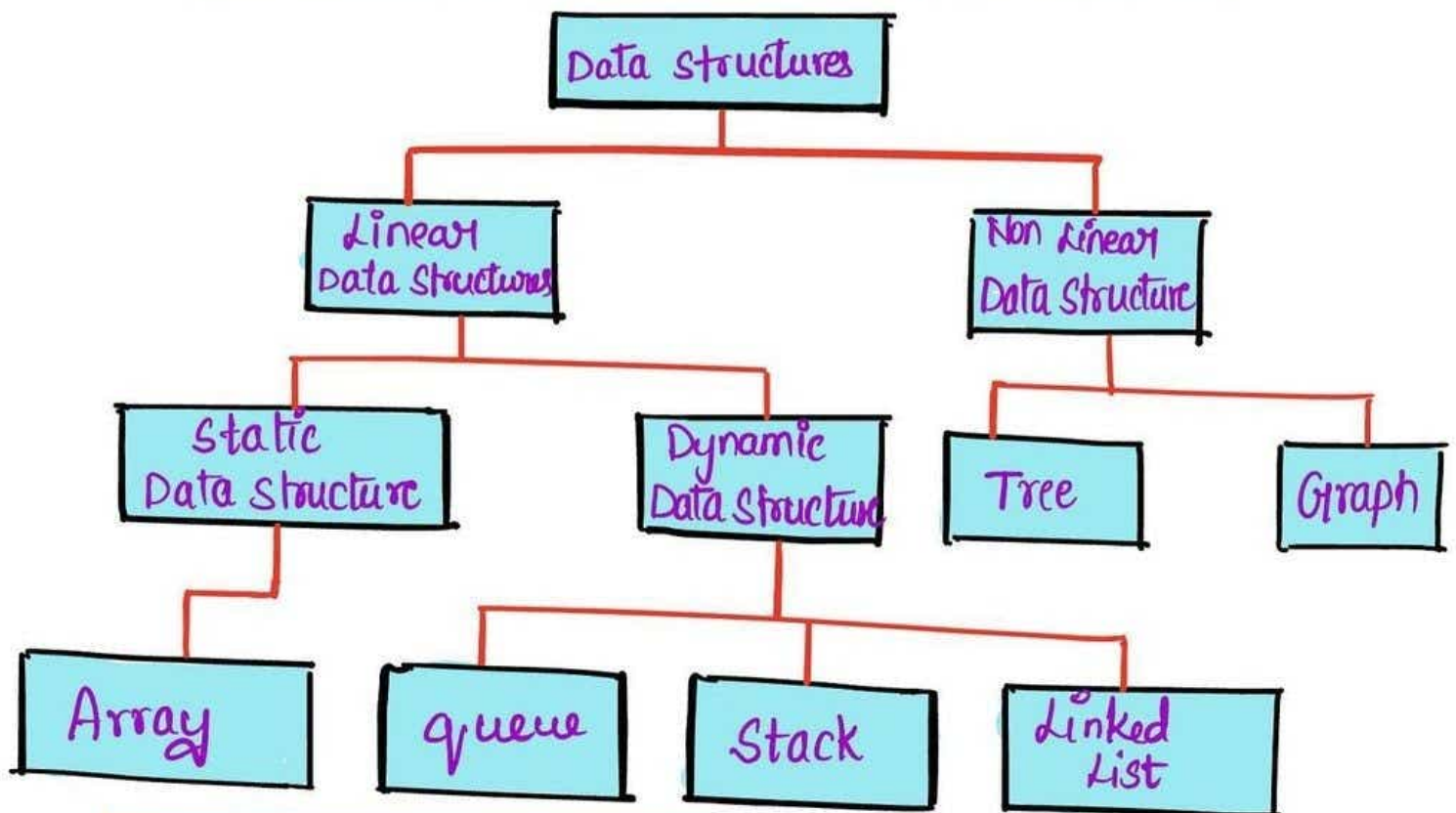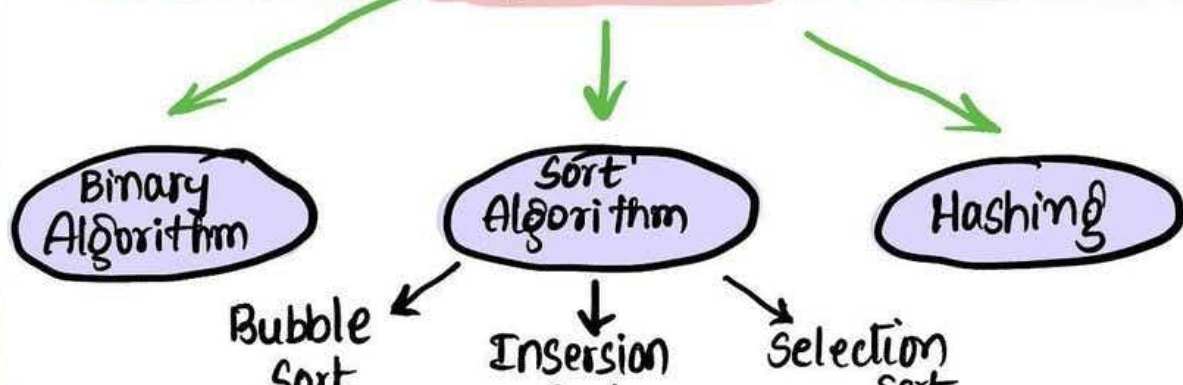# Data Structures!

