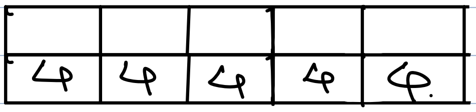
Consider array 5 of integers.

```
int a[5];
```

(1) a is ________________ a :

(2) a is array 5 of ____________ a :

(3) a is array 5 of integers ________ a :

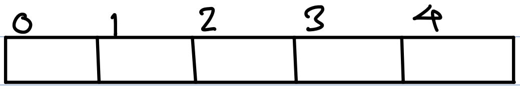


```
struct Date{
    int day;
    int month;
    int year;
};
```

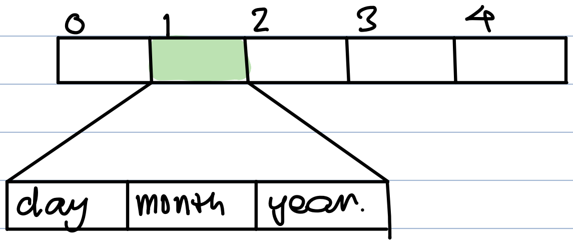
```
struct Date dt_arr[5];
```

1) dt_arr is: dt_arr :

2) dt_arr is array 5 of: dt_arr :



3) dt_arr is array 5 of struct Date:



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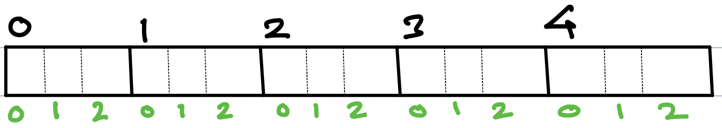
3) int a[5][3];

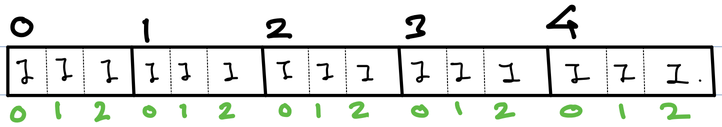
1) a is : a :

2) a is array 5 of : a :

3) a is array 5 of array 3 of



4) a is array of 5 of array 3 of int:



int a[5] [3]

a is array 5 of

array 3 of integers

4) int a[3][5][4];

