

# CS & IT ENGINEERING



**Data Structures**

**Arrays**

**DPP**

Discussion Notes




By- Pankaj Sharma sir





## TOPICS TO BE COVERED



**01 Question**

**02 Discussion**

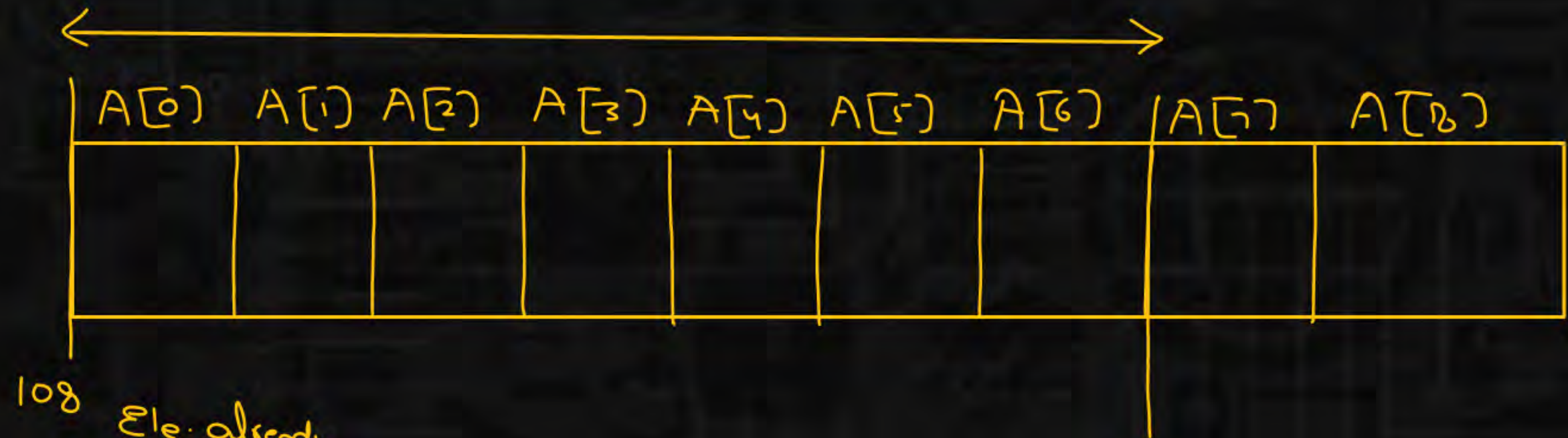
Q.1



Consider a 1D array  $a$  with 9 elements. If the base address of the array is 108 and the size of each array element is 4 bytes, the address of  $a[7]$  is- 136

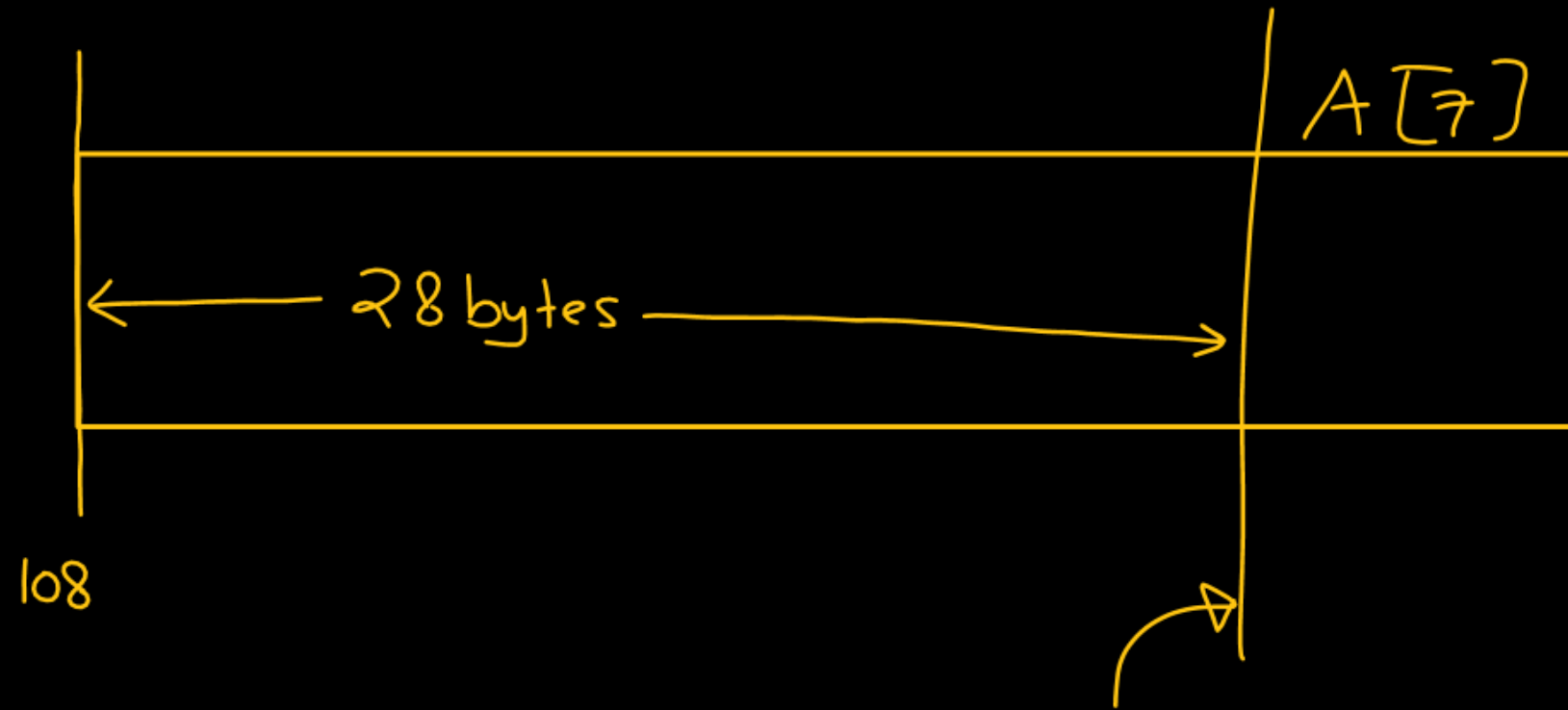
[NAT]

