

Paper-1

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- Q.9 Give the post fix notation of the given infix notation. A+B/C-D (CO-4)
- Q.10 Each node of a binary tree can have at most _____ children. (CO-5)

4th Sem. / Trade : Computer Engg.

Subject : Data Structure using C

Time : 3 Hrs.

M.M. : 100

SECTION-A

Note: Objectives questions. All questions are compulsory (10x1=10)

Q.1 The identifier whose value does not change during execution of program is called _____ (CO-1)

→ Q.2 For a linear array A [15, 16, 27, , 25], Find the total number of elements. (CO-2)

Q.3 When the function calls itself it is called _____ (CO-4)

Q.4 Linked list is a _____ data Structure. (CO-3)

Q.5 Node of a linked list contains _____ and _____ parts. (CO-3)

Q.6 Expand the term LIFO _____ (CO-4)

Q.7 Deletion operation in a Stack is called _____ (CO-4)

Q.8 Give an example of sorting method which uses partitioning. (CO-6)

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SECTION-B

- Note:** Very Short answer type questions. Attempt any ten parts 10x2=20

Q.11 Define Algorithm (CO-1)

Q.12 Name any four linear data Structures (CO-1) (CO-3)

Q.13 Define linked list. (CO-2)

Q.14 What are the various operations that can be performed on an Array. (CO-2)

Q.15 Give the formula for calculating the address of an element in column Major form representation of array. (CO-2)

Q.16 Give the node structure of a linked list. (CO-3) (CO-4)

Q.17 Define Queue. (CO-4)

Q.18 Give two applications of a stack. (CO-4)

Q.19 Define Complete Binary Tree. (CO-5)

Q.20 Define Degree of a Tree (CO-5)

Q.21 What is the precondition for performing binary search operation on a given list of elements. (CO-6)

Q.22 What are the advantages of Doubly Linked List. (CO-3)

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SECTION-C

Note: Short answer type questions. Attempt any eight questions.
8x5=40

Q.23 Explain the various types of data structures.
(CO-1)

Q.24 Give five differences between a Array and a
LinkedList.
(CO-2)

Q.25 Explain linear and non linear data structures.
(CO-1)

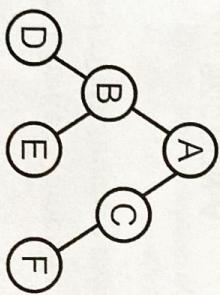
Q.26 Give algorithm for adding a element in the
beginning of the linkedlist.
(CO-3)

Q.27 Define Array. Give algorithm for traversing an
array.
(CO-2)

Q.28 Give algorithm for deleting an element form the
stack.
(CO-4)

Q.29 What is the limitation of a linear queue. How is it
removed.
(CO-4)

Q.30 Give inorder, postorder and preorder traversal
of the following tree.
(CO-5)



Q.31 Give differences between sequential search
and binary search.
(CO-6)

Q.32 Sort the following list of elements using bubble
sort. Show result after each step.
(CO-6)

6 10 2 9 1 5 7

SECTION-D

Note: Long answer type questions. Attempt any three
questions.
3x10=30

Q.33 What are different types of Arrays? Explain how
element of arrays are stored in memory?
(CO-2)

Q.34 Explain Sequential search technique with
suitable example? Give algorithm.
(CO-6)

Q.35 Convert the following expressions into postfix
notation using Stack
(CO-4)

$$A + B * C + D / E - F$$

(CO-1)

Q.36 Write short note on
a) Structured programming
b) Tower of Hanoi

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Section-A

- ① The identifier whose value does not change during execution of program is called constant.
- ② When the function calls itself it is called recursion.
- ③ Linked List is a linear data structure.
- ④ Node of a linked list contains data and link to next node parts.
- ⑤ Expand the term LIFO Last In First Out.
- ⑥ Deletion operation in a Stack is called POP
- ⑦ Give an example of sorting method which uses partitioning.
→ Quicksort
- ⑧ Give the post fix notation of the given infix notation.
 $A + B / C - D \longrightarrow \del{ABC/-D+}$ ABC/+D-
- ⑨ Each node of a binary tree can have at most two children.