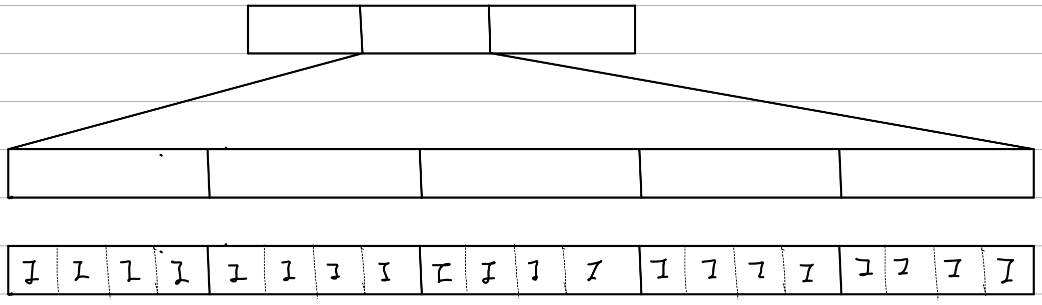
1) a is

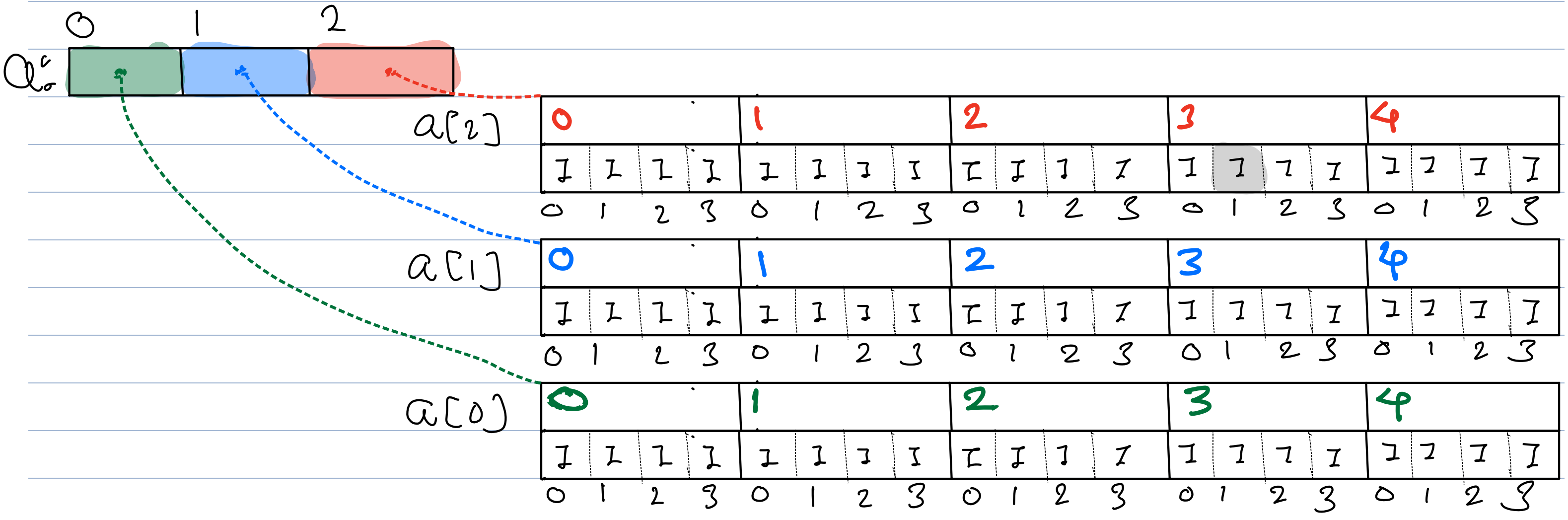
2) a is array 3 of

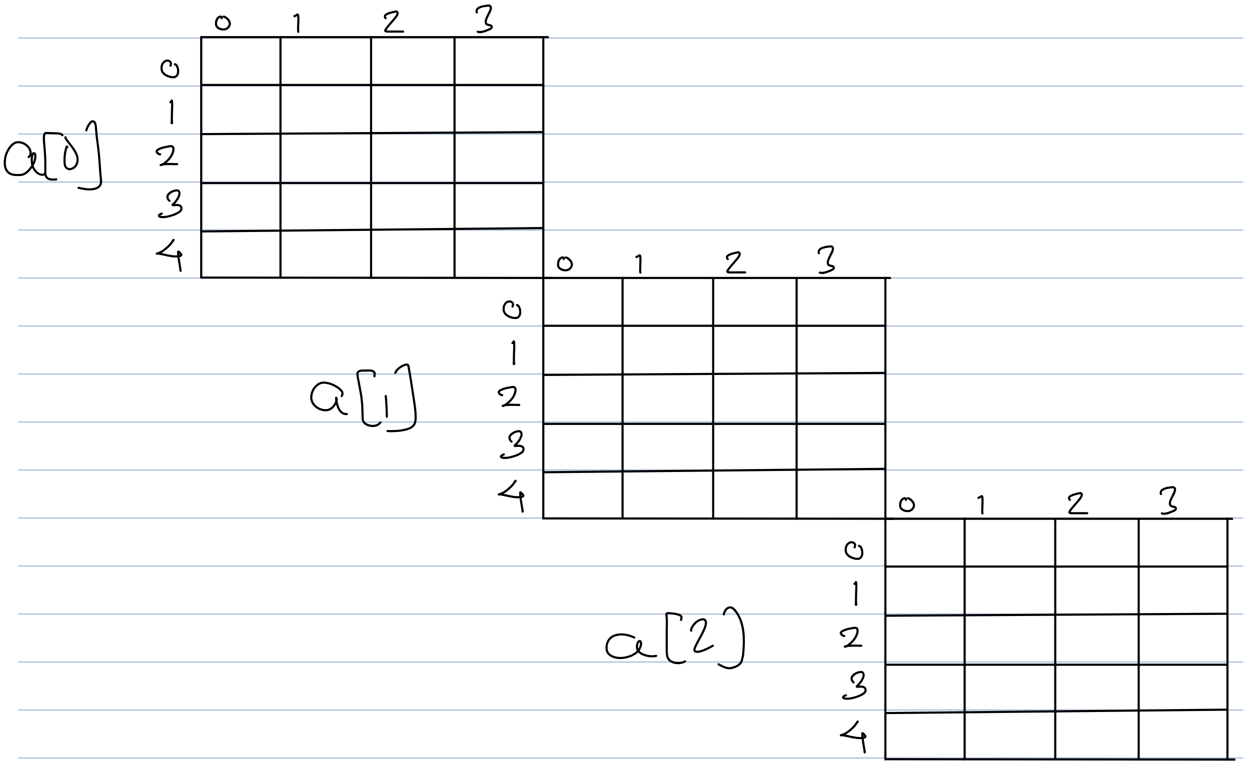
3) a is array 3 of array 5 of

4) a is array 3 of array 5 of array 4 of

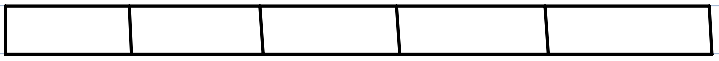
5) a is array 3 of array 5 of array 4 of int.



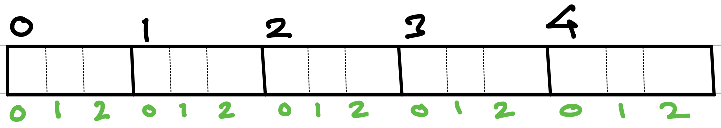




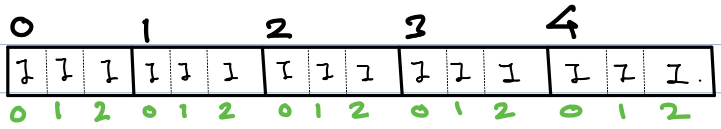
1) a is : a :



2) a is array 5 of



3) a is array 5 of array 3 of int



int a[5][3]

type(a) (in the context of array access) : int [5][3]

type(a[i]) : int [3] where i=0,1,2,3,4

type(a[i][j]) : int where i=0,1,2,3,4 and j=0,1,2