(Assume array index starts from 0)



108  
Ele. already filled before = index from 0 to 6 =  $6 - 0 + 1 = 7$  elements  
 $A[7]$   
Memory already filled before  $A[7] = 7 \times 4 \text{ byte} = 28 \text{ bytes}$





$$\begin{aligned} \text{add}(A[7]) &= 108 + 28 \\ &= \underline{\underline{136}} \end{aligned}$$

Q.2



Consider a 1D array  $a[-127 \dots +255]$  where  $-127$  and  $+255$  are the starting index and ending index of the array [NAT] respectively. The number of elements in the array is

383.

$a[-127 \dots +255]$   
Smallest  $\swarrow$   $\searrow$  largest index

$-127$  to  $+255$

$$= 255 - (-127) + 1$$

$$= 255 + 127 + 1$$

$$= 255 + 128$$

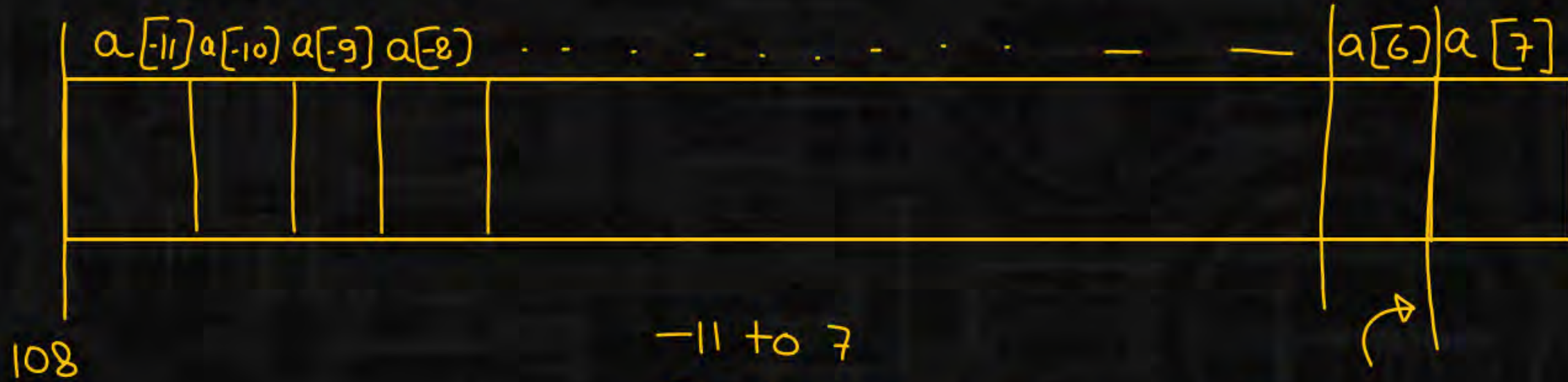
$$= 383$$



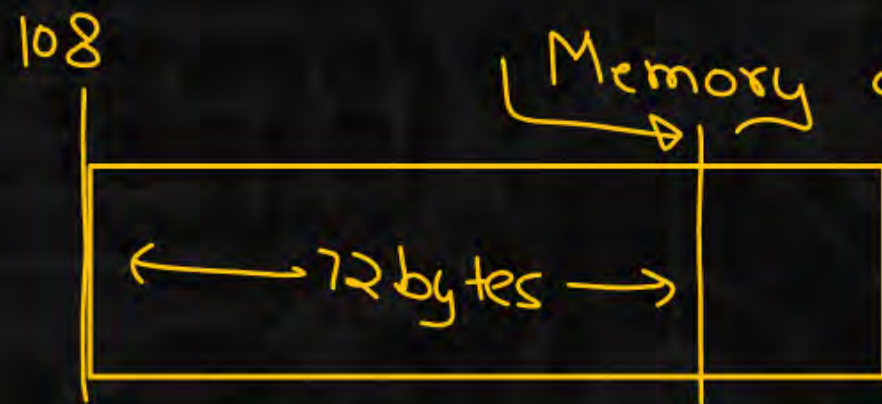
Q.3



Consider a 1D array  $a$  with 19 elements. If the base address of the array is 108 and the size of each array element is 4 bytes, the address of  $a[7]$  is- (Assume array index starts from -11) 180 [NAT]



