficient data structure?
(a) Array       (b) Linked list       (c) Stack       (d) Queue       (e) none
(b) Linked list

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

17. In an AVL tree, at what condition the balancing is to be done?
If the ‘pivotal value’ (or the ‘Height factor’) is greater than 1 or less than –1.

18. What is the bucket size, when the overlapping and collision occur at same time?
One. If there is only one entry possible in the bucket, when the collision occurs, there is no way to accommodate the colliding value. This results in the overlapping of values.

19. Traverse the given tree using Inorder, Preorder and Postorder traversals.

Given tree:
20. There are 8, 15, 13, 14 nodes were there in 4 different trees. Which of them could have formed a full binary tree?

In general:
There are $2^n - 1$ nodes in a full binary tree.

By the method of elimination:
Full binary trees contain odd number of nodes. So there cannot be full binary trees with 8 or 14 nodes, so rejected. With 13 nodes you can form a complete binary tree but not a full binary tree. So the correct answer is 15.

Note:
Full and Complete binary trees are different. All full binary trees are complete binary trees but not vice versa.

21. In the given binary tree, using array you can store the node 4 at which location?

```
          1
         / \
        2   3
      /     \
     4      5
```

```
1  2   3  -  -  4  -  -  5
```

Root  LC1  RC1  LC2  RC2  LC3  RC3  LC4  RC4

where LCn means Left Child of node n and RCn means Right Child of node n
22. Sort the given values using Quick Sort?

Sorting takes place from the pivot value, which is the first value of the given elements, this is marked bold. The values at the left pointer and right pointer are indicated using \( L \) and \( R \) respectively.

\[
\begin{array}{cccccccccc}
65 & 70 & 75 & 80 & 85 & 60 & 55 & 50 & 45 \\
\end{array}
\]

Since pivot is not yet changed the same process is continued after interchanging the values at \( L \) and \( R \) positions

\[
\begin{array}{cccccccccc}
65 & 45 & 75^L & 80 & 85 & 60 & 55 & 50^R & 70 \\
65 & 45 & 50 & 80^L & 85 & 60 & 55^R & 75 & 70 \\
65 & 45 & 50 & 55 & 85^L & 60^R & 80 & 75 & 70 \\
65 & 45 & 50 & 55 & 60^R & 85^L & 80 & 75 & 70 \\
\end{array}
\]

When the \( L \) and \( R \) pointers cross each other the pivot value is interchanged with the value at right pointer. If the pivot is changed it means that the pivot has occupied its original position in the sorted order (shown in bold italics) and hence two different arrays are formed, one from start of the original array to the pivot position-1 and the other from pivot position+1 to end.

\[
\begin{array}{cccccccccc}
60^L & 45 & 50 & 55^R & 65 & 85^L & 80 & 75 & 70^R \\
55^L & 45 & 50^R & 60 & 65 & 70^R & 80^L & 75 & 85 \\
50^L & 45^R & 55 & 60 & 65 & 70 & 80^L & 75^R & 85 \\
\end{array}
\]

In the next pass we get the sorted form of the array.

\[
\begin{array}{cccccccccc}
45 & 50 & 55 & 60 & 65 & 70 & 75 & 80 & 85 \\
\end{array}
\]
Merge Sort

Merge-sort is based on the divide-and-conquer paradigm. The Merge-sort algorithm can be described in general terms as consisting of the following three steps:

1. **Divide Step**
   
   If given array $A$ has zero or one element, return $S$; it is already sorted. Otherwise, divide $A$ into two arrays, $A_1$ and $A_2$, each containing about half of the elements of $A$.

2. **Recursion Step**

   Recursively sort array $A_1$ and $A_2$.

3. **Conquer Step**

   Combine the elements back in $A$ by merging the sorted arrays $A_1$ and $A_2$ into a sorted sequence.

We can visualize Merge-sort by means of binary tree where each node of the tree represents a recursive call and each external nodes represent individual elements of given array $A$. Such a tree is called Merge-sort tree. The heart of the Merge-sort algorithm is conquer step, which merge two sorted sequences into a single sorted sequence.
23. For the given graph, draw the DFS and BFS?

The given graph:

- **BFS:** A X G H P E M Y J
- **DFS:** A X H P E Y M J G

24. Classify the Hashing Functions based on the various methods by which the key value is found.
- Direct method,
- Subtraction method,
- Modulo-Division method,
- Digit-Extraction method,
- Mid-Square method,
- Folding method,
- Pseudo-random method.

25. 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…

26. 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.

