Data Structures

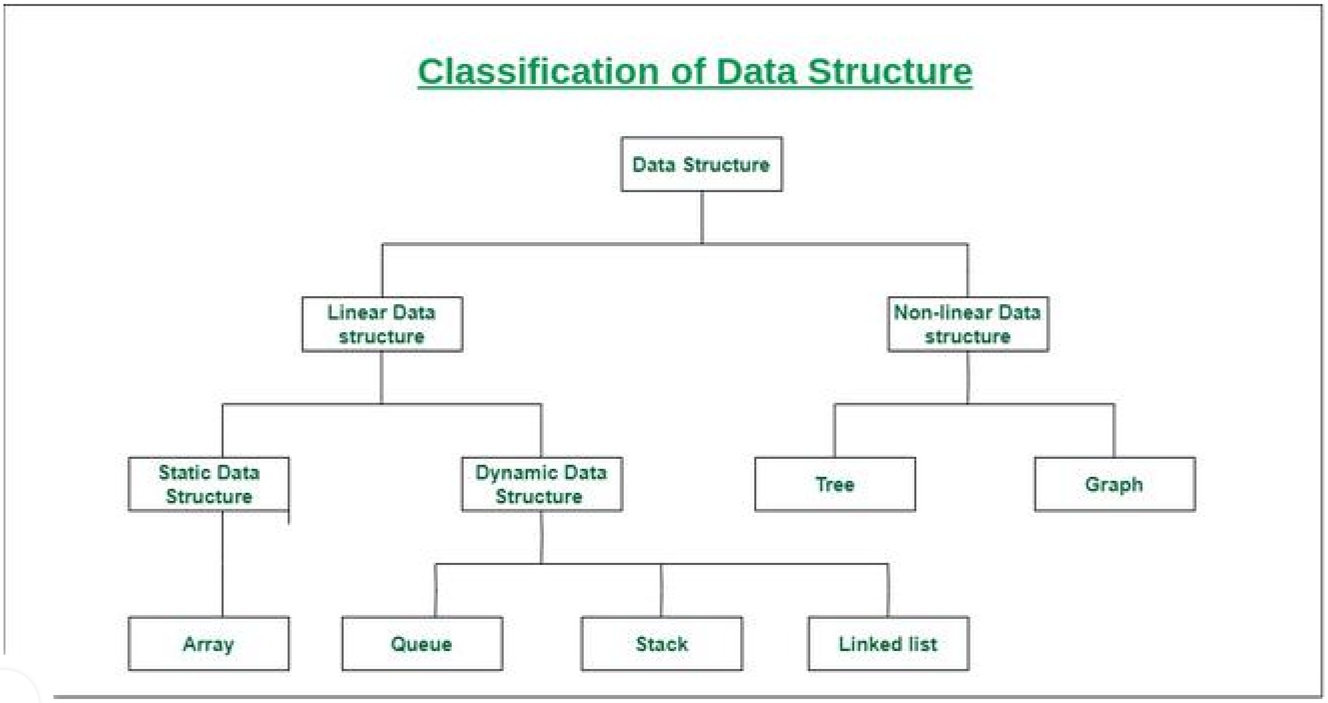
Last Updated : 10 Aug, 2022

What is Data Structure:

> *A data structure is a storage that is used to store and organize data. It is a way of arranging data on a computer so that it can be accessed and updated efficiently.*

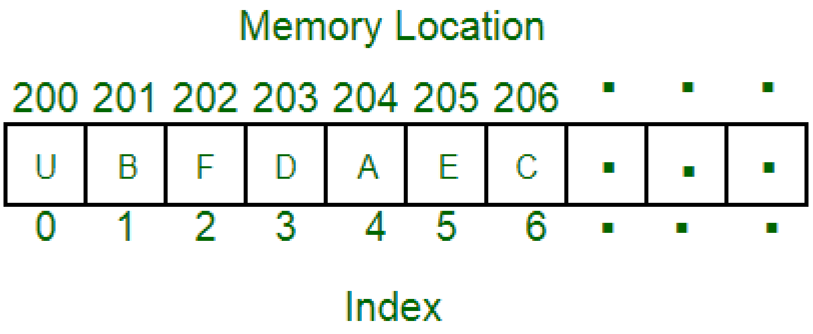
A data structure is not only used for organizing the data. It is also used for processing, retrieving, and storing data. There are different basic and advanced types of data structures that are used in almost every program or software system that has been developed. So we must have good knowledge about data structures.