a is array: therefore, [index] can be applied on it/.

Important fact: as 'a' is array, the expression a[i] is also an array.

a[i][j][k]

int a1[5]; : type(a1) : int [5]
type(a1[i]) : int where i=0,1,2,3,4

a1[i][j]

type(a1[i]) == int, and int is not compatible with [index] operator,
a1[i][j] becomes invalid.

int a2[5][3];

type(a2[i][j]) == int where i=0,1,2,3,4 and j=0,1,2

a2[i][j][k]

type(a2[i][j]) == int and it is not compatible with [index]. therefore invalid

a2 is an array.
a2[index_1]

a2[index_1] is also an array as long as index_1=0,1,2,3,4
a2[index_1][index_2] as long as index_1=0,1,2,3,4 and index_2=0,1,2

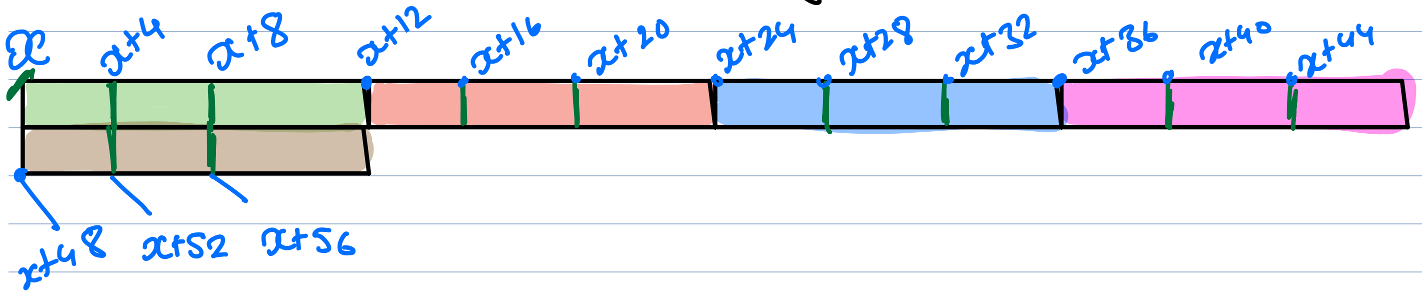
int a[N];   a[i]