What is Data Structures?

A Data structure is a storage that is used to store and organize data. It is a way of arranging data on a computer So that it can be accessed and updated efficiently.

CLASSIFICATION OF DATA STRUCTURES

```
                    Data Structures
                          |
          ┌───────────────┴───────────────┐
     Linear                          Non Linear
  Data Structures                   Data Structure
          |                               |
   ┌──────┴──────┐                  ┌──────┴──────┐
 Static        Dynamic            Tree          Graph
Data Structure Data Structure
    |              |
  Array    ┌───────┼────────┐
         queue   Stack    Linked
                           List
```

TYPES OF ALGORITHMS IN DATA STRUCTURE

```
    ↓              ↓              ↓
 Binary          Sort         Hashing
Algorithm      Algorithm
              ↙    ↓    ↘
         Bubble  Insersion  Selection
         Sort                Sort
```

Linear Data Structure:

Data Structure in which data elements are arranged Sequentially or linearly, where each element is attached to its previous and next adjacent element, is called a linear data structures.

→ **Static Data Structure:** Static data structure has a fixed memory size. It is easier to access the elements in a Static data structures.

→ **Dynamic Data Structure:** In this, the size is not fixed

Non Linear Data Structure:

Data Structures where data elements are not placed Sequentially or Linearly are called non Linear data-structures.

Popular types of Data Structures.

* **Array Data Structure:**

An array is a collection of items stored at contiguous memory locations. The idea is to store multiple items of the same type together. This makes it easier to calculate The position of each element by simply adding an offset to a base value i.e, the memory location of the first element of the array.
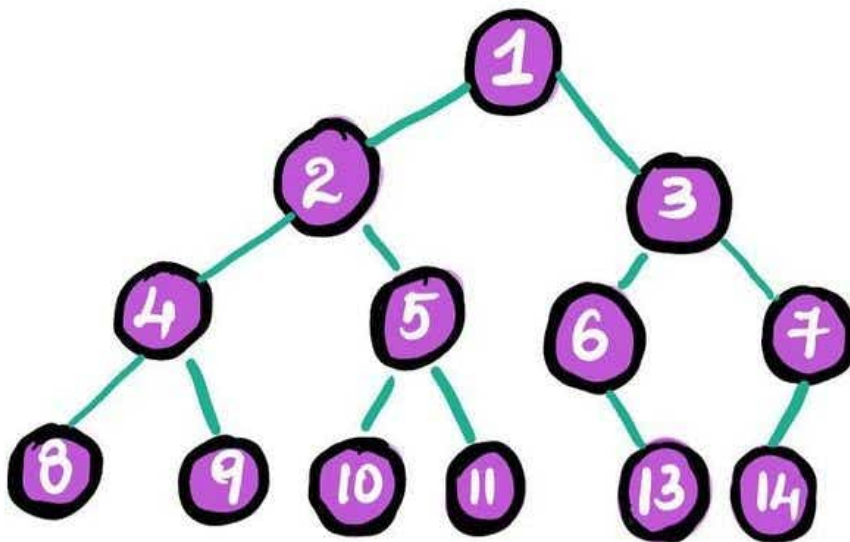
| 200	201	202	203	204	205	206			
U	B	F	D	A	E	C	•	•	•
0	1	2	3	4	5	6	•	•	•

* Binary Tree Data Structure:

