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-: OBJECTIVE :-

1. Understanding of the basic Concepts of data structure and their operations like, insertion, deletion, searching and sorting.

2. Design algorith and pseudo Codes of various linear and non- linear data structures.

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UNIT-1

Qus-1 What is the difference between linear and non-linear data Structures? Explain with suitable example

Ans- Linear Data structure - Data structure where data elements are arranged sequentially or linearly where each and every element is attached to its previous and next adjacent is called a linear data structure. In linear data structure, single level is involved.
Example - array, stack, queue, linked list.

1. Array - The array is a type of data structure that stores elements of the same type.

2. Stack - The data structure follows the rule of LIFO (Last in First Out) where the data last added element is removed first.

Non-Linear Data structure - Data structures where data elements are not arranged sequentially or linearly are called non-linear data structures. In a non-linear data structure, single level is not involved.
Example - trees and graph

1. Trees - A tree data structure consists of various nodes linked together.

2. Graph - Graphs are those types of non-linear data structure which consist of a definite quantity of ~~various~~ vertices and edges

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Que-2 What are arrays and why are they need? How is an array represent in money?

Ans- An array is a block of money that holds N element of a given type. If the type is an integer, it will take 4 bytes to store each element. If the array Contains (or has space for) 10 integers, the array will occuby a space of 40 bytes in memory. The 40 bytes are sequential (all in a big block, and not spread out).

Array are a simple Collection of data, which is useful when we deal with many data items of the same kind,

The array.Values () function is an inbuilt function in Java script which is used to returns a new array Iterator object that Contains the Values for each index in the array.

Que-3 Explain the terms infix expression, prefix expression and postfix expression Convert the following infix expression to their postfix expressions.

a $A-B+C$ (b) $(A-2*(B+C)/D*E)+F$

Ans- Infix- An infix expression is a single letter, or an operator, proceeded by one infix string and followed by another infix String.

A

A+B

(A+B)+(C-D)

PREFIX- A prefix expression is a single letter, or an operator, followed by two prefix strings. Every prefix string longer than a single variable Contains an operator, first Operands and second operand

A
+AB
++ AB- CD

POSTFIX- A postfix expression (also Called Reverse Polish Notation) is a single letter or an operator, preceded by two postfix strings.

A
AB+
AB+CD-

(i) A+B*C
=

Postfix = ab+c*

(ii) ((a+b)*c)-d

Postfix = ab+c*d-

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Que-4 Draw the queue structure in each Case when the following Operations are performed on an empty queue:

(a) Add A, B, C, D, E, F
(b) Delete two letters
(c) Add G
(d) Add H
(e) Delete four letters
(f) Add I

Ans.

OPERATION	QUEUE	REAR	FRONT
Add A, B, C, D, E, F	F, E, D, C, B, A	F	A
Delete two letters	F, E, D, C	F	C
Add G	G, F, E, D, C	G	C
Delete four letters	H, G, F, E, D, C	H	G
Add I	I, H, G	~~H~~ I	G
ADD H	H, G, F, E, D, C	H	C

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UNIT- II

Que-1 Explain the Concept of binary tree and discuss its applications.

Ans- A binary tree is a tree data structure Comprising of nodes with at most two Children i.e a right and left child. The node at the top is referred to as the root.

Applications of binary trees -

* Binary Search Tree - Used in many search applications where data is Constantly entering / leaving, such as the map and set object in many languages' libraries.

* Binary Space Partition - Used in almost every 3D video game to determine what Objects need to be rendered.

* Binary Tries - Used in almost every high-bandwidth router for storing router - tables.

* Treap - Randomized data structure used in wireless networking and memory allocation.

Que-2 What is the maximum number of nodes that can be found in a binary tree at levels 3,4 and 12?

Ans - The maximum amount of nodes in a binary tree when the tree is balanced.