(1) No. of elements already filled before  $a[7] \Rightarrow -11$  to 6  
 $= 6 - (-11) + 1 = 18$  element



$$\Rightarrow 108 + 72 = 180$$



**Q.4**

Consider a 2D array  $a[-127 \text{ to } +255][-13 \text{ to } +14]$ . The number of elements in the array is \_\_\_\_\_.

**[NAT]**

$$\begin{array}{r} 612 \\ 383 \\ 28 \\ \hline 3064 \\ 766 \times \\ \hline \boxed{10724} \end{array}$$

$$\begin{aligned} \text{No. of rows} &= -127 \text{ to } 255 \\ &= 255 - (-127) + 1 \\ &= 255 + 127 + 1 \\ &= 255 + 128 \\ &= 383 \end{aligned}$$

$$\begin{aligned} \text{No. of col} &= -13 \text{ to } +14 \\ &= 14 - (-13) + 1 \\ &= 28 \end{aligned}$$

$$\text{Total Elements} = 383 \times 28 = \boxed{10724}$$

$$\begin{array}{c} -127 \\ -126 \\ \vdots \\ \vdots \\ 0 \\ 1 \\ 2 \\ \vdots \\ \vdots \\ 255 \end{array} \left[ \begin{array}{cccccccc} -13 & -12 & \dots & 0 & 1 & 2 & \dots & 14 \end{array} \right]$$



**Q.5**

Consider the natural numbers from 1 to 256 are stored in a 2D array  $\text{arr}[-28 \text{ to } 3][-3 \text{ to } 3]$ . Find the element present at location  $\text{arr}[-16][1]$ . (Suppose, the elements are stored in row-major order) 89

**[NAT]**

$$\begin{aligned}\text{No. of rows} &= 3 - (-28) + 1 = 32 \\ \text{No. of cols} &= 3 - (-3) + 1 = 7\end{aligned}$$

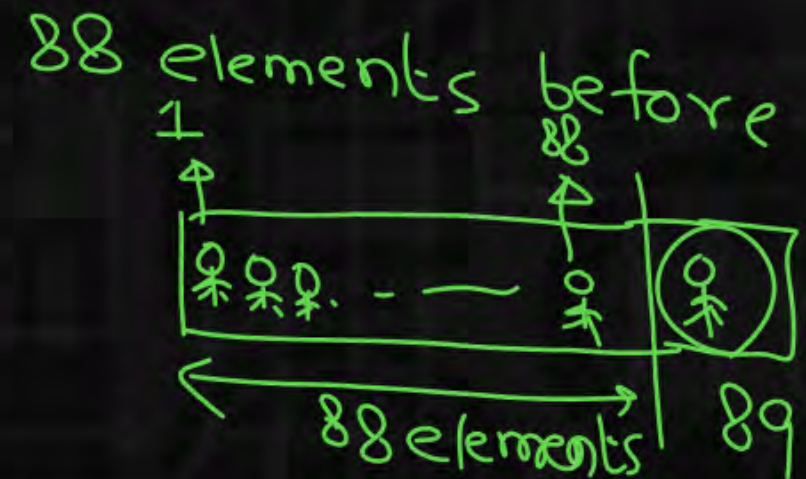
$$\text{arr}[-28 \dots 3][-3 \text{ to } 3]$$

Each index in  
this dim = 7 elem

$a_{-16, 1}$

rows already filled =  $-28 \text{ to } -17$   
 $= -17 - (-28) + 1$   
 $= -17 + 29$   
 $= 12 \text{ rows}$   
 $12 \times 7 = 84 \text{ elements}$

$-3 \text{ to } 0$   
 $0 - (-3) + 1$   
 $= 4$





Q.6



Consider the natural numbers from 1 to 256 are stored in a 2D array  $\text{arr}[-28 \text{ to } 3][-3 \text{ to } 3]$ . Find the address of the location  $\text{arr}[-16][1]$  if the starting address of the array is 625 and size of each element is 4 bytes. (Suppose, the elements are stored in row-major order)

[NAT]

