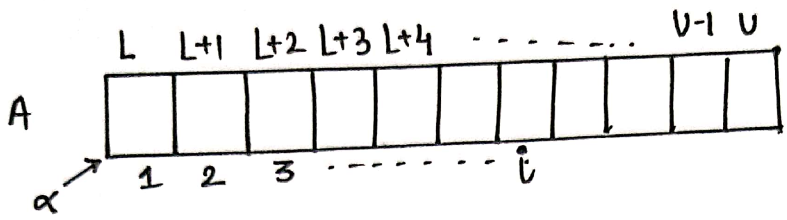
ADDRESS CALCULATION IN 1-D ARRAY



→ $A[L:U]$

→ How many elements = $U-L+1$

- first Assumption - index starts as 1.
- Second Assumption → every element is of 1 bytes. or requires 1 byte.

→ Address of $A[1] = \alpha$

$A[2] = \alpha+1$

$A[3] = \alpha+2$

$A[4] = \alpha+3$

$\vdots$

$A[i] = \alpha+(i-1)$

Now suppose every element requires n bytes.

$A[1] = \alpha$

$A[2] = \alpha+1\cdot n$

$A[3] = \alpha+2\cdot n.$

$A[4] = \alpha+3\cdot n.$

$\vdots$

$A[i] = \alpha+(i-1)n$

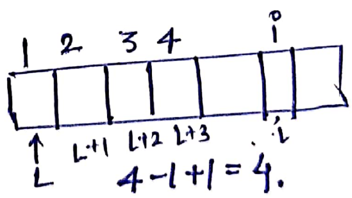
$\cancel{A[i] = \alpha+(L-i-1)n}$

$A[i] = \alpha+(i-(L-1)\mp 1)n$

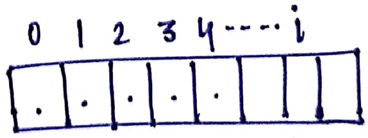
$\boxed{A[i] = \alpha+(i-L)n.}$

Base Address :

$i-L\cancel{+1}\cancel{-1}$



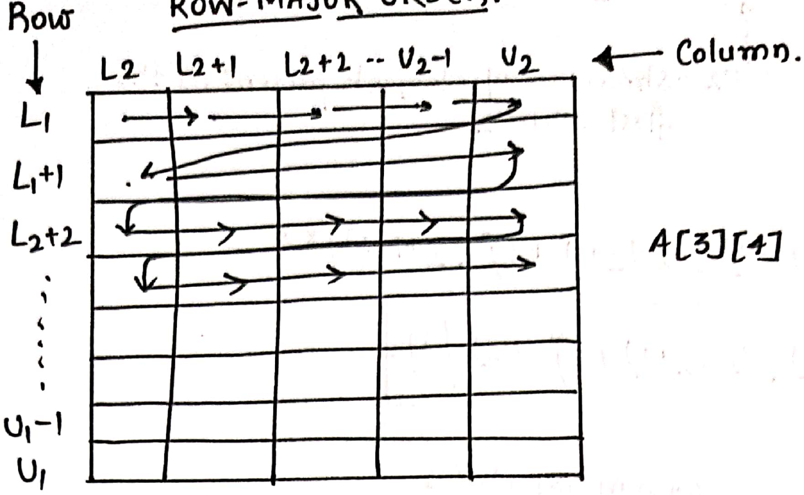
$4-1+1 = 4.$



$4-0+1 = 5$ elements.

INDEX FORMULA COMPUTATION – 2D ARRAY.

ROW-MAJOR ORDER.



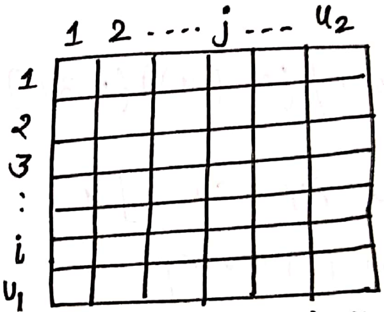
A[3][4]

$$A\left[\underset{\text{Row}}{[L_1 : U_1]}\ ,\ \underset{\text{Column.}}{[L2 : U2]}\right]$$

Assumption
1). 1 Byte storage per element.

$$A[\underset{\text{row}}{1 : U_1}\ ,\ \underset{\text{column.}}{1 : U2}]$$

→ immediately after U_2, $(L_1+1 : L2)$ will get stored.



→ Add of $A[1,1] = \alpha$

$A[1,2] = \alpha + 1$

$A[1,3] = \alpha + 2$

$A[1,U_2] = \alpha + (U_2 - 1)$

:

there will be U2 element in the first row.

