

PAST PAPERS QUESTIONS OF DSA 2016,17,18,19,20,21,22

- A data structure is a group of data elements are collected together under a single name and is defined by a specific storing and organisation structure inside a computer memory.
- It can also said as the mathematical model of organising data in a computer memory and methods to process them
- They are mainly of two types:
- Linear Data structure: Here the Data elements are organised in a sequence of some manner.
- Non-linear Data structure: Here the data is ordered in any arbitrary order and not in a sequence
- Some common data structures are
- Linked list
- Arrays
- Stacks
- Queues
- Binary trees
- Hash tables

ABDULLAH

Q1) Why linear data structures are easy to implement rather than non-linear data structures?

Ans. In linear data structure, single level is involved. Therefore, we can traverse all the elements in single run only. 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.

OR

The structure involves only a single level- allowing a user to traverse all its components in a single run. The linear data structure is very easy to understand and implement **due to its linear arrangement**, for example, stack, array, linked list, queue, etc.

Q2) What factors should affect the time complexity analysis of any algorithms?

- **Recursion** – Recursion can cause a lot of overhead which increases the running time of an algorithm.
- **CPU Utilization** - If CPU is already utilized by some other processes then running time of algorithm will increase.

Q3) Where in a max-heap might the smallest element reside, assuming that all elements are distinct?

(CLRS 6.1-4) Where in a max-heap might the smallest element reside, assuming that all elements are distinct?

Solution: Since the parent is greater or equal to its children, the smallest element must be a leaf node.

Q4) How insertion sort and selection sorts are different?

Ans. Insertion sort is a simple sorting algorithm that builds the final sorted list by transferring one element at a time. Selection sort, in contrast, is a simple sorting algorithm that repeatedly searches remaining items to find the smallest element and moves it to the correct location.

OR

The insertion sort inserts the values in a presorted file to sort a set of values. On the other hand, the selection sort finds the minimum number from the list and sort it in some order. Sorting is a basic operation in which the elements of an array is arranged in some specific order to enhance its search ability.

OR

Selection sort: repeatedly pick the smallest element to append to the result. Insertion sort: repeatedly add new element to the sorted result.

Insertion Sort	Selection Sort
Inserts the value in the presorted array to sort the set of values in the array.	Finds the minimum / maximum number from the list and sort it in ascending / descending order.
It is a stable sorting algorithm.	It is an unstable sorting algorithm.
It is more efficient than the Selection sort.	It is less efficient than the Insertion sort.

Q5) Define divide and conquer approach?

Ans. In computer science, divide and conquer is an algorithm design paradigm. A divide-and-conquer algorithm recursively breaks down a problem into two or more sub-problems of the same or related type, until these become simple enough to be solved directly.

Q6) What is meant by a sorting algorithm is stable?

Ans. The stability of a sorting algorithm is concerned with how the algorithm treats equal (or repeated) elements. Stable sorting algorithms **preserve the relative order of equal elements**, while unstable sorting algorithms don't.

Q7) Why does insertion at the front of a linked list have to be done differently from insertion elsewhere?

Ans. Because it takes up a specific space in memory, in order to insert or remove from anywhere other than the front of the list requires shifting the entire rest of the list forward.

Q8) What is complete binary tree?

Ans. What is full and complete binary tree?

A full binary tree (sometimes proper binary tree or 2-tree) is a tree in which every node other than the leaves has two children. A complete binary tree is a binary tree in which every level, except possibly the last, is completely filled, and all nodes are as far left as possible.

OR

A complete binary tree is a **binary tree in which all the levels are completely filled except possibly the lowest one, which is filled from the left**. A complete binary tree is just like a full binary tree, but with two major differences. All the leaf elements must lean towards the left.

Q9) Define Complexity of an algorithm.

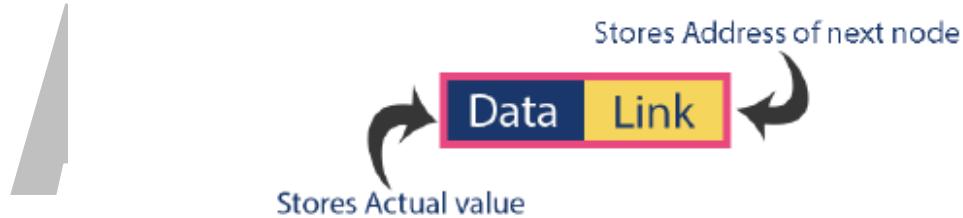
Complexity of an algorithm is a measure of the amount of time and/or space required by an algorithm for an input of a given size (n).

Q10) What is linked list. Explain it with an example

Ans.

Linked List

"Single linked list is a sequence of elements in which every element has link to its next element in the sequence."



What is an example for linked list?

Just like a garland is made with flowers, **a linked list is made up of nodes**. We call every flower on this particular garland to be a node. And each of the node points to the next node in this list as well as it has data (here it is type of flower). ^

Q11) How do you reference all the elements in a one dimensional array?

Ans.

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.

Q12) In what areas do data structures are applied?

Ans.

Data structure is important 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.

Areas of Application

- Data structures are used in any program or software.
- They are used in the areas of
- Compiler Design
- Operating System
- DBMS
- Graphics
- Simulation
- Numerical Analysis
- Artificial Intelligence



Q13) What is LIFO?

Ans. LIFO is an abbreviation for **last in, first out**. It is a method for handling data structures where the first element is processed last and the last element is processed first.

The LIFO is an important data structure used in computer science. For example, **the stack data structure** follows the LIFO principle..

Q14) What is a queue?

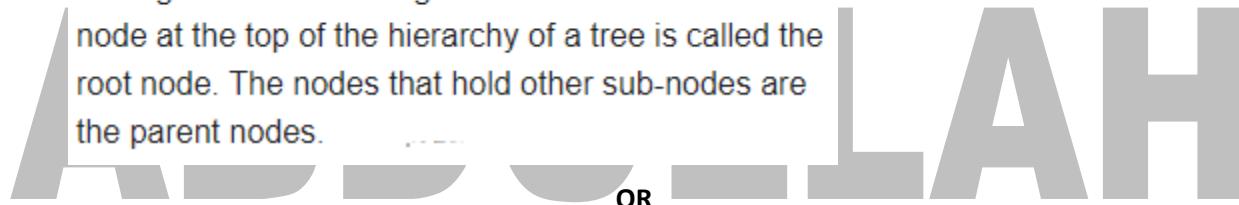
Ans.

A queue is **an abstract data type that holds an ordered, linear sequence of items**. You can describe it as a first in, first out (FIFO) structure; the first element to be added to the queue will be the first element to be removed from the queue. New elements are added to the back or rear of the queue.

It is also known as "**first-come first-served**." The simplest example of a queue is the typical line that we all participate in from time to time. We wait in a line for a movie, we wait in the check-out line at a grocery store, and we wait in the cafeteria line

Q15) What are binary trees?

Ans. A binary tree is **a tree-type non-linear data structure with a maximum of two children for each parent**. Every node in a binary tree has a left and right reference along with the data element. The node at the top of the hierarchy of a tree is called the root node. The nodes that hold other sub-nodes are the parent nodes.



A binary search tree in a data structure is typically used to represent or store hierarchical data. A "binary tree" is **a tree data structure where every node has two child nodes (at the most) that form the tree branches**. These child nodes are called left and right child nodes.

Q16) Which data structures are applied when dealing with a recursive function?

Ans. **Stack data structure** is used for implementing the recursion.

Recursion, which is basically 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.

Q17) What is a stack?

Ans.

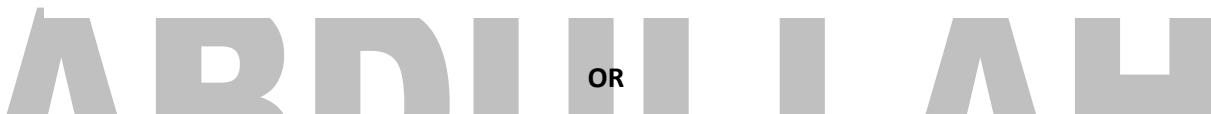
Stacks in Data Structures is a linear type of data structure that follows the LIFO (Last-In-First-Out) principle and allows insertion and deletion operations from one end of the stack data structure, that is top.

A stack is **an abstract data type that holds an ordered, linear sequence of items**. In contrast to a queue, a stack is a last in, first out (LIFO) structure. A real-life example is a stack of plates: you can only take a plate from the top of the stack, and you can only add a plate to the top of the stack.

Q18) What are multidimensional arrays?

Ans.

A multidimensional array **associates each element in the array with multiple indexes**. The most commonly used multidimensional array is the two-dimensional array, also known as a table or matrix. A two-dimensional array associates each of its elements with two indexes.



A multi-dimensional array is **an array with more than one level or dimension**. For example, a 2D array, or two-dimensional array, is an array of arrays, meaning it is a matrix of rows and columns (think of a table). A 3D array adds another dimension, turning it into an array of arrays of arrays.

Q19) How does dynamic memory allocation help in managing data?

Ans.

It is the memory that can be allocated or de-allocated by the operating system during the run-time of a C++ program. It is more efficient than static memory because **we can de-allocate and reuse our memory during the run-time of our program**.

Q20) What is an ordered list?

Ans.

An ordered or linear list is a **collection of data elements organized and accessed in an explicit sequential fashion**. It is a fundamental structure upon which a wide variety of more complex data structures are built.

Q21) Define isomorphic graphs?

Ans. A graph can exist in different forms having the same number of vertices, edges, and also the same edge connectivity. Such graphs are called isomorphic graphs.

OR

If we are given two simple graphs, G and H. Graphs G and H are isomorphic if there is a structure that preserves a one-to-one correspondence between the vertices and edges. In other words, the two graphs differ only by the names of the edges and vertices but are structurally equivalent :

Q22) Define digraphs?

Ans. Digraphs. A directed graph (or digraph) is a set of vertices and a collection of directed edges that each connects an ordered pair of vertices. We say that a directed edge points from the first vertex in the pair and points to the second vertex in the pair.

