

# Introduction $\Rightarrow$

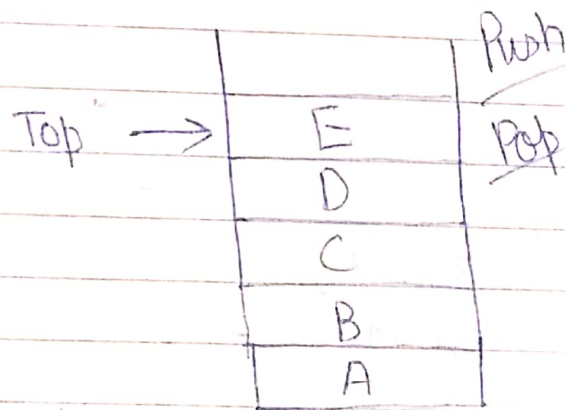
## Data Structure

Structured way of organizing data such that operations like Insertion, Deletion, Traversing, Searching & Sorting can be performed efficiently. (Primitive Operations)

**Array**  $\rightarrow$  Collection of Homogeneous data element stored in contiguous memory allocation.

All 5 primitive Operations are performed.

**Stack**  $\rightarrow$  Last in first out



Ordered collection of item into which items may be inserted and removed from the same end called Top of the stack.

**Order**  $\Rightarrow$  Last in First Out

LIFO List,

Insertion process is PUSH

Deletion process is POP

**Application**  $\Rightarrow$

- 1) Strings can be reversed using stack.
- 2) Resolving Recursive Function  $\rightarrow$
- 3) Palindrome check
- 4) Resolving Func & Procedure calls
- 5) Evaluation of postfix & prefix expression.
- 6) Conversion of infix to prefix and postfix.
- 7) Visibility of message on WhatsApp.

8) Visibility of windows on OS is following stack

Recursion  
Factorial (int N)  
{

if (N == 0)  
return 1;

else  
return N \* Factorial (N-1)  
}

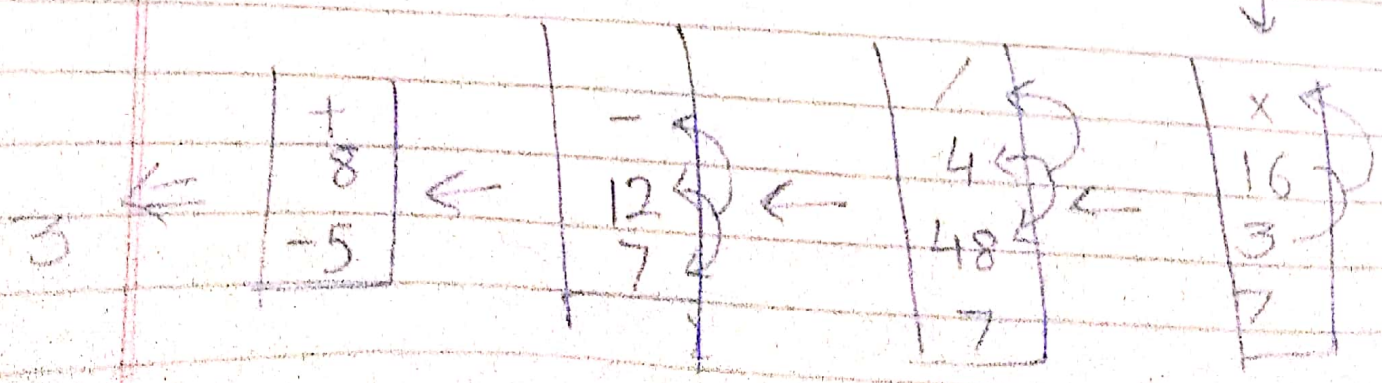
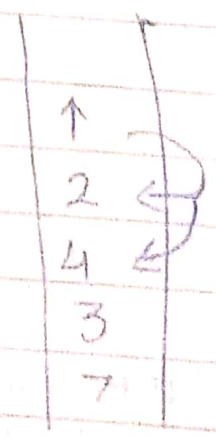
Operators

↑ Right Associated  
/ \* %  
+ - Left Associated.

(3 ↑ 2 ↑ 2) → First this  
→ Then this

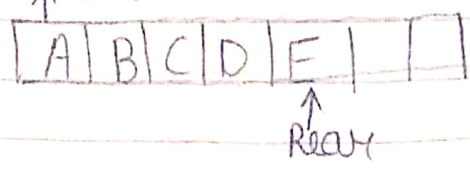
Infix - a+b  
Postfix - ab+  
Prefix - +ab

7-3\*4↑2/4+8  
7 3 4 2 ↑ \* 4 / - 8 +





Queue  $\rightarrow$  First in First Out   
 Front.



