# ***Data Structures***

What is data? Data is the integral part of the programs/applications.

Program: If I defined a program, Program is the set of instruction which perform some operation to get result. Without data there is no meaning of instruction.

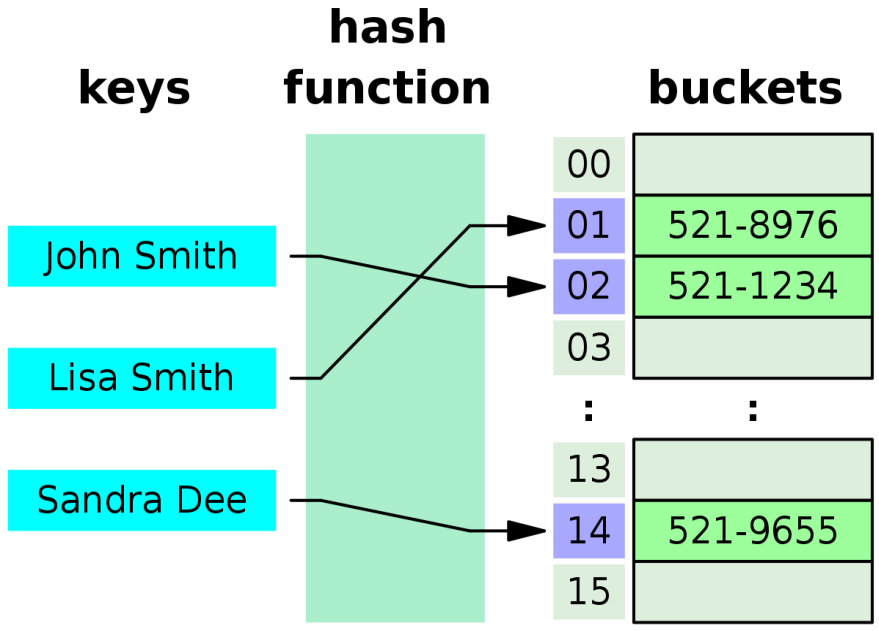
Data use in many place-

- Data structure
- Data bases
- Data Warehouse
- Big Data

What is Data Structure?

In computer science, a data structure is a data organization, management, and storage format that is usually chosen for efficient access to data. More precisely, a data structure is a collection of data values, the relationships among them, and the functions or operations that can be applied to the data, i.e., it is an algebraic structure about data.

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.



## Usage

Data structures serve as the basis for abstract data types (ADT). The ADT defines the logical form of the data type. The data structure implements the physical form of the data type.

Different types of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks. For example, relational databases commonly use B-tree indexes for data retrieval, while compiler implementations usually use hash tables to look up identifiers.

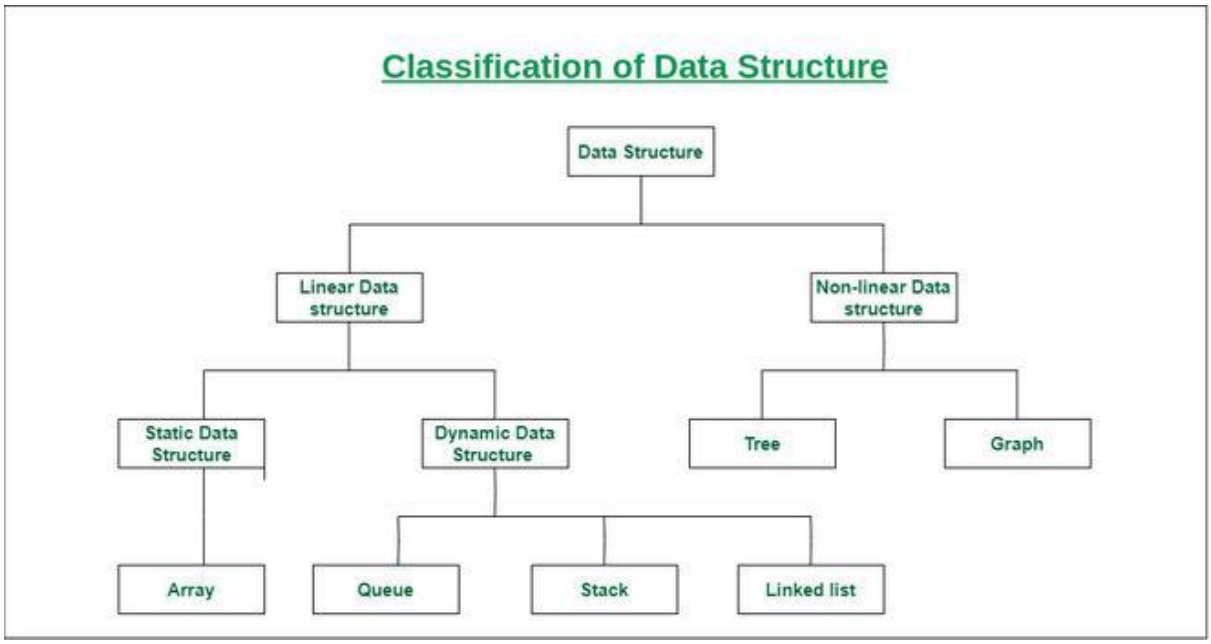
Data structures provide a means to manage large amounts of data efficiently for uses such as large databases and internet indexing services. Usually, efficient data structures are key to designing efficient algorithms. Some formal design methods and programming languages emphasize data structures, rather than algorithms, as the key organizing factor in software design. Data structures can be used to organize the storage and retrieval of information stored in both main memory and secondary memory.[8]

## Implementation

Data structures are generally based on the ability of a computer to fetch and store data at any place in its memory, specified by a pointer—a bit string, representing a memory address, that can be itself stored in memory and manipulated by the program. Thus, the array and record data structures are based on computing the addresses of data items with arithmetic operations, while the linked data structures are based on storing addresses of data items within the structure itself.

The implementation of a data structure usually requires writing a set of procedures that create and manipulate instances of that structure. The efficiency of a data structure cannot be analyzed separately from those operations. This observation motivates the theoretical concept of an abstract data type, a data structure that is defined indirectly by the operations that may be performed on it, and the mathematical properties of those operations (including their space and time cost).

## Classification of Data Structure:




*Classification of Data Structure*

- **Linear data structure:** Data structure in which data elements are arranged sequentially or 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.*