DATA STRUCTURE

CHAPTER – 1

INTRODUCTION AND OVERVIEW

Recommended books

- **Data Structures** By **Seymour Lipschutz** [Schaum's Outline]

- **An Introduction to Data structures with Applications** by **Tremblay and Sorenson**

LECTURE 1 CONTENTS:-

- Overview
- Basic Terminology
- Introduction to Data Structure
- Data Structure Types
- Data Structure Operations
- Selecting a data structure

OVERVIEW:-

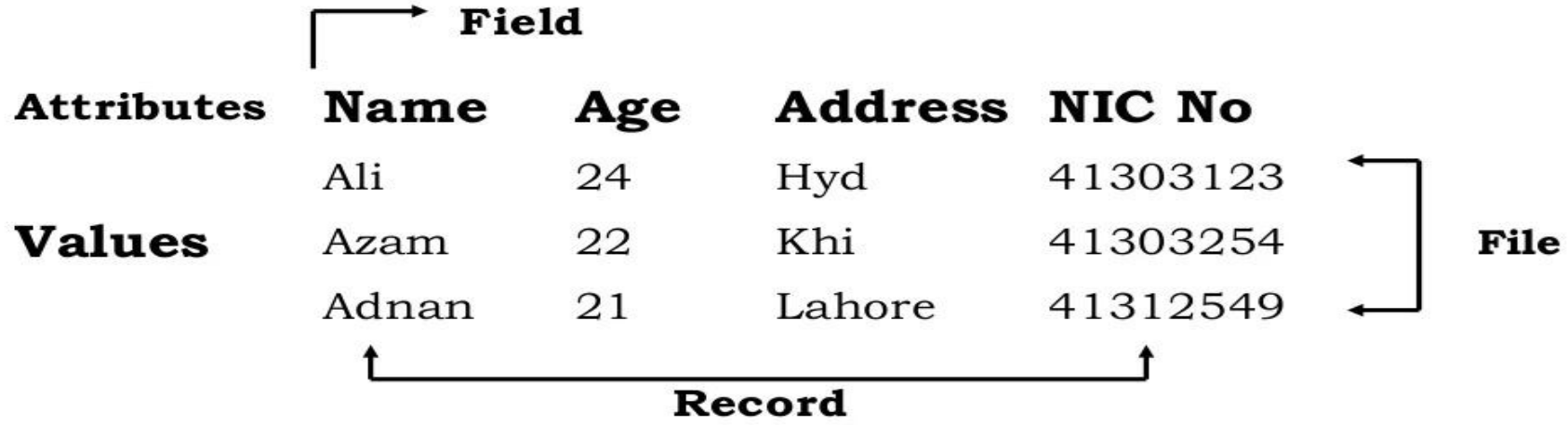
- The study of computer science teaches us how to use computers and how to organize the data so that they can be manipulated by a program.
- The term data structure refers to a scheme for organizing data into memory.
- Organization of data in some cases is of immense importance. Therefore, the data will be stored in a special way so that the required result should be calculated as fast as possible.

BASIC TERMINOLOGY:

- **DATA:** Data are simply values or set of values. Or data is raw material which we fed in computer for processing.
- **DATA ITEMS:** A data item refers to a single unit of values.
- **GROUP ITEMS:** Data items that are divided into sub items are called group items.

  e.g an employee's name may divide into three sub items, first name, middle name, and last name.

- In data structure collection of data is frequently organized in to hierarchy of fields, records and files.
- **FIELD:** a field is an single elementary unit of information representing an attribute of an entity.
- **RECORD:** A record is a collection of field values of a given entity.
- **FILE:** A file is a collection of records of the entities in a given entity set.



STRUCTURE:

DATA STRUCTURE: A data structure is specialized format for organizing and storing data.

OR

In computer science, a **DATA STRUCTURE** is a way of storing data in a computer memory so that it can be used efficiently.

Importance of Data Structure

- Let's discuss why we need data structures and what sort of problems can be solved with their use. Data structures help us to organize the data in the computer, resulting in more efficient programs.

- An efficient program executes faster and helps minimize the usage of resources like memory, disk.

- Computers are getting more powerful with the passage of time with the increase in CPU speed in GHz, availability of faster network and the maximization of disk space. Therefore people have started solving more and more complex problems.

What does organizing the data mean?

- It means that the data should be arranged in a way that it is easily accessible.
- Because data is inside the computer and we want to see it. We may also perform some calculations on it.
- Suppose the data contains some numbers and the programmer wants to calculate the average, standard deviation etc. May be we have a list of names and want to search a particular name in it. To solve such problems, data structures and algorithm are used.
- Sometimes you may realize that the application is too slow and taking more time. There are chances that it may be due to the data structure used, not due to the CPU speed and memory.

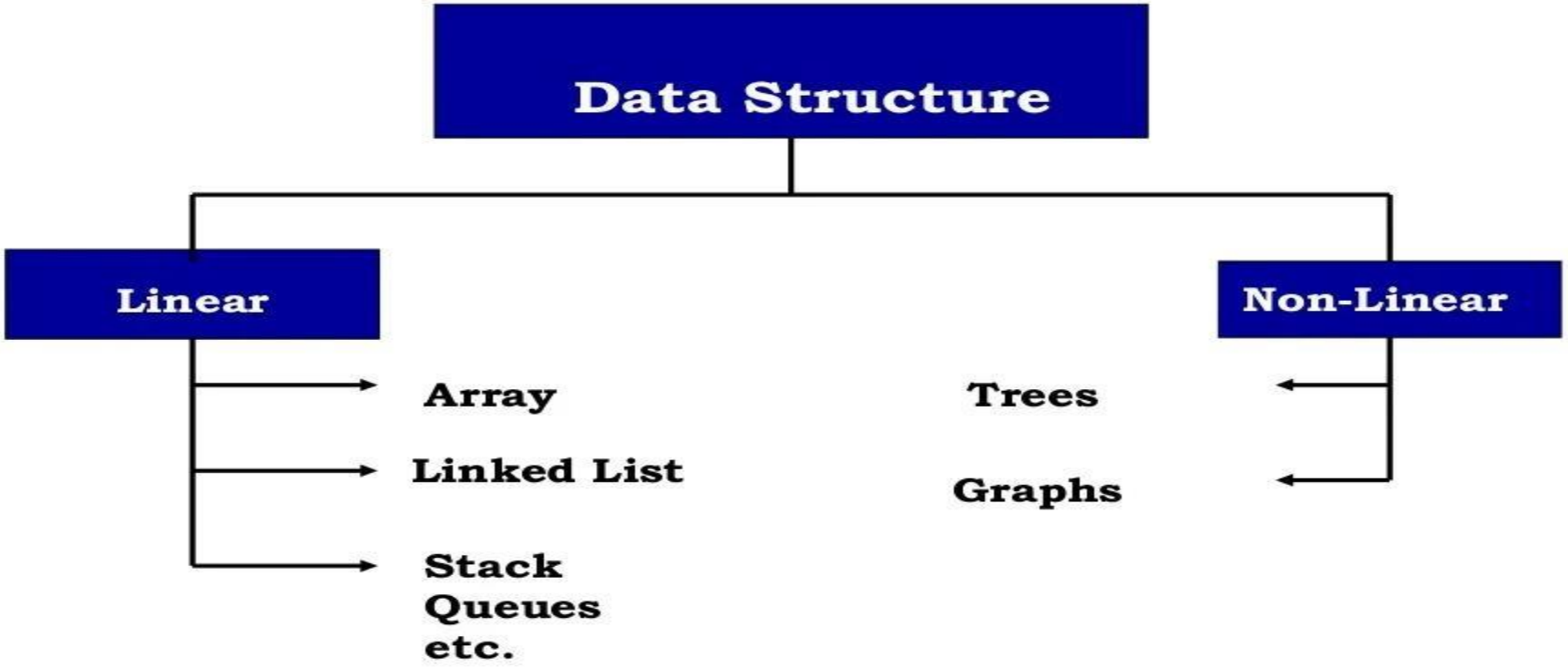
DATA STRUCTURE TYPES:-

- Data structure are classified either Linear or non-linear.

- LINEAR DATA STRUCTURE: A data structure is linear if every item is related (or attached) to its pervious and next item (e.g Array, Linked list)

- NON-LINEAR DATA STRUCTURE: A data structure is non-linear if every item is attached to many other items in specific ways to reflect relationships (e.g Trees)

DATA STRUCTURES TYPES CONT....



DATA STRUCTURE OPERATIONS:-

- The data appearing in our data structure is processed by means of certain operations.
- The following four operations play a major role:

- Transversing
- Searching
- Inserting
- Deleting

- **TRANSVERSING:** Accessing each record exactly once so that certain items in the record may be processed.

  This accessing or processing is sometimes called 'visiting' the records.

- **SEARCHING:** finding the location of the record or finding the location of all records, which satisfy one or more conditions.

- **INSERTING:** Adding new records to the structure.

- **DELETING:** Removing a record from the structure.

DATA STRUCTURE OPERATIONS CONT…

- The following two operations which are used in special situations will also be considered.
- **SORTING:** Arranging the records in some logical orders.
- **MERGING:** Combining the records in two different sorted files into a single file.

SELECTING A DATA STRUCTURE:-

- How we can select the data structure?
- There are different kinds of data structure suited to different kinds of applications and some are highly specialized to certain tasks.
- Whenever we need to select a data structure we must keep some points in mind.
- Select the data structure as follows:

- **First of all, we have to analyze the problem to determine the resources constraints that a solution must meet.**
- **Secondly, it is necessary to determine the basic operations that must be supported. Quantify the resources constraints for each operations.**
- **Finally, select the data structure that meets these requirements the maximum.**

Algorithm Design/Specifications

- Algorithm: Finite set of instructions that, if followed, accomplishes a particular task.
- Describe: in natural language / pseudo-code / diagrams / etc.
- Criteria to follow:
  - Input: Zero or more quantities (externally produced)
  - Output: One or more quantities
  - Definiteness: Clarity, precision of each instruction
  - Effectiveness: Each instruction has to be basic enough and feasible
  - Finiteness: The algorithm has to stop after a finite (may be very large) number of steps

Implementation, Testing and Maintenance

- Implementation
  - Decide on the programming language to use
    - C, C++, Python, Java, Perl, etc.
  - Write clean, well documented code

- Test, test, test

- Integrate feedback from users, fix bugs, ensure compatibility across different versions → Maintenance

Algorithm Analysis

- Space complexity
  - How much space is required
- Time complexity
  - How much time does it take to run the algorithm