

# C-Programming and DS

## Today Class Topics :

- Passing Array to function ✓
- Array of pointers ✓
- Multidimensional Arrays ✓
- 2D Array ✓
- 3D Array ✓
- Strings ✓



## Passing Array to function :-

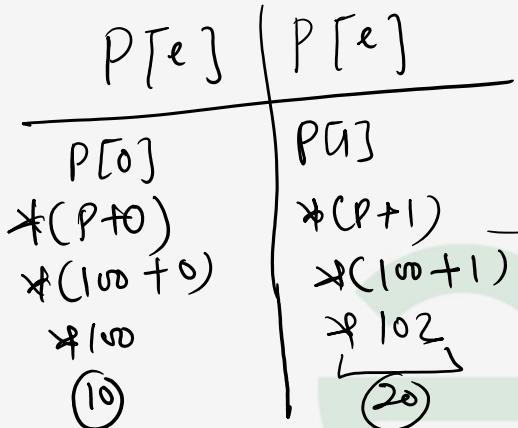
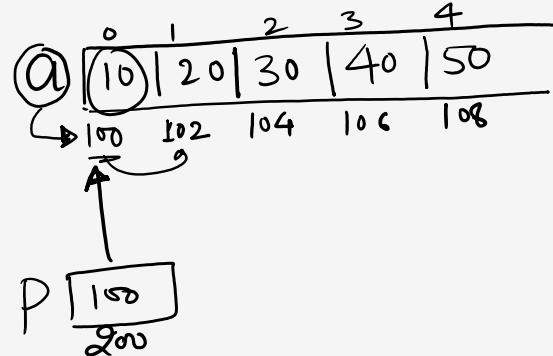
Ex:- main()

```
{
    int a[5] = {10, 20, 30, 40, 50};
    display(a, 5); // display(100, 5)
}
```

display(int \*P, int n)

```
{
    int i;
    for(i=0; i<n; i++)
        printf("%d", P[i]);
}
```

O/P=? 10 20 30 40 50



GATE:

```
int f(int *a, int n)
{
    if (n <= 0) return 0;
    else if (*a % 2 == 0)
        return *a + f(a+1, n-1);
    else
        return *a - f(a+1, n-1);
}

main()
{
    int a[6] = {12, 7, 13, 4, 11, 6};
    printf("%d", f(a, 6));
}
```

(15) Ans

Q) 

0	1	2	3	4	5
12	7	13	4	11	6

↓  
100 102 104 106 108 110

$f(100, 6)$  (S)  
 $\rightarrow 12 + f(102, 5) = 15$

$\rightarrow 7 - f(104, 4) = 3$

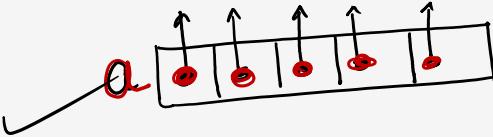
$13 - f(106, 3) = 4$

$4 + f(108, 2) = 9$

$11 - f(110, 1) = 10$

$6 + f(112, 0) = 6 \rightarrow \infty$

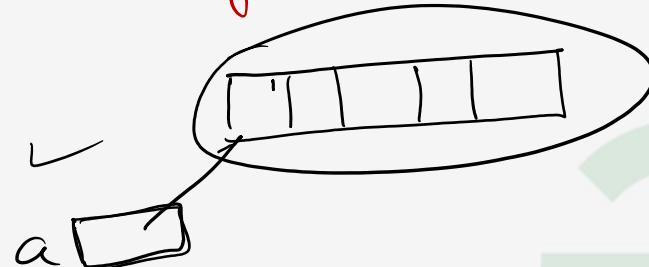
## Array of Pointers:-



① int \*a[5]; // a is an array of 5 elements where every element is an integer pointer

② int (\*a)[5]; // a is Pointer to Array of 5 elements and every element is integer

$$\textcircled{1} \neq \textcircled{2}$$



Ex:-

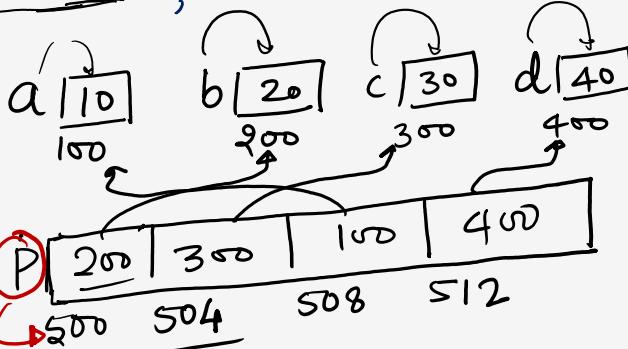
main()

{ int a=10, b=20, c=30, d=40;

int \*P[4] = {&b, &c, &a, &d};

int \*\*ptr = P;

}



Pf(\*ptr)?