977

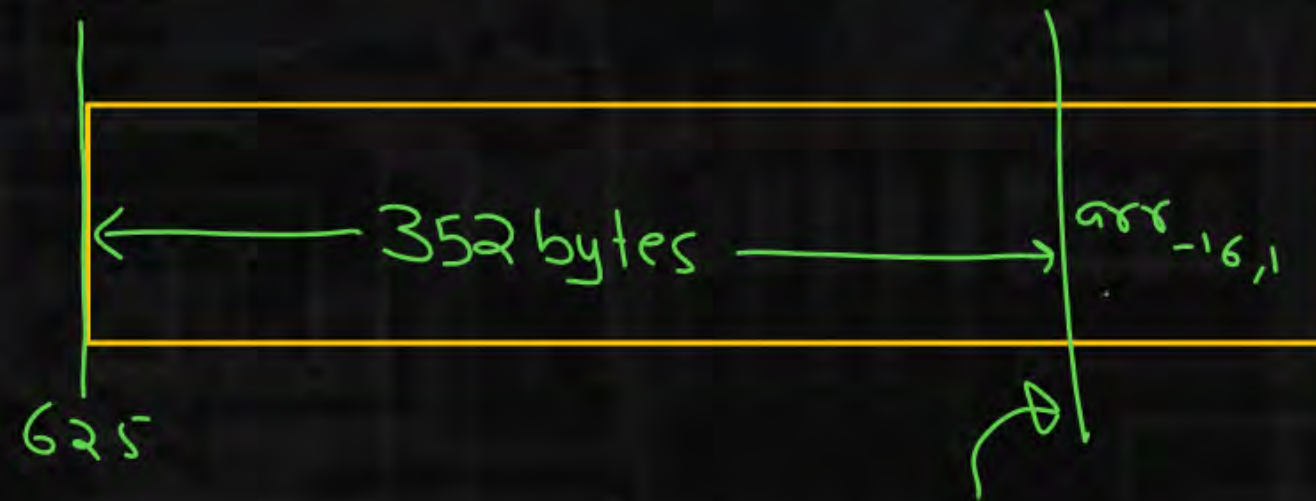
Total no. of elements already filled before  $\text{arr}[-16][1] = 88$

Memory already filled before  $\text{arr}[-16][1] = 88 \times 4 = 352$  bytes

$$\text{add}(\text{arr}[-16][1])$$

$$= 625 + 352$$

$$= 977$$





Q.7

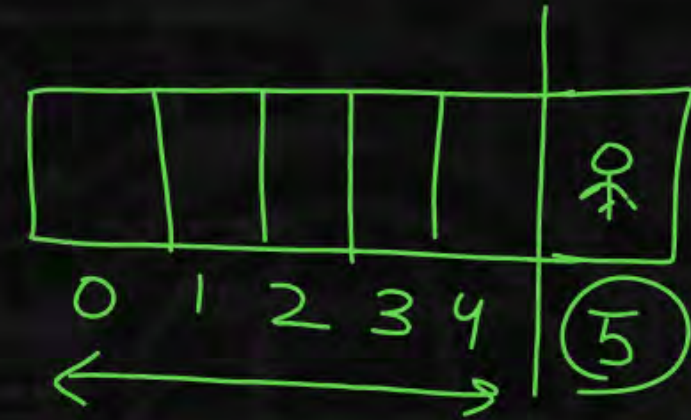


Consider the whole numbers from 0 to 127 are stored in a 2D array  $\text{arr}[0 \text{ to } 15][0 \text{ to } 7]$ . Find the element present at location  $\text{arr}[6][4]$ . (Suppose, the elements are stored in column-major order) 70

[NAT]

$\text{arr}[0 \dots 15][0 \dots 7]$

Each index = 16 ele.



$\text{arr}_{6,4}$

0 to 5  
 $5 - 0 + 1$   
6

# of col. filled = 0 to 3 =  $3 - 0 + 1 = 4$  cols  
 $4 \times 16 = 64$  elements



Total 70 elements are already filled before  $\text{arr}[6][4]$



Q.8



Consider a 2D array  $\text{arr}[-15 \text{ to } 15][-7 \text{ to } 7]$ . Find the address of the location  $\text{arr}[-1][5]$  if the starting address of the array is 500 and size of each element is 4 bytes. (Suppose, the elements are stored in column-major order)

[NAT]

$$\begin{array}{r} 3386 \\ 4 \\ \hline 1544 \end{array}$$

2044

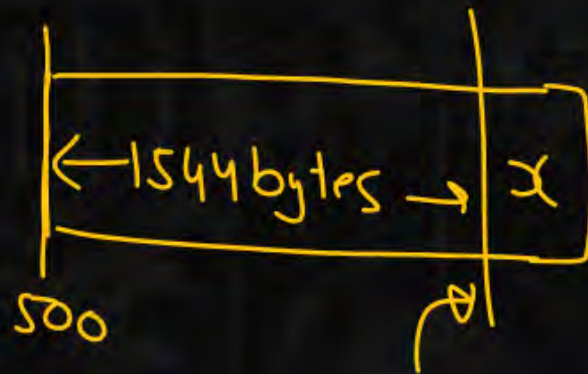
$$\text{arr}^{31}[-15 \dots 15]^{15}[-7 \dots 7]$$

$$\text{arr}[-1][5]$$

1 col = 31 elements

$$\begin{aligned} \text{Total ele} &= 372 + 14 \\ &= 386 \text{ ele} \end{aligned}$$