OR

A directed graph, also called a digraph, is a graph in which the edges have a direction. This is usually indicated with an arrow on the edge:

Q23) What are vertices and edges in graphs? Describe shortly with an example?

Ans. In a diagram of a graph, a vertex is usually represented by a circle with a label, and an edge is represented by a line or arrow extending from one vertex to another.

A vertex (or node) of a graph is one of the objects that are connected together. The connections between the vertices are called edges or links. A graph with 10 vertices (or nodes) and 11 edges (links).

Q24) What do you understand regarding heap sort?

A heap sort is a sorting algorithm based on the binary heap data structure. The idea behind a heap sort is to find the highest value and place it at the end, repeating the process until everything is sorted.

Q25) What are pointers?

Ans. A pointer is a variable that stores the address of another variable. Unlike other variables that hold values of a certain type, pointer holds the address of a variable. For example, an integer variable holds (or you can say stores) an integer value, however an integer pointer holds the address of a integer variable.

Q26) How do you understand hash tables?

Hash Table is a data structure which stores data in an associative manner. In a hash table, data is stored in an array format, where each data value has its own unique index value. Access of data becomes very fast if we know the index of the desired data.



Q27) Define acyclic graph with an example?

An acyclic graph is a graph having no graph cycles.

A connected acyclic graph is known as a tree, and a possibly disconnected acyclic graph is known as a forest (i.e., a collection of trees).

Examples of acyclic graphs are Trees and Forests.

Q28) What is circular queue? Why we use it?

Ans. A Circular Queue is a special version of queue where the last element of the queue is connected to the first element of the queue forming a circle. The operations are performed based on FIFO (First In First Out) principle. It is also called 'Ring Buffer'. ...

OTHER NAMES: a circular buffer, circular queue, cyclic buffer or ring buffer

Why we use circular queue?

Circular Queues offer a quick and clean way to store FIFO data with a maximum size. Conserves memory as we only store up to our capacity (opposed to a queue which could continue to grow if input outpaces output.)

ABDULLAH

Q29) Differentiate insertion and selection sort shortly?

Ans.	Insertion Sort	Selection Sort
	Inserts the value in the presorted array to sort the set of values in the array.	Finds the minimum / maximum number from the list and sort it in ascending / descending order.
	It is a stable sorting algorithm.	It is an unstable sorting algorithm.
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Q30) Differentiate stack and queue data structure?

Stack is used in solving problems works on recursion .	Queue is used in solving problems having sequential processing.
Stack does not have any types.	Queue is of three types – 1. Circular Queue 2. Priority queue 3. double-ended queue.
Insert operation is called push operation.	Insert operation is called enqueue operation.
Stacks are implemented using an array or linked list data structure.	Queues are implemented using an array or linked list data structure.
Delete operation is called pop operation.	Delete operation is called dequeue operation.
A stack is a data structure that stores a collection of elements, with operations to push (add) and pop (remove) elements from the top of the stack.	A queue is a data structure that stores a collection of elements, with operations to enqueue (add) elements at the back of the queue, and dequeue (remove) elements from the front of the queue.
Stacks are based on the LIFO principle, i.e., the element inserted at the last, is the first element to come out of the list.	Queues are based on the FIFO principle, i.e., the element inserted at the first, is the first element to come out of the list.

Q31) Can array of pointers be used as a link list?

Sure, easily done. Your memory space is represented by an array, and the items point to each other by referencing an array subscript. So instead of storing a pointer to the next item in the linked list, your “pointer” is just an integer — the array element number of the next item.

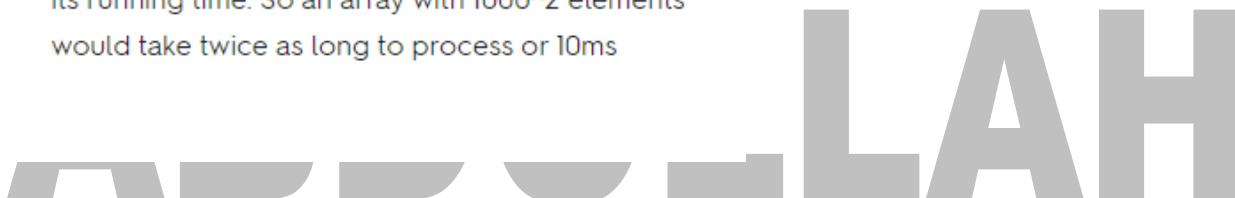
Q32) Define Big O asymptotic notations?

The Big-O notation describes the worst-case running time of a program. We compute the Big-O of an algorithm by counting how many iterations an algorithm will take in the worst-case scenario with an input of N. We typically consult the Big-O because we must always plan for the worst case.

Asymptotic notations are the mathematical notations used to describe the running time of an algorithm when the input tends towards a particular value or a limiting value.

Q33) If the binary search took 5ms to run on an array of 1000 elements, how long would you expect it to take to run on an array of 1,000,000 elements on the same computer?

The binary search runs in logarithmic time, so squaring the size of the problem should only double its running time. So an array with 1000^2 elements would take twice as long to process or 10ms



Q34) What is recursive function? List the four fundamental rules of recursion?

In programming terms, a recursive function can be defined as a routine that calls itself directly or indirectly.

The classic example of recursive programming involves computing factorials.

The four fundamental rules of recursion are:

1. **Base case:** There must be one or more base cases that can be solved without recursion. The base case defines the simplest version of the problem, which can be solved directly without any further recursion.
2. **Forward progress:** The recursion must always make progress toward the base case. This means that the parameters of the function must be modified in such a way that the base case will eventually be reached.
3. **Recursive call:** The function must call itself, either directly or indirectly, in order to solve a smaller version of the problem.
4. **Combined solution:** The results of the recursive call(s) must be combined in some way to produce the final solution to the original problem.

Q35) What are the advantage of single circular link list over single link list?

Unlike a singly linked list, which has a NULL pointer at the end of the list, a circular linked list has a pointer that points back to the first node in the list. This makes it possible to traverse the entire list without having to keep track of the end of the list.

Advantages of Doubly Linked List

- It allows traversing in both forward and backward directions because of the next and previous pointers, unlike the singly linked list, which allows traversing in only one direction.
- Deletion of elements is more straightforward compared to a singly linked list.

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Q37) What are the minimum and maximum number of elements in a heap of height h?

(CLRS 6.1-1) What are the minimum and maximum number of elements in a heap of height h ?

Solution: The minimum number of elements is 2^h and the maximum number of elements is $2^{h+1} - 1$.

Q38) What is Huffman's algorithm?

Huffman Coding is a technique of compressing data to reduce its size without losing any of the details. It was first developed by David Huffman.

Huffman Coding is generally useful to compress the data in which there are frequently occurring characters.

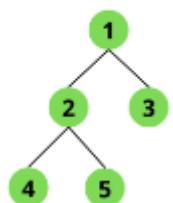
Define divide and conquer approach?

In computer science, divide and conquer is an algorithm design paradigm. A divide-and-conquer algorithm recursively breaks down a problem into two or more sub-problems of the same or related type, until these become simple enough to be solved directly.

What is Strictly Binary Tree?

A Strict Binary Tree is also known as Proper Binary Tree and Full Binary Tree. A Binary Tree is identified as a Strict Binary Tree if each parent node contains either no or two children. All nodes contain two children in a Strict Binary Tree except the leaf nodes which have 0 children.

Strict



What is stack and where it can be used?

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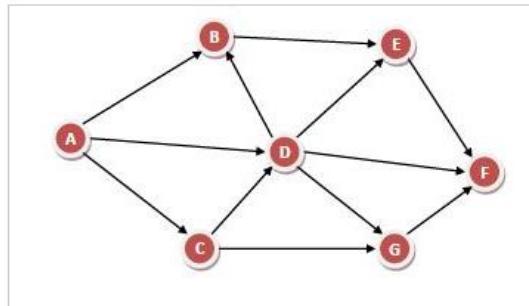
A Stack can be used for evaluating expressions consisting of operands and operators. Stacks can be used

to convert one form of expression to another form. It can be used for systematic Memory Management.

Define DAG?



In computer science and mathematics, a directed acyclic graph (DAG) refers to a directed graph which has no directed cycles.



In the above directed graph, if we find the paths from any node, say u, we will never find a path that come back to u. Hence, this is a DAG.

What is an AVL tree?

In computer science, an AVL tree is a self-balancing binary search tree. It was the first such data structure to be invented. In an AVL tree, the heights of the two child subtrees of any node differ by at most one; if at any time they differ by more than one, rebalancing is done to restore this property.

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The Big-O notation describes the worst-case running time of a program. We compute the Big-O of an algorithm by counting how many iterations an algorithm will take in the worst-case scenario with an input of N. We typically consult the Big-O because we must always plan for the worst case.

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What is Best, Worst and average case time complexity of merge sort.

Case	Time Complexity
Best Case	$O(n \log n)$
Average Case	$O(n \log n)$
Worst Case	$O(n \log n)$

List the major differences between reference types and primitive types.

The main difference between primitive and reference type is that primitive type always has a value, it can never be null but reference type can be null, which denotes the absence of value.

Where in a max heap might the smallest element reside, assuming that all elements are distinct?

(CLRS 6.1-4) Where in a max-heap might the smallest element reside, assuming that all elements are distinct?

Solution: Since the parent is greater or equal to its children, the smallest element must be a leaf node.

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ABOVE

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What is stack and where it can be used?

Define DAG?

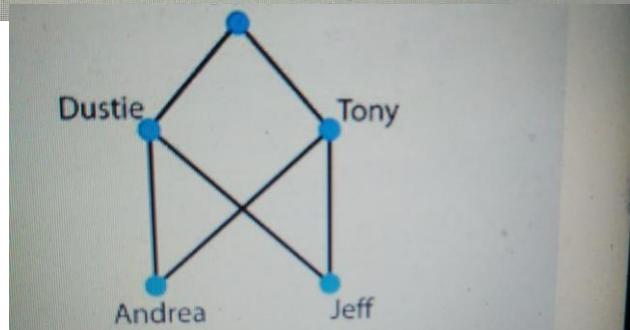
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How many pointers (minimum) can be used to maintain a circular queue? And usually which node the pointer points to?