Pf(\*500)

⊕

200

ptr [500]

NOTE:

- 1) Array name means Base Address
- 2) Variable name means inside data

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1) Array name means Base Address

2) Variable name means inside data

Assume Pointertake 4 byte

$$Pf(a) = 10$$

$$Pf(P) = 500$$

$$Pf(ptr) = 500$$

$$Pf(P+1) = 504$$

$$Pf(ptr+1) = 504$$

$$Pf(*P) = 200$$

$$Pf(ptr-P) = \frac{500-500}{4} = \frac{0}{4} = 0$$

Ex:-

main()

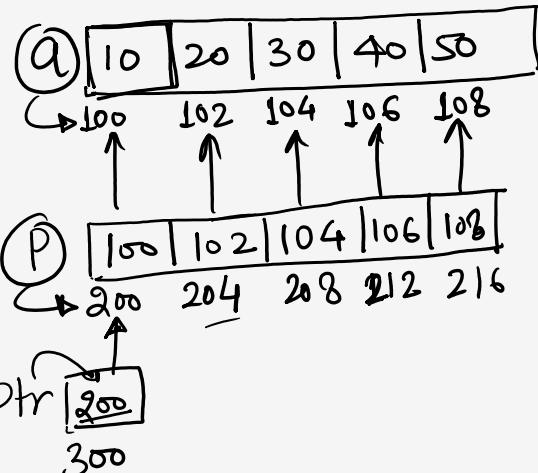
{ int a[5] = {10, 20, 30, 40, 50};

int \*p[5] = {a, a+1, a+2, a+3, a+4};

int \*\*ptr;

ptr = p;

}



$$Pf(a) = ? \quad 100$$

$$Pf(p) = ? \quad 200$$

$$Pf(ptr) = ? \quad 200$$

$$Pf(a+1) = ? \quad 102$$

$$Pf(p+1) = ? \quad 204$$

$$Pf(ptr+1) = ? \quad 204$$

$$Pf(*a) = ? \quad 10$$

$$Pf(*p) = ? \quad 100$$

$$Pf(*ptr) = ? \quad 100$$

$$Pf(*ptr-a) = ? \quad \frac{100 - 100}{2} = 0$$

$$Pf(\underline{ptr-p}) = ?$$

$$\frac{200 - 200}{4} = 0$$

Ex:- main()

{

int a[5] = {0, 1, 2, 3, 4};

int \*p[5] = {a, a+1, a+2, a+3, a+4};

int \*\*ptr = p;

ptr++; //  $\frac{204 - 200}{4} = 1$        $\frac{102 - 100}{2} = 1$        $*\frac{204}{102} = 1$

① Pf(ptr - P, \*ptr - a, \*\*ptr); //

~~\*ptr++;~~  $\frac{208 - 200}{4} = 2$        $\frac{104 - 100}{2} = 2$        $*\frac{208}{104} = 2$

② Pf(ptr - P, \*ptr - a, \*\*ptr); //

~~\*++ptr;~~  $\frac{212 - 200}{4} = 3$        $\frac{106 - 100}{2} = 3$        $*\frac{212}{106} = 3$

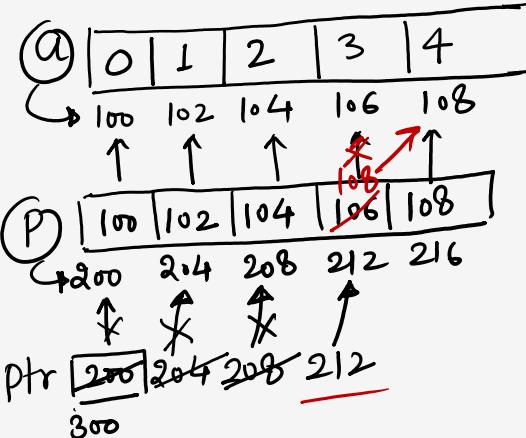
③ Pf(ptr - P, \*ptr - a, \*\*ptr); //

~~++\*ptr;~~  $\frac{212 - 200}{4} = 3$        $\frac{108 - 100}{2} = 4$        $*\frac{212}{108} = 4$