$$\begin{aligned} \text{Memory} &= 386 \times 4 \\ &= 1544 \text{ bytes} \end{aligned}$$



$$-15 \text{ to } -2$$

$$\begin{aligned} &= -2 - (-15) + 1 \\ &= -2 + 16 \\ &= 14 \end{aligned}$$

$$\# \text{ cols} \Rightarrow -7 \text{ to } 4$$

$$\begin{aligned} &= 4 - (-7) + 1 \\ &= 12 \text{ cols} \end{aligned}$$

$$\begin{aligned} &= 12 \times 31 \text{ elements} \\ &= 372 \text{ elements} \end{aligned}$$

$$500 + 1544 = 2044$$



Q.1

Consider a lower triangular 2D array `arr[][5]` with 15 elements.  
The number of rows in `arr` is- 5 **[NAT]**





Q.2



Consider an integer 2D array  $a[-7 \text{ to } +7] [-7 \text{ to } +7]$  that stores an upper triangular matrix  $\text{uppertm}$  where  $\text{uppertm}[i][j]$  is 1 for all  $i \leq j$ . The sum of all the elements in the array is 120.

	1	2	3	4
1	1	1	1	1
2	0	1	1	1
3	0	0	1	1
4	0	0	0	1

Row col  
1 1, 2, 3, 4

$a_{ij} = 0 \quad i > j$

$$= 4 + 3 + 2 + 1 \\ = \frac{4 \times 5}{2} = 10$$

[NAT]

	1	2	3	4
1	x	x	x	x
2	0	x	x	x
3	0	0	x	x
4	0	0	0	x



$$7 - (-7) + 1$$

$$= 15$$

$$15 \times 15$$

$$15 + 14 + 13 + \dots + 1$$

$$= 1 + 2 + \dots + 13 + 14 + 15$$

$$= \frac{15 \times 16^8}{2} = \underline{120}$$

$$\begin{array}{c} -7 \\ -6 \\ -5 \\ \vdots \\ 1 \\ 1 \\ 1 \\ 1 \\ +7 \end{array} \left[ \begin{array}{ccccccc} -7 & -6 & -5 & \dots & \dots & \dots & +7 \end{array} \right]$$



Q.3



Consider an integer lower triangular 2D array  $\text{arr}[-16 \text{ to } +15][-16 \text{ to } +15]$  having base address 1000. If the size of the integer is 4 bytes, the address of the element  $\text{arr}[8][7]$  is- 2292

RMO

$\text{arr}[8][7]$

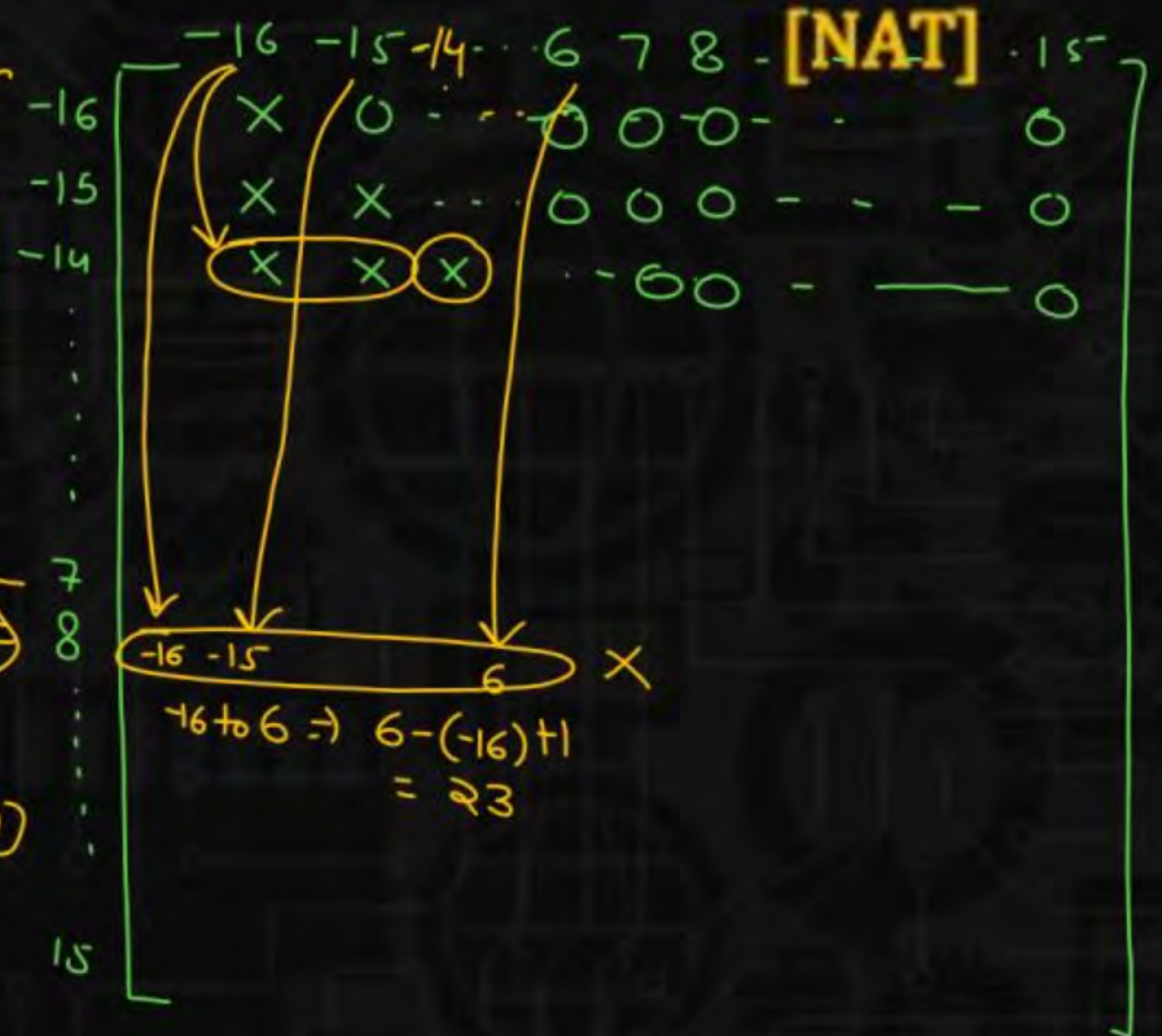
Rows already filled =  $-16 \text{ to } 7$   
 $= 7 - (-16) + 1$   
 $= 24$