27. Draw the B-tree of order 3 created by inserting the following data arriving in sequence – 92 24 6 7 11 8 22 4 5 16 19 20 78

28. Of the following tree structure, which is, efficient considering space and time complexities?
   (a) Incomplete Binary Tree
   (b) Complete Binary Tree
   (c) Full Binary Tree

   (b) Complete Binary Tree.
   By the method of elimination:
Full binary tree loses its nature when operations of insertions and deletions are done. For incomplete binary trees, extra storage is required and overhead of NULL node checking takes place. So complete binary tree is the better one since the property of complete binary tree is maintained even after operations like additions and deletions are done on it.

29. 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.

30. Does the minimum spanning tree of a graph give the shortest distance between any 2 specified nodes?
No. Minimal spanning tree assures that the total weight of the tree is kept at its minimum. But it doesn’t mean that the distance between any two nodes involved in the minimum-spanning tree is minimum.

31. Convert the given graph with weighted edges to minimal spanning tree.

![Graph](image)

the equivalent minimal spanning tree is:

![Minimal Spanning Tree](image)

32. Which is the simplest file structure?
(a) Sequential
(b) Indexed
(c) Random
(a) Sequential

33. 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.

34. Draw a binary Tree for the expression:

\[ A \times B - (C + D) \times (P / Q) \]

\[
\begin{align*}
&- \\
&\times \\
&A \quad B \\
&\times \\
&C \quad D \\
&\div \\
&P \quad Q
\end{align*}
\]

35. For the following COBOL code, draw the Binary tree?

```
01 STUDENT_REC.
   02 NAME.
      03 FIRST_NAME PIC X(10).
      03 LAST_NAME PIC X(10).
   02 YEAR_OF_STUDY.
      03 FIRST_SEM PIC XX.
      03 SECOND_SEM PIC XX.
```
what is binary search, traversal, hashing etc.
given a scenario what is the suitable data structure.
write a code to count the no. of 1's in a binary rep. of a number.
memory taken for char *, int * etc.
char *cp; int *ip; cp++,ip++ - what is the result.
I was asked about stack, queue, linked list, binary tree, b tree
write code for quick sort. what are the various types of sorting.
( selection sort, merge sort, heap sort,)

1) What is a data structure?
2) What does abstract data type means?
3) Evaluate the following prefix expression " ++
    26 + - 1324" (Similar types can be asked)
4) Convert the following infix expression to post fix notation
    ((a+2)*(b+4)) -1 (Similar types can be asked)
5) How is it possible to insert different type of elements in stack?
6) Stack can be described as a pointer. Explain.
7) Write a Binary Search program
8) Write programs for Bubble Sort, Quick sort
9) Explain about the types of linked lists
10) How would you sort a linked list?
11) Write the programs for Linked List (Insertion and Deletion) operations
12) What data structure would you mostly likely see in a non recursive implementation of a recursive algorithm?
13) What do you mean by Base case, Recursive case, Binding Time, Run-Time Stack and Tail Recursion?
14) Explain quick sort and merge sort algorithms and derive the time-constraint relation for these.
15) Explain binary searching, Fibonacci search.
16) What is the maximum total number of nodes in a tree that has N levels? Note that the root is level (zero)
17) How many different binary trees and binary search trees can be made from three nodes that contain the key values 1, 2 & 3?
18) A list is ordered from smaller to largest when a sort is called. Which sort would take the longest time to execute?
19) A list is ordered from smaller to largest when a sort is called. Which sort would take the shortest time to execute?
20) When will you sort an array of pointers to list elements, rather than sorting the elements themselves?
21) The element being searched for is not found in an array of 100 elements. What is the average number of comparisons needed in a sequential search to determine that the element is not there, if the elements are completely unordered?
22) What is the average number of comparisons needed in a sequential search to determine the position of an element in an array of 100 elements, if the elements are ordered from largest to smallest?
23) Which sort show the best average behavior?
24) What is the average number of comparisons in a sequential search?
25) Which data structure is needed to convert infix notations to post fix notations?
26) What do you mean by:
27) Syntax Error
28) Logical Error
29) Runtime Error
30) How can you correct these errors?
31) In which data structure, elements can be added or removed at either end, but not in the middle?
32) How will inorder, preorder and postorder traversals print the elements of a tree?
33) Parenthesis are never needed in prefix or postfix expressions. Why?
34) Which one is faster? A binary search of an ordered set of elements in an array or a sequential search of the elements.

where do you use double linked list. (queing the process in cpu).
write a program to accept name & sort them.
Datastructures esp :Linked list and trees

Construct a doubly linked list using a single pointer in each node