④ Pf(ptr - P, \*ptr - a, \*\*ptr); //

}

~~\*ptr++~~  
1) ptr++  
2) \*ptr  
++(\*ptr)  $\Rightarrow *ptr = *ptr + 1$



OP =

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

~~An~~

Question: main()  $\star + + \star \text{ptr} \Rightarrow \star \text{ptr} = \star \text{ptr} + 1$

$\{\text{int } a[5] = \{10, 20, 30, 40, 50\};$

$\text{int } *P[5] = \{a+2, a+1, a+3, a, a+4\};$

$\text{int } *+\star \text{ptr} = P;$

$\star \star \text{ptr}++;$   $\frac{204-200}{4} = 1$        $\frac{102-100}{2} = 1$        $\star \star 204$   
 $\star \star \text{ptr}$        $\star \star \text{ptr}$        $\star \star \text{ptr}$

① —  $\check{\text{Pf}}(\text{ptr}-P, \star \text{ptr}-a, \star \star \text{ptr});$       20

✓  $\star \star \star \text{ptr};$   $\frac{204-200}{4} = 1$        $\frac{104-100}{2} = 2$        $\star \star \text{ptr}$   
 $\star \star \star \text{ptr}$        $\star \star \star \text{ptr}$        $\star \star \star \text{ptr}$

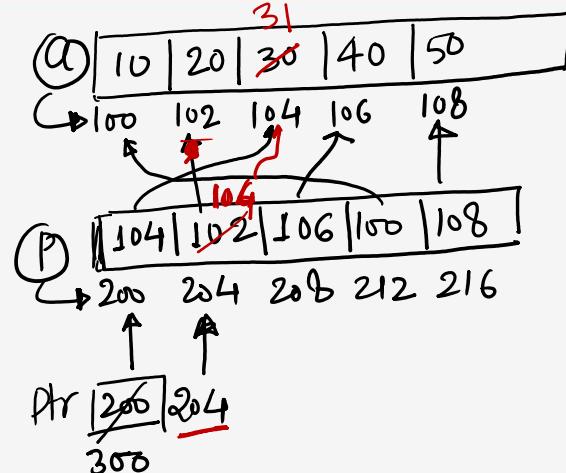
② —  $\check{\text{Pf}}(\text{ptr}-P, \star \text{ptr}-a, \star \star \text{ptr});$       20

✓  $\star \star \star \text{ptr};$   $\frac{204-200}{4} = 1$        $\frac{104-100}{2} = 2$       30  
 $\star \star \star \text{ptr}$        $\star \star \star \text{ptr}$        $\star \star \star \text{ptr}$

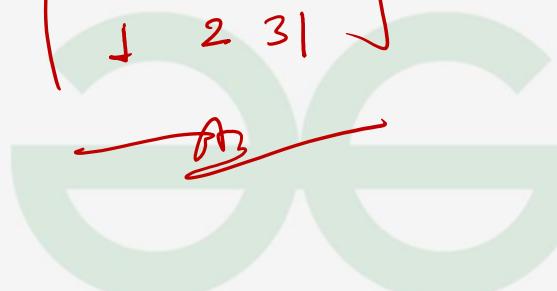
③ —  $\text{Pf}(\text{ptr}-P, \star \text{ptr}-a, \star \star \text{ptr});$       31

}

$\star \star \star \text{ptr} \Rightarrow \star \star (\star (\star \text{ptr}))$



$$\%P = \begin{bmatrix} 1 & 1 & 20 \\ 1 & 2 & 30 \\ \downarrow & 2 & 31 \end{bmatrix}$$



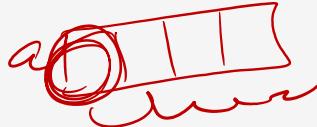
NOTE:

$\ast \underline{\text{ptr}++}$	$\ast \text{++ptr}$	$\text{++}\ast \text{ptr}$	$(\ast \text{ptr})++$
e) $\underline{\text{ptr}++}$	e) $\underline{\text{++ptr}}$	$\ast \text{ptr} = \ast \text{ptr} + 1$	$\ast \text{ptr} = \ast \text{ptr} + 1$
ee) $\underline{\ast \text{ptr}}$	ee) $\underline{\ast \text{ptr}}$		

$\text{++}\ast \ast \text{ptr}$



Multidimensional Array:- Array name without Subscript always gives constant base address of 0<sup>th</sup> element