$$1 + 2 + 3 + \dots + 24 = \frac{24 \times 25}{2} = 300 \Rightarrow$$

within row with index 8  
elements already filled before  $\text{arr}[8][7]$

Total ele already filled =  $300 + 23 = 323$

Rows  
already  
filled





Memory already filled =  $323 \times 4 = 1292$  bytes



add

$$= 1000 + 1292$$

$$= \textcircled{2292}$$



Q.4



Consider an integer upper triangular 2D array  $\text{arr}[-8 \text{ to } +7][-8 \text{ to } +7]$  having base address 1000. If the size of integer is 4 bytes, the address of the element present at location  $\text{arr}[-6][4]$  is-

1164

$$\# \text{ of rows} = 7 - (-8) + 1 = 16$$

$$\# \text{ of cols} = 16$$

$$1^{\text{st}} \text{ row} = 16$$

$$2^{\text{nd}} \text{ row} = 15$$

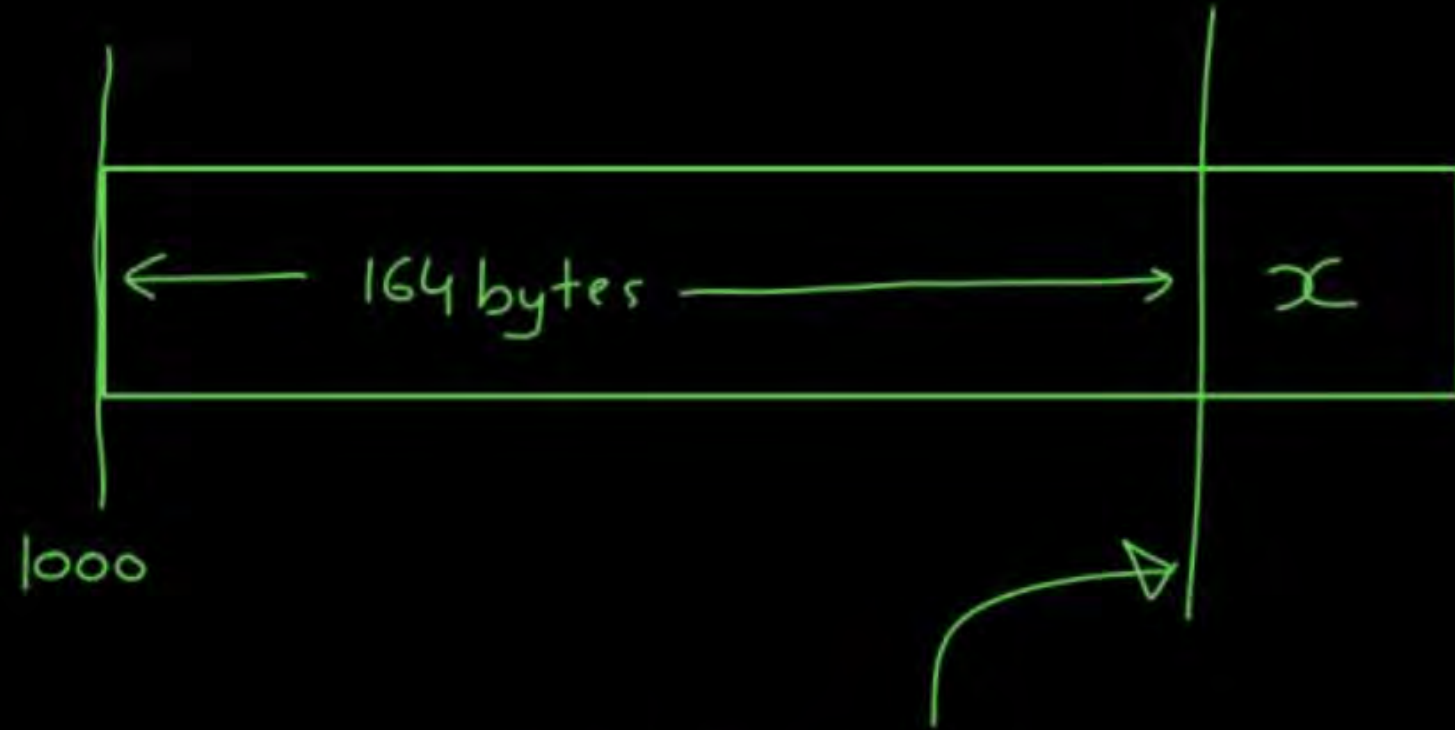
$$3^{\text{rd}} \text{ row} = 4 - (-6) = 10$$