int a[N1][N2];   a[i][j]

int a[N1][N2][N3]; a[i][j][k];

---

int a[5][3] : a is array 5 of.



Compiler : int a[5][3];

3 × 5 × sizeof (int) = 3 × 5 × 4 = 15 × 4 = 60

&a[0] = x

&a[1] = x+12

&a[2] = x+24

&a[3] = x+36

&a[4] = x+48.

int a[5][3]

type(a) = int [5][3]

type(a[i]) = int [3] where i=0,1,2,3,4.

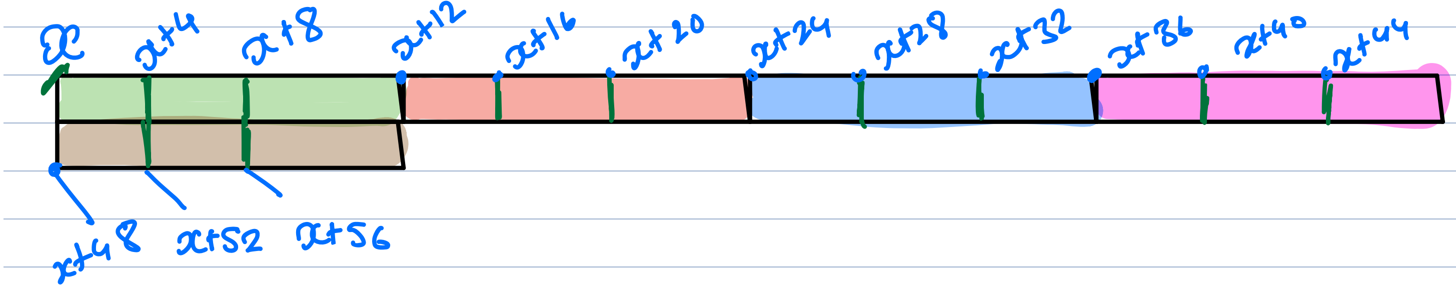
a[i] = Base Address of a
+ i * sizeof(typeof(a[i]))
= Base Address of a
+ i * sizeof(int [3]).
= Base Address of a
+ i * 3 * sizeof(int)
= Base Address of a
+ i * 3 * 4.
= Base Address of a
+ i * 12

a[i] = x + i * 12

i=0,1,2,3,4, x+0 * 12, x+1 * 12, x+2 * 12, x+3 * 12, x+4 * 12

x, x+12, x+24, x+36, x+48

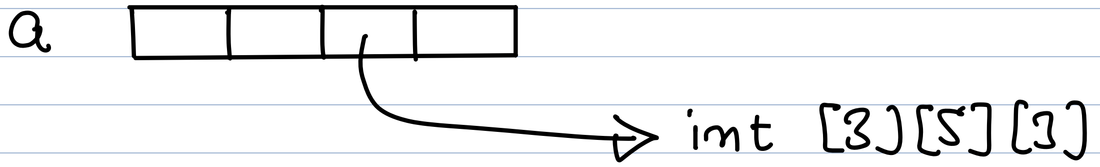
int a[5][3] : a is am ay 5 of.



4 Dimensional Array

int a[4][3][5][3];

a is array 4 of array 3 of array 5 of array 3 of int.