Section-B

- ⑩ Define Algorithm.
An algorithm is a process or a set of rules required to perform calculations or some other problem-solving operations especially by a computer.
- ⑪ Name any four linear data structure.
 - Array
 - linked list
 - stack
 - queue

(B) Define linked list.

Linked list can be defined as collection of data elements called nodes that are randomly stored in memory.

structure of node:

| | |
|------|-------------------|
| Data | link of next node |
|------|-------------------|

A node contains two fields:

- data stored at that particular address
- the pointer which contain the address of the next node in the memory.

The last node of the list contains pointer to the null.

(A) What are the various operations that can be performed on an Array.

- Traversal
- Copying
- Reversing
- Sorting
- Insertion
- Deletion
- Searching
- Merging
- ~~Traversed~~.

(C) Give the formula for calculating the address of an element in column Major form representation of array.

$$\text{Address}(a[i][j]) = ((j * m) + 1) * \text{size} + BA$$

Here,

m = no. of rows

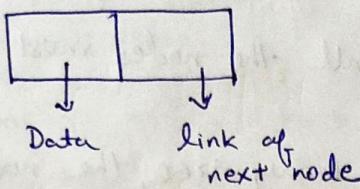
j = no. of columns.

BA = base address of array.

size = weight of a datatype.

⑥ Give the node structure of a linked list.

Structure of node of linked list:



A node contains 2 fields:

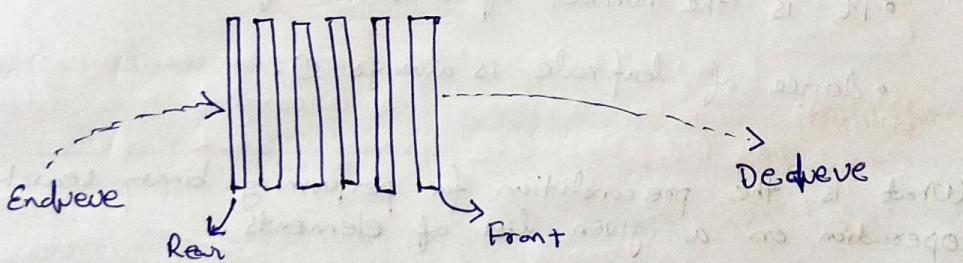
- data stored at that particular address
- the pointer which contain the address of the next node in the memory.

The last node of the list contains pointer to the null.

⑦ Define queue.

A queue is a linear data structure which follows a particular order in which the operations are performed.

- The order is FIFO.
- Insertion ~~and~~ and deletion happens at both ends.



⑧ Give two applications of stack.

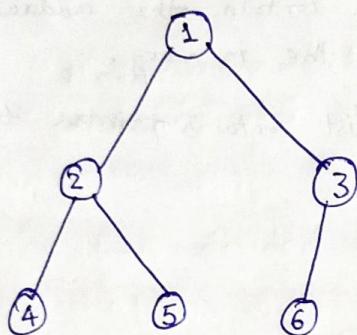
- Stack can be used for backtracking.
- It can be also used to convert one form of expression to another form.
- Reverse a data
- Processing Function calls.

⑯ Define complete binary tree.

The complete binary tree is a tree in which all the nodes are completely filled except the last level.

In last level, all the nodes must be as left as possible.

In a complete binary tree, the node must be added from the left.



⑰ Define degree of a tree.

The degree of a tree is the maximum degree of a node among all the nodes in the tree.

- It is the number of subtrees of a node.

- degree of leaf node is always 0.

⑱ What is the precondition for performing binary search operation on a given list of elements.

The precondition for performing binary search operation on a given list of elements is that the array should be sorted.

(22) What are the advantages of Doubly linked list.