$$\begin{aligned} \text{Total ele. already filled before } \text{arr}[-6][4] &= 16 + 15 + 10 \\ &= 41 \text{ elements} \end{aligned}$$

$$\begin{aligned} \text{Memory already filled} &= 41 \times 4 \\ &= 164 \text{ bytes} \end{aligned}$$







$$1000 + 164 = 1164$$



Q.5



Consider the natural numbers starting from 1 are stored in a lower triangular matrix  $\text{arr}[-3 \text{ to } 3][-3 \text{ to } 3]$ . Find the element present at location  $\text{arr}[1][1]$ . 15

$\text{arr}[1][1]$

$$\begin{aligned} & -3 \text{ to } 0 \\ & 0 - (-3) + 1 \\ & = 4 \end{aligned}$$

$$\begin{aligned} & 1 + 2 + 3 + 4 \\ & = \frac{4 \times 5}{2} \\ & = 10 \end{aligned}$$

Total ele. already filled before  $\text{arr}[1][1] = 14$

In row  
with index 1  
ele. already  
filled

$$\begin{aligned} & = -3 \text{ to } 0 \\ & = 0 - (-3) + 1 \\ & = 4 \end{aligned}$$

	-3	-2	-1	0	1	2	3
-3	X						
-2	X	X					
-1	X	X	X				
0	X	X	X	X			
1	X	X	X	X	X		
2	X	X	X	X	X	X	
3	X	X	X	X	X	X	X

[NAT]

15



Q.6



Consider the natural numbers starting from 1 are stored in a upper triangular 2D array  $\text{arr}[-3 \text{ to } 3][-3 \text{ to } 3]$ . Find the element present at location  $\text{arr}[1][2]$ .

RMO

24

$$\begin{aligned}\# \text{ of col} &= -3 \text{ to } +3 \\ &= +3 - (-3) + 1 \\ &= 7\end{aligned}$$

$$\# \text{ of rows} = 7$$

$$1^{\text{st}} \Rightarrow 7$$

$$2^{\text{nd}} \Rightarrow 6$$

$$3^{\text{rd}} \Rightarrow 5$$

$$4^{\text{th}} \Rightarrow 4$$

$$\text{Total} = 22$$

rows already filled

$$\begin{aligned}&= -3 \text{ to } 0 \\ &= 0 - (-3) + 1 \\ &= 4 \text{ rows}\end{aligned}$$

$\text{arr}[1][2]$  within  $\Rightarrow$  row with index 1, ele. already filled before  
 $\text{arr}[1][2] \Rightarrow 2-1 = 1 \text{ element}$

	-3	-2	-1	0	1	2	3 [NAT]
-3	X	X	X	X	X	X	X
-2	0	X	X	X	X	X	X
-1	0	0	X	X	X	X	X
0	0	0	0	X	X	X	X
1	0	0	0	0	X	X	X
2	0	0	0	0	0	X	X
3	0	0	0	0	0	0	X



Q.6



Consider the natural numbers starting from 1 are stored in a upper triangular 2D array  $\text{arr}[-3 \text{ to } 3][-3 \text{ to } 3]$ . Find the element present at location  $\text{arr}[1][2]$ .

RMO

24

$$\begin{aligned}\# \text{ of col} &= -3 \text{ to } +3 \\ &= +3 - (-3) + 1 \\ &= 7\end{aligned}$$

$$\# \text{ of rows} = 7$$

$$1^{\text{st}} \Rightarrow 7$$

$$2^{\text{nd}} \Rightarrow 6$$

$$3^{\text{rd}} \Rightarrow 5$$

$$4^{\text{th}} \Rightarrow 4$$

$$\text{Total} = 22$$

rows already filled

$$\begin{aligned}&= -3 \text{ to } 0 \\ &= 0 - (-3) + 1 \\ &= 4 \text{ rows}\end{aligned}$$