$A[2,1] = \alpha + (U_2 - 1) + 1 = \alpha + U_2 = \alpha + 1 \cdot U_2$

$A[2,2] = \alpha + U_2 + 1.$

:

U_2 elements of first row.
U_2 element of second row.

$A[3,1] = \alpha + U_2 + U_2 = \alpha + 2 \cdot U_2$

.
.
.

$A[i,1] = \alpha + (i-1)u_2 =$

$A[i,2] = \alpha + (i-1)u_2 + 1$

$A[i,3] = \alpha + (i-1)u_2 + 2$

$$\boxed{A[i,j] = \alpha + (i-1)u_2 + (j-1)}$$

$A[i,j] = \alpha + [(i-1)U_2 + (j-1)] * n.$

U_2 - show no. of elements present in the first ~~column~~. row

$A[i,j] = \alpha + [(i-L_1+1-1)(U_2-L_2+1) + (j-L_2+1-1)] * n$

$$\boxed{A[i,j] = \alpha + [(i-L_1)(U_2-L_2+1) + (j-L_2)]n.}$$

Row Major Order

Q. $L_1 \; U_1 \; L_2 \; U_2$

Arr $[-4 \ldots 6, 3 \ldots 8]$

$n = 4$ bytes

Base address $= \alpha = 1430$

$i = 3$

$j = 6$

$A[3][6] = 1430 + [(3-(-4))(8-3+1) + (6-3)]4$

$= 1430 + [7 * 6 + 3]4$

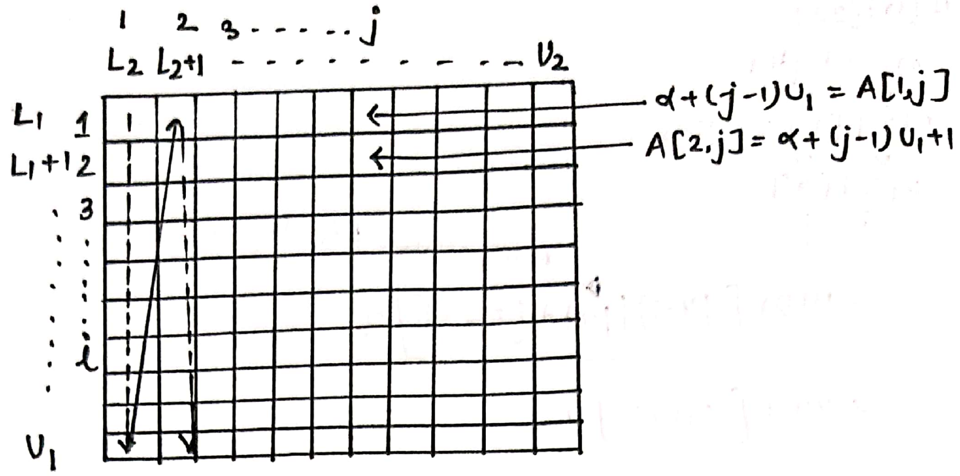
$= 1430 + [45 * 4]$

$= 1430 + 180$

$= \underline{1610}$

2-D ARRAY ADDRESS CALCULATION

COLUMN MAJOR ORDER



$A[1,1] = \alpha$

$A[2,1] = \alpha+1$

$A[3,1] = \alpha+2$

$\vdots$

$A[U_1,1] = \alpha+(U_1-1)$

$A[1,2] = \alpha+(U_1-1)+1 = \alpha+U_1$

$A[1,3] = \alpha+U_1+U_1 = \alpha+2U_1$

$\vdots$

$A[1,4] = \alpha+U_1+U_1+U_1 = \alpha+3U_1$

$\vdots$

$A[1,j] = \alpha+(j-1)U_1$

$A[2,j] = \alpha+(j-1)U_1+1$

$A[3,j] = \alpha+(j-1)U_1+2$

$\boxed{A[i,j] = \alpha+(j-1)U_1+(i-1)}$

$\boxed{A[i,j] = \left[\alpha+\left[(j-1)U_1+(i-1)\right]*n\right]}$

$A[i,j] = \alpha+\left[(j-L_2+1-1)(U_1-L_1+1) + (i-L_1+1-1)\right]*$

$\boxed{A[i,j] = \alpha+\left[(j-L_2)(U_1-L_1+1)+(i-L_1)\right]*n.}$

Column major order.

$A[i,j] = \alpha + [(j-L_2)(U_1-L_1+1) + (i-L_1)]n$

Ques, B[10][20]

$n = 2$ bytes

$B[2][1] = 2140$ (L_1, U_1)

$B[5][4]$ (L_2, U_2)

i j

No of element in the row.

