

Data Structure and Algorithms

LECTURE - 1

Data and Information

- **Data** : Data are simple values or set of values
- **Data item**: single unit of values
 - Group items: that are divided into sub items- name.
 - elementary types: that cannot be divided- social security number.
- **Information**: data with given attributes or meaningful or processed data.

What is Data Structure

- In Computer Science, a **data structure** is a particular way of organizing data in a computer so that it can be used efficiently.
- The logical or mathematical model of a particular organization of data is called a data structure.
 - **A data structure is defined by**
 - (1) the logical arrangement of data elements, combined with
 - (2) the set of operations we need to access the elements.

Classification of Data Structure

1. Primitive

- 1.1 Integer
- 1.2 Real
- 1.3 Character
- 1.4 Boolean

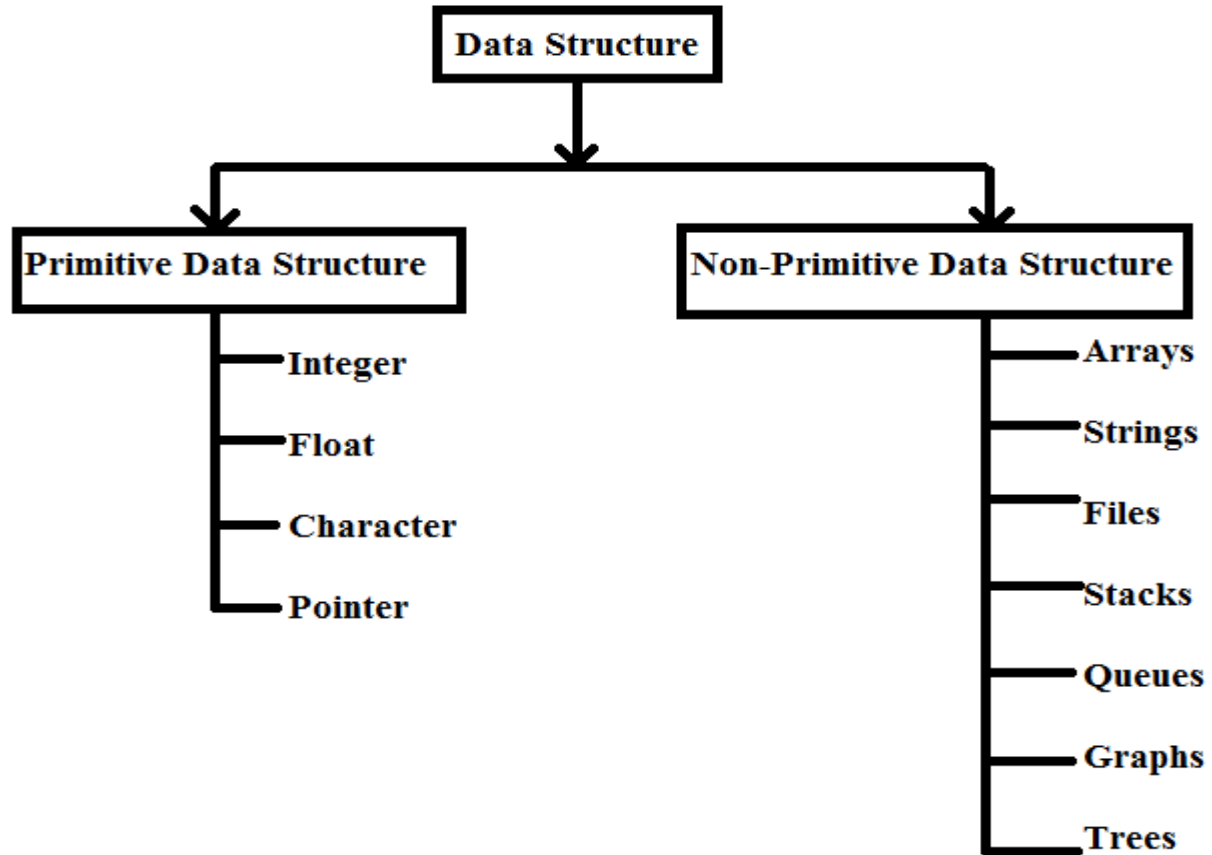
2. Non-Primitive

2.1 Linear

- 2.1.1 Arrays
- 2.1.2 Linked List
- 2.1.3 Stack
- 2.1.4 Queue

2.2 Non-Linear

- 2.2.1 Trees
- 2.2.2 Graph



Classification of Data Structure

Solving a problem involves processing data, and an important part of the solution is the careful organization of the data