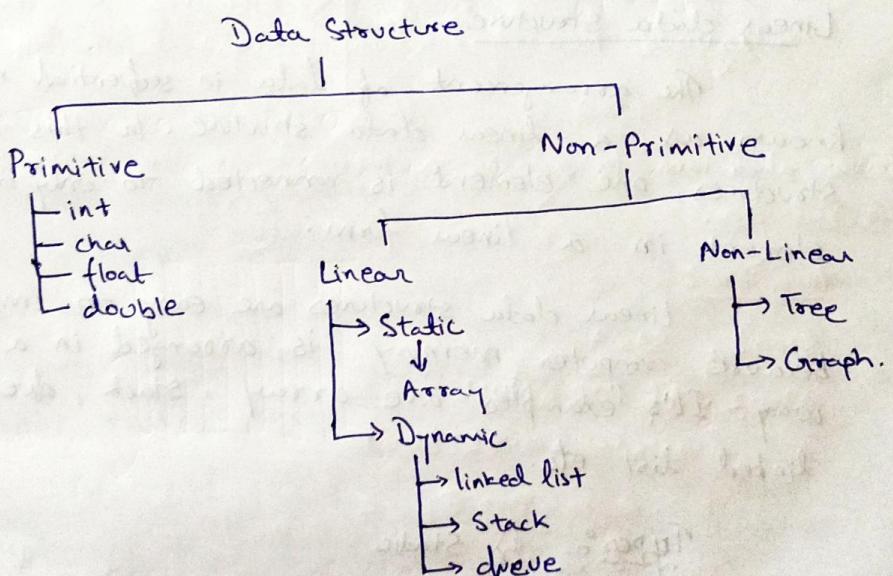
Advantages of doubly linked list are:-

- It allows traversing in both forward and backward directions.
- Deletion of nodes can be done easily.
- Reversing of linked list is easy.
- Insertion can be performed efficiently at any node.

Section-C

(23) Explain the various types of data structures.

Various types of data structures:



There are two types of data structures:-

- o Primitive data structure
- o Non- Primitive data structure .

o Primitive Data Structure

The primitive data structure are primitive data types. Primitive data structure are basic data structures that are directly operate upon the machine instructions.

They have different representations on different computers. The int, char, float, double and pointer are the primitive data structures that can hold a single value.

o Non-Primitive Data Structure

Non-primitive data structures are more complicated data structures and are derived from primitive data structures.

It is divided into two types.

- Linear data structure
- Non-linear data structure

Linear data structure

The arrangement of data in sequential manner is known as a linear data structure. In this data structures, one element is connected to only one another element in a linear form.

Linear data structures are easy to implement because computer memory is arranged in a linear way. Its examples are array, stack, queue, linked list, etc.

- Types :-
- i) Static
 - ii) Dynamic

Static data structure -

It is a type of data structure where the size is allocated at the compile time. In the static data structure the size of the structure is fixed.

The content of data structure can be modified but without changing the memory space allocated to it. Therefore, the maximum size is fixed.

Eg. - array.

Dynamic data structure -

It is a type of data structure where the size is allocated at run-time. In dynamic data structure the size of the structure is not fixed and can be modified during operations performed on it. Dynamic data structure are designed to facilitate change of data structures in the run time. Therefore, the maximum size is flexible.

Eg. - linked list, queue, stack.

Non Linear data Structure:

Data structures ~~where~~ where data elements are not arranged sequentially or linearly are called as non-linear data structures. In a non-linear data structure, single level is not involved. Therefore, we cannot traverse all the elements in single run only.

Non-linear data structure are not easy to implement in comparison to linear data structure. It utilizes computer memory efficiently in comparison to a linear data structure.

Eg. - trees, graphs.

(24) Give five differences between an Array and a linked list.

Difference b/w an Array and a linked list are as follows:

Array

- 1) Size of an Array is fixed
- 2) It is a collection of similar datatypes.
- 3) Memory is allocated from stack.
- 4) It works with static data structure.
- 5) Elements are stored in contiguous memory locations.

Linked list

- 1) Size of a linked list is not fixed.
- 2) It is a collection of nodes.
- 3) Memory is allocated from heap.
- 4) It works with linear data structure.
- 5) Elements can be stored anywhere in the memory.