$2140 + [(4-1)(10) + (5-2)]2$

$2140 + [30+3]2$

$2140 + 66$

$\underline{2206}$

Address = Base Address + W * [(i − LBR) + (j − LBC) * M]

total no. of row.

Lower Bound Row

Lower Bound Column

Ques→ arr[15][20]

LBR LBC

Base address Arr [1][1] = 4000

address of arr [6][8] = ~~44400~~ 4440

i j

$4400 = 4000 + W[(6-1) + (8-1)*15]$

$4400 = 4000 + W[5 + 7*15]$

$44400 = 4000 + \cancel{110W}\ 110W$

$4\ \cancel{\frac{440}{110}} = W$

$\boxed{W = 4}$ Answer.

Ques A[m][m]

W = 4

LBR LBC

Base Address A[1][1] = 1500

add of A[4][5] = 1608

i j

m = ?

$1608 = 1500 + 4((4-1) + (5-1)m)$

$1608 = 1500 + 4(3 + 4m) = 1500 + 12 + 16m$

$108 - 12 = 16m$

$96 = 16m = 6$ $= \boxed{m = 6}$ Answer.

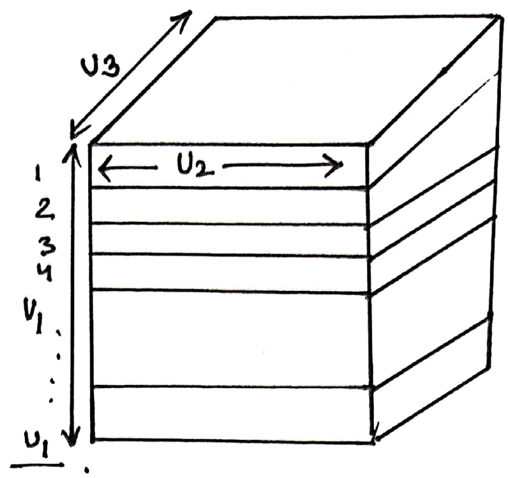
3-D ARRAY.

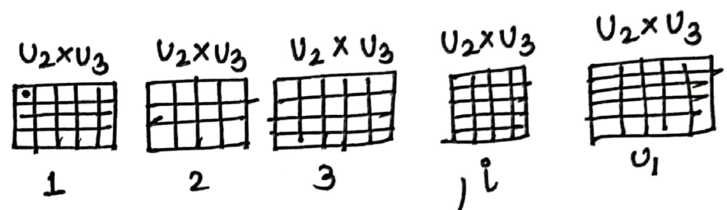
→ INDEX ARRAY CALCULATION.

ROW MAJOR ORDER.

→ A[L1:U1, L2:U2, L3:U3]

→ A[1:U_1, 1:U2, 1:U3]





$\Rightarrow A[1,1,1] = \alpha$

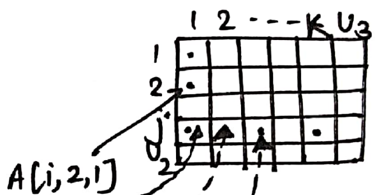
$\Rightarrow A[2,1,1] = \alpha + U_2U_3$

$\Rightarrow A[3,1,1] = \alpha + 2(U_2 \times U_3)$

$\Rightarrow A[i,1,1] = \alpha + (i-1)(U_2 * U_3)$

$\Rightarrow A[i,2,1] = \alpha + (i-1)U_2U_3 + U_3$

$\Rightarrow A[i,3,1] = \alpha + (i-1)U_2U_3 + 2U_3$



$\Rightarrow A[i,j,1] = \alpha + (i-1)U_2U_3 + (j-1)U_3$

$\Rightarrow A[i,j,2] = \alpha + (i-1)U_2U_3 + (j-1)U_3 + 1$

$\Rightarrow A[i,j,3] = \alpha + (i-1)U_2U_3 + (j-1)U_3 + 2$

$$\Rightarrow \boxed{A[i,j,K] = \alpha + [(i-1)U_2U_3 + (j-1)U_3 + (K-1)] \times \eta}$$

$$= \alpha + [(i-L_1)(U_2-L_2+1)(U_3-L_3+1) + (j-L_2)(U_3-L_3+1) + (K-L_3)] * \eta.$$

Index Formula Computation - 3-D Array.