In order to do that, we need to identify:

1. The collection of data items
2. Basic operation that must be performed on them

Abstract Data Type (ADT): a collection of data items together with the operations on the data

- The word “abstract” refers to the fact that the data and the basic operations defined on it are being studied independently of how they are implemented
- We think about **what** can be done with the data, not **how** it is done

Implementation of ADT

The term of Data Structure and Abstract Data Type are often used interchangeably

However, we use ADT when data is studied at a logical level

The term data structure refers to a construct in programming language that can be used to store data

ARRAYS

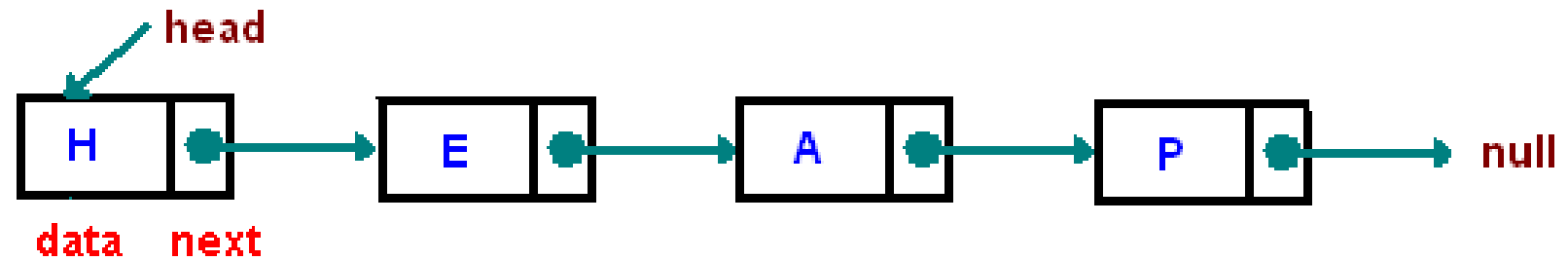
a [i]	a [0]	a [1]	a [2]	a [n]
element	5	7	2	12
Address	1000	1002	1004	n

