

DATA STRUCTURES AND NUMERICAL METHODS

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Introduction to Data Structure

Computer is an electronic machine which is used for data processing and manipulation.

- When programmer collects such type of data for processing, he would require to store all of them in computer's main memory.
- In order to make computer work we need to know
 - ❖ Representation of data in computer.
 - ❖ Accessing of data.
 - ❖ How to solve problem step by step.
- For doing this task we use data structure.

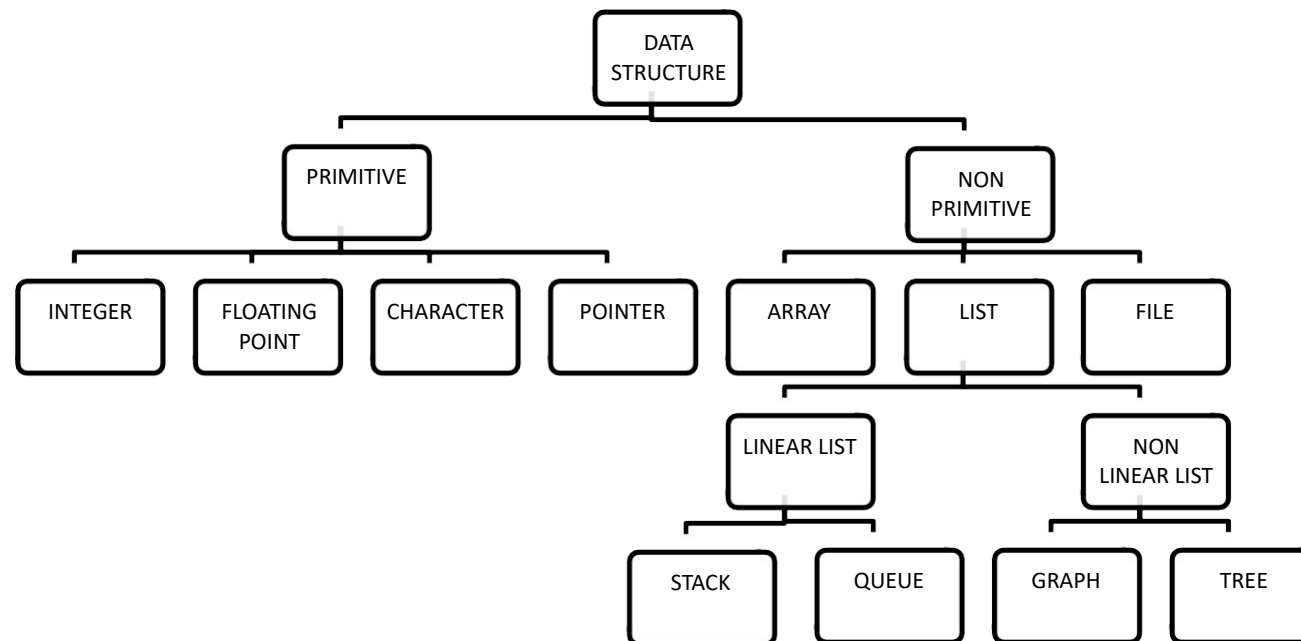
What is Data Structure?

- **Data structure** is a representation of the logical relationship existing between individual elements of data.
- Data Structure is a way of organizing all data items that considers not only the elements stored but also their relationship to each other.
- We can also define data structure as a mathematical or logical model of a particular organization of data items.
- **The representation of particular data structure in the main memory of a computer is called as storage structure.**
- **The storage structure representation in auxiliary memory is called as file structure.**
- It is defined as the way of storing and manipulating data in organized form so that it can be used efficiently.
- Data Structure mainly specifies the following four things
 - ❖ Organization of Data
 - ❖ Accessing methods
 - ❖ Degree of associativity
 - ❖ Processing alternatives for information
- Algorithm + Data Structure = Program

Introduction to Data Structure

- Data structure study covers the following points
 - ❖ Amount of memory require to store.
 - ❖ Amount of time require to process.
 - ❖ Representation of data in memory.
 - ❖ Operations performed on that data.

Classification of Data Structure



Introduction to Data Structure

Data Structures are normally classified into two broad categories

- Primitive Data Structure
- Non-primitive data Structure

Data types

A particular kind of data item, as defined by the values it can take, the programming language used, or the operations that can be performed on it.

Primitive Data Structure

- Primitive data structures are basic structures and are directly operated upon by machine instructions.
- Primitive data structures have different representations on different computers.
- Integers, floats, character and pointers are examples of primitive data structures.
- These data types are available in most programming languages as built in type.
 - Integer: It is a data type which allows all values without fraction part. We can use it for whole numbers.
 - Float: It is a data type which is used for storing fractional numbers.
 - Character: It is a data type which is used for character values.
 - Pointer: A variable that holds memory address of another variable is called pointer.

Non primitive Data Type

- These are more sophisticated data structures.
- These are derived from primitive data structures.
- The non-primitive data structures emphasize on structuring of a group of homogeneous or heterogeneous data items.
- Examples of Non-primitive data type are Array, List, and File etc.

Introduction to Data Structure

- A Non-primitive data type is further divided into Linear and Non-Linear data structure
 - **Array:** An array is a fixed-size sequenced collection of elements of the same data type.
 - **List:** An ordered set containing variable number of elements is called as Lists.
 - **File:** A file is a collection of logically related information. It can be viewed as a large list of records consisting of various fields.

Linear data structures

- A data structure is said to be Linear, if its elements are connected in linear fashion by means of logically or in sequence memory locations.
- There are two ways to represent a linear data structure in memory,
 - Static memory allocation
 - Dynamic memory allocation
- The possible operations on the linear data structure are: Traversal, Insertion, Deletion, Searching, Sorting and Merging.
- Examples of Linear Data Structure are Stack and Queue.
- Stack: Stack is a data structure in which insertion and deletion operations are performed at one end only.
 - The insertion operation is referred to as 'PUSH' and deletion operation is referred to as 'POP' operation.
 - Stack is also called as Last in First out (LIFO) data structure.
- Queue: The data structure which permits the insertion at one end and Deletion at another end, known as Queue.
 - End at which deletion is occurs is known as FRONT end and another end at which insertion occurs is known as REAR end.
 - Queue is also called as First in First out (FIFO) data structure.

Introduction to Data Structure

Nonlinear data structures

- ◆ Nonlinear data structures are those data structure in which data items are not arranged in a sequence.
- ◆ Examples of Non-linear Data Structure are Tree and Graph.
- ◆ Tree: A tree can be defined as finite set of data items (nodes) in which data items are arranged in branches and sub branches according to requirement.
 - Trees represent the hierarchical relationship between various elements.
 - Tree consist of nodes connected by edge, the node represented by circle and edge lives connecting to circle.
- **Graph:** Graph is a collection of nodes (Information) and connecting edges (Logical relation) between nodes.
 - A tree can be viewed as restricted graph.
 - Graphs have many types:
 - Un-directed Graph
 - Directed Graph
 - Mixed Graph
 - Multi Graph
 - Simple Graph
 - Null Graph
 - Weighted Graph

Introduction to Data Structure

Difference between Linear and Non Linear Data Structure

Linear Data Structure	Non-Linear Data Structure
Every item is related to its previous and next time.	Every item is attached with many other items.
Data is arranged in linear sequence.	Data is not arranged in sequence.
Data items can be traversed in a single run.	Data cannot be traversed in a single run.
Eg. Array, Stacks, linked list, queue.	Eg. tree, graph.
Implementation is easy.	Implementation is difficult.