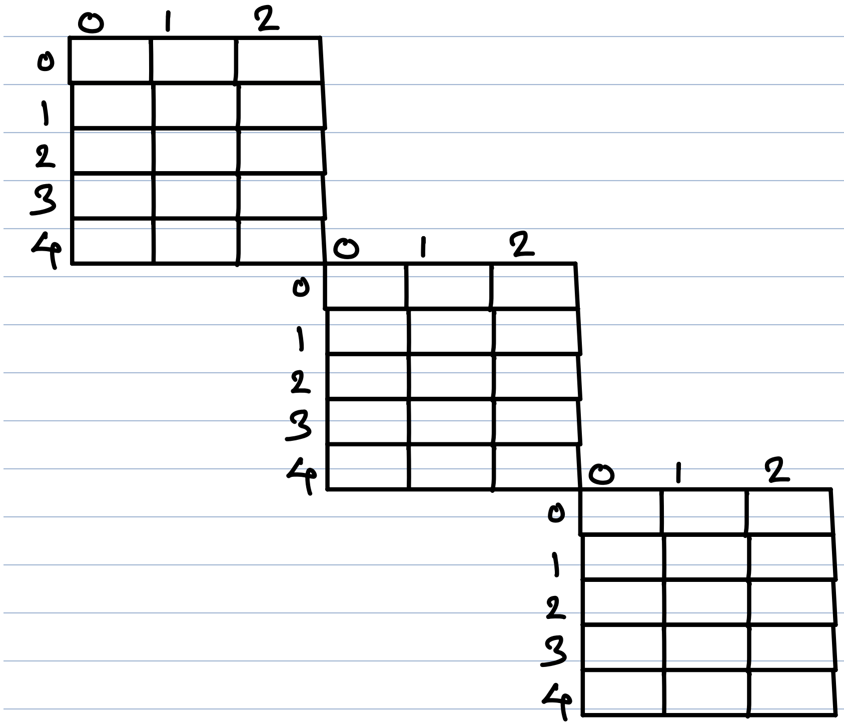


int [3][5][3]

int [5][3]

int [3]