A 2-Dimensional Array: table

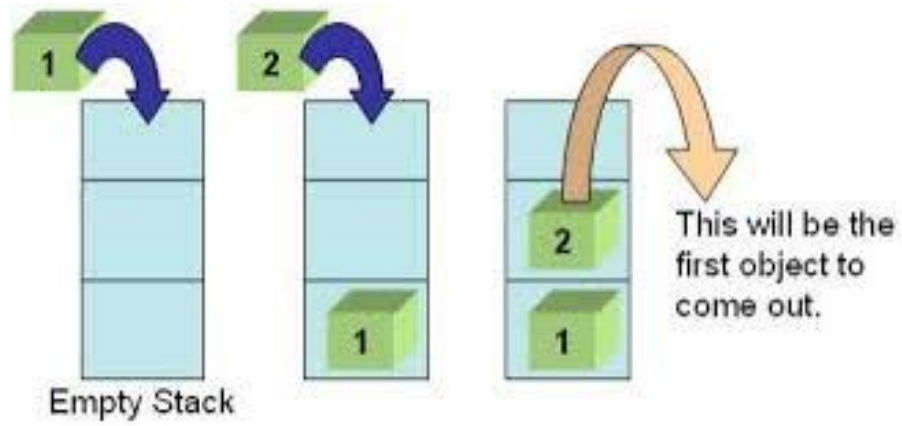
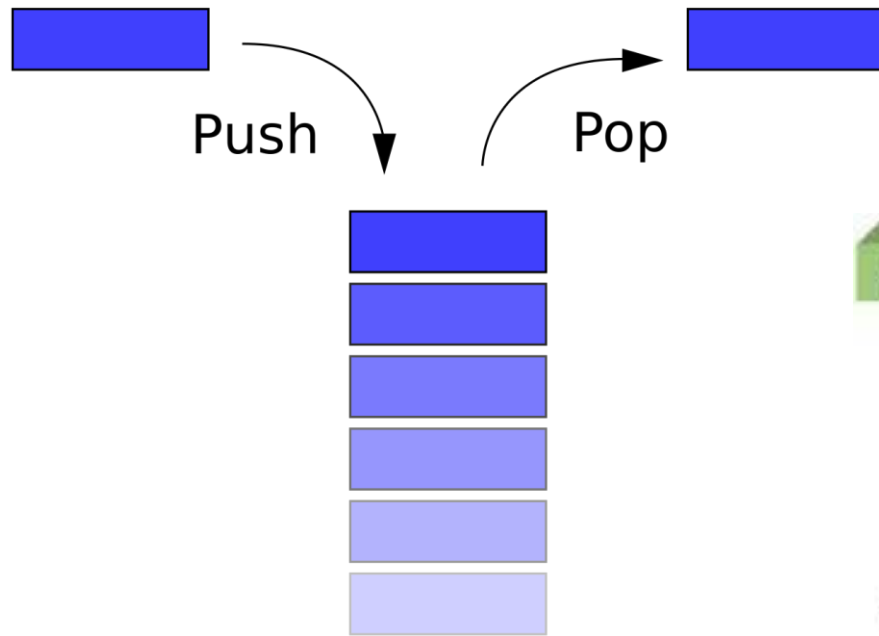
		Columns				
		0	1	2	3	...
Rows	0					
	1					
	2					
	3					
	...					

Diagram illustrating a 2-Dimensional Array (table) structure. The array is represented as a grid with Rows (0, 1, 2, 3, ...) and Columns (0, 1, 2, 3, ...). Blue arrows point to specific elements: `table [0][1]` (Row 0, Column 1) and `table [1][3]` (Row 1, Column 3).