Classification of Data Structure:



linearly, where each element is attached to its previous and next adjacent elements, is called a linear data structure.
Examples of linear data structures are array, stack, queue, linked list, etc.
  - **Static data structure:** Static data structure has a fixed memory size. It is easier to access the elements in a static data structure.
    An example of this data structure is an array.
  - **Dynamic data structure:** In dynamic data structure, the size is not fixed. It can be randomly updated during the runtime which may be considered efficient concerning the memory (space) complexity of the code.
    Examples of this data structure are queue, stack, etc.
- **Non-linear data structure:** Data structures where data elements are not placed sequentially or linearly are called non-linear data structures. In a non-linear data structure, we can't traverse all the elements in a single run only.
  Examples of non-linear data structures are trees and graphs.

For example, we can store a list of items having the same data-type using the *array* data structure.



Array Data Structure

This page contains detailed tutorials on different data structures (DS) with topic-wise problems.

Introduction to Data Structures:

- What is Data Structure: Types, Classifications and Applications
- Introduction to Data Structures
- Common operations on various Data Structures

Popular types of Data Structures:

- Stack
- Queue
- Heap
- Hashing
- Misc
- Advanced Data Structure

Overview:

- Overview of Data Structures | Set 1 (Linear Data Structures)
- Overview of Data Structures | Set 2 (Binary Tree, BST, Heap and Hash)
- Overview of Data Structures | Set 3 (Graph, Trie, Segment Tree and Suffix Tree)
- Abstract Data Types

Linked List:

Singly Linked List:

1. Introduction to Linked List
2. Linked List vs Array
3. Linked List Insertion
4. Linked List Deletion (Deleting a given key)
5. Linked List Deletion (Deleting a key at given position)
6. A Programmer's approach of looking at Array vs. Linked List
7. Find Length of a Linked List (Iterative and Recursive)
8. How to write C functions that modify head pointer of a Linked List?
9. Swap nodes in a linked list without swapping data
10. Reverse a linked list
11. Merge two sorted linked lists
12. Merge Sort for Linked Lists
13. Reverse a Linked List in groups of given size
14. Detect and Remove Loop in a Linked List
15. Add two numbers represented by linked lists | Set 1
16. Rotate a Linked List
17. Generic Linked List in C

ular Linked List:

3. Circular Linked List Traversal
4. Split a Circular Linked List into two halves
5. Sorted insert for circular linked list

Doubly Linked List:

1. Doubly Linked List Introduction and Insertion
2. Delete a node in a Doubly Linked List
3. Reverse a Doubly Linked List
4. The Great Tree-List Recursion Problem.
5. QuickSort on Doubly Linked List
6. Merge Sort for Doubly Linked List

All Articles of Linked List

Quiz on Linked List

Coding Practice on Linked List

Recent Articles on Linked List

Stack:

1. Introduction to Stack
2. Infix to Postfix Conversion using Stack
3. Evaluation of Postfix Expression
4. Reverse a String using Stack
5. Implement two stacks in an array
6. Check for balanced parentheses in an expression
7. Next Greater Element
8. Reverse a stack using recursion
9. Sort a stack using recursion
10. The Stock Span Problem
11. Design and Implement Special Stack Data Structure
12. Implement Stack using Queues
13. Design a stack with operations on middle element
14. How to efficiently implement k stacks in a single array?
15. Sort a stack using recursion

iz on Stack

Articles on Stack

Queue:

1. Queue Introduction and Array Implementation
2. Linked List Implementation of Queue
3. Applications of Queue Data Structure
4. Priority Queue Introduction
5. Deque (Introduction and Applications)
6. Implementation of Deque using circular array
7. Implement Queue using Stacks
8. Find the first circular tour that visits all petrol pumps
9. Maximum of all subarrays of size k
10. An Interesting Method to Generate Binary Numbers from 1 to n
11. How to efficiently implement k Queues in a single array?