The circular queue work as follows: two pointers FRONT and REAR. FRONT track the first element of the queue. REAR track the last elements of the queue.

What is completely connected graph? Give an example in favour of your answer.

A complete graph is a graph in which each vertex is connected to every other vertex. That is, a complete graph is an undirected graph where every pair of distinct vertices is connected by a unique edge. 23-Feb-2022



What are the necessary conditions maintained while implementing recursion?

1. A recursive algorithm must call itself, recursively.
2. A recursive algorithm must have a **base case**.
3. A recursive algorithm must change its state and move toward the base case.

What do you mean by tail recursion?

Tail recursion is defined as a recursive function in which the recursive call is the last statement that is executed by the function. So basically nothing is left to execute after the recursion call.

Which sorting algorithm usually gives better result?(Bubble sort or insertion sort)

On average, the bubble sort performs poorly compared to the insertion sort. Due to the high number of swaps, it's expected to generate twice as many write operations and twice as many cache misses. 09-Nov-2022

How many nodes are there in strictly binary tree when there are 5 leaves in the tree?

A strictly binary tree with N leaves always contains $2N - 1$ nodes.

**Is it possible to draw a unique binary tree when only preorder or post order traversal has been given?
Justify your answer?**

False : For unique tree 'inorder' must be present along with pre-order or post-order.

Which data structures are used for traversing a graph by two traversal algorithms

The graph has two types of traversal algorithms. These are called the Breadth First Search and Depth First Search. 27-Aug-2019

Which data structure is applied when dealing with a recursive function?

Stack data structure is used for implementing the recursion.

Why Dijkstra algorithm is used?

Dijkstra's algorithm allows us to find the shortest path between any two vertices of a graph. It differs from the minimum spanning tree because the shortest distance between two vertices might not include all the vertices of the graph.

What is B Tree

B-tree is a special type of self-balancing search tree in which each node can contain more than one key and can have more than two children. It is a generalized form of the binary search tree.

Why Hashing function is used?

Hashing in the data structure is used to quickly identify a specific value within a given array. It creates a unique hash code for each element in the array and then stores the hash code instead of the actual element.

Write the name of two kinds of complexities considered while implementing an algorithm?

Time Complexity of an Algorithm

The time complexity is defined as the process of determining a formula for total time required towards the execution of that algorithm. This calculation is totally independent of implementation and programming language.

Space Complexity of an Algorithm

Space complexity is defining as the process of defining a formula for prediction of how much memory space is required for the successful execution of the algorithm. The memory space is generally considered as the primary memory.

Define structure of a node used in doubly linked list.

In computer science, a doubly linked list is a linked data structure that consists of a set of sequentially linked records called nodes. Each node contains three fields: two link fields (references to the previous and to the next node in the sequence of nodes) and one data field.

Write the name of two non-linear data structures.

Some examples of non-linear data structures are Trees, and Graphs. 16-Jan-2022

Which data structure is used in recursion and why?

Recursion is implemented using stack because activation records are to be stored in LIFO order i.e. last in first out. An activation record of a function call contains three parts: first is arguments, return address and local variables of the function. 12-Oct-2022

Write the name of two prominent operations performed on queue

Basic Operations of Queue

- Enqueue: Add an element to the end of the queue.
- Dequeue: Remove an element from the front of the queue.
- IsEmpty: Check if the queue is empty.
- IsFull: Check if the queue is full.
- Peek: Get the value of the front of the queue without removing it.

What is postfix expression of A+b*C?

A + B * C would be written as + A * B C in prefix. The multiplication operator comes immediately before the operands B and C, denoting that * has precedence over +. The addition operator then appears before the A and the result of the multiplication. In postfix, the expression would be A B C * +.

Two parameters to define a graph?

A graph is a non-linear kind of data structure made up of nodes or vertices and edges. The edges connect any two nodes in the graph, and the nodes are also known as vertices. 03-Apr-2023

Write the name of two collision resolution techniques used in hashing?

Collision resolution techniques are either chaining or open addressing.

26-Jul-2022

What are the two necessary conditions of recursion?

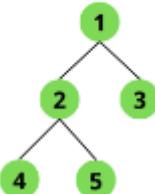
1. A recursive algorithm must call itself, recursively.
2. A recursive algorithm must have a **base case**.
3. A recursive algorithm must change its state and move toward the base case.

Write the name of two recursive algorithms used in sorting?

Two such algorithms which will be examined here are Mergesort and Quicksort.

What is strictly binary tree?

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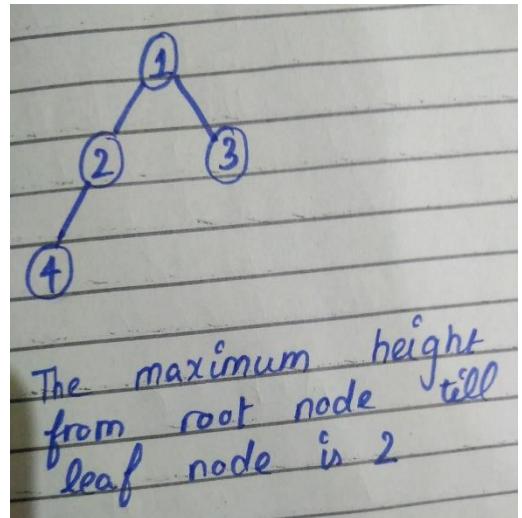
Write the total number of nodes in a strictly binary tree having 9 leaves

A strictly binary tree with 9 leaves has $2(9) - 1 = 17$ total nodes.

What is height of tree? Give an example.

In a tree data structure, the number of edges from the leaf node to the particular node in the longest path is known as the height of that node. In the tree, the height of the root node is called "Height of Tree".

20-Feb-2023



The height of a tree (also known as depth) is the maximum distance between the root node of the tree and the leaf node of the tree. It can also be defined as the number of edges from the root node to the leaf node.

09-Oct-2022

Define Merging?

Merge sort is one of the most efficient sorting algorithms. It is based on the divide-and-conquer strategy. Merge sort continuously cuts down a list into multiple sublists until each has only one item, then merges those sublists into a sorted list.

Write the name of sorting algorithm in which a pivot element is selected to sort the array.

The quicksort algorithm is a sorting algorithm that sorts a collection by choosing a pivot point, and partitioning the collection around the pivot, so that elements smaller than the pivot are before it, and elements larger than the pivot are after it.

19-Jun-2017

What is special in binary search tree?

Binary Search Tree Representation

Binary Search tree exhibits a special behavior. A node's left child must have a value less than its parent's value and the node's right child must have a value greater than its parent value.

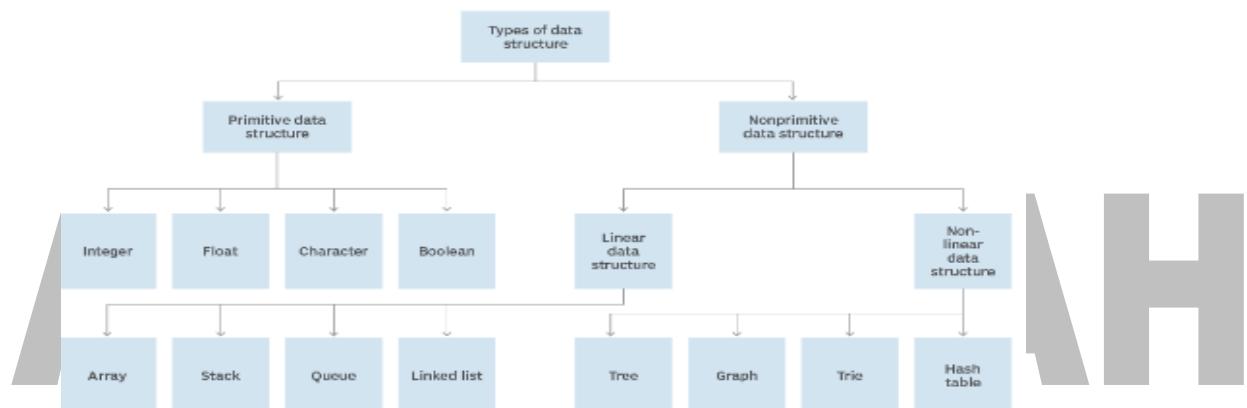
How many references are maintained in a queue?

Two references are maintained: One is the head reference and the other is tail reference.

Define data structure?

A data structure is a specialized format for organizing, processing, retrieving and storing data. There are several basic and advanced types of data structures, all designed to arrange data to suit a specific purpose.

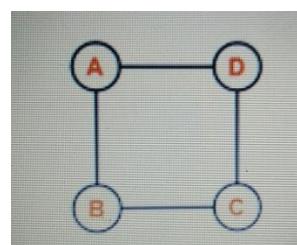
Data structure hierarchy



What is a cycle in a graph?

What Is a Cycle? In graph theory, a path that starts from a given vertex and ends at the same vertex is called a cycle. 24-Mar-2023

A cycle of a graph , also called a circuit



What is ADT? List its benefits?

Abstract data types (ADTs) are important for large-scale programming. They package data structures and operations on them, hiding internal details. For example, an ADT table provides insertion and lookup operations to users while keeping the underlying structure, whether an array, list, or binary tree, invisible....

Benefits of using Abstract Data Types

- Code is easier to understand (e.g., it is easier to see "high-level" steps being performed, not obscured by low-level code).
- Implementations of ADTs can be changed (e.g., for efficiency) without requiring changes to the program that uses the ADTs.
- ADTs can be reused in future programs.