(25) Give algorithm for adding an element in the beginning of the linked list.

Algorithm:

Step 1. Start

Step 2. If PTR = NULL
Write, OVERFLOW

Go to Step 8

(End of if)

Step 3. Set NewNode = PTR

Step 4. Set PTR = PTR → NEXT

Step 5. Set NewNode → Data = VAL

Step 6. Set NewNode → Next = HEAD

Step 7. Set HEAD = NewNode

Step 8. End.

(27) Define Array. Give algorithm for traversing an array.

An array is a container object that holds a fixed number of values of a single type. The length of an array is established when the array is created. After creation, its length is fixed.

It has two types:-

→ ~~one~~ single dimensional array

→ multi dimensional array.

Algorithm for traversing an array:

Step 1. Start

Step 2. [Initialize] counter i = lower bound index

Step 3. Repeat step 4 and 5 while $i <$ upper bound.

Step 4. Apply the specified operation on $A[i]$

Step 5. Increment counter: $i = i + 1$.

[Loop Ends]

Step 6. Exit.

(28) Give algorithm for deleting an element from the stack.

Algorithm:

Step 1. Start

Step 2. If $\text{Top} = \text{Null}$.

Print "Underflow" and exit.

Step 3. Set item = $\text{Stack}[\text{top}]$

Step 4. Set $\text{top} = \text{top} - 1$.

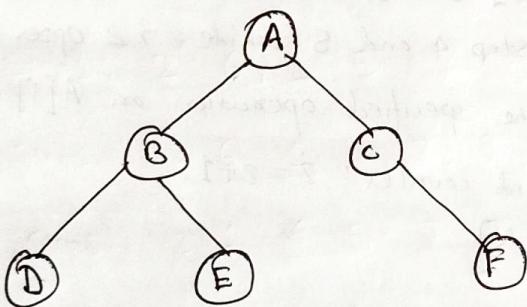
Step 5. Stop.

(29) What is the limitations of a linear queue. How is it removed?

The limitation of linear queue is that insertion is done only from the rear end. If the 1st three elements are deleted from the queue. We cannot insert more elements even though the space is available in the linear queue. In this, linear queue show the overflow condition as rear is pointing to the last element.

This limitation is overcome by using circular queue. If the empty space is available in a circular queue. The new element can be added in an empty space by simply incrementing the value of rear.

(30) Give inorder, post order and pre order traversal of the following tree.



In-order - DBEACF

Pre-order - ABD ECF

Post-order - DEBFCA

⑧ Give difference between sequential search and binary search.

Difference between sequential search and binary search are as follows:

Sequential Search

- ① Records are search sequentially.
- ② Simple method for searching.
- ③ Can applied on sorted or unsorted data.
- ④ Also called linear search.
- ⑤ Time complexity is $O(N)$.

Binary Search

- ① Records are partitioned in two parts and it is compared with middle key value.
- ② Fast and efficient method for searching.
- ③ Can applied only on sorted data.
- ④ Also called half interval search.
- ⑤ Time complexity is $O(\log 2N)$.

⑨ Sort the following list of elements using bubble sort. Show result after each step.

6 10 2 9 1 5 7.

Part 1

Step 1. 6 10 2 9 1 5 7

Step 2. 6 10 2 9 1 5 7

Step 3. 6 2 10 9 1 5 7

Step 4. 6 2 9 10 1 5 7

Step 5. 6 2 9 1 10 5, 7

Step 6. 6 2 9 1 5 10 7.