* Level 0 (root) has a single node
* Level 1 can have 2 nodes (the 2 children of the root).
* level 2 can have 4 nodes (each node of level 2 has 2 children.)
* Level i can contain up to 2^i nodes

So the answer would be

* Level 3: Maximum 8 nodes
* Level 4: Maximum 16 nodes
* Level 12: Maximum 4096 nodes

Note that for balanced binary trees the number of nodes of a level is an exponential function of the depth of the level, which is why balanced binary search trees can be used to effectively store sorted data (insertion, removal and retrieval all seen in O(log(n))).

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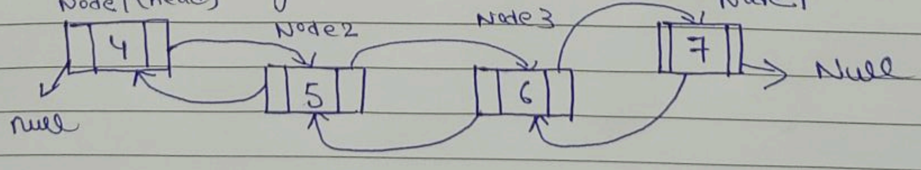
Qu - 3 Explain the difference between singly linked list and doubly linked list with proper example.

Ans - Singly linked list - A singly linked list is a type of linked list that is Unidirectional, that is it, Can be traversed in only one direction from head to the last node (tail).

Each element in a linked list is Called a node. A single node Contains data and a pointer to the next node which helps in maintaining the structure of the list.
Example - Linked list Can be defined as a Collection of Objects Called nodes that are randomly stored in the memory.

Doubly linked list - A Doubly linked list (DLL) Contains an extra pointer, typically Called previous pointer, together with next pointer and data which are there in singly linked list.

Example - A doubly linked list is like a singly linked list only it has the previous pointer. The last element (tail) will have the next property pointing at null.



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Que-4 Specific the use of header node in a linked list.

Ans- The header node does not represent an item in the linked list. This data part of this node is generally used to hold any global information about the entire linked list. The next part of the header Fide node points to the first node in the list. Grounded header linked list that stores Null in the last node's next field.

The header linked lists are frequently used to maintain the polynomials in memory. The header node is used to represent the zero polynomial. From the polynomial represented by F(x) it is clear that this polynomial has two parts, coefficient and exponent, where, x is formal parameter.

UNIT- 3

Que 1 Explain the Concept of binary search trees. Also explain the operations possible on binary search tree.

Ans - The BST is built on the idea of the binary search algorithm, which allows for fast lookup, insertion and removal of nodes. The way that they are set up means that, on average, each comparison allows the operations to skip about half of the tree, so that each lookup, insertion or deletion takes time proportional to the logarithm of the number of items stored in the tree, o(logn). However, some times the worst case can happen, when the tree isn't balanced and the time complexity is o(n) for all three of these junction.

Basic Operations on a BST

- * Create : Creates on empty tree.
- * Insert : insert a node in the tree.
- * Search : Searches for a node in the tree.
- * Delete : Delete a node from the tree
- * Inorder : in- order traversal of the tree.
- * Preorder : Pre - order traversal of the tree
- * Postorder : Post - order traversal of the trees.

Qu-2 How is an AVL tree better than binary search tree.

Ans - Searching in binary search tree is less efficient as Compared to AVL tree.
Efficient searching Can be done by AVL tree because it is strictly balanced. All binary search Can't be an AVL tree becouse either they Can be balanced or unbalanced.

The height of the AVL tree is always balanced. The height number of nodes in the tree. It gives better search time Complexity when Compared to simple Binary search trees. AVL trees have self - balancing Capabilities.

Qu-3 Give a brief summary of m-way search trees.

Ans - The m - way search trees are multi - way trees which are generalised versions of binary trees where each node Contains multiple elements. In an m- way tree of order m, each node Contains a maximum of m-1 elements and m children.
The goal of m- way search tree of height h calls for o(h) no. of accessors for an insert | delete | retrieval operations. Hence it ensures that the height h is close to $\log_m (n+1)$.