Write different categories of strings?

there are two types of string datatypes: *fixed-length strings*, which have a fixed maximum length to be determined at compile time and which use the same amount of memory whether this maximum is needed or not, and *variable-length strings*, whose length is not arbitrarily fixed and which can use varying amounts of memory depending on the actual requirements at run time



What are pointers?

Introduction to Pointers in Data Structure. Pointers are the variables that are used to store the location of value present in the memory. A pointer to a location stores its memory address. The process of obtaining the value stored at a location being referenced by a pointer is known as dereferencing.

How do you understand hash tables?

Hash Table is a data structure which stores data in an associative manner. In a hash table, data is stored in an array format, where each data value has its own unique index value. Access of data becomes very fast if we know the index of the desired data.

Define acyclic graph with an example

A cyclic graph is a graph containing at least one graph cycle. A graph that is not cyclic is said to be acyclic. A cyclic graph possessing exactly one (undirected, simple) cycle is called a unicyclic graph.

Acyclic is an adjective used to describe a graph in which there is no cycle, or closed path. In other words, it is a path with no repeated vertices (nodes that form the graph, or links between vertices), excluding the starting and ending vertices.

In computer science, it is used in the phrase “directed acyclic graph” (DAG).

Technically, DAG is a graph formed by connecting different vertices with edges that are directed in a manner that does not allow navigating through a sequence that can have a vertex passing through it more than twice; therefore, there is no closed path.

A cycle is a path traversed through a sequence of vertices, such that both the start and end vertices are the same point. If a graph has no such cycles, then it is referred to as acyclic. For example, consider the three vertices, X, Y and Z linked in a graph. While traversing from any of the three vertices through its structure in different possible ways, if one cannot return back to the same starting vertex without visiting any vertex (excluding the starting vertex or point) twice, then it is an Acyclic graph.

Examples of acyclic graphs are Trees and Forests. An acyclic and undirected graph with any two vertices connected by only one path is called a tree. A family tree is a good example of the concept of a directed acyclic tree. A forest is an undirected graph whose subsets are trees.

What is circular queue? Why we use it?

- A Circular Queue is a **special version of queue where the last element of the queue is connected to the first element of the queue forming a circle**. The operations are performed based on FIFO (First In First Out) principle. It is also called 'Ring Buffer'.

OTHER NAMES: a circular buffer, circular queue, cyclic buffer or ring buffer

Why we use circular queue?

Circular Queues offer a **quick and clean way to store FIFO data with a maximum size**. Conserves memory as we only store up to our capacity (opposed to a queue which could continue to grow if input outpaces output.)

How to find total number of nodes?

If the last level of the binary tree is completely filled(a perfect binary tree), then this left height will give us the total count of nodes present by the formula: $2^h - 1$. 06-Feb-2022

What is complete binary search tree?

What is full and complete binary tree?

A full binary tree (sometimes proper binary tree or 2-tree) is a tree in which every node other than the leaves has two children. A complete binary tree is a binary tree in which every level, except possibly the last, is completely filled, and all nodes are as far left as possible.

A complete binary tree is **a binary tree in which all the levels are completely filled except possibly the lowest one, which is filled from the left**. A complete binary tree is just like a full binary tree, but with two major differences. All the leaf elements must lean towards the left.



What are tree traversals? How many traversals of binary tree are possible?

In computer science, tree traversal is a form of graph traversal and refers to the process of visiting each node in a tree data structure, exactly once. Such traversals are classified by the order in which the nodes are visited. [Wikipedia](#)

There are three types of traversal of a binary tree.

1. Inorder tree traversal
2. Preorder tree traversal
3. Postorder tree traversal

Binary Trees in data structure may be traversed in depth-first or breadth-first order. There are three common ways to traverse them in depth-first order: in-order, pre-order and post-order.

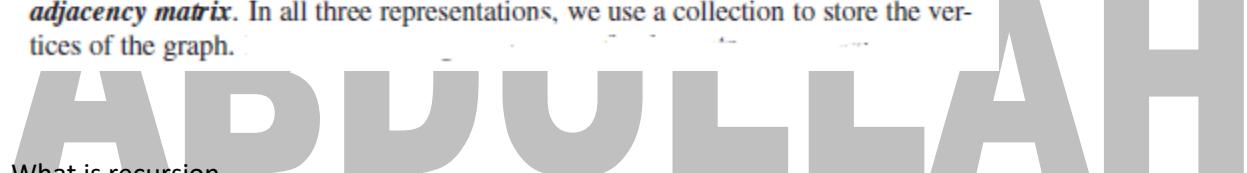
When we should not use sequential search?

The worst case of sequential search is if either the last element was the target or if the target was not even in the list. Both cases would take comparisons, with being the size of the list in question. Thus the worst case complexity is . 09-Oct-2018

Linear search scans each element sequentially until the computer identifies the intended element or searches the entire data set. Linear search's disadvantage is the time complexity. Because linear search scans each element starting from the beginning, it is highly inefficient. 04-Jan-2022

What are different methods to represent a graph

we discuss three popular ways of representing graphs, which are usually referred to as the **edge list** structure, the **adjacency list** structure, and the **adjacency matrix**. In all three representations, we use a collection to store the vertices of the graph.



What is Recursion?

The process in which a function calls itself directly or indirectly is called recursion and the corresponding function is called a recursive function. Using a recursive algorithm, certain problems can be solved quite easily. Examples of such problems are [Towers of Hanoi \(TOH\)](#), [Inorder/Preorder/Postorder Tree Traversals](#), [DFS of Graph](#), etc.

In computer science, recursion is a method of solving a computational problem where the solution depends on solutions to smaller instances of the same problem. Recursion solves such recursive problems by using functions that call themselves from within their own code. [Wikipedia](#)

What is adjacency list?

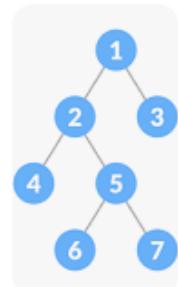
In graph theory and computer science, an adjacency list is a collection of unordered lists used to represent a finite graph. Each unordered list within an adjacency list describes the set of neighbors of a particular vertex in the graph. [Wikipedia](#)

An adjacency list, also called an edge list, is one of the most basic and frequently used representations of a network. Each edge in the network is indicated by listing the pair of nodes that are connected.

An adjacency list represents a graph as an array of linked lists. The index of the array represents a vertex and each element in its linked list represents the other vertices that form an edge with the vertex.

Define full binary tree?

A full Binary tree is a special type of binary tree in which every parent node/internal node has either two or no children. It is also known as a proper binary tree.



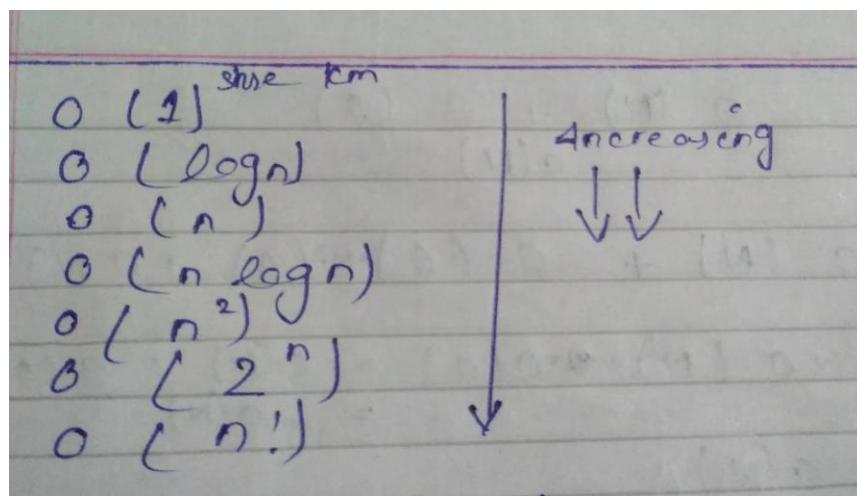
(data structure) Definition: A binary tree in which each node has exactly zero or two children. Also known as proper binary tree.

What is a Full Tree? A full tree is a tree where every node has either zero or two children. This means that all of the nodes in the tree are either leaf nodes (nodes without children) or internal nodes (nodes with children).

What is Big oh notation?

In plain words, Big O notation describes the complexity of your code using algebraic terms.

Big O Notation in Data Structure is used to express algorithmic complexity using algebraic terms. It describes the upper bound of an algorithm's runtime and calculates the time and amount of memory needed to execute the algorithm for an input value.



Big O notation is a mathematical notation that describes the limiting behavior of a function when the argument tends towards a particular value or infinity.

What is minimum number of queues needed when implementing a priority queue?

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

What is a deque?

In computer science, a double-ended queue is an abstract data type that generalizes a queue, for which elements can be added to or removed from either the front or back. It is also often called a head-tail linked list, though properly this refers to a specific data structure implementation of a deque. [Wikipedia](#)

A verb meaning "to remove from a queue" An abbreviation for double-ended queue (more commonly, deque)

A **deque**, also known as a double-ended queue, is an ordered collection of items similar to the queue. It has two ends, a front and a rear, and the items remain positioned in the collection. What makes a deque different is the unrestrictive nature of adding and removing items. New items can be added at either the front or the rear. Likewise, existing items can be removed from either end. In a sense, this hybrid linear structure provides all the capabilities of stacks and queues in a single data structure. [Figure 1](#) shows a deque of Python data objects.

It is important to note that even though the deque can assume many of the characteristics of stacks and queues, it does not require the LIFO and FIFO orderings that are enforced by those data structures. It is up to you to make consistent use of the addition and removal operations.



What are dynamic data structures?

Examples of dynamic data structures include linked lists, trees, queues, and stacks. 02-Jun-2023

Dynamic Data Structure is that kind of data structure that changes its size during runtime. The values stored in the data structure can be changed easily either it be static or dynamic data structure. But the dynamic data are designed in such a way that both the data and the size of the data structure can be easily changed at the runtime.