Queue are ordered collection of item in which items are inserted at rear end of queue and remove from another called front of the queue

- ✓ Insertion - Enqueue
- ✓ Deletion - Dequeue
- ✓ Traverse
- ✓ Search
- X Sorting not possible

Applications  $\rightarrow$

- 1) Booking of ticket
- 2) Barber Shop
- 3) Waiting list in a Train
- 4) Buffer of memory in a computer follows Queue
- 5) Relaying of message is queue.

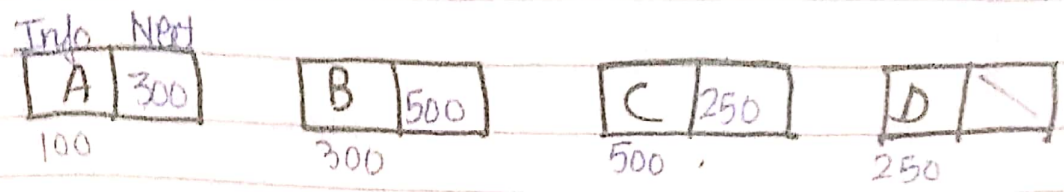
Variant

- Simple Queue
- Level Order Traversal of Binary Tree
- Breadth First Search
- Topological Sort.
- Priority Queue

Double Ended Queue

Queue in which both side insertion, deletion can occur.

# Linked List. → Collection of Node



Collection of Nodes. Each Node contains at least 2 fields. One of it is info and other one is address of next node

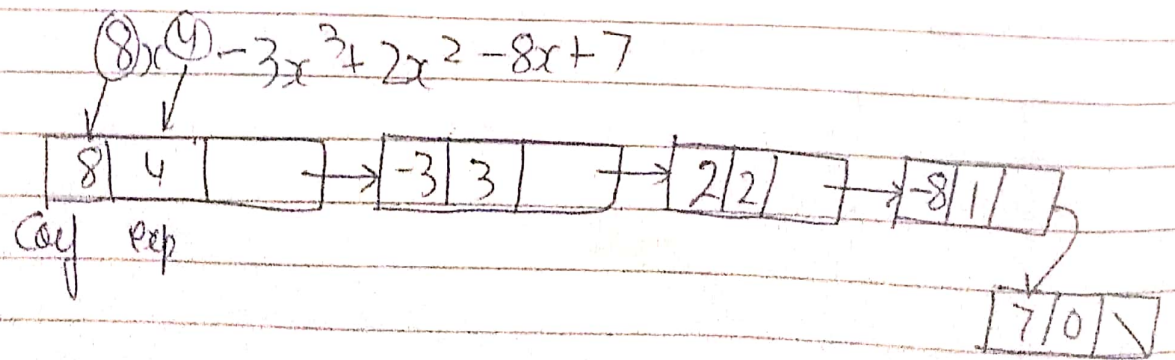
As Dynamic Memory Allocation So no need of shifting

Array   
 Memory wastage   
 Contiguous MA   
 Require Shifting

Link list   
 No memory wastage   
 Dynamic Memory Allocation   
 No need of Shifting

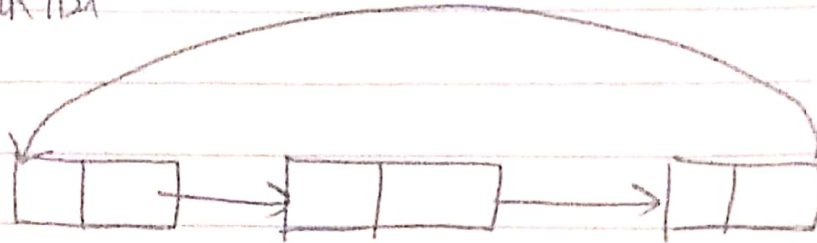
## Application →

- Long number arithmetic
- Polynomial arithmetic
- Implementation of any D Structure
- Stack, Queue, Graph