Quiz on Queue

All Articles on Queue

Coding Practice on Queue

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Binary Tree:

1. Binary Tree Introduction
2. Binary Tree Properties
3. Types of Binary Tree
4. Handshaking Lemma and Interesting Tree Properties
5. Enumeration of Binary Tree
6. Applications of tree data structure
7. Tree Traversals
8. BFS vs DFS for Binary Tree
9. Level Order Tree Traversal
10. Diameter of a Binary Tree
11. Inorder Tree Traversal without Recursion
12. Inorder Tree Traversal without recursion and without stack!
13. Threaded Binary Tree
14. Maximum Depth or Height of a Tree

17. Construct Tree from given Inorder and Preorder traversals
18. Maximum width of a binary tree
19. Print nodes at k distance from root
20. Print Ancestors of a given node in Binary Tree
21. Check if a binary tree is subtree of another binary tree
22. Connect nodes at same level

Quiz on Binary Tree

Quiz on Binary Tree Traversals

All articles on Binary Tree

Coding Practice on Binary Tree

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Binary Search Tree:

1. Search and Insert in BST
2. Deletion from BST
3. Minimum value in a Binary Search Tree
4. Inorder predecessor and successor for a given key in BST
5. Check if a binary tree is BST or not
6. Lowest Common Ancestor in a Binary Search Tree.
7. Inorder Successor in Binary Search Tree
8. Find k-th smallest element in BST (Order Statistics in BST)
9. Merge two BSTs with limited extra space
10. Two nodes of a BST are swapped, correct the BST
11. Floor and Ceil from a BST
12. In-place conversion of Sorted DLL to Balanced BST
13. Find a pair with given sum in a Balanced BST
14. Total number of possible Binary Search Trees with n keys
15. Merge Two Balanced Binary Search Trees
16. Binary Tree to Binary Search Tree Conversion

All Articles on Binary Search Tree

Coding Practice on Binary Search Tree

Recent Articles on BST

Heap:

1. Binary Heap
2. Why is Binary Heap Preferred over BST for Priority Queue?
3. Binomial Heap
4. Fibonacci Heap
5. Heap Sort
6. K’th Largest Element in an array
7. Sort an almost sorted array/
8. Tournament Tree (Winner Tree) and Binary Heap

All Articles on Heap

Quiz on Heap

Coding Practice on Heap

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Hashing:

1. Hashing Introduction
2. Separate Chaining for Collision Handling
3. Open Addressing for Collision Handling
4. Print a Binary Tree in Vertical Order
5. Find whether an array is subset of another array
6. Union and Intersection of two Linked Lists
7. Find a pair with given sum
8. Check if a given array contains duplicate elements within k distance from each other
9. Find Itinerary from a given list of tickets
10. Find number of Employees Under every Employee

Quiz on Hashing

All Articles on Hashing

Coding Practice on Hashing

cent Articles on Hashing

1. Graph and its representations
2. Breadth First Traversal for a Graph
3. Depth First Traversal for a Graph
4. Applications of Depth First Search
5. Applications of Breadth First Traversal
6. Detect Cycle in a Directed Graph
7. Detect Cycle in a an Undirected Graph
8. Detect cycle in an undirected graph
9. Longest Path in a Directed Acyclic Graph
10. Topological Sorting
11. Check whether a given graph is Bipartite or not
12. Snake and Ladder Problem
13. Minimize Cash Flow among a given set of friends who have borrowed money from each other
14. Boggle (Find all possible words in a board of characters)
15. Assign directions to edges so that the directed graph remains acyclic

All Articles on Graph Data Structure

Quiz on Graph

Quiz on Graph Traversals

Quiz on Graph Shortest Paths

Quiz on Graph Minimum Spanning Tree

Coding Practice on Graph

Recent Articles on Graph

Advanced Data Structure:

Advanced Lists:

1. Memory efficient doubly linked list
2. XOR Linked List – A Memory Efficient Doubly Linked List | Set 1
3. XOR Linked List – A Memory Efficient Doubly Linked List | Set 2
4. Skip List | Set 1 (Introduction)
5. Self Organizing List | Set 1 (Introduction)
6. Unrolled Linked List | Set 1 (Introduction)

2. Segment Tree | Set 2 (Range Minimum Query)
3. Lazy Propagation in Segment Tree
4. Persistent Segment Tree | Set 1 (Introduction)

All articles on Segment Tree

Trie:

1. Trie | (Insert and Search)
2. Trie | (Delete)
3. Longest prefix matching – A Trie based solution in Java
4. Print unique rows in a given boolean matrix
5. How to Implement Reverse DNS Look Up Cache?
6. How to Implement Forward DNS Look Up Cache?