The main use case for which the Dynamic Data Structures are defined is to easily facilitate the change in the size of the data structure at the runtime without hindering the other operations that are associated with that data structure before increasing or decreasing the size of the data structure.

Why to use PREFIX and POSTFIX notations when we have simple INFIX notation?

Infix notation is easy to read for humans, whereas pre-/postfix notation is easier to parse for a machine. The big advantage in pre-/postfix notation is that there never arise any questions like operator precedence.

Postfix has a number of advantages over infix for expressing algebraic formulas. First, any formula can be expressed without parenthesis. Second, it is very convenient for evaluating formulas on computers with stacks. Third, infix operators have precedence.

What is an AVL tree?

In computer science, an AVL tree is a self-balancing binary search tree. In an AVL tree, the heights of the two child subtrees of any node differ by at most one; if at any time they differ by more than one, rebalancing is done to restore this property. [Wikipedia](#)

AVL tree is a self-balancing binary search tree in which each node maintains extra information called a balance factor whose value is either -1, 0 or +1.

AVL tree got its name after its inventor Georgy Adelson-Velsky and Landis.

There are 8,15,13 and 14 nodes in 4 different trees. Which one of them can form a full binary tree? Why?

Full binary trees contain odd number of nodes. So there cannot be full binary trees with 8 or 14 nodes,

According to me: 15 and 13 both answers are correct depending on the definitions that you have studied.

- A full binary tree of a given height h has $2^h - 1$ nodes.

— — — — — A complete binary tree can have at most $(2^{h+1} - 1)$ nodes in total where h is the height of the tree

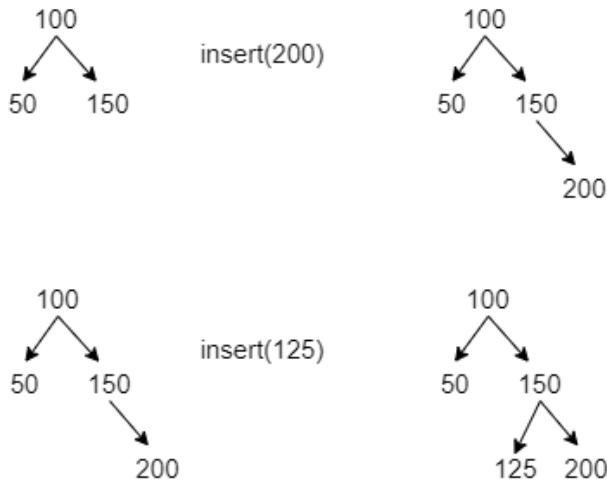
How do you insert a new item in a binary search tree?

How to Insert a value in a Binary Search Tree:

A new key is always inserted at the leaf by maintaining the property of the binary search tree. We start searching for a key from the root until we hit a leaf node. Once a leaf node is found, the new node is added as a child of the leaf node. The below steps are followed while we try to insert a node into a binary search tree:

- Check the value to be inserted (say X) with the value of the current node (say val) we are in:
 - If X is less than val move to the left subtree.
 - Otherwise, move to the right subtree.
- Once the leaf node is reached, insert X to its right or left based on the relation between X and the leaf node's value.

Example



Differentiate linear from non linear data structure.

Difference Between Linear and Non-linear Data Structures

Parameter	Linear Data Structure	Non-Linear Data Structure
Arrangement of Data Element	In a linear data structure, the data elements connect to each other sequentially. A user can transverse each element through a single run.	In a non-linear data structure, the data elements connect to each other hierarchically. Thus, they are present at various levels.
Complexity of Implementation	The linear data structures are comparatively easier to implement.	The non-linear data structures are comparatively difficult to implement and understand as compared to the linear data structures.
Traversal	You can traverse a linear data structure in a single run.	It is not easy to traverse the non-linear data structures. The users need multiple runs to traverse them completely.
Utilization of Memory	It is not very memory-friendly. It means that the linear data structures can't utilize memory very efficiently.	The data structure is memory-friendly. It means that it uses memory very efficiently.
Complexity of Time	The time complexity of this data structure is directly proportional to its size. It means that the time complexity increases with increasing input size.	Non-linear data structure's time complexity often remains the same with an increase in its input size.
Applications	Linear data structures work well mainly in the development of application software.	Non-linear data structures work mainly well in image processing and Artificial Intelligence.
Examples	List, Array, Stack, Queue.	Map, Graph, Tree.

2. Can you tell how linear data structures differ from non-linear data structures?

- If the elements of a data structure result in a sequence or a linear list then it is called a linear data structure. Whereas, traversal of nodes happens in a non-linear fashion in non-linear data structures.
- Lists, stacks, and queues are examples of linear data structures whereas graphs and trees are the examples of non-linear data structures.

Differentiate file structure from storage structure?

1. Can you explain the difference between file structure and storage structure?

- File Structure: Representation of data into secondary or auxiliary memory say any device such as hard disk or pen drives that stores data which remains intact until manually deleted is known as a file structure representation.
- Storage Structure: In this type, data is stored in the main memory i.e RAM, and is deleted once the function that uses this data gets completely executed.
- The difference is that storage structure has data stored in the memory of the computer system, whereas file structure has the data stored in the auxiliary memory.

Are linked lists considered linear or non-linear data structures? Give reason?



6. Are linked lists of linear or non-linear type?

Linked lists can be considered both linear and non-linear data structures. This depends upon the application that they are used for.

- When linked list is used for access strategies, it is considered as a linear data-structure. When they are used for data storage, it can be considered as a non-linear data structure.

3. What is an array?

- Arrays are the collection of **similar** types of data stored at **contiguous** memory locations.
- It is the simplest data structure where the data element can be accessed randomly just by using its index number.

5. What is a linked list?

A linked list is a data structure that has **sequence of nodes** where every node is connected to the next node by means of a reference pointer. The elements are **not stored in adjacent** memory locations. They are linked using pointers to form a chain. This forms a chain-like link for data storage.

- Each node element has two parts:
 - a data field
 - a reference (or pointer) to the next node.

7. How are linked lists more efficient than arrays?

1. Insertion and Deletion

- Insertion and deletion process is expensive in an array as the room has to be created for the new elements and existing elements must be shifted.
- But in a linked list, the same operation is an easier process, as we only update the address present in the next pointer of a node.

2. Dynamic Data Structure

- Linked list is a dynamic data structure that means there is no need to give an initial size at the time of creation as it can grow and shrink at runtime by allocating and deallocating memory.
- Whereas, the size of an array is limited as the number of items is statically stored in the main memory.

3. No wastage of memory

- As the size of a linked list can grow or shrink based on the needs of the program, there is no memory wasted because it is allocated in runtime.
- In arrays, if we declare an array of size 10 and store only 3 elements in it, then the space for 3 elements is wasted. Hence, chances of memory wastage is more in arrays.

ABDULLAH

- Below are the cases where we use arrays over the linked list:
 - When we need to index or randomly access elements more frequently.
 - When we know the number of elements in the array beforehand in order to allocate the right amount of memory.
 - When we need speed while iterating over the elements in the sequence.
 - When memory is a concern:
 - Due to the nature of arrays and linked list, it is safe to say that filled arrays use less memory than linked lists.
 - Each element in the array indicates just the data whereas each linked list node represents the data as well as one or more pointers or references to the other elements in the linked list.
- To summarize, requirements of space, time, and ease of implementation are considered while deciding which data structure has to be used over what.

9. What is a doubly-linked list (DLL)? What are its applications.

- This is a complex type of a linked list wherein a node has two references:
 - One that connects to the next node in the sequence
 - Another that connects to the previous node.
- This structure allows traversal of the data elements in both directions (left to right and vice versa).
- Applications of DLL are:
 - A music playlist with next song and previous song navigation options.
 - The browser cache with BACK-FORWARD visited pages
 - The undo and redo functionality on platforms such as word, paint etc, where you can reverse the node to get to the previous page.

10. What is a stack?

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

ABDULLAH

11. What is a queue? What are the applications of queue?

- A queue is a linear data structure that follows the FIFO (First In First Out) approach for accessing elements.
- Dequeue from the queue, enqueue element to the queue, get front element of queue, and get rear element of queue are basic operations that can be performed.
- Some of the applications of queue are:
 - CPU Task scheduling
 - BFS algorithm to find shortest distance between two nodes in a graph.
 - Website request processing
 - Used as buffers in applications like MP3 media player, CD player, etc.
 - Managing an Input stream

12. How is a stack different from a queue?

- In a stack, the item that is most recently added is removed first whereas in queue, the item least recently added is removed first.

Which data structures is applied when dealing with a recursive function?

Stack data structure is used for implementing the recursion.

Recursion uses more memory, because the recursive function adds to the stack with each recursive call, and keeps the values there until the call is finished. The recursive function uses LIFO (LAST IN FIRST OUT) Structure just like the stack data structure.

What is an ordered list?

An ordered or linear list is **a collection of data elements organized and accessed in an explicit sequential fashion**. It is a fundamental structure upon which a wide variety of more complex data structures are built.

What is data abstraction?

Data abstraction is the process of delivering the necessary data to the outside world while concealing the necessary details within, i.e., representing only the necessary details in the program. Data abstraction is a programming method that separates the program's interface and implementation details.

Data abstraction is the reduction of a particular body of data to a simplified representation of the whole.

Abstraction, in general, is the process of removing characteristics from something to reduce it to a set of essential elements.

In what areas do data structure applied?

Areas of Application

- Data structures are used in any program or software.
- They are used in the areas of
- Compiler Design
- Operating System
- DBMS
- Graphics
- Simulation
- Numerical Analysis
- Artificial Intelligence

What is the number of nodes that a binary tree can have?

Maximum number of nodes present in binary tree of height h is $2^h - 1$.

