

# Data Structure

## Introduction :-

Any program is written to process one or more data. To be processed the data is needed to be stored in the computer's memory. If we have to work with an individual information we just store them by defining a variable. But when we need to work with a collection of data items. We need to follow some organisation to correlate those data items when stored in the memory.

The most common way to organise the data each hierarchy of -  
(bit  $\rightarrow$  byte  $\rightarrow$  field  $\rightarrow$  record  $\rightarrow$  files)

But this hierarchy of organisation is not suitable to handle every situation. In some situations we need to organise our data in some different way. The physical or logical model of a data organisation



is called data structure.

In another way, we say that data structure represents the mathematical and logical relationship in between the data items of a group of list.

So, many data structures are available in the world of programming. According to the mode in which they are stored in the memory, the data structure can be divided into two types-

- (A) Static data structure
- (B) Dynamic data structure

#### (A) Static data structure:-

It is also called as array. The data items forming the array are stored contiguously in the memory location. Therefore if the address of one data item is known, we can easily calculate the address of other data items of array coming after or before. It means the element





of an array are related physically or mathematically. For this reason we must have to know about the size of the array before its creation and it would be stable during the execution of the procedure therefore called as static data structure.

### (B) Dynamic data structure :-

A data structure is said to be as dynamic when its size is not predefined and after the creation it could be shrinked or grown because the items of the structure are not stored in contiguous memory location, rather they are stored in the memory in scattered form. Each of the item correlates with the item coming next by a pointer or link holding the addresses. A dynamic structure is commonly called as linked list.

All the data structures are stored in the memory as an array or as a linked list but to fulfill our



different requirements we provide some limitations and models the array or linked list in some logical manner. According to the logical structure of list or collection, the data structure are classified linear or non-linear.

### (a) Linear data structure :-

In the linear data structure all data items are present in a sequence, that means such a data structure can be traversed either from beginning to end or from end to beginning. The examples are Array, Linked list, Stack.

### (b) Non-linear data structure :-

The items of non-linear structured are not present in a sequence rather they are organised in hierarchical model or as collection of pairs.

The examples are tree, heap, graph.



① Array :- Array is collection of similar type of data item which are stored in contiguous memory location that means, the element of array have mathematical relationship therefore the array is static in nature.

Array may be of two types -

(i) Single Dimensional Array

(ii) Multi-Dimensional Array

②. Linked List - linked list is also a linear structure but the data items are not stored contiguously rather they are connected together by holding the address of nodes coming after in a pointer or link. A collection of data value along with the link make a node. The list is developed by adding the nodes. The nodes can be inserted or deleted from any where, thus the link<sup>list</sup> is dynamic in nature. The list is accessed through a pointer holding the address of the first node commonly called



as start or home.

There are three types of linked list -

- (i) Single linked list
- (ii) Doubly linked list
- (iii) Circular linked list

(3). Stack:- A bundle of things gathered one upon another is called a stack. Anything can be put to this stack on its top and anything from the top of the stack can only be removed. If an array or linked list is organised with the same fashion that the data items can be inserted or deleted to or from the top, it is called stack. The stack is also known as LIFO List.

(4). Queue:- Queue is a data structure organised with the constraint that the insertion of data items can be done from one point called as rear of the queue and deletion of the data item can be done from the opposite point called as front of the



queue. The queue is also called FIFO list.

⑤ Tree:- A tree is a non-linear collection of data items where each of the data items is called as a node. The nodes are collected in a hierarchical relationship with in which a parent child relationship exists. Each of the tree has multiple levels where at the top level there would be a single node called as roots of the tree. The tree has so many sub-types such as general tree, binary tree, binary search tree, threaded tree, etc.

⑥ Heap:- Heap is also a hierarchical structure. Actually heap is a binary tree with two properties. These properties are shape property and order property.

The shape property describes that the heap will always be a complete binary tree that means at each level it has the maximum number of nodes.



The order property describes that each node has all its children either smaller than the node or the larger than the node called as min-heap and max-heap respectively.

(7). Graph - A graph is an ordered set of  $(V, E)$  where  $V$  is called a vertex or element and  $E$  is called an edge which connects the vertices. That means a graph is a collection of pairs not necessarily present in hierarchical structure.