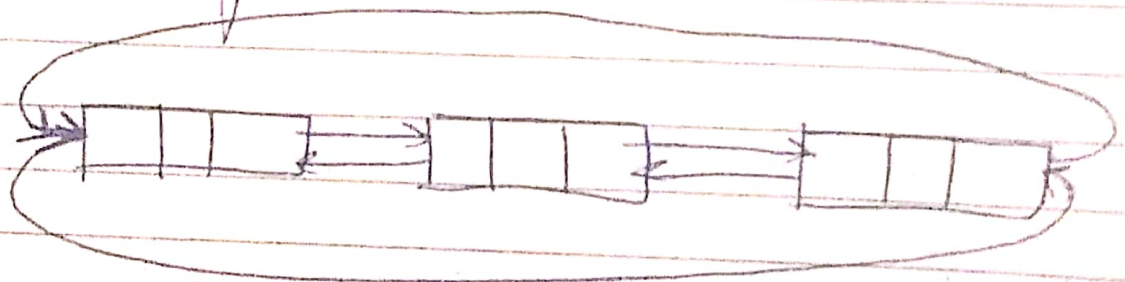
Circular Link list



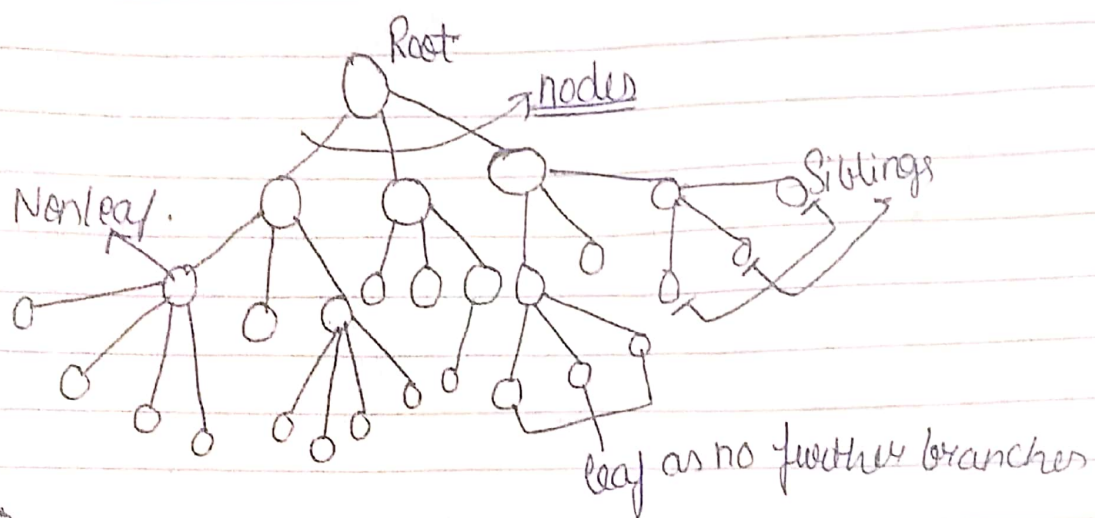
Doubly Link list



Circular Doubly Link List

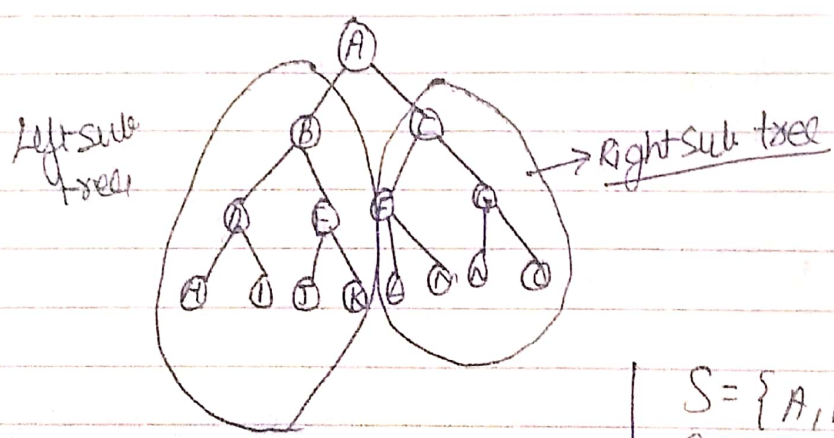


# (4) Tree → Non Linear Data Structure.



## Organization Hierarchy

Not more than 2 nodes allowed is binary tree



$$S = \{A, B, C, D, E, F, G, H, I, J, K, L, M, N\}$$

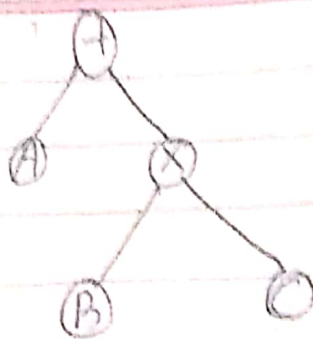
$$S_1 = \{A\}$$

$$S_2 = \{B, D, E, H, I, J, K, L\}$$

$$S_3 = \{C, F, G, M, N\}$$

Binary tree has finite set of elements which is either empty or partitioned into 3 disjoint subsets. One of which is called a root node and other 2 are themselves the binary called left and right sub tree