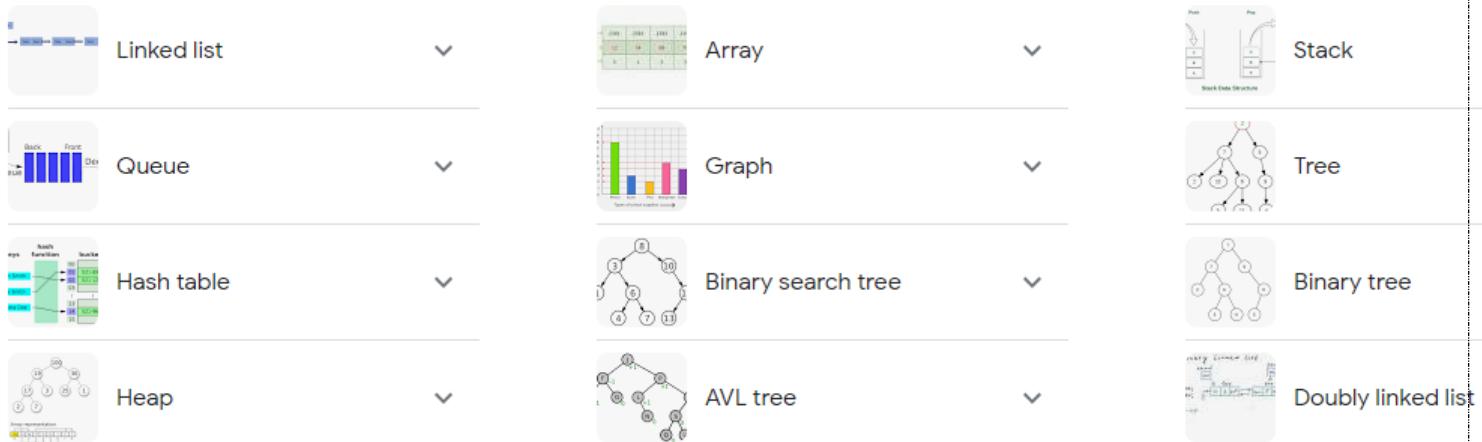
what is data structure

- A data structure is a group of data elements are collected together under a single name and is defined by a specific storing and organisation structure inside a computer memory.
- It can also said as the mathematical model of organising data in a computer memory and methods to process them
- They are mainly of two types:
- Linear Data structure: Here the Data elements are organised in a sequence of some manner.
- Non-linear Data structure: Here the data is ordered in any arbitrary order and not in a sequence

what are various data structures available

Different data structures

From sources across the web



what is algorithm

In mathematics and computer science, an algorithm is a finite sequence of rigorous instructions, typically used to solve a class of specific problems or to perform a computation. Algorithms are used as specifications for performing calculations and data processing. [Wikipedia](#)

a process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.

why we need to do algorithm analysis

Algorithm analysis is important in practice because the accidental or unintentional use of an inefficient algorithm can significantly impact system performance. In time-sensitive applications, an algorithm taking too long to run can render its results outdated or useless.

Algorithm analysis is an important part of computational complexity theory, which provides theoretical estimation for the required resources of an algorithm to solve a specific computational problem. Analysis of algorithms is the determination of the amount of time and space resources required to execute it.

Why Analysis of Algorithms is important?

- To predict the behavior of an algorithm without implementing it on a specific computer.
- It is much more convenient to have simple measures for the efficiency of an algorithm than to implement the algorithm and test the efficiency every time a certain parameter in the underlying computer system changes.
- It is impossible to predict the exact behavior of an algorithm. There are too many influencing factors.
- The analysis is thus only an approximation; it is not perfect.
- More importantly, by analyzing different algorithms, we can compare them to determine the best one for our purpose.

what are the criteria of algorithm analysis

All algorithms must satisfy the following criteria: Zero or more input values. One or more output values. Clear and unambiguous instructions.

Input – An algorithm should have 0 or more well-defined inputs.
Output – An algorithm should have 1 or more well-defined outputs, and should match the desired output.
Finiteness – Algorithms must terminate after a finite number of steps.

what are asymptotic notations

Asymptotic notations are the mathematical notations used to describe the running time of an algorithm when the input tends towards a particular value or a limiting value.

For example: In bubble sort, when the input array is already sorted, the time taken by the algorithm is linear i.e. the best case.

Asymptotic Notation is used to describe the running time of an algorithm - how much time an algorithm takes with a given input, n . There are three different notations: big O, big Theta (Θ), and big Omega (Ω).

give some examples of greedy algorithms

Examples of such greedy algorithms are Kruskal's algorithm and Prim's algorithm for finding minimum spanning trees and the algorithm for finding optimum Huffman trees. Greedy algorithms appear in the network routing as well.

ABDULLAH

why do we use stacks

A Stack can be used for evaluating expressions consisting of operands and operators. Stacks can be used for Backtracking, i.e., to check parenthesis matching in an expression. It can also be used to convert one form of expression to another form. It can be used for systematic Memory Management.

how breadth first traversal works

Breadth-first traversal means that we start from the top node, then go one level down, go through all of the children nodes from left to right. 19-Mar-2022

Breadth-First Search Algorithm or BFS is the most widely utilized method. BFS is a graph traversal approach in which you start at a source node and layer by layer through the graph, analyzing the nodes directly related to the source node. Then, in BFS traversal, you must move on to the next-level neighbor nodes. 20-Feb-2023

what is an AVL tree

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ABDULLAH

what is minimum spanning tree(MST)

A minimum spanning tree or minimum weight spanning tree is a subset of the edges of a connected, edge-weighted undirected graph that connects all the vertices together, without any cycles and with the minimum possible total edge weight. That is, it is a spanning tree whose sum of edge weights is as small as possible. [Wikipedia](#)

A spanning tree is a sub-graph of an undirected connected graph, which includes all the vertices of the graph with a minimum possible number of edges. If a vertex is missed, then it is not a spanning tree.

what is interpolation search technique

Interpolation search is an algorithm for searching for a key in an array that has been ordered by numerical values assigned to the keys (key values). It was first described by W. W. Peterson in 1957.

what is recursion

The process in which a function calls itself directly or indirectly is called recursion and the corresponding function is called a recursive function. Using a recursive algorithm, certain problems can be solved quite easily. Examples of such problems are [Towers of Hanoi \(TOH\)](#), [Inorder/Preorder/Postorder Tree Traversals](#), [DFS of Graph](#), etc. A recursive function solves a particular problem by calling a copy of itself and solving smaller subproblems of the original problems. Many more recursive calls can be generated as and when required. It is essential to know that we should provide a certain case in order to terminate this recursion process. So we can say that every time the function calls itself with a simpler version of the original problem.

what is adjacency list

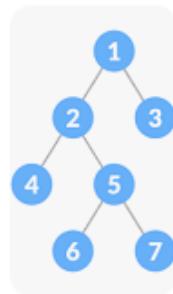
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(data structure) Definition: A binary tree in which each node has exactly zero or two children. Also known as proper binary tree.

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what is abstract data type

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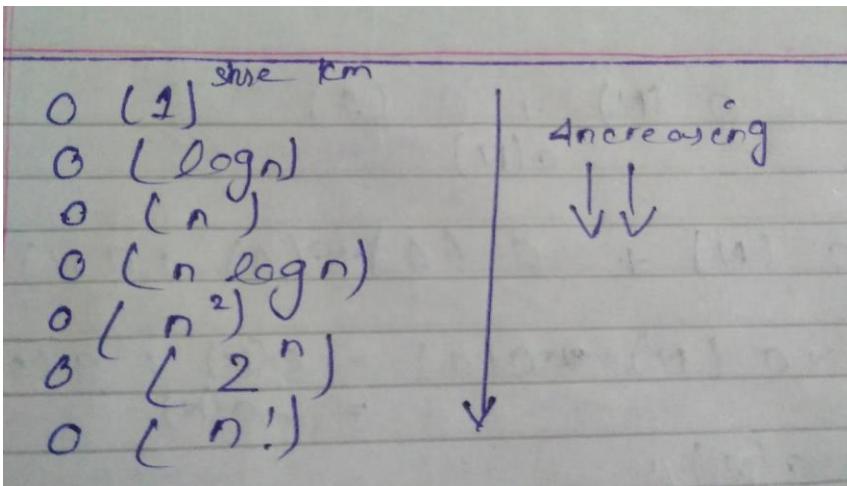
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- Code is easier to understand (e.g., it is easier to see "high-level" steps being performed, not obscured by low-level code).
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define O-notation

In plain words, Big O notation describes the complexity of your code using algebraic terms.

Big O Notation in Data Structure is used to express algorithmic complexity using algebraic terms. It describes the upper bound of an algorithm's runtime and calculates the time and amount of memory needed to execute the algorithm for an input value.



Big O notation is a mathematical notation that describes the limiting behavior of a function when the argument tends towards a particular value or infinity.

ABDULLAH

what is linear data structure

A linear data structure is one in which data items are ordered sequentially or linearly, with each member attached to its previous and next neighboring elements. All the elements in the linear data structure can be traversed in a single run.

when is a binary search best applied

When is a binary search best applied? Answer: Binary search is a type of algorithm. It is best applied to search in a list in which the elements are already in order or sorted.

Binary search is an efficient algorithm for finding an item from a sorted list of items. It works by repeatedly dividing in half the portion of the list that could contain the item, until you've narrowed down the possible locations to just one.

list out the advantages of using a linked list

In short, there are several advantages of linked list over arrays, such as dynamic size, efficient insertion and deletion, memory efficiency, easy implementation of abstract data types, and more efficient sorting in some cases.

28-Sept-2021

why do we use stacks

A Stack can be used for evaluating expressions consisting of operands and operators. Stacks can be used for Backtracking, i.e., to check parenthesis matching in an expression. It can also be used to convert one form of expression to another form. It can be used for systematic Memory Management.

ABDULLAH

define PUSH and POP operations

PUSH Operation

Push operation refers to inserting an element in the stack. Since there's only one position at which the new element can be inserted—Top of the stack, the new element is inserted at the top of the stack.