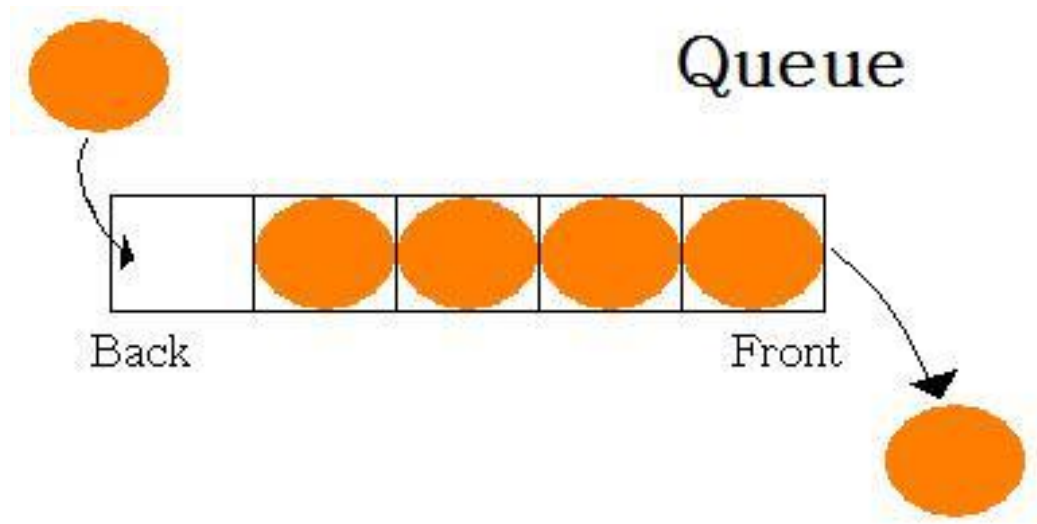
LINKED LIST



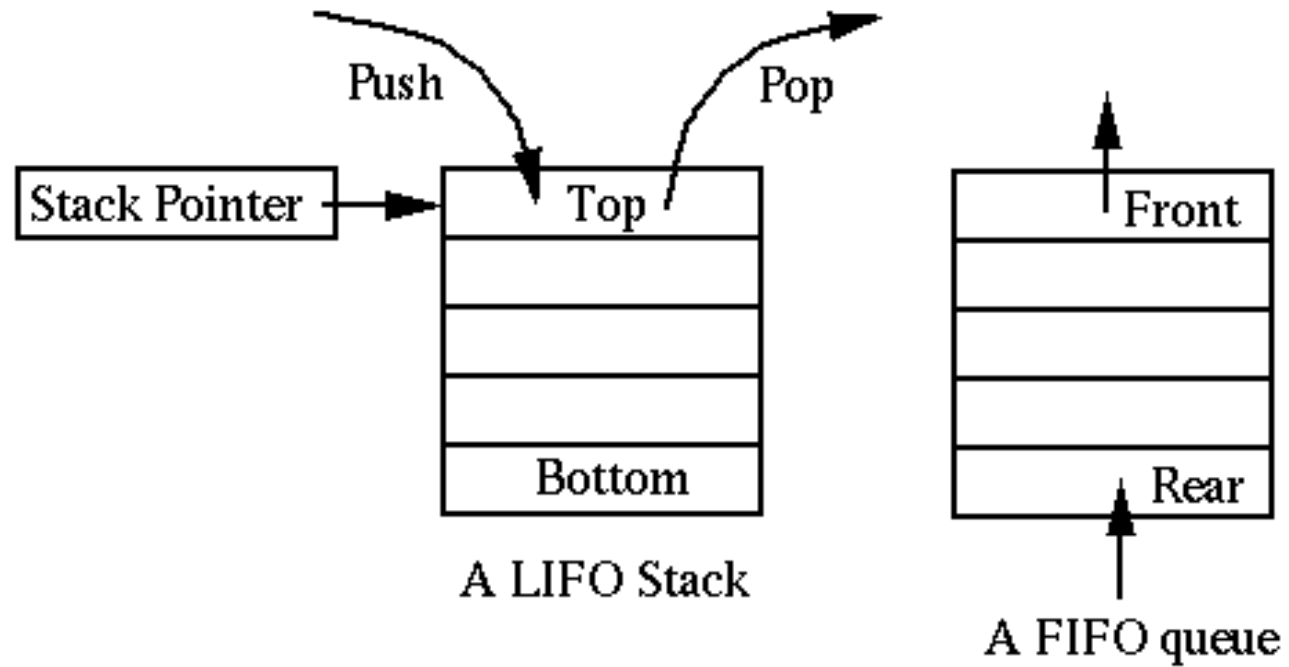
STACK



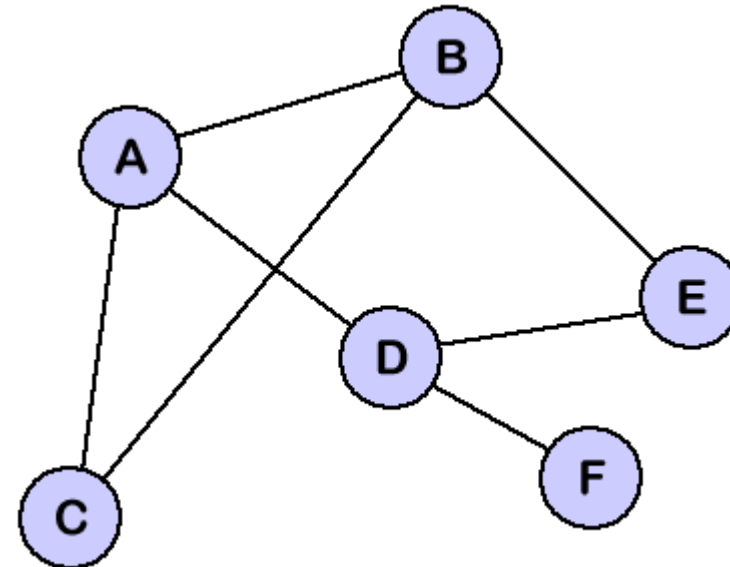
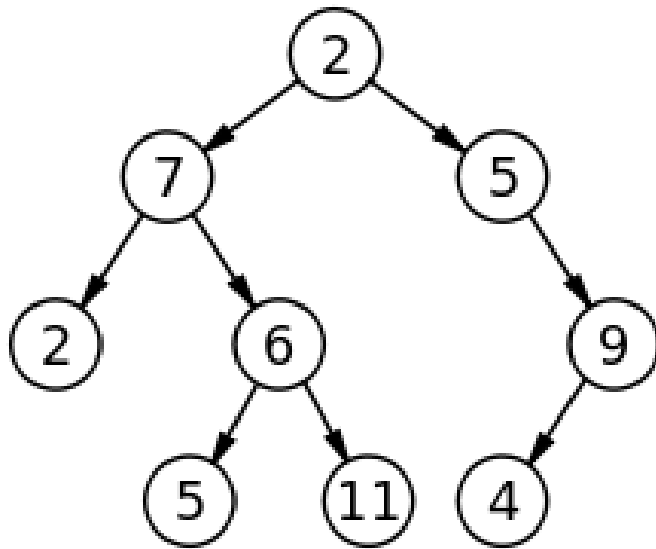
QUEUE



STACK VS. QUEUE



TREE & GRAPH



DATA STRUCTURE OPERATIONS

1. Traversing
2. Inserting
3. Deleting
4. Searching
5. Sorting
6. Merging

If the sequence of operations -

```
push (1)
push (2)
pop
push (1)
push (2)