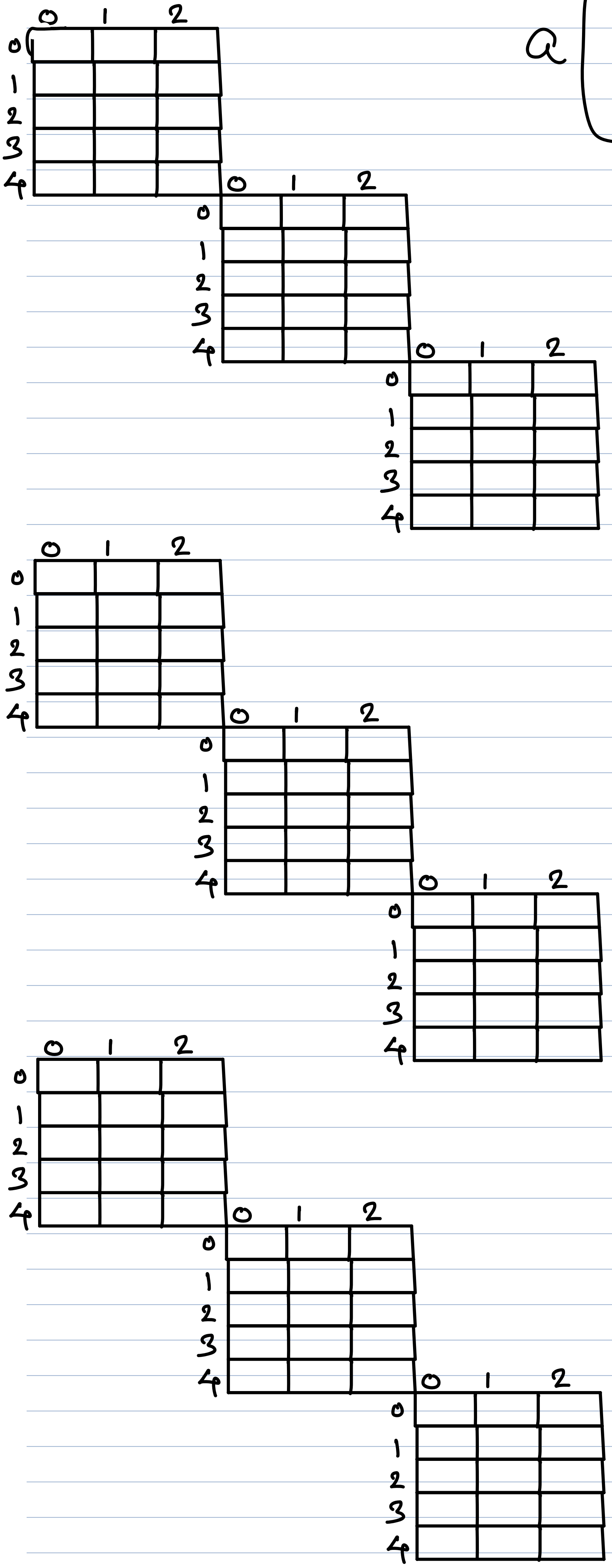
int



One element in a.

a[0], a[1],
a[2], a[3]

$a\begin{pmatrix} 0 \text{ or} \\ 1 \text{ or} \\ 2 \text{ or} \\ 3 \end{pmatrix} \begin{bmatrix} 0 \\ \text{or} \\ 1 \\ \text{or} \\ 2 \end{bmatrix} \begin{bmatrix} 0 \text{ or} \\ 1 \text{ or} \\ 2 \text{ or} \\ 3 \text{ or} \\ 4 \end{bmatrix}$



a[0]

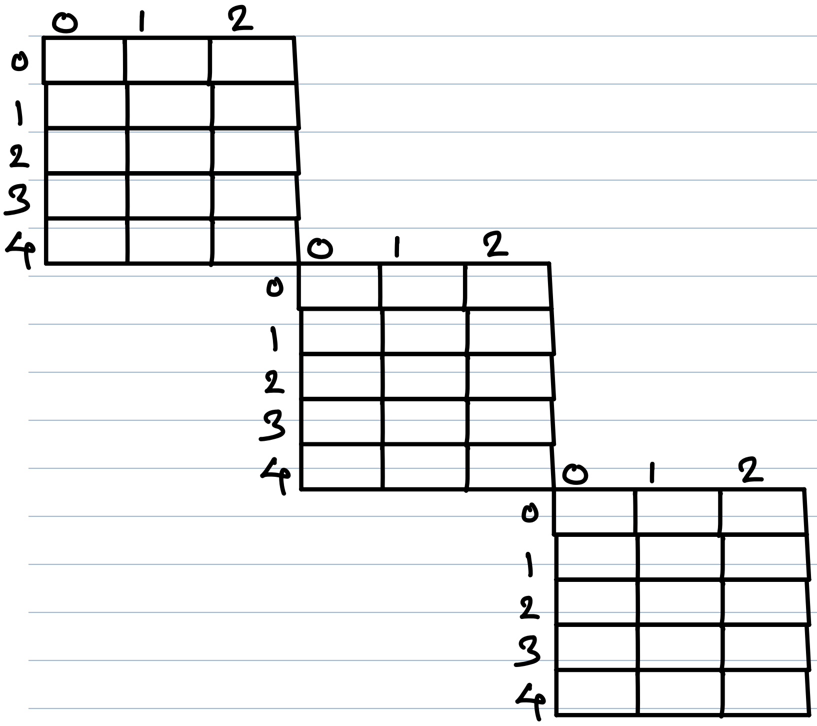
int [3][5][3]

a[1]

int [3][5][3]

a[2]

int [3][5][3]



a[3]

int [3][5][3]

---

int a[4]$\underline{[3][5][3]}$

base addr $(a[i_1])$ = Base Addr (a) +
i_1 * sizeof(int) * 3 * 5 * 3

Base addr $(a[i_1][i_2])$ =
Base addr(a) + i_1 * sizeof(int) * 3 * 5 * 3 +
i_2 * sizeof(int) * 5 * 3 +