POP Operation

Pop operation refers to the removal of an element. Again, since we only have access to the element at the top of the stack, there's only one element that we can remove. We just remove the top of the stack.

what is FIFO

In computing and in systems theory, FIFO is an acronym for first in, first out, a method for organizing the manipulation of a data structure where the oldest entry, or "head" of the queue, is processed first.

FIFO stands for First In First Out, in which we will enter the data elements into the data structure; the data element added at last in any data structure will be removed out last and the element added first will be removed first.

what is the postfix of $(a+b/c*(d*e))$

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what is merge sort

In computer science, merge sort is an efficient, general-purpose, and comparison-based sorting algorithm. Most implementations produce a stable sort, which means that the order of equal elements is the same in the input and output. [Wikipedia](#)

Inventor: John von Neumann

Worst complexity: $n \log(n)$

Average complexity: $n \log(n)$

Best complexity: $n \log(n)$

Space complexity: n

Method: Merging

Stable: Yes

In the context of sorting elements in a list and in ascending order, the merge sort method divides the list into halves, then iterates through the new halves, continually dividing them down further to their smaller parts. 31-Mar-2022

define a complete binary tree

What is full and complete binary tree?

A full binary tree (sometimes proper binary tree or 2-tree) is a tree in which every node other than the leaves has two children. A complete binary tree is a binary tree in which every level, except possibly the last, is completely filled, and all nodes are as far left as possible.

A complete binary tree is **a binary tree in which all the levels are completely filled except possibly the lowest one, which is filled from the left**. A complete binary tree is just like a full binary tree, but with two major differences. All the leaf elements must lean towards the left.

ABDULLAH

define leaves node in tree

Leaf – The node which does not have any child node is called the leaf node.

what is spanning tree

A spanning tree is defined as **a subset of a connected undirected graph that has all the vertices covered with the minimum number of edges possible**.

In the mathematical field of graph theory, a spanning tree T of an undirected graph G is a subgraph that is a tree which includes all of the vertices of G . In general, a graph may have several spanning trees, but a graph that is not connected will not contain a spanning tree.

A spanning tree is a subset of Graph G , which has all the vertices covered with minimum possible number of edges. Hence, a spanning tree does not have cycles and it cannot be disconnected..

what is a graph

What Are Graphs in Data Structure? A graph is a non-linear kind of data structure made up of nodes or vertices and edges. The edges connect any two nodes in the graph, and the nodes are also known as vertices.

03-Apr-2023

A Graph is a non-linear data structure consisting of vertices and edges. The vertices are sometimes also referred to as nodes and the edges are lines or arcs that connect any two nodes in the graph. More formally a Graph is composed of a set of vertices(V) and a set of edges(E). The graph is denoted by G(E, V).

what is max heap

Max-Heap: A type of heap where the value of the parent node's values is always greater than its children. This property must be recursively true for all sub-trees in that Binary Tree. The root node consists of the highest value of the heap.

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what is hashing

Hashing is a technique or process of mapping keys, values into the hash table by using a hash function. It is done for faster access to elements. The efficiency of mapping depends on the efficiency of the hash function used

when are linked list best suited

A linked list is best suited for a structure that is continually changing in size. Only the necessary number of nodes are formed. As a result, there is no need to declare the size at the start, which overcomes the constraint of static arrays.

what is time complexity of bubble sort algorithm

Best Time Complexity: $O(n^2)$

Average Time Complexity: $O(n^2)$

Worst Time Complexity: $O(n^2)$

what do you mean by non linear data structures

What Is a Non-Linear Data Structure? It is a form of data structure where the data elements don't stay arranged linearly or sequentially. Since the data structure is non-linear, it does not involve a single level. Therefore, a user can't traverse all of its elements in a single run.

name any two non linear data structures

Take graphs and trees as perfect examples of non-linear data structure.

what do you mean by space complexity

Space complexity refers to the total amount of memory space used by an algorithm/program, including the space of input values for execution. Calculate the space occupied by variables in an algorithm/program to determine space complexity.

ABDULLAH

define array

3. What is an array?

- Arrays are the collection of similar types of data stored at contiguous memory locations.
- It is the simplest data structure where the data element can be accessed randomly just by using its index number.

what is index number of the middle element of an array of size 11

what is hashing

Hashing in the data structure is used to quickly identify a specific value within a given array. It creates a unique hash code for each element in the array and then stores the hash code instead of the actual element.

Hashing is a technique or process of mapping keys, values into the hash table by using a hash function. It is done for faster access to elements. The efficiency of mapping depends on the efficiency of the hash function used

what is B tree

B-tree is a special type of self-balancing search tree in which each node can contain more than one key and can have more than two children. It is a generalized form of the binary search tree.

what is a complete BST

A binary tree is called complete binary tree when all the level of binary tree is completely filled except possibly the last level, which is filled from left side. In other words all the nodes are as far left as possible in complete binary tree.

discuss a scenario where a B tree is similar to a linked list

Binary trees are basically two dimensional linked lists. Each node has a value and pointers to two sub-trees, one to the left and one to the right. Both sub-trees may either be the value None or be the root node to another binary tree.



what is merge sort

In computer science, merge sort is an efficient, general-purpose, and comparison-based sorting algorithm. Most implementations produce a stable sort, which means that the order of equal elements is the same in the input and output. [Wikipedia](#)

Inventor: John von Neumann

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Space complexity: n

Method: Merging

Stable: Yes

In the context of sorting elements in a list and in ascending order, the merge sort method divides the list into halves, then iterates through the new halves, continually dividing them down further to their smaller parts. 31-Mar-2022

what is datatype

Data type is one of the forms of a variable to which the value can be assigned of a given type only. Data structure is a collection of data of different data types.

A data type is an attribute associated with a piece of data that tells a computer system how to interpret its value.

Most programming languages

support various types of data, including integer, real, character or string, and Boolean.

what is stack

stack

Stacks in Data Structures is a linear type of data structure that follows the LIFO (Last-In-First-Out) principle and allows insertion and deletion operations from one end of the stack data structure, that is top.



A stack is an abstract data type that holds an ordered, linear sequence of items. In contrast to a queue, a stack is a last in, first out (LIFO) structure. A real-life example is a stack of plates: you can only take a plate from the top of the stack, and you can only add a plate to the top of the stack.

A Stack can be used for evaluating expressions consisting of operands and operators. Stacks can be used

to convert one form of expression to another form. It can be used for systematic Memory Management.

discuss any application of stack

Application of the Stack

1. A Stack can be used for evaluating expressions consisting of operands and operators.
2. Stacks can be used for Backtracking, i.e., to check parenthesis matching in an expression.
3. It can also be used to convert one form of expression to another form.
4. It can be used for systematic Memory Management.

what is an algorithm

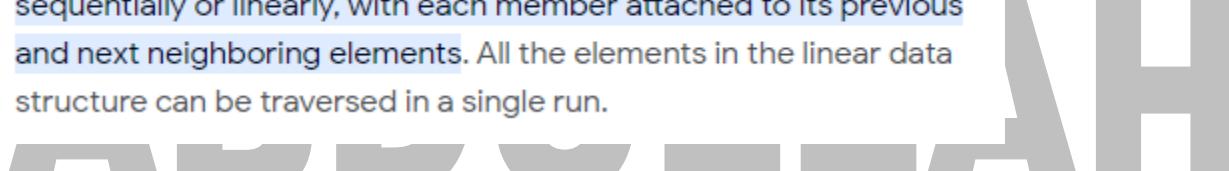
In mathematics and computer science, an algorithm is a finite sequence of rigorous instructions, typically used to solve a class of specific problems or to perform a computation. Algorithms are used as specifications for performing calculations and data processing. [Wikipedia](#)

a process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.

what is data structure

data structure

A linear data structure is one in which data items are ordered sequentially or linearly, with each member attached to its previous and next neighboring elements. All the elements in the linear data structure can be traversed in a single run.



- A data structure is a group of data elements are collected together under a single name and is defined by a specific storing and organisation structure inside a computer memory.
- It can also said as the mathematical model of organising data in a computer memory and methods to process them
- They are mainly of two types:
- Linear Data structure: Here the Data elements are organised in a sequence of some manner.
- Non-linear Data structure: Here the data is ordered in any arbitrary order and not in a sequence

what is divide and conquer approach

In computer science, divide and conquer is an algorithm design paradigm. A divide-and-conquer algorithm recursively breaks down a problem into two or more sub-problems of the same or related type, until these become simple enough to be solved directly.

what is the postfix notation of $(a+b)*(c+d)$

which sorting algorithm is best if the list is already sorted? why?

Insertion sort is the best sort when the list is already sorted as the no of comparison reduces its complexity is n.

what operations can be performed on queues

<i>Queue Method</i>
size()
empty()
front()
enqueue(<i>e</i>)
dequeue()

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what is tower of Hanoi

Tower of Hanoi, is a mathematical puzzle which consists of three towers (pegs) and more than one rings is as depicted – These rings are of different sizes and stacked upon in an ascending order, i.e. the smaller one sits over the larger one.

what is fibonacci series

The Fibonacci sequence is a set of integers (the Fibonacci numbers) that starts with a zero, followed by a one, then by another one, and then by a series of steadily increasing numbers. The sequence follows the rule that each number is equal to the sum of the preceding two numbers.



The Fibonacci Sequence is the series of numbers:

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ...

The next number is found by adding up the two numbers before it:

- the 2 is found by adding the two numbers before it (1+1),
- the 3 is found by adding the two numbers before it (1+2),
- the 5 is (2+3),
- and so on!

Example: the next number in the sequence above is $21+34 = 55$

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what is linear search

In computer science, a linear search or sequential search is a method for finding an element within a list. It sequentially checks each element of the list until a match is found or the whole list has been searched.