All Articles on Trie

Binary Indexed Tree:

1. Binary Indexed Tree
2. Two Dimensional Binary Indexed Tree or Fenwick Tree
3. Binary Indexed Tree : Range Updates and Point Queries
4. Binary Indexed Tree : Range Update and Range Queries

All Articles on Binary Indexed Tree

Suffix Array and Suffix Tree:

1. Suffix Array Introduction
2. Suffix Array nLogn Algorithm
3. kasai's Algorithm for Construction of LCP array from Suffix Array
4. Suffix Tree Introduction
5. Ukkonen's Suffix Tree Construction – Part 1
6. Ukkonen's Suffix Tree Construction – Part 2
7. Ukkonen's Suffix Tree Construction – Part 3
8. Ukkonen's Suffix Tree Construction – Part 4,
9. Ukkonen's Suffix Tree Construction – Part 5
10. Ukkonen's Suffix Tree Construction – Part 6
11. Generalized Suffix Tree
12. Build Linear Time Suffix Array using Suffix Tree
13. Substring Check

16. Longest Common Substring, Longest Palindromic Substring

All Articles on Suffix Tree

AVL Tree:

1. AVL Tree | Set 1 (Insertion)
2. AVL Tree | Set 2 (Deletion)
3. AVL with duplicate keys

Splay Tree:

1. Splay Tree | Set 1 (Search)
2. Splay Tree | Set 2 (Insert)

B Tree:

1. B-Tree | Set 1 (Introduction)
2. B-Tree | Set 2 (Insert)
3. B-Tree | Set 3 (Delete)

Red-Black Tree:

1. Red-Black Tree Introduction
2. Red Black Tree Insertion.
3. Red-Black Tree Deletion
4. Program for Red Black Tree Insertion

All Articles on Self-Balancing BSTs

Dimensional Tree:

1. KD Tree (Search and Insert)

Others:

1. Treap (A Randomized Binary Search Tree)
2. Ternary Search Tree
3. Interval Tree
4. Implement LRU Cache
5. Sort numbers stored on different machines
6. Find the k most frequent words from a file
7. Given a sequence of words, print all anagrams together
8. Tournament Tree (Winner Tree) and Binary Heap
9. Decision Trees – Fake (Counterfeit) Coin Puzzle (12 Coin Puzzle)
10. Spaghetti Stack
11. Data Structure for Dictionary and Spell Checker?
12. Cartesian Tree
13. Cartesian Tree Sorting
14. Sparse Set
15. Centroid Decomposition of Tree
16. Gomory-Hu Tree

Recent Articles on Advanced Data Structures.

Array:

1. Search, insert and delete in an unsorted array
2. Search, insert and delete in a sorted array
3. Write a program to reverse an array
4. Leaders in an array
5. Given an array A[] and a number x, check for pair in A[] with sum as x
6. Majority Element
7. Find the Number Occurring Odd Number of Times
8. Largest Sum Contiguous Subarray
9. Find the Missing Number
10. Search an element in a sorted and pivoted array
11. Merge an array of size n into another array of size m+n
12. Median of two sorted arrays
13. Program for array rotation
14. Reversal algorithm for array rotation

17. Sort elements by frequency | Set 1
18. Count Inversions in an array

All Articles on Array

Coding Practice on Array

Quiz on Array

Coding Practice on Array

Recent Articles on Array

Matrix:

1. Search in a row wise and column wise sorted matrix
2. Print a given matrix in spiral form
3. A Boolean Matrix Question
4. Print unique rows in a given boolean matrix
5. Maximum size square sub-matrix with all 1s
6. Print unique rows in a given boolean matrix
7. Inplace M x N size matrix transpose | Updated
8. Dynamic Programming | Set 27 (Maximum sum rectangle in a 2D matrix)
9. Strassen’s Matrix Multiplication
10. Create a matrix with alternating rectangles of O and X
11. Print all elements in sorted order from row and column wise sorted matrix
12. Given an n x n square matrix, find sum of all sub-squares of size k x k
13. Count number of islands where every island is row-wise and column-wise separated
14. Find a common element in all rows of a given row-wise sorted matrix

All Articles on Matrix

Coding Practice on Matrix

Recent Articles on Matrix.

Misc:

1. Commonly Asked Data Structure Interview Questions | Set 1
2. A data structure for n elements and O(1) operations
3. Expression Tree

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