Binary tree is defined a tree data structure with almost 2 children. Since each element in a binary tree can have only 2 children, we typically name them the left and Right child.
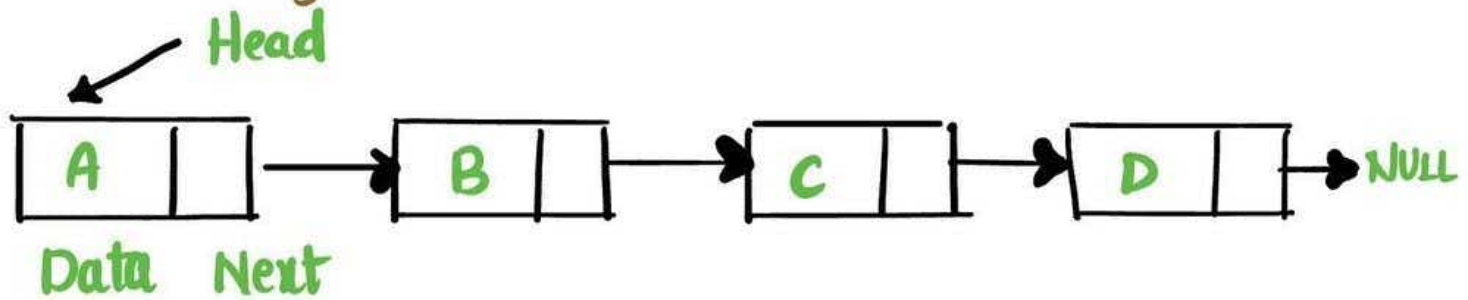

Binary Tree

* Graph Data Structure:

A graph is a non linear data structure consisting of Vertices and edges. the vertices are sometimes also reffered to as nodes and the edges are linear or arcse that conne--ct any two nodes in the graph. more formally a graph is composed of a set of vertices (V) and a set of edges (E).


Nodes/vertices →

Edges
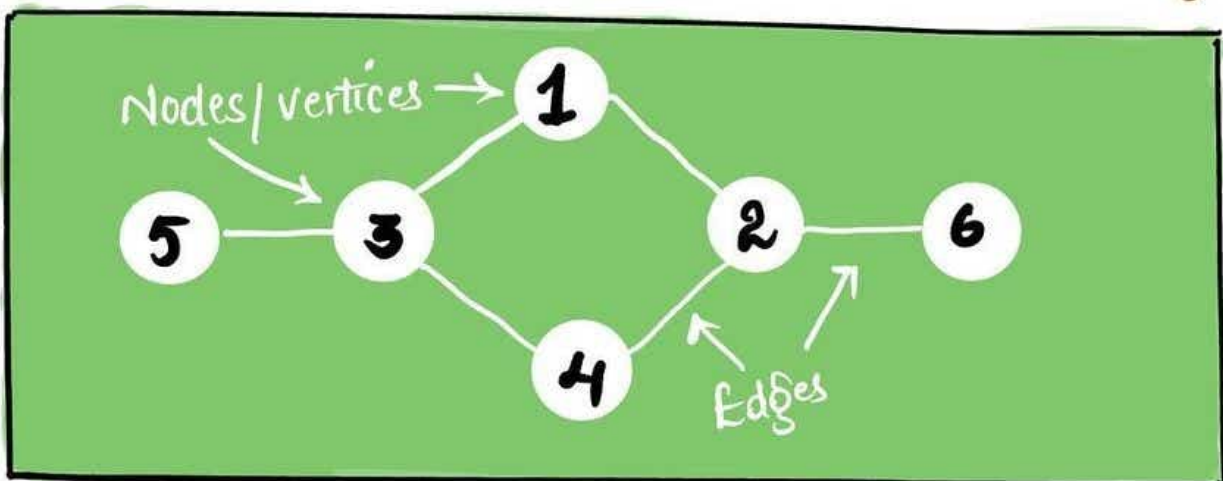
* Linked List Data Structure:

A linked list is a Linear data structure, in which the remains are not stored at contiguous memory locations, the elements in a linked list are linked using pointers as shown in the below image.

Head

```
┌──────┬──┐      ┌──────┬──┐      ┌──────┬──┐      ┌──────┬──┐
│  A   │  │─────▶│  B   │  │─────▶│  C   │  │─────▶│  D   │  │──▶ NULL
└──────┴──┘      └──────┴──┘      └──────┴──┘      └──────┴──┘
```

Data Next

* Binary Search Tree :