[Wikipedia](#)

Worst complexity: $O(n)$

A linear search is the simplest method of searching a data set. Starting at the beginning of the data set, each item of data is examined until a match is made. Once the item is found, the search ends. If there is no match, the algorithm must deal with this.

what is data encapsulation

In software systems, encapsulation refers to the bundling of data with the mechanisms or methods that operate on the data. It may also refer to the limiting of direct access to some of that data, such as an object's components. [Wikipedia](#)

In general, encapsulation is a process of wrapping similar code in one place. In C++, we can bundle data members and functions that operate together inside a single class.

in which data structures we use pointers

Pointers that are used in linked list have various applications

Programmers use pointers and dynamic memory allocation to create dynamic or linked data structures.

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what are multidimensional arrays

Multidimensional arrays are an extension of 2-D matrices and use additional subscripts for indexing. A 3-D array, for example, uses three subscripts. The first two are just like a matrix, but the third dimension represents pages or sheets of elements.

what is bubble sort

Bubble sort, sometimes referred to as sinking sort, is a simple sorting algorithm that repeatedly steps through the input list element by element, comparing the current element with the one after it, swapping their values if needed. [Wikipedia](#)

Worst complexity: n^2

Average complexity: n^2

Best complexity: n

Space complexity: 1

Method: Exchanging

Stable: Yes

Bubble sort is a basic algorithm for arranging a string of numbers or other elements in the correct order. The method works by examining each set of adjacent elements in the string, from left to right, switching their positions if they are out of order.

how insertion sort and selection sort are different

The insertion sort inserts the values in a presorted file to sort a set of values. On the other hand, the selection sort finds the minimum number from the list and sort it in some order. Sorting is a basic operation in which the elements of an array is arranged in some specific order to enhance its searchability.

what is meant by sorting algorithm is stable

A stable sorting algorithm maintains the relative order of the items with equal sort keys. An unstable sorting algorithm does not. In other words, when a collection is sorted with a stable sorting algorithm, items with the same sort keys preserve their order after the collection is sorted. 28-Dec-2018

differentiate between stack and array



A stack is a type of linear data structure that is represented by a collection of pieces that are arranged in a predetermined sequence. An array is a collection of data values that are associated to one another and termed elements. Each element is recognized by an indexed array.

what is min heap

A Min Heap Binary Tree is a Binary Tree where the root node has the minimum key in the tree. The above definition holds true for all sub-trees in the tree. This is called the Min Heap property. Almost every node other than the last two layers must have two children. 03-Aug-2022

what is the postfix notation of $(a+b)*(c+d)$

Application of queues:

The following are some of the most common queue applications in data structure:

- Managing requests on a single shared resource such as CPU scheduling and disk scheduling.
- Handling hardware or real-time systems interrupts.
- Handling website traffic.
- Routers and switches in networking.
- Maintaining the playlist in media players.

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list two shortcomings of Dijkstra's algorithm

1. It does an obscured exploration that consumes a lot of time while processing,
2. It is unable to handle negative edges,
3. As it heads to the acyclic graph, so can't achieve the accurate shortest path, and
4. Also, there is a need to maintain tracking of vertices, have been visited.

differentiate between queue and priority queue

Difference between Queue and PriorityQueue Implementation :

Queue	Priority Queue
Queue is a linear data structure.	Priority Queue is an extension of Queue with priority factor embedded.
Follows First In First Out (FIFO) algorithm to serve the elements.	Serves the element with higher priority first.
Enqueue and dequeue done in O(1).	Enqueue and dequeue done in O(log n) using binary heaps.
Used in algorithms such as Breadth First Search.	Used in algorithms such as Dijkstra's Algorithm, Prim's Algorithms, CPU Scheduling.

Difference between Priority Queue and Normal Queue

In a queue, the **first-in-first-out rule** is implemented whereas, in a priority queue, the values are removed **on the basis of priority**. The element with the highest priority is removed first.

Difference between Priority Queue and Queue in Java

Area	Priority Queue	Queue
Definition	A priority queue is the queue in which each of its elements has some priorities. The elements from the queue are removed based on their priorities.	Queue is an interface in Java that uses FIFO principle to remove its elements.
Types	Min priority queue and Max priority Queue.	It has no type.
Structure	Each element in priority queue has priority.	The queue elements have no priority.
deQueue operation	Elements are removed on the basis of their highest priority.	Elements from the queue are removed in FIFO order.
Element ordering	It is an ordered queue making searching easy.	It is a randomly organized queue.
Complexity	It is difficult to implement a priority queue.	It is a simple queue with easy implementation.

differentiate between best case and worst case analysis

Best case is the function which performs the minimum number of steps on input data of n elements. Worst case is the function which performs the maximum number of steps on input data of size n.

what does a hash function do

A hash function takes a group of characters (called a key) and maps it to a value of a certain length (called a hash value or hash). The hash value is representative of the original string of characters, but is normally smaller than the original.

Hashing is done for indexing and locating items in databases because it is easier to find the shorter hash value than the longer string. Hashing is also used in encryption.

A hash function is any function that can be used to map data of arbitrary size to fixed-size values, though there are some hash functions that support variable length output. The values returned by a hash function are called hash values, hash codes, digests, or simply hashes.

list the four fundamental rules of recursion

The number 1 rule of recursion:

You must always have some base cases, which can be solved without recursion.

The number 2 rule of recursion:

For cases that are to be solved recursively, the recursive call must always be a case that makes progress toward a base case.

The 3rd and 4th rules of recursion:

3. Assume that all recursive calls work.

4. Never duplicate work by solving the same instance of a problem in separate recursive calls.

. The Three Laws of Recursion

- A recursive algorithm must have a base case.
- A recursive algorithm must change its state and move toward the base case.
- A recursive algorithm must call itself, recursively.

show the results of the following sequence: add(4),add(8),add(1),add(6),remove()

and remove() when the add and remove operations correspond to the basic operations in the following

a.Stack

b.Queue

list two advantages of linked list over array

In short, there are several advantages of linked list over arrays, such as dynamic size, efficient insertion and deletion, memory efficiency, easy implementation of abstract data types, and more efficient sorting in some cases.

In short, there are several disadvantages of linked list over arrays, such as slower access times, extra memory usage, and more complex implementation.

One Can Prefer Linked List Over the Array in Below Mentioned Cases

- When you do not know the total number of elements to be processed, this is because, in the array, we must predefine the size and length of an array, which should be followed during the whole code unless changed at the root (where declaration takes place).
- When elements could increase or decrease during run time.
- When the probability of insertion and deletion at the end or in the beginning position is more just like in the implementation of stack and queue, a linked List is always preferred over the array.

list five operations that can be applied to a reference type

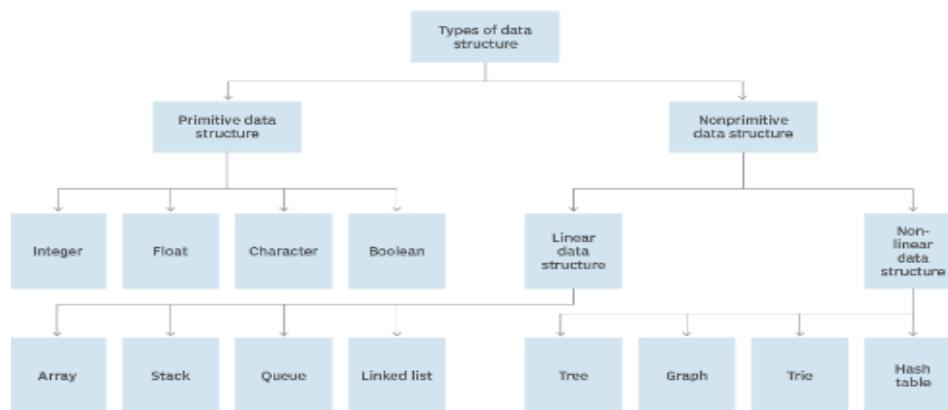
There are three basic operations performed using references: **assigning by reference, passing by reference, and returning by reference.** 04-Mar-2007

The basic operations that can be applied to a reference type are assignment via `=`, comparison via `=` and `≠`, the dot operator, type conversion, and `.`

define data structure

A data structure is a specialized format for organizing, processing, retrieving and storing data. There are several basic and advanced types of data structures, all designed to arrange data to suit a specific purpose. Data structures make it easy for users to access and work with the data they need in appropriate ways. Most importantly, data structures frame the organization of information so that machines and humans can better understand it.

Data structure hierarchy



AH

In computer science, a data structure is a data organization, management, and storage format that is usually chosen for efficient access to data.

what is max heap

A max heap is a complete binary tree in which the value of a node is greater than or equal to the values of its children.

Max Heap data structure is useful for sorting data using heap sort. 03-Aug-2022

In computer science, a min-max heap is a complete binary tree data structure which combines the usefulness of both a min-heap and a max-heap, that is, it provides constant time retrieval and logarithmic time removal of both the minimum and maximum elements in it.

which algorithm is best if the list is already sorted? why?

Insertion sort is the best sort when the list is already sorted as the no of comparison reduces its complexity is n.

what is hashing

Hashing in the data structure is used to quickly identify a specific value within a given array. It creates a unique hash code for each element in the array and then stores the hash code instead of the actual element.

Hashing is the process of transforming any given key or a string of characters into another value. This is usually represented by a shorter, fixed-length value or key that represents and makes it easier to find or employ the original string.



Hashing is the process of transforming any given key or a string of characters into another value. This is usually represented by a shorter, fixed-length value or key that represents and makes it easier to find or employ the original string.

The most popular use for hashing is the implementation of hash tables. [Learn more](#)

what is a graph

What Are Graphs in Data Structure? A graph is a non-linear kind of data structure made up of nodes or vertices and edges. The edges connect any two nodes in the graph, and the nodes are also known as vertices. 03-Apr-2023

In computer science, a graph is an abstract data type that is meant to implement the undirected graph and directed graph concepts from the field of graph theory within mathematics. [Wikipedia](#)

A Graph is a non-linear data structure consisting of vertices and edges. The vertices are sometimes also referred to as nodes and the edges are lines or arcs that connect any two nodes in the graph. More formally a Graph is composed of a set of vertices(V) and a set of edges(E). The graph is denoted by G(E, V).