Step 7. 6 2 9 1 5 7 10

Pars 2

Step 1. 6 2, 9 1 5 7 10

Step 2. 2 6 9 1 5 7 10

Step 3. 2 6 9 1, 5 7 10

Step 4. 2 6 1 9 5, 7 10

Step 5. 2 6 1 5 9 7, 10

Step 6. 2 6 1 5 7 9 10,

Step 7. 2 6 1 5 7 9 10

Pars 3

Step 1. 2 6 1 5 7 9 10

Step 2. 2 6 1, 5 7 9 10

Step 3. 2 1 6 5, 7 9 10

Step 4. 2 1 5 6 7, 9 10

Step 5. 2 1 5 6 7 9, 10

Step 6. 2 1 5 6 7 9 10,

Step 7. 2 1 5 6 7 9 10

Pars 4

Step 1. 2 1, 5 6 7 9 10

Step 2. 1 2 5, 6 7 9 10

Step 3. 1 2 5 6, 7 9 10

Step 4. 1 2 5 6 7, 9 10

Step 5. 1 2 5 6 7 9 10

Step 6. 1 2 5 6 7 9 10

Step 7. 1 2 5 6 7 9 10

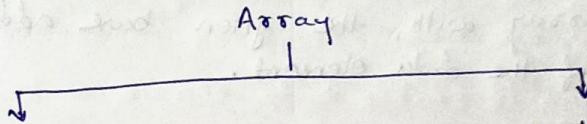
After, sorting the list through bubble sort,
the result is—

1 2 5 6 7 9 10

Section-D

- (33) What are the different types of Arrays? Explain how elements of array are stored in memory.

Types of Array:



Single dimensional Array

Single dimensional arrays are used to store list of values of same datatype. In other words, these are used to store a ~~single~~ row/column of values. In single dimensional array, data is stored in linear form. They are also called One dimensional array.

Multi-dimensional array

An array of arrays is called as multi-dimensional array. In simple words, an array is created with more than one dimension is called as multi-dimensional array. Multi-dimensional array can be of two dimensional array or three dimensional array or four dimensional array or more.

Element of array stored in memory:

- Each element of an array is of same data type and carries the same size.
- Elements of array are stored at contiguous memory locations where the first element is stored at the smallest memory location.
- Elements of array can be randomly accessed since we can calculate the address of each element of the array with the given base address and the size of the data element.

(Q) Explain Sequential search technique with suitable example - give algorithm.

Linear search is a simplest algorithm and often called sequential search.

In this type of searching we simply traverse the list completely and match each element of the list with the item whose location is to be found.

If the match found then location of the item ~~and~~ is returned ~~otherwise~~ otherwise the algorithm returns NULL

Algorithm for linear Search:

LinearSearch (A, N, VAL)

Step 1. Start

Step 2. SET POS = 0

Step 3. SET I = 0

Step 4. Repeat step 5 while $I \leq N$

Step 5. If $A[I] = VAL$

 SET POS = $I + 1$

 PRINT POS

 Go to step 7.

(End of if)

 SET $I = I + 1$.

(End of loop)

Step 6. If $POS = 0$

 Point ("Value is not present in the list")

(End of if)

Step 7. End.

(35) Write a short note on structured programming.

Structured programming is a programming paradigm that facilitates the creation of programs with readable code and reusable components.

A structured program can be developed by using four basic control structures.

- Sequential
- Conditional
- Repetition
- Procedures.

Sequential - These structure composed of statements executed one after another. There is only one entry point and one exit point.

Conditional - It is also known as selection structure. In this statements are executed depending on certain condition.

Repetitive - It repeat a set of statements while certain conditions are met.

Procedure - It enables us to replace a set of statements with a single statement.

It uses one of two approaches:

Top Down Approach

Bottom up Approach.

Top Down Approach -

A "top-down" approach is where an executive decision maker or other top person makes the decisions of how something should be done.

Bottom up Approach -

A bottom-up approach is a way of making corporate decisions that starts from the bottom of hierarchy, rather than at the top.

- ③ Convert the following expressions into postfix notation using Stack.

$$A + B * C + D / E - F$$

| Expression | Stack | Output |
|------------|-------|--------------------|
| A | Empty | A |
| + | + | A |
| B | + | AB |
| * | +* | AB@ |
| C | +* | ABC ABC |
| + | + | ABC*+ |
| D | + | ABC*+D |
| / | +/ | ABC*+D |
| E | +/ | ABC*+DE |
| - | +- | ABC*+DE/ |
| F | +- | ABC*+DE/F |
| | | ABC*+DE/FT- |