This is a node-based binary tree data structure which has the following properties ① The lest Subtree of a node contains only nodes with keys lesser than the node's key ② The right Sub tree of a node contains only nodes with keys greater than the node's key ③ The left and Right Sub tree each must also be a binary search tree.

```
              8
            ↙   ↘
          3       10
         ↙ ↘        ↘
        1    6       14
           ↙  ↘      ↓
          4    7     13
```
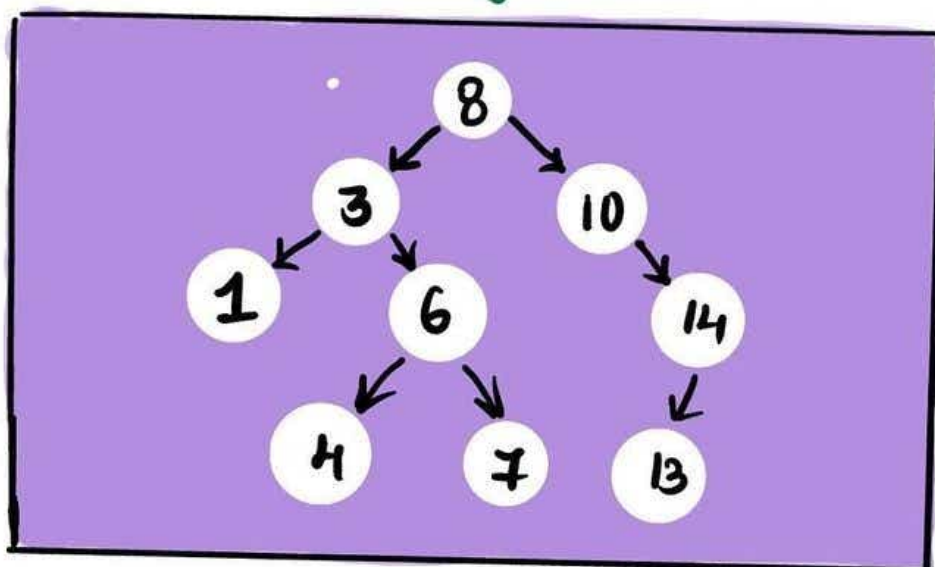
* Matrix Data Structure:

A matrix represents a collection of numbers arranged in an order of rows and columns. It is necessary to enclose the elements of a matrix in paranthesis or brackets
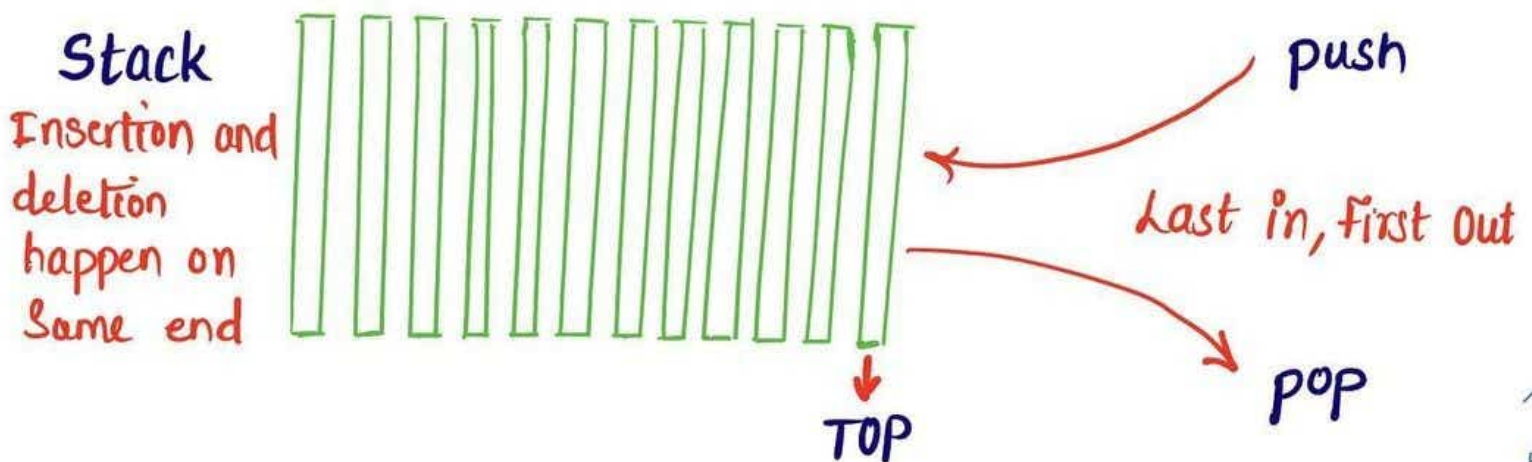
Example

A matrix with 9 elements is shown below.