pop
pop
pop
push (2)
pop
```

are performed on a stack, the sequence of popped out values are ?

A

2 2 1 2 2

B

2 1 2 2 1

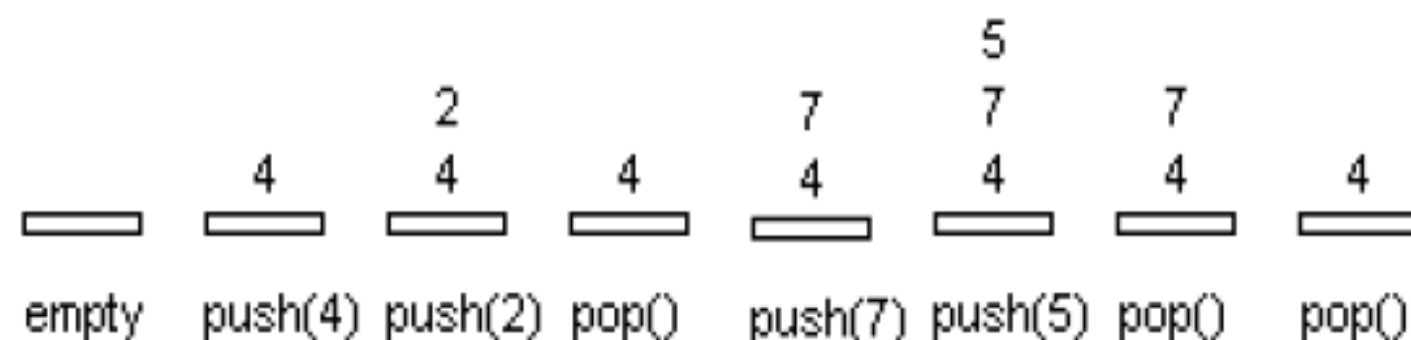
C

2 2 1 1 2

D

2 1 2 2 2

A sequence of stack operations



A sequence of queue operations

empty	front	
enqueue(4)	front	4
enqueue(2)	front	4 2
dequeue()	front	2
enqueue(7)	front	2 7
enqueue(5)	front	2 7 5
dequeue()	front	7 5
dequeue()	front	5