$A[-1:5,\ -1:6,\ 0:10]$

$\quad L_1\ U_1 \quad L_2\ U_2 \quad L_3\ U_3$

α = Base Address = 1000

$\eta = 4$

$A = [2, 4, 6]$

$\quad i\ \ j,\ K.$

$$A = \alpha + [(i-L1)(U_2-L2+1)(U_3-L_3+1) + (j-L2)(U3-L3+1) + (K-L3)]\eta$$

$$= 1000 + [2-(-1)(6-(-1)+1)(10-0+1) + (4-(-1))(10-0+1) + (6-0)]4$$

$$= 1000 + (3(8)(11) + (5)(11) + 6]4$$

$$= 1000 + (\overset{264}{\cancel{176}} + 55 + 6] \times 4$$

$$= 1000 + [\cancel{276}\ \cancel{264} + 325] \times 4$$

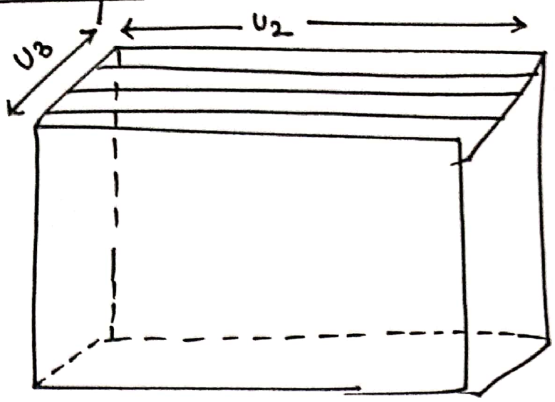
$$= 1000 + [325] * 4$$

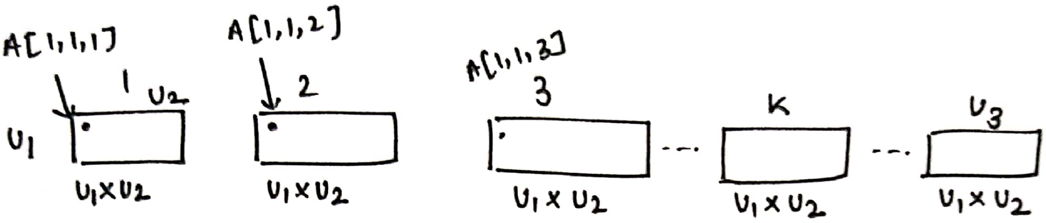
$$= 1000 + \cancel{2024}\ 1300$$

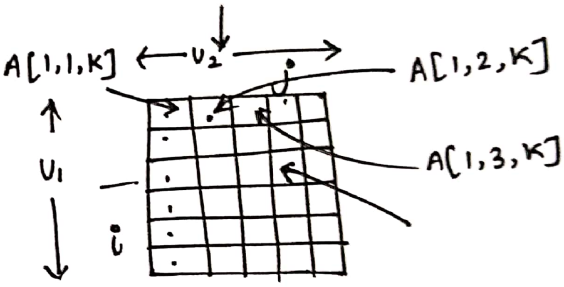
$= \underline{2300}$. Answer.

↳ Column Major Order - 3D - Array.

$A[L1:U_1, L2\ U_2, L_3 U_3]$
$i \quad j \quad k$







A [1,1,1]

$[A[1:U_1, 1:U_2, 1:U_3]]$

1Byte.

$A[1,1,1] = \alpha$

$A[1,1,2] = \alpha + U_1 \times U_2$

$A[1,1,3] = \alpha + 2U_1U_2$

$A[1,1,k] = \alpha + (k-1)U_1U_2$

$A[1,2,k] = \alpha + (k-1)U_1U_2 + U_1$

$A[1,3,k] = \alpha + (k-1)U_1U_2 + 2U_1$

$A[1,j,k] = \alpha + (k-1)U_1U_2 + (j-1)U_1$

$A[2,j,k] = \alpha + (k-1)U_1U_2 + (j-1)U_1 + 1$

$A[3,j,k] = \alpha + (k-1)U_1U_2 + (j-1)U_1 + 2$

$\boxed{A[i,j,k] = \alpha + (k-1)U_1U_2 + (j-1)U_1 + (i-1)}$

$\boxed{\text{No. of elements} = U - L + 1}$

P.

$$\boxed{\begin{aligned} i &= i - L_1 + 1 \\ j &= j - L_2 + 1 \\ k &= k - L_3 + 1 \\ U_1 &= U_1 - L_1 + 1 \\ U_2 &= U_2 - L_2 + 1 \end{aligned}}$$

$A[i,j,k] = \alpha + [(k - L_3 \cancel{+1-1})(U_1 - L_1 + 1)(U_2 - L_2 + 1) + (j - L_2 + 1 - 1)(U_1 - L_1 + 1) + (i - L_1 + 1 - 1)] * n$

$\boxed{A[i,j,k] = \alpha + [(k - L_3)(U_1 - L_1 + 1)(U_2 - L_2 + 1) + (j - L_2)(U_1 - L_1 + 1) + (i - L_1)] * N}$