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$$

* Stack Data Structure:

Stack is a linear data structure which follows a particular order in which the operations are performed. the order may be LIFO (Last In First Out) or FILO (First In Last Out)
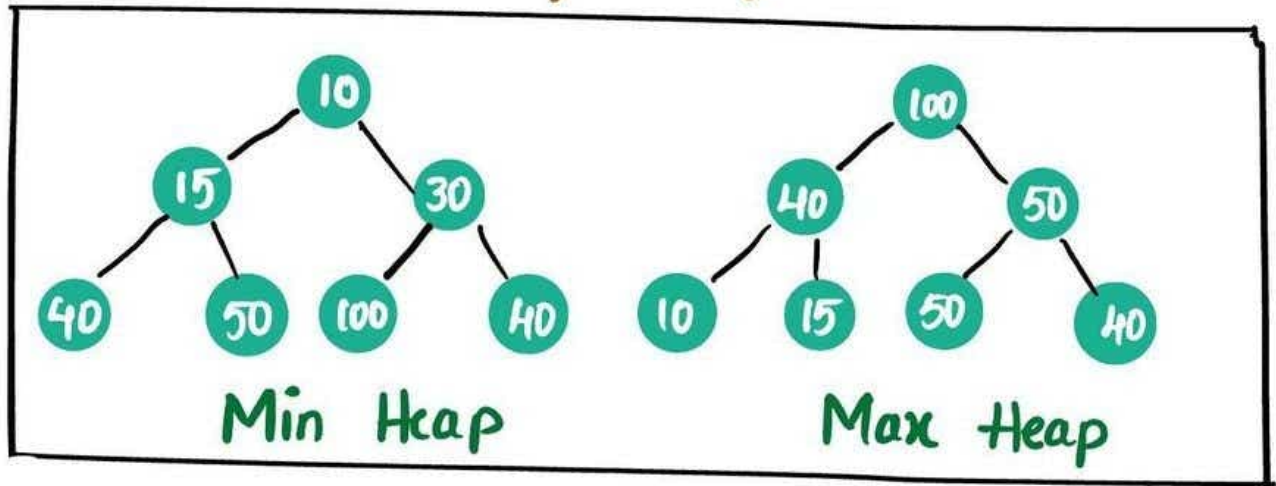
Stack

Insertion and deletion happen on Same end

push

Last in, First Out

pop

TOP

* Heap Data structure.

A heap is a special tree-based data structure in which the tree is a completely binary tree.

Min Heap   Max Heap

* Queue Data structure:
A queue is defined as a Linear data structure that is open at both ends and the operations are performed First in First Out (FIFO) order.

Front/Head   Back/Tail/Rear

Dequeue | 3 | 4 | 5 | 6 | 7 | 8 | Enqueue
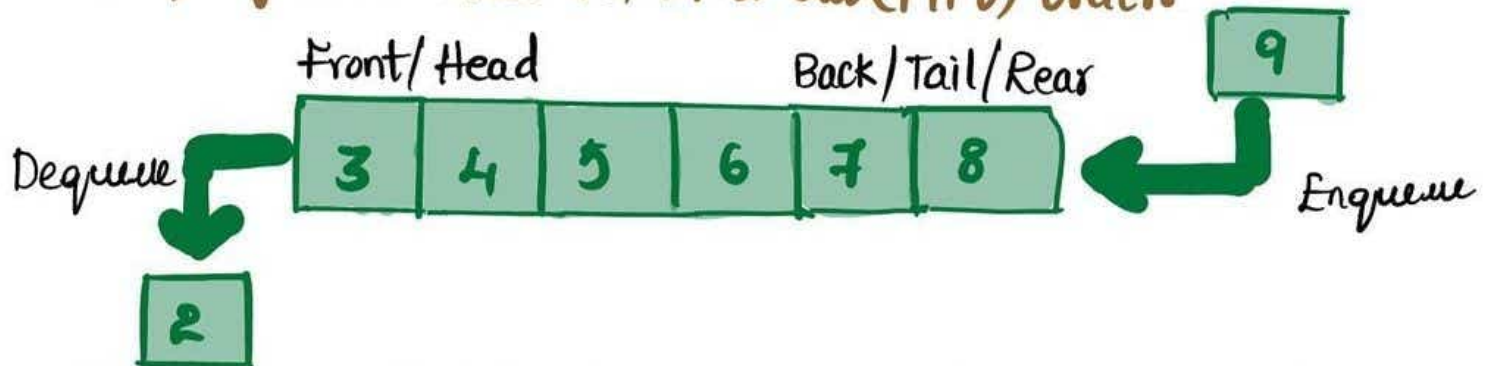
* Hashing Data Structure:
Is a technique of mapping keys, and values into the hash table by using a hash function.

List = [11, 12, 13, 14, 15]

$H(x) = [x \% 10]$

Hash Table	0	1	2	3	4	5
		11	12	13	14	15

$11\%10$ $12\%10$ $13\%10$ $14\%10$ $15\%10$

Hashing Data Structure