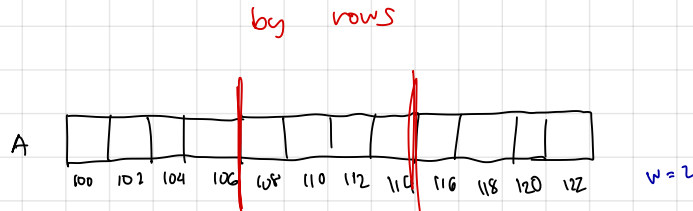


## Row major and Column Major order

eg `int A[3][4];`

A	0	1	2	3
0	100	102	104	106
1	108	110	112	114
2	116	118	120	122

addresses



find the address of `Add(A[2][1])`

$$\text{add}[A[i][j]] = L_0 + (i * n + j) * w$$

Similar to this formula

$$L_0 + i * w$$

$m$  = total rows  
 $n$  = total columns

$$\begin{aligned} \text{add}(A[2][1]) &= 100 + [2 * 4 + 1] * 2 \\ &= 100 + 9 * 2 \\ &= 100 + 18 \\ &= 118 \end{aligned}$$

## Column major formula

`int A[3][4];`

1M A[3][4]  $m \times n$

0	1	2	3	4	5	6	7	8	9	10	11
$a_{00}$	$a_{10}$	$a_{20}$	$a_{01}$	$a_{11}$	$a_{21}$	$a_{02}$	$a_{12}$	$a_{22}$	$a_{03}$	$a_{13}$	$a_{23}$
200/1	2	4	6	208/9	10	12	14	216	18	20	222/23
col 0			col 1			col 2			col 3		

A	0	1	2	3
0	$a_{00}$	$a_{01}$	$a_{02}$	$a_{03}$
1	$a_{10}$	$a_{11}$	$a_{12}$	$a_{13}$
2	$a_{20}$	$a_{21}$	$a_{22}$	$a_{23}$

find `Add(A[i][j])` = based from complex formula =  $L_0 + i * w$

$$\text{add}[A[i][j]] = L_0 + (j * m + i) * w$$

$m$  = total rows  
 $n$  = total columns

$\uparrow$   
# of rows

Note

Row major (left to right)

$$A[i][j] = L_0 + (i * n + j) * w$$

Column major (right to left)

$$A[i][j] = L_0 + (j * m + i) * w$$

## 52 Formula for n dimension Array

• Row major (→)

int  $A[d_1][d_2][d_3][d_4];$

$$\text{find } \text{Add}(A[i_1][i_2][i_3][i_4]) = L_0 + \left( \underbrace{i_1 * d_2 * d_3 * d_4}_{\text{row 1}} + \underbrace{i_2 * d_3 * d_4}_{\text{row 2}} + \underbrace{i_3 * d_4 + i_4}_{\text{row 3}} \right) * W$$

Kaya ganito ang formula

$A[d_1][d_2]$

$$\text{add}(A[i][j]) = L_0 + (i * d_2 + j) * W$$

Column major (←)

int  $A[d_1][d_2][d_3][d_4];$

$$\text{find } \text{Add}(A[i_1][i_2][i_3][i_4]) = L_0 + \left( i_4 d_3 d_2 d_1 + i_3 d_2 d_1 + i_2 d_1 + i_1 \right) * W$$

General formula

Row major

$$\text{Add}(A[i_1][i_2] \dots [i_p]) = L_0 + \left( \sum_{p=1}^n i_p * \underbrace{\prod_{q=p+1}^n d_q}_{\text{row } q=p+1} \right) * W$$

Time complexity

if  $n=4$

$n=5$

⋮

how many multiplications

3

4

$$= n-1 + n-2 + \dots + 3 + 2 + 1 = \frac{n(n-1)}{2}$$

$$\rightarrow O(n^2)$$