$\text{arr}[1][2]$

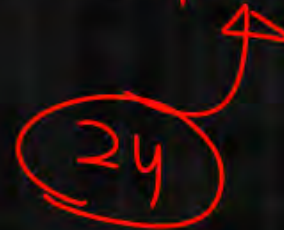
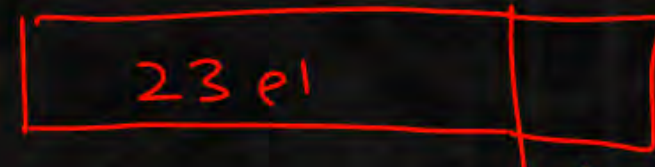
within  $\Rightarrow$

row with index 1, ele. already filled before  $\text{arr}[1][2] \Rightarrow 2-1 = 1 \text{ element}$

Total ele. already [NAT]

filled before  $\text{arr}[1][2]$

$$= 23 \text{ elements}$$





[illegible][illegible]



Q.7



Consider a 2D array  $\text{arr}[-4 \text{ to } +4][-4 \text{ to } 4]$  stores an upper triangular matrix. Find the address of the location  $\text{arr}[-1][-1]$  if the starting address of the array is 500 and size of each element is 8 bytes. Assume that elements are stored in column-major order.

arr[-1][-1]

within col index -1  
ele. already filled before  
 $\text{arr}[-4][-1]$   
 $= -4 \text{ to } -2$   
 $= -2 - (-4) + 1$   
 $= -2 + 4 + 1 = 3$

No. of cols filled  
 $= -4 \text{ to } -2$   
 $= -2 - (-4) + 1$   
 $= 3 \text{ cols}$   
 $1 + 2 + 3$   
 $= 6 \text{ elements}$

	-4	-3	-2	-1	0	1	2	3	4
-4	X								
-3	0	X							
-2	0	0	X						
-1	0	0	0	X					
0	0	0	0	0	X				
1					X	X			
2						X	X		
3							X	X	
4								X	X

[NAT]

Total ele already filled before  $\text{arr}[-1][-1]$   
 $= 9 \text{ ele.}$



Q.7

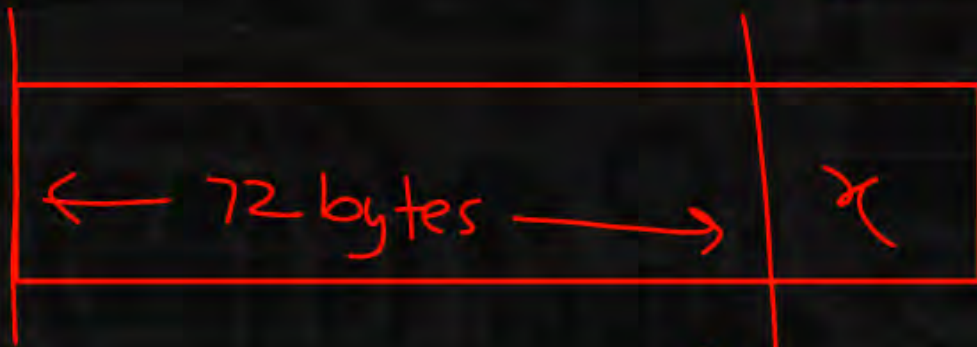


Consider a 2D array  $\text{arr}[-4 \text{ to } +4][-4 \text{ to } +4]$  stores an upper triangular matrix. Find the address of the location  $\text{arr}[-1][-1]$  if the starting address of the array is 500 and size of each element is 8 bytes. Assume that elements are stored in column-major order.

572

Memory already filled  
=  $9 \times 8$  bytes  
= 72 bytes

500



$$500 + 72 = 572$$

	-4	-3	-2	-1	0	1	2	3	4
-4	x	x	x	x	x	x	x	x	x
-3	0	x	x	x	x	x	x	x	x
-2	0	0	x	x	x	x	x	x	x
-1	0	0	0	x	x	x	x	x	x
0	0	0	0	0	x	x	x	x	x
1						x	x	x	x
2							x	x	x
3								x	x
4									x

[NAT]

Total ele  
already  
filled before  
 $\text{arr}[-1][-1]$   
= 9 ele.



**Q.8**



Consider a 2D array `arr[-4 to +4][-4 to +4]` stores a lower triangular matrix. Find the address of the location `arr[-2][-3]` if the starting address of the array is 500 and size of each element is 8 bytes. Assume, that elements are stored in column major order.

580

Total etc already filled = 10

filled = 10

$$= 10 \times 8 \text{ bytes}$$

= 80 bytes

[illegible]



**Q.8**



$9$   
 $4 - (-4) + 1$

$9$   
 $4 - (-4) + 1$

4 to +4][-4 to +4] stores a lower  
 e address of the location arr[-2][-3] if  
 e array is 500 and size of each element  
 nents are stored in column major order

$-4$   $-3$   $-2$   $-1$   $0$   $1$   $2$   $3$   $4$  [NAT]

$-4$  X  
 $-3$  X X  
 $-2$  X (X) X  
 $-1$  (X) X X X  
 $0$  X X X X  
 $1$  X X X X X  
 $2$  X X X X X X  
 $3$  X X X X X X X  
 $4$  X X X X X X X X



