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1. INTRODUCTION.

Basic terminologies:

'Data' refers to values / set of values
'Data item' refers to single unit of values.
Data items that can be divided into subitems are called "group items" while those that are not are called "elementary items"

Ex: Student name can be divided into first / last name
Student roll no cannot be divided.

Entity is something that has certain attributes or properties that can be assigned values.

Ex: Attributes:	Name.	Age.	Sex	Aadhar No.
Values	Aditya	30	M	xxxx 1234 xxxx

Entities with similar attributes for an "entity set"
Ex: Employees in an organization, students in college.

A field is a single unit of information representing an attribute of an entity.

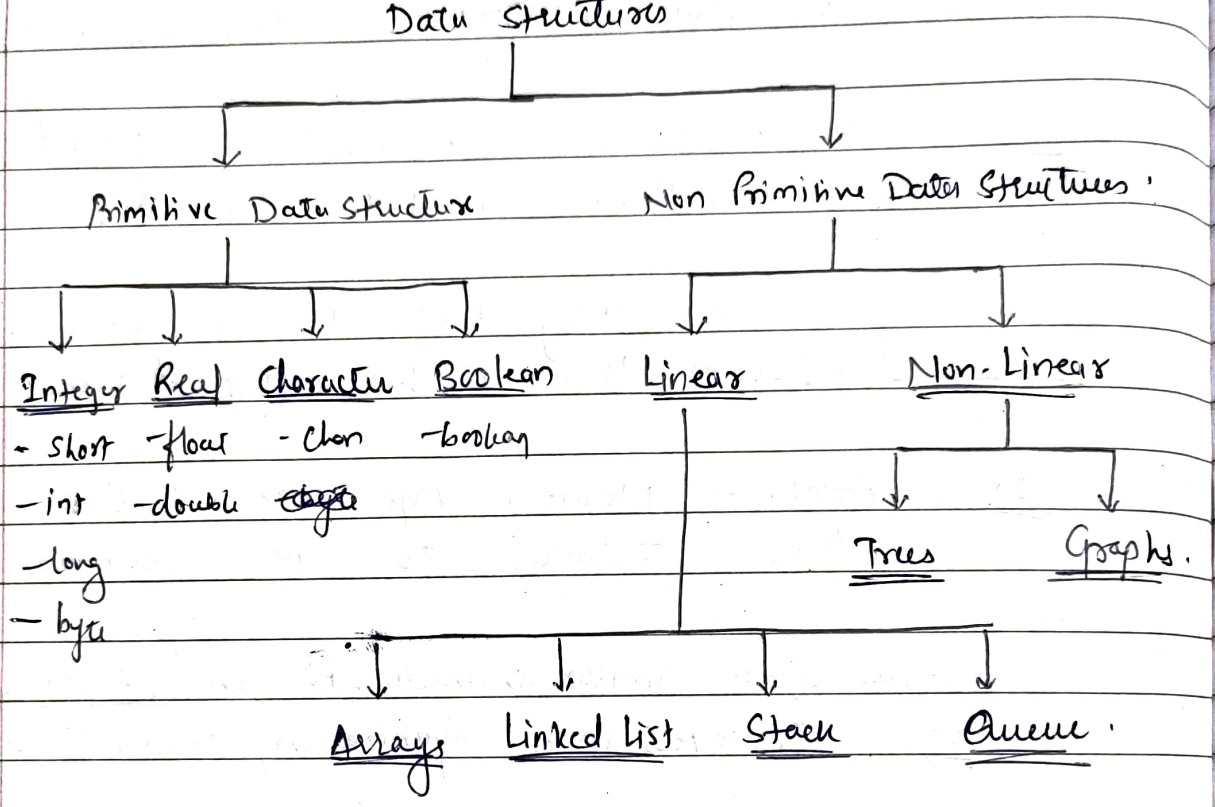
A record is a collection of field values of a given entity.

A file is the collection of records of the entities in entity set.

* Data Structures

The logical or mathematical model of a particular organization of data is called data structure.

Classification of Data Structures



A DS is said to be linear if its elements form a sequence or a linear list.
Here, data is arranged in a linear fashion although the way they are stored in memory need not be sequential. Ex: Array, Stack, Queue

A DS is non linear if data is not arranged in sequence.
Ex: Trees, Graphs

Arrays

Simplest type of DS is 1-D Array. List of finite no. 'n' of similar data elements.

If A is array, then its elements are denoted by -

$a_1, a_2, a_3, \ldots, a_n$

A(1), A(2), A(3), ..., A(n)

A[1], A[2], A[3], --, A[n].

Number 'k' in A[k] is called subscript and A[k] is called subscripted variable.

Linked List

Ex :- A brokerage firm maintains a file where each record contains a customer's name and his/her salesperson.

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

Fig 1

	Customer	Pointer
1	A	3
2	B	2
3	C	1
4	D	2
5	E	3
6	F	1
7	G	2
8	H	3
9	I	2

	Salesperson
1	Jones
2	Ray
3	Smith

Fig 2

Suppose, we want the list of customers for a given salesperson.
Fig 2 would search through entire customer file.

	Salesperson	Pointer
1	Jones	3, 6
2	Ray	2, 4, 7, 9
3	Smith	1, 5, 8.

Fig. 3.

Another very popular way of storing the data would be -

	Customer	Link
1	A	5
2	B	4
3	C	6
4	D	7
5	E	8
6	F	0
7	G	9
8	H	0
9	I	0

Salesperson	Pointer	
Jones	3	1
Ray	2	2
Smith	1	3

Fig 4.

