Unit - I

01-07-19

Introduction.

- **Data :**
  - Data are simply values or set of values.
  - A data item refers to single unit of values.
  - Data items that are divided into sub items called group items those that are not called elementary items.
  - for eg:
    A student name or employee name may be divided into 3 sub items i.e., first name, middle name & last name but Roll No. should normally be treated as single item.

  - Collection of data are frequently organized into hierachy of fields records & files.
  - An entity is something that has certain attributes or properties which may be assign values. The values may be either numeric or non-numeric.

  - for eg:

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The following are possible attributes & their corresponding values for an entity, an employee of a given organisation

- **Employee :**

Attri.	E-ID	E-Name	E-Age	E-sex	E-dept	E-dis
values	134-42-13	XYZ	25	M	CS	professor.

Transversing : open & close & visiting files.

- Entities with similar attributes form an entity set each attributes of an entity set has a range of value, the set of all possible values that could be assign to the particular attribute.

- The term "information" is sometimes used for data with given attributes in other words meaningful or proceed data. The way that data are organized into the hierarchy of fields, records & files reflects the relationship between attributes, entities & entity set i.e., a field is a single elementary unit to information representing an attributes of an entity, records is the collection of field values of a given entity & a file is the collection of records of the entities in a given entity set.

- Each record in file may contain many field items but the value in a certain field may uniquely determined record in the file such a field 'K' is called primary key & the values $K = K_1, K_2, K_3 \ldots, K_n$. In such field are called keys or keys value.

Eg. Suppose an automobile delearship maintain an eventary file where each record contains the following data.

Ser No.	Type	year	price	Accessories

The sr. no. fields can serve as a primary key for the file, since each automobile has a unique serial no.

Eg. Suppose an organisation maintain a membership file where each record contains the following data.

Name	address	telephone no.	Dues.

There are 4 data items name & address may be group items. Here the name field is a primary keys some members may belong to the some family & have the same address & telephone no.

- Record may be also classified according to length. A file can have fixed length record or variable length records.
- In fixed length records, all the records contains the same data items with same amount of space assign to each data items.
- In variable length records file records may contain different length.

Eg. Student records usually have variable length, since different students take different no. of courses usually variable length records have minimum & maximum length.

- The above organisation of data into fields records & file may not be complex enough to maintain efficiently proceed certain collections of data for this reason - data are also organised into more complex types of structure. The study of such data structure which from the subject matter of this text include the

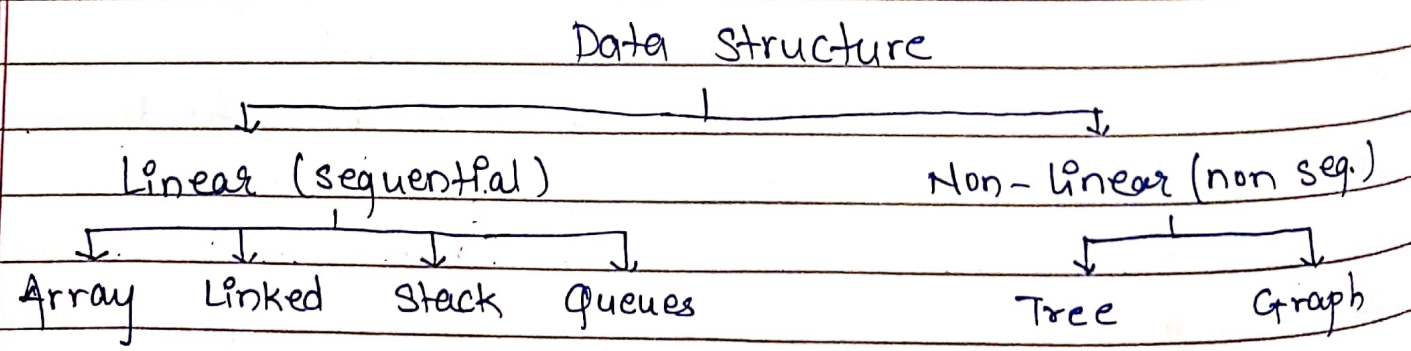
following three steps :

Step I: Logical or mathematical discription of structure.
Step II: Implementation analysis of the structure on computer.
Step III: Quantitative analysis of the structure which includes determining amount of memory needed to store the structure & time required to process the structure.

- **Data Structure :**
  Data may be organised in many different ways, the mathematical or logical method for a particular organization data is called data structure.

- The choice of particular data model depends on two considerations.
- It must be reach enough in structure to mirror the actual relationships of the data in real world.
- The structure should be simple enough that one can efficiently processed the data when necessary.

★ **Type of Data Structure :**



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I] Linear Array :

The simplest type of data structure is a linear array (1-D). It means a list of finite no. 'n' of similar data elements resp. by a set of 'n' consecutive nos usually 1, 2, 3, ... n. If we choose the name 'A' for the array then the elements of A denoted by subscript notation i.e., $A = a_1, a_2, a_3, \ldots a_n$.

$A = A_{(1)}, A_{(2)}, A_{(3)}, \ldots A_{(n)}$ → Paranthesis notation.

Regardless of the notation the no. 'K' in A[K] is called subscript of A[K] is called subscript variables.

for eg : STUDENTS

Raksha
Chaitanya
Priyanka
Vaishnavi
Pradnya

A linear array consisting of the name of 5 students pictured in above fig. Here, STUDENT [1] denotes Raksha then STUDENTS [2] denotes Chaitanya & so on.

Linear array are called 1-D array because each element in such an array is referrenced by 1 subscript.

A 2-D array is a collection of similar data elements where each element is referred by 2 subscript [Matrice] in mathematics or table.

Multidimensional array are difined analogously.

Store / Name	1	2	3
1	XYZ		
2	PQR		
3	ABC		

STUDENT [1,1] = XYZ
STUDENT [1,2] = PQR
STUDENT [1,3] = ABC

★ Linked List :

Serial No.	Customer	Salesperson
1	Adam	Smith
2	Brown	Ray
3	Clark	Jones
4	Drew	Ray
5	Evan	Smith
6	Farmer	Jones
7	Geller	Ray
8	Hill	Smith
9	Infield	Ray

Customer	Pointer
A	3
B	2
C	1
D	2
E	3
F	1
G	2
H	3
I	2

Salesperson				
Smith	1		1	Jones
Ray	2		2	Ray
Jones	3		3	Smith.

A list refers to the linear collections of data element or item like list of student, list of employee, list of grocery, etc.

A linked list or one-way list is a linear collection of data elements called node where the linear order is given by means of pointer.

Each node is divided into 2 parts. 1st part contain info & 2nd part contains link or next pointer field contains the address of next node in the list.

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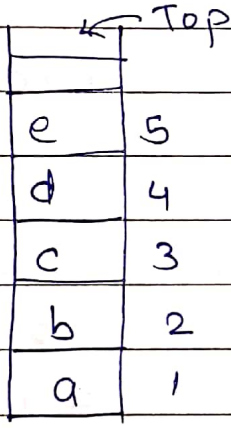
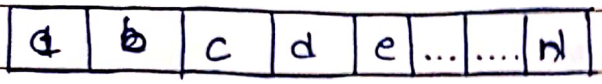
★ Stack :

- It is also called as last in first out (LIFO).
- It is a linear list in which insertions & deletions can take place only at one end called top of the stack. This structure is similar in its operation to stack of dishes.
- Note that new dishes are inserted only top of the stack & dishes can be deleted only from top of the stock

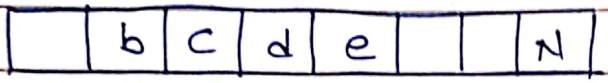


★ Queue :

- It is also called as first in first out [FIFO]. It is a linear list in which deletions can take place only at one end of the list.
- 'The Front' of the list & insertion can take place only at the other end of the list 'The Rare'.
- This structure operates in much the same way as a line of the pepple waiting at bus stop.



front : 1
Rear : 5.



front : 2
Rear : 5.

Non-Linear Data Structure :

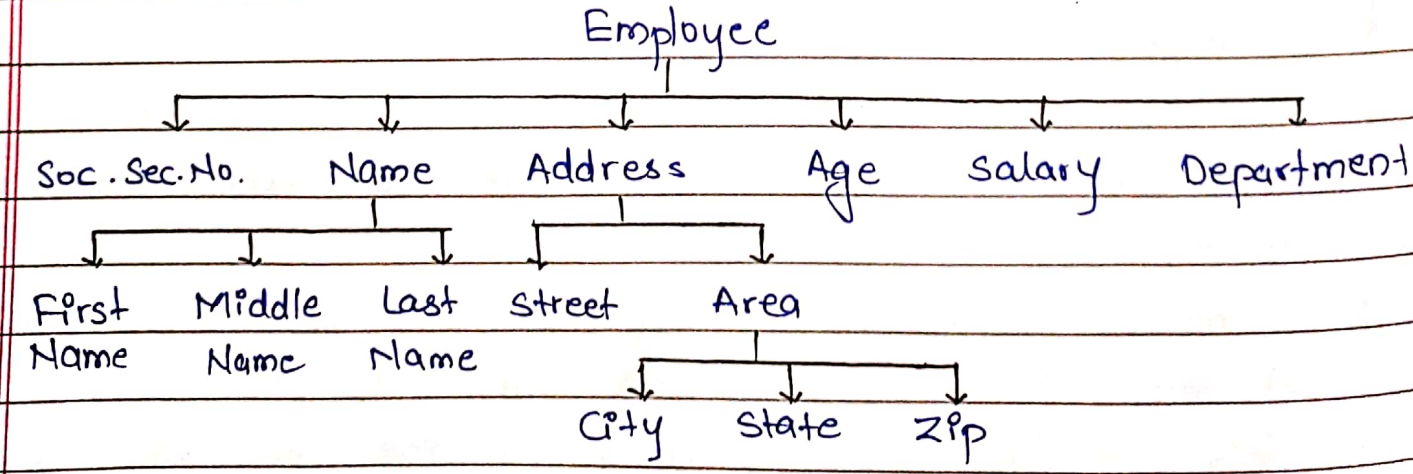
★ Tree :

Data frequently contain a hierarchical relationship between various elements. The data structure which reflects this relationship is called a rooted tree graph or simply a tree.

A tree is also called a binary tree. A binary tree 'T' is defines as a finite set of elements called nodes such that -

i) 'T' is empty, it is called null tree / empty tree.

ii) 'T' contain distinguish notes 'R' called root of 'T' & the remaining nodes of 'T' form an ordered pair of disjoint binary trees 'T_1' & 'T_2'.



★ Graph :

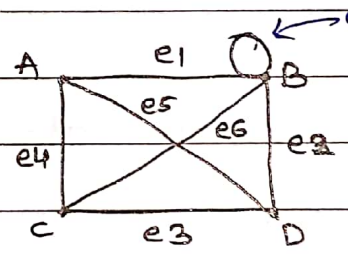
A data sometimes contain a relationship between pairs of elements which is not necessary hierachical in nature. The data structure which reflects this type of relationship is called graphs.

- Collection of nodes means graphs.
- A graph denoted by 'G' consist of two things.

i) A set of a 'V' elements called nodes (vertices).

ii) A set 'E' of edges such that each edge 'e' in 'E' is identified with a unique (unordered pair (u,v)) of nodes 'v' denoted by (e=u,v).

- The nodes u & v are called the end points of 'e' & u & v are said to be adjacent nodes or neighbour.



vertices = 4

edges = 6.

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★ Operation on Data Structure :

- Basic Operation

i) Traversing

ii) Insertion

iii) Deletion

iv) Searching

- Special Operation

i) Sorting ii) Merging

The data appearing in our data structure are processed by means of certain operation. The particular data structure that one chooses for a given situation depends largly on the frequency with which specific operation are performs. The most frequency used of these operation.

The following are four operation play measure role in text.

i) Traversing :

Accessing each record exactly once so that certain items in the record may be processed or visiting each records called traversing.

ii) Inserting :

Adding a new record into a structure is called inserting.

iii) Deleting :

Removing the record from structure is called deleting.

iv) Searching :

finding the location of record with a given key value or finding the location of record with statisfy one or more condition is called searching.

- There are two types of searching :

i) Linear Search

ii) Binary Search.

Some times two or more of the operation may be used in given situations.
Eg.: We may wait to delete the record with a given key which many we first need to search for the location of the record.

- The following two operation which are used in special situation.

i) Sorting :
Arranging the record in some logical order alphabetically to some NAME key or numerical order according to some number key.

ii) Merging :
Combining the record in two different sorted files into a single sorted files.

★ Algorithm Complexity :
An algorithm is well defined steps to solve a particular problem. One measure purpose of this step is to develop efficient algorithm for the processing of our data.
The time & space it uses a two major measures of the efficiently of an algorithm.
The complexity of an algorithm is the function which use the running. Time & space interms of the input size.

The notation of complexity is denoted by C(n).
Each algorithm involves particular data structure, we may not always be able to use the most efficient algorithm. because the choice of data structure depends on many things including the type of data & the frequency with which various data operation are applied.

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The choice of data structure involves time, space, trade of : by increasing the amount of space for storing the data one may be able to reduce the time needed for processing the data or voice ~versa.

following is an ideas illustrate this example with the help of searching methods.

- Consider a membership file in which each record contains among other data the name & telephone numbers of it's member. Suppose we are the given the name of member & we want to find his binary search through the file applying following algorithm.

★ Linear Search :

Search each record of the file one at a time until finding the given name & corresponding telephone number.

first of all it is clear that the time require to execute algorithm is proportional to the number of comparisons also assuming that each name in the file is equally like to be pick.

It is initially clear that the average no. of comparisons for a file with 'n' records is equal to n/2. The complexity of the linear search algorithm

is given by $C(n) = n/2$

* Binary search :

Compare the given name with the name in the middle of list this tells half of the list contain name. Then compare name with the name in the middle of correct half to ~~dete~~ determine which quater of the last contain name. Continuous the process until finding the name in list.

The complexity of binary search algorithm is $(cn) = \log_2 n$.

* Assignment

1. What is data structure. Explain types of data structure with example.
2. Explain operation of data structure.
3. What is algorithm. Explain complexity of algorithm.
4. What is Linear Array ? Explain representation of Linear array in memory.
5. What is traversing ? Write an algorithm for Traversing linear array.