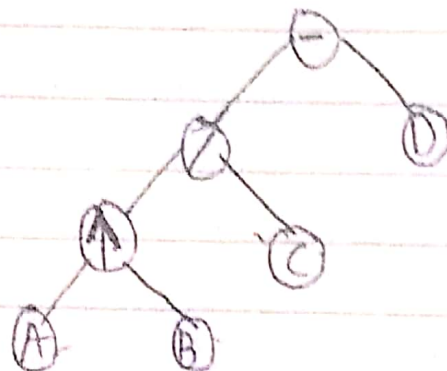
$A + B * C$

Win Zip file is used to compress file

Bottom up approach can be used in tree

$A * B / C - D$

$A - B / C + D$

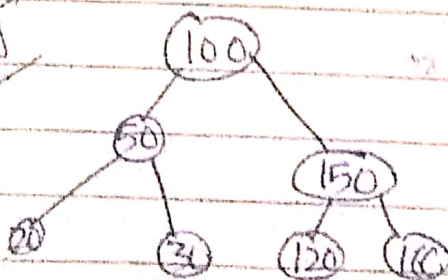


- 1) Text Compression through Huffman Coding
- 2) For efficient <sup>binary</sup> searching and <sup>highly</sup> sorting
- 3) Evaluation of arithmetic expression through tree
- 4) Building expression tree for evaluation

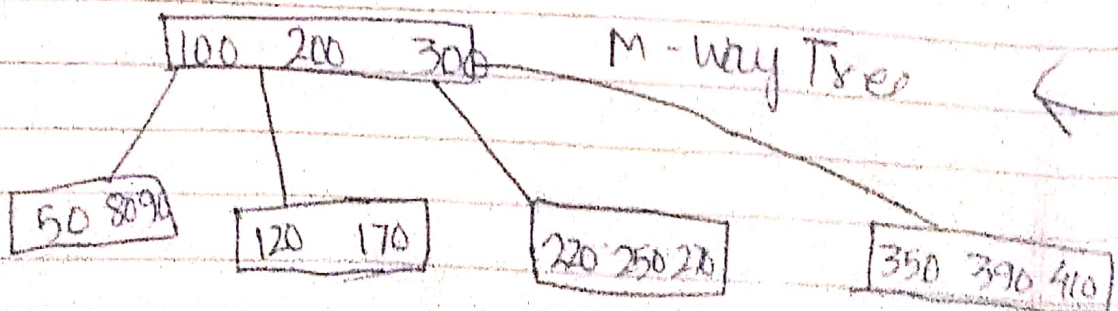
Efficient Searching Tree

A X M P

M-way Tree



Binary search Tree  
(If only 2 paths only)



# Balanced Multiway Search Tree & B Tree

B-Tree use

Maintain directory structure of computer

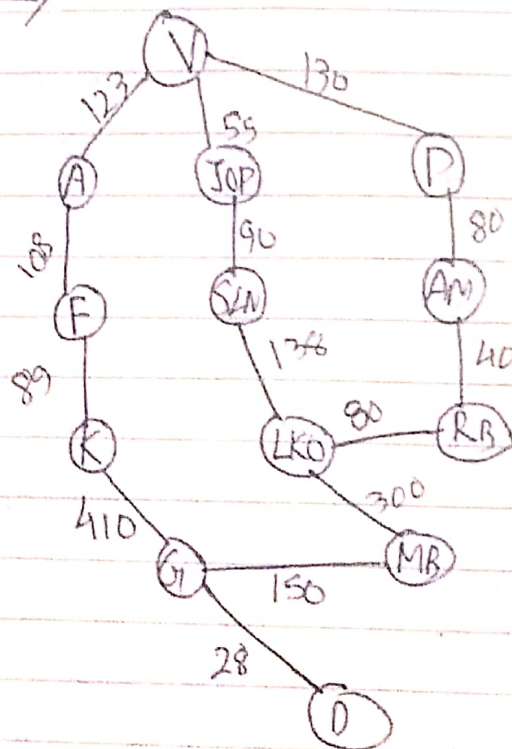
Variation

B+ Tree

Database

Growth is possible in any direction in Binary Tree.

Graph  $\Rightarrow$



## Application

- Shortest path between 2 places & User (Source-Destination fixed and not repeat the nodes)
- Travelling salesman Problem (nodes repeat street do not repeat)
- Chinese Postman problem (water tanks)
- Maximum Flow problem
- Inter connections between telephones
- PCB designing
- Printing Circuit Board
- Minimum Spanning Tree