Base addr $(a[i_1](i_2][i_3])$ =
Base Addr(a) + i_1 * sizeof(int) * 3 * 5 * 3 +
i_2 * sizeof(int) * 5 * 3 + i_3 * sizeof(int) * 3

Base addr $(a[i_1](i_2][i_3][i_4]))$ =

Base Addr(a) + i_1 * sizeof(int) * 3*5*3 +
i_2 * sizeof(int) * 5*3 + i_3 * sizeof(int) * 3
+ i_4 * sizeof(int)

Assume, a is k-dimensional array of int.

r^{th} dimension is N_r where $1 \leq r \leq k$

[1D, N_1, 2D, N_2, 3D N_3, — k-D, N_k]

int a[N_1][N_2][N_3]---[N_k];

let i_1, i_2, i_3 --, i_k be k index variables.

$0 \leq i_1 < N_1$, $0 \leq i_2 < N_2$, $0 \leq i_3 < N_3$, ..., $0 \leq i_k < N_k$.

Base Addr $(a[i_1][i_2][i_3)$ -- $[i_k])$

= Base Addr (a) +

$i_1 * S_{int} * N_2 * N_3 * \text{--} * N_k$ +

$i_2 * S_{int} * N_3 * N_4 * \cdots * N_k$ +

$i_3 * S_{int} * N_4 * N_5 * \text{--} * N_k$ +

$\vdots$

$i_k * S_{int}$.

$$= \text{Base Addr}(a) + \left[\sum_{r=1}^{r=k-1} i_r \times \left(\prod_{s=r+1}^{s=k} N_s \right) \right] * S_{int} + i_k * S_{int}$$

→ Important for freshers.

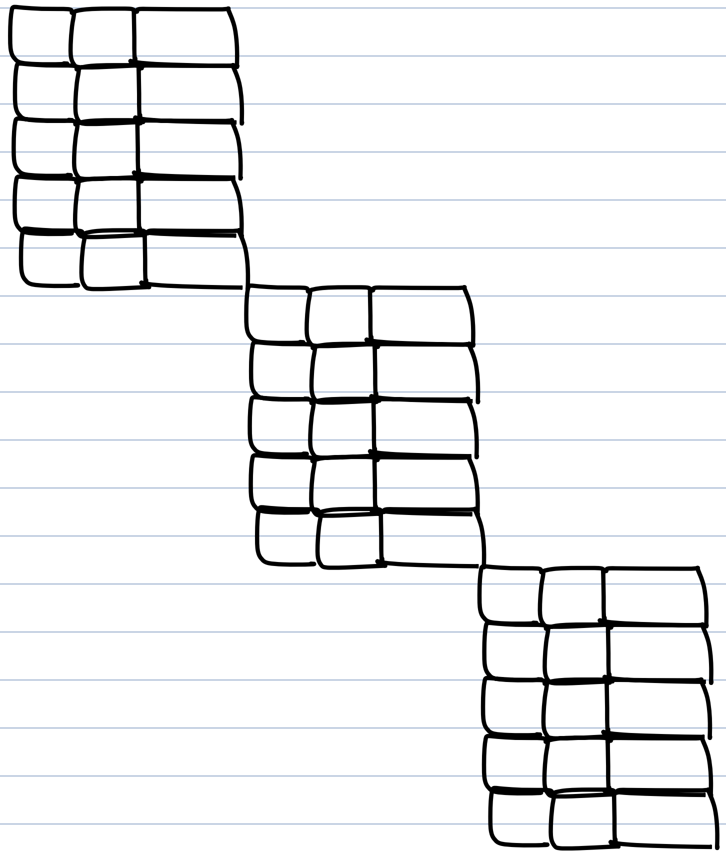
→ C + DSA interview.

$\underline{\underline{\text{int}}}\ a[4][3][5]\underline{[3]}$

int [3]

int [5][3]

int [3][5][3]



Trembley & Sorenson: DSA

Question: