Data Structure.- Array

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One – Dimensional Arrays

- The address of the first location is called the **base address** of the array and is denoted by base (**BA**) and the rest of the array elements come after this address.
- Computer does not need to keep track of the address of every array element, but need to track only the address of the first element of the array **Base Address (BA)** and to reach to any array element and the compiler use the following formula to do so.

$$\textbf{Loc (N [I]) = BA + (I) } \times \textbf{ Size}$$

- **Loc N[I]** : The location of the element **I**, **BA**: Fixed base address, **Size:** A fixed constant, is also known as size of the data type.

One – Dimensional Arrays: Example

Example : Consider an one dimension array (N) with size 10 and the base address equal (3002) and each element of the array occupy 1 byte. find the address the element number six.

Loc (N [I]) = BA + (I) × Size

then, Loc (N [5]) = 3002 + (5) × 1

Loc (N [5]) =3007.

The Physical Representation Of Array In Memory

Logical address	Physical address	Memory
N[0]	3002	
N[1]	3003	
N[2]	3004	
N[3]	3005	
N[4]	3006	
N[5]	**3007**	
:	:	
N[9]	3011	
Programmer view	Compiler view	

One – Dimensional Arrays: Example

Example 2: Consider an one dimension array (N) with size 30 and the base address equal (200) and each element of the array occupy 2 byte. find the address the element number 16.

Loc (N [I]) = BA + (I) × Size

then, **Loc (N [15]) = 200 + (15) × 2**

Loc (N [15]) =230.

The Physical Representation Of Array In Memory

Logical address	Physical address	Memory
N[0]	200	
	201	
:	:	
N[15]	**230**	
	231	
:	:	
N[30]	260	
	261	

Two – Dimensional Arrays

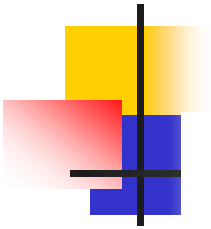
- • **2D array** is a data structure type that consists of a set of elements that are
- all of the same type, and all elements are distributed on a set of rows and
- columns that represent the size of the array.
- • **Int N[3][5];** That is mean we reserves (3*5=15) successive memory
- locations and each location is large enough to conation single integer. The
- number of Rows or Columns is called the range of the dimension.
- • The array N will be represented in the memory by block of (3 × 5)
- sequential memory location. Programming language will store array N
- either :
- **1. Column by Column**: called (Column-Major Order) Ex: Fortran, Matlab.
- **2. Row by Row**: called (Row-Major Order) Ex: C, C++, Java.

Two – Dimensional Arrays

Representation Of The Two Dimensional Array In The Memory
(A) By Row
(B) By Column

(B)		Memory
Col 0	N[0][0]	
	N[1][1]	
	N[2][2]	
Col 1	N[0][3]	
	N[1][4]	
	N[2][0]	
Col 2	N[0][1]	
	N[1][2]	
	N[2][3]	
Col 3	N[0][4]	
	N[1][0]	
	N[2][1]	
Col 4	N[0][2]	
	N[1][3]	
	N[2][4]	

(A)		Memory
Row 0	N[0][0]	
	N[0][1]	
	N[0][2]	
	N[0][3]	
	N[0][4]	
Row 1	N[1][0]	
	N[1][1]	
	N[1][2]	
	N[1][3]	
	N[1][4]	
Row 2	N[2][0]	
	N[2][1]	
	N[2][2]	
	N[2][3]	
	N[2][4]	



Column-Major Order :

Column-Major Order :

- **Loc (N [I][J]) = BA + (m × J + I) × Size**
- **Where:**
- **Loc N[I][J] :** the location of the element **I,J**.
- **BA:** fixed base address.
- **m:** number of row.
- **Size:** a fixed constant, is also known as size of the data type.

Column-Major Order : Example

Example: Consider a two dimension array (N) with size (m=3 × n= 5) and the base address equal (300) and each element of the array occupy 1 byte. find the address the element N[1][2].Suppose the programming store 2D using Column-Major.

Loc (N [I][J]) = BA + (m × J + I) × Size

Loc (N [1][2]) = 300 + (3 × 2 + 1) × 1

Loc (N [I][J]) = 307

The Physical Representation Of 2D Array In Memory

	L.A.	P.A.	Memory
Col 0	N[0][0]	300	
	:	:	
Col 1	N[0][3]	303	
	:	:	
Col 2	N[0][1]	306	
	N[1][2]	**307**	
	N[2][3]	308	
Col 3	N[0][4]		
	:	:	
Col 4	N[0][2]		
	:	:	

Row-Major Order :Example

Example : Consider a two dimension array (N) with size (m=3 × n= 5) and the base address equal (600) and each element of the array occupy 1 byte. find the address the element N[2][3].Suppose the programming store 2D using Row-Major.

Loc (N [I][J]) = BA + (n × I + J) × Size

Loc (N [2][3]) = 600 + (5 × 2 + 3) × 1

Loc (N [I][J]) = 613

The Physical Representation Of 2D Array In Memory

	L.A.	P.A	Memory
Row 0	N[0][0]	600	
	:	:	
Row 1	N[1][0]	605	
	:	:	
Row 2	N[2][0]	610	
	N[2][1]	611	
	N[2][2]	612	
	N[2][3]	**613**	
	N[2][4]	614	