Data Structures and Algorithms

RECOMMENDED BOOKS

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

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

- Data

- Structure

- Algorithm

- Data are values or a set of values
- Data item refers to single unit of values
- Data item
  - Group item :
    Data item that can be subdivided into sub item.
    Ex Name : First Name, Middle initial and Last Name
  - Elementary item:
    Data item that can not be sub divided into sub item
    Ex : PAN card number / Bank Pass Book Number is treated as single item

Collection of data are frequently organized into a hierarchy of fields, records and files

- Entity :
  - Something that has certain attributes or properties which may be assigned values
  - Values may be numeric or non-numeric

- Ex: The employee of an organization

Attributes	Name	Age	Sex	Employee Code
Values	John	33	M	13472

- **Entity** with similar attributes (e.g all employees of an organization) form an **entity set**

- Each attribute of an entity set has a **range of values** [the set of possible values that could be assigned to the particular attribute]

- **Information**: Data with given attribute or processed data

- **Field** is a single elementary unit of information representing an attribute of an entity

- **Record** is the collection of field values of a given entity

- **File** is the collection of records of the entities in a given entity set

Name	Age	Sex	Roll Number	Branch
A	17	M	109cs0132	CSE
B	18	M	109ee1234	EE
C	19	F	109ce0012	CE
D	20	F	108mm0132	MM

Record

- Fixed Length
- Variable Length

- Study of Data Structure includes the following three steps
  - Logical or Mathematical description of the structure
  - Implementation of the structure on a computer
  - Quantitative analysis of the structure, which includes determining the amount of memory needed to store the structure and the time required to process the structure

DATA TYPES

- A data type is a term which refers to the kind of data that may appear in computation.
- Ex: in C
  - int, float, char, double, long double, etc.

- ❑ Data Structure
  - ❑ The logical or mathematical model of a particular organization of data

- ❑ Choice of a model depends on two factor
  - ❑ It must be rich enough in structure to mirror the actual relationships of the data in the real world
  - ❑ The structure should be simple enough that one can effectively process the data when necessary

Customer	Salesperson
Adams	Smith
Brown	Ray
Clark	Jones
Drew	Ray
Evans	Smith
Farmer	Jones
Geller	Ray
Hill	Smith

Customer	Pointer
Adams	3
Brown	2
Clark	1
Drew	2
Evans	3
Farmer	1
Geller	2
Hill	3

Salesperson
Jones
Ray
Smith

Customer	Pointer
Adams	3
Brown	2
Clark	1
Drew	2
Evans	3
Farmer	1
Geller	2
Hill	3

Salesperson	Pointer
Jones	3,6
Ray	2,4,5,7
Smith	1,5,8

Customer	Pointer
Adams	5
Brown	4
Clark	6
Drew	7
Evans	8
Farmer	0
Geller	0
Hill	0

Salesperson	Pointer
Jones	3
Ray	2
Smith	1

DATA STRUCTURES

- A data structure is a way to logically organize data that specifies:
  - A set of data elements i.e., a data object and
  - A set of operations which may legally be applied to elements of this data object.

OPERATIONS

- Data appearing in DS are processed by means of certain operation

- Particular DS one chooses for a given situation depends largely on the frequency with which specific operations are performed

MAJOR OPERATION

❑ Traversing: Accessing each record exactly once so that certain items in the record may be processed

[Also known as Visiting the record]

❑ Searching: Finding the location of the record with a given key value, or finding the locations of all record which satisfy one or more conditions

MAJOR OPERATION

- Inserting : Adding a new record to the structure

- Deleting : Removing a record from the structure

DATA STRUCTURES

- In real life applications, various kind of data other than the primitive data are involved.
- Manipulation of real-life data (user data) requires the following essential tasks:

a) *Storage representation of user data*: User data should be stored in such a way that computer can understand

b) *Retrieval of stored data*: Data stored in a computer should be retrieved in such a way that user can understand.

c) *Transformation of user data*: Various operations which require to be performed on user data so that it can be transformed from one form to another.

CLASSIFICATION OF DATA STRUCTURES

Classic data structure

Linear data structure
- Arrays
- Linked List
- Stack
- Queues

Non-linear data structure
- Tree
- Graph
- Tables
- Sets