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The number of elements in an m-way search tree of height h ranges from a minimum of h to a maximum of $m^h - 1$.

An m-way search tree of n elements ranges from a minimum height of $\log_m(n+1)$ to a maximum of n An example of a 5-way search tree is shown. i. Observe how each node has at most 5 child nodes & therefore has at most 4 keys contained in it.

Que-4 B-trees of order 2 are fully binary trees. Justify this statement. Write the applications of B-trees.

Ans- According to Fundamentals of Data structure in c++ by Horowitz, it mentioned that B tree of order 2 indeed must be a full tree. Hoever not any tree (any number of nodes) of order 2 (with 1 and 2 children) can be a B tree, only those having 2^k nodes can form a B tree of order 2.

Application of B-trees -

B trees are used to index the data especially in large databases as access to data stored in large databases on disks is very time-consuming. Searching of data in large unsorted data sets takes a lot of time but this can be improved significantly with indexing using B tree.

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UNIT-IV

Qu1 Define Sorting searching. What are the different types of sorting and searching techniques?

Ans- The processes of looking up a particular data record in the database is called searching. The process of ordering the records in a database is called sorting. Sorting and searching together constitute a major area of study in computational methods.

The linear Search and the Binary search are the examples of searching algorithms. The Bubble Sort, Insertion Sort, Selection sort, Merge Sort, Quick Sort etc are the example of Sorting algorithm. Sorting and Searching is one of the most vital topic in DSA. Storing and retrieving information is one of the most common application of Computers now-a-days. According to time the amount of data and information stored and accessed via Computer has turned to huge databasees So many techniques and algorithm have been developed to efficiently maintain and process information in databases.

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Que-2 Sort the elements 77, 49, 25, 12, 9, 33, 56, 81 using-

a) Insertion sort

b) Selection Sort

Write step by step procedure of Sorting.

ns- Insertion sort - Is a simple sorting algorithm that works similar to the way you sort playing Cards in your hands. Th array is virtually split into a sorted and an unsorted part.

* Iterate from arr[1] to arr[n] over the array.

* Compare the Current element (key) to its prodecssor.

* IF they element is similar than its prodecessor, Compare it to the element before.

utput- 9, 12, 25, 33, 49, 56, 77, 81.

Selection sort - Algorithm sorts an array by repeatedly finding the minimum elment (considering ascending order) from the unsorted part and putting it at the beginning.

* The subarray is already sorted.

* The remaining subarray is unsorted

orted array * A small list is to be sorted.

* The Cost of swapping does not matter.

* Checking of all the element is Campulsory.

* Cost of writing to memory matters like in flash memory (number of swaps is O(n) as Compared to O (n2) of bubble Sort).

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Que-3 Write a short note on linear probing, quadratic and double hashing.

Ans- Linear probing - Is a scheme in Computer programming for resolving Collisions in hash tables, data structures for maintaining a Collection of key -Value pairs and looking up the value associated with a given key. It was invented in 1954 by Gene Amdahl, Elaine M. McGraw, and Arthur Samuel and first and first analyzed in 1963 by Donald Knuth.

Quadratic hashing - Hashing is an improvement over Direct Acces Table. The idea is to use a hash function that Converts a given phone number or any other key to a smaller number and uses the small number as the index in a table Called a hash table.

Double hashing - It is a Collison resolution technique in open addressing hash table that is used to avoid Collision. A Collision occurs when two keys are hashed to the same index in a hash table. The reason for occuring Collision is that every slot in hash table is supposed to store a single element.

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Que-4 Consider a hash table with size =10. Using linear probing, insert the keys 27, 72, 63, 42, 36, 18, 29 and 101 in to the table.

Ans.1 Consider a hash table with size = 10. Using linear probing, insert the keys 27, 72, 63, 42, 36, 18, 29 and 101 in to the table.

2. Consider a hash table with size = 10. Using quadratic probing, insert the keys 27, 72, 63, 42, 36, 18, 29, and 101 in to the table. Take $C_1 = 1$ and $C_2 = 3$.

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