Using this representation, one can easily ~~represent~~ obtain entire list of customer for a given salesperson.

Pointer :- When element in one list points to element in different list.

Link :- When an element in a list points to an element in that same list.

* **Stack :-**

Also called as LIFO system, is a linear list where insertions and deletions can take place only at one end, called the "top".

Ex: Stack of dishes. Dishes are inserted only at top and can be deleted only from the top of the stack.

* **Queue :-**

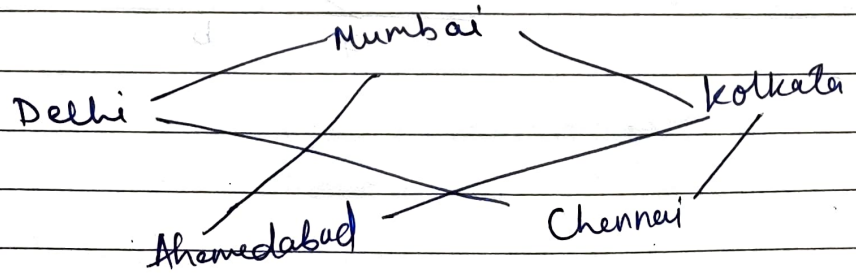
Also called as FIFO system, is a linear list where deletions can take place only at one end of the list, called the "front" of the list. Insertions can take place only at the other end of the list called the "rear" of the list.

Ex :- Line of people waiting at a bus stop.
Cars waiting at signal.

* **Graphs :-**

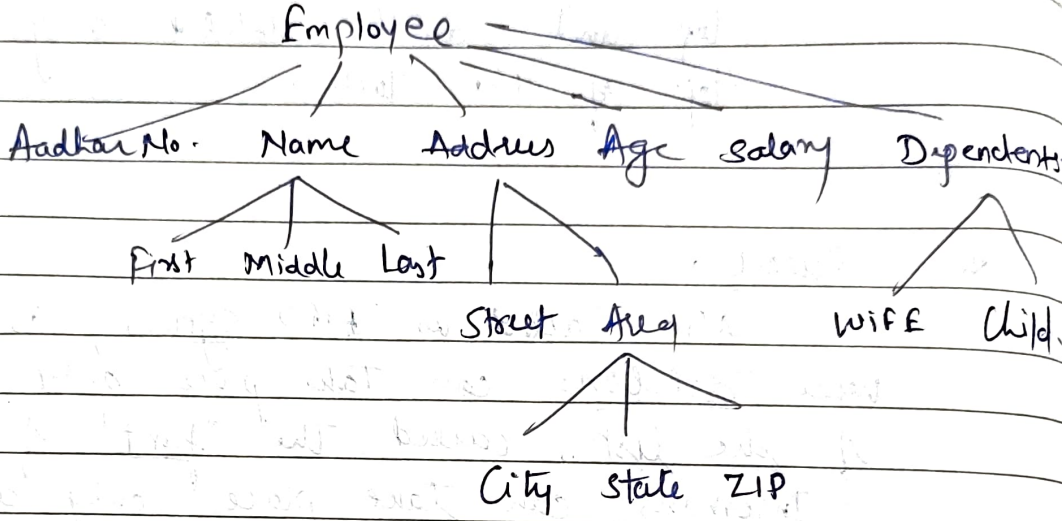
Data sometimes contain a relationship between pairs of elements which is not necessarily hierarchical in nature. This type of relationship is called a graph.

Ex :- Airlines flying between various cities.



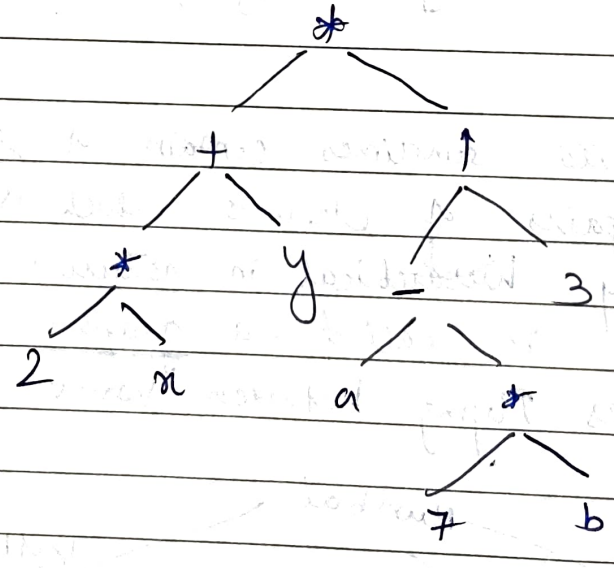
Trees

Data frequently contains a hierarchical relationship between various elements. D.S. that reflects this relationship is called a rooted tree graph, or simply a tree.



or

$(2x+y)(a-7b)^3$



* Data structures Operations

Data appearing in our D.S. are processed by means of certain operations.

① **Traversing** : Accessing each record exactly once. (Also called as "visiting" the record)

② **Searching** : Find location of the record with a given key value.

③ **Insertion** : Adding a new record to D.S.

④ **Deleting** : Removing a record from D.S.

Multiple operations may be performed.
Ex:. Deleting may require searching first.

Two operations for special situation.

① **Sorting** : Arranging records in some logical order.

② **Merging** : Combining the records in two different sorted files into a single sorted file.