❖ FUNDAMENTALS OF DATA STRUCTURE

Data Item: an elementary description of things, events, activities, and transactions that are recorded, classified, and stored, but not organized to convey any specific meeting.

Information: is data that have been organized so that they have meaning and value to the recipient

Data structure: A collection of data elements whose organization is characterized by accessing (Mechanism for organizing information) operation that are used to store and retrieve the individual of elements.

Algorithm: it is finite set of instructions which, if followed, accomplish a particular task.

Program: An implementation of an algorithm in some programming language such as C,C#,ect.

How to choose the suitable data structure

For each set of, data there are different methods to organize these data in a particular data structure. To choose the suitable data structure, we must use the following criteria.

1- Data size and the required memory.

2- The dynamic nature of the data.

3- The required time to obtain any data element from the data structure.

4- The programming approach and the algorithm that will be used to manipulate these.

Data Structure Types

- ❖ Built –in: array , structure
- ❖ Linked : linked list, binary tree

Built – In Data Structures

Programming language usually provide some data structures that are built into the language, for instance, C x C++ provide structures and arrays of various dimensions.

Arrays

Array is the first data structure that is built in the C language so it can be considered as a data type in the language. The simplest form of array a one dimensional array that may be defined abstractly as a finite ordered set of homogenous elements.

- **Finite** : means that these is a specific number of elements in the array. This number may be large or small, but it must exit.
- **Ordered**: means that the elements of the array are arranged so that there is a zeroth, first, second, third, and so forth.
- **Homogeneous**: means that all the elements in the array must be of the same type. For example an array may contain all integers or all characters but may not contain both.

Memory address	Index	Content
100	0	D
101	1	A
102	2	T
103	3	A

One-Dimensional Array

General array declaration statement:

Data -type array-name [**number-of-items**];

Ex: int aa[6];

Individual elements of the array can be accessed by specifying the name of the array and the index of element, example aa[3]

aa[0]	aa[1]	aa[2]	aa[3]	aa[4]	aa[5]

- Warning: indices assume values from 0 to number-of-items -1!!

Two-dimensional Array

A two-dimensional array consists of both rows and columns of elements.

General 2d array declaration statement:

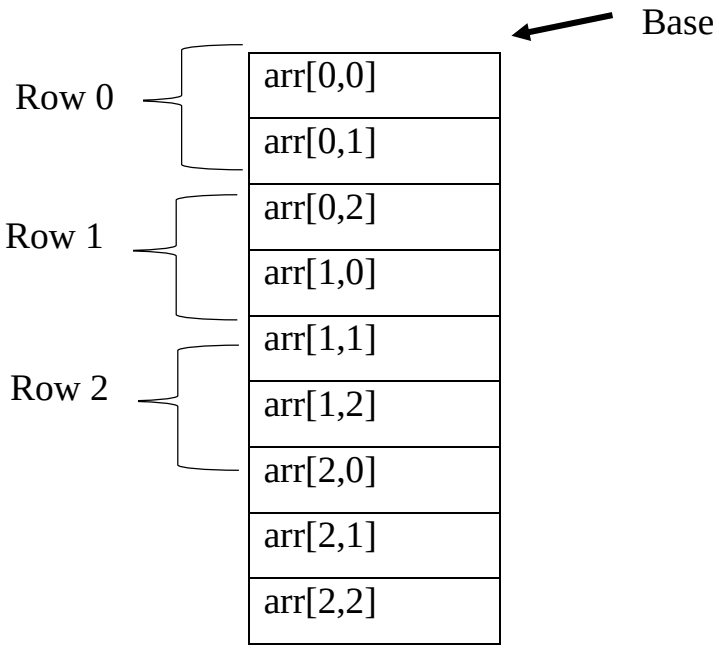
data-type array-name [**number-of-rows**][**number-of-columns**];

The number-of-rows and number-of-columns must be specified before declaring the array.

```
int rows = 3;
int cols = 5;
float arr2D[rows][cols];
```

arr2D[0,0]	arr2D[0,1]	arr2D[0,2]	arr2D[0,3]	arr2D[0,4]
arr2D[1,0]	arr2D[1,1]	arr2D[1,2]	arr2D[1,3]	arr2D[1,4]
arr2D[2,0]	arr2D[2,1]	arr2D[2,2]	arr2D[2,3]	arr2D[2,4]

Dimensional reference to the linear representation. One method of representing a two-dimensional array in memory is the raw-major representation. Under this representation the first row of the array occupies the first set of memory locations reserved for the array, the second row occupies in next set, and so forth. Let us suppose that a two-dimensional integer array is stored in row-major sequence as in the figure below:



Calculating The Address Of Array Elements

1. One dimension array:

Location (X[I]) = Base address + (I*Size)

Ex1:let aa[6] What is the address of the element aa[3], Base Address=100, suppose that each element of the array requires a single unit of storage.

Location (aa[3]) = 100 + (3*1)
=100+3
=103

Ex2:let int M[7] What is the address of the element M[3], Base Address=110?

Location (M[3]) = 110 + (3*2) because int type required 2 byte storages memory
=110+3
=113

Home Work

Q1:let float Z[7] What is the address of the element Z[3], Base Address=110?
Q2: let char Z[10] What is the address of the element Z[7], Base Address=150?
Q3:let int A[9], location of A[5] is 250,what is the base address ??