0<sup>th</sup> element means:-

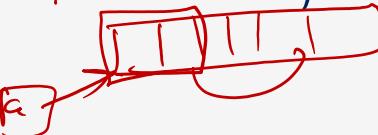
1) if it is 1-D Array then 0<sup>th</sup> element means base address of normal element

Ex:- int a[5]; // a = int \*;

a -

2) if it is a 2-D Array then 0<sup>th</sup> element means base address of 0<sup>th</sup> 1-D Array

Ex:- int a[3][4]; // a = int (\*)[];



a + 1 =

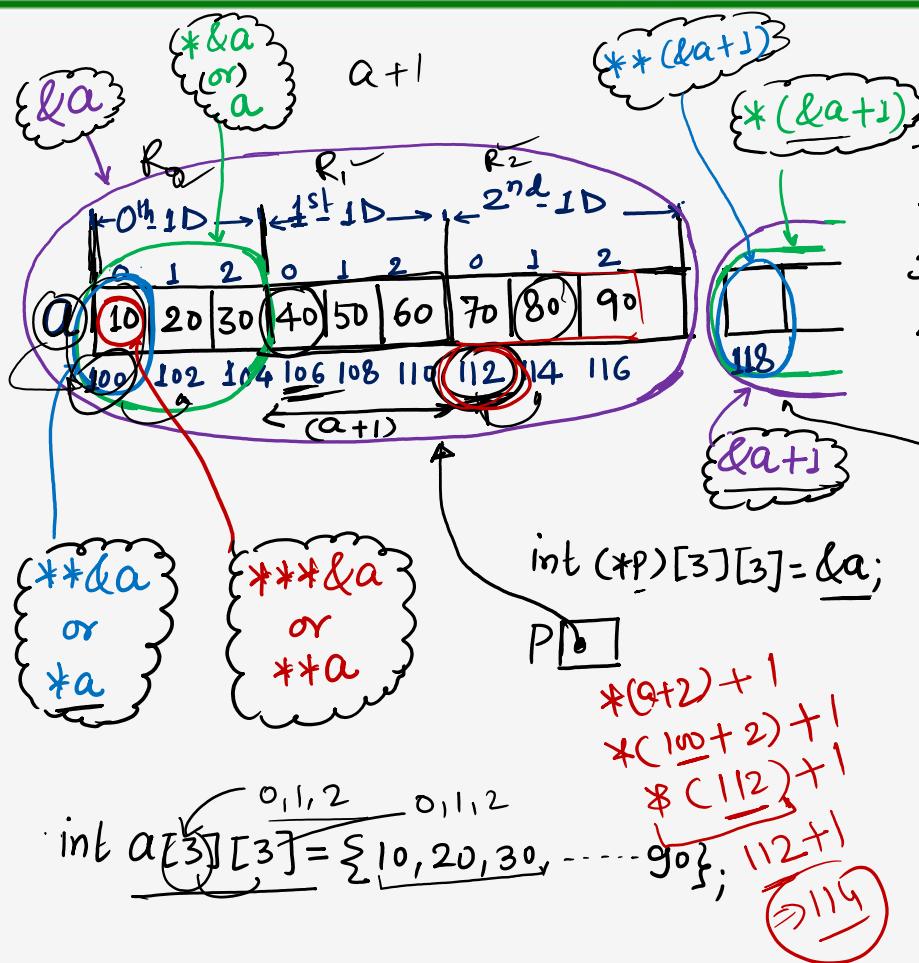
3) if it is a 3-D Array then 0<sup>th</sup> element means base address of 0<sup>th</sup> 2-D Array

Ex:- int a[3][4][5]; // a = int (\*)[][];

a + 1 =>

2 D - Array :- int a[3][3] = { 10, 20, 30, 40, 50, 60, 70, 80, 90 }; a[1]

- 1) In the 2-D Array a[i] represents Constant base address of i<sup>th</sup> row 0<sup>th</sup> element and it can not be changed
- 2) if we Perform a[i] = 2000, then it gives error because we can't modify Constant base address of i<sup>th</sup> row 0<sup>th</sup> element
- 3) 2-D Array will be stored in the memory, in the form of multiple 1D - Arrays
- 4) Array name Without Subscript gives base address of 0<sup>th</sup> 1D Array
- 5) a[i][j] = 20; it means i<sup>th</sup> row j<sup>th</sup> column replaced with 20



Expression	Point value	Type	Meaning
1> $\&a$	100	int( $\&a$ )[][],	BA of entire 2-D Array
2> $a$	100	int(*[])	BA of 0 <sup>th</sup> 1DArray
3> $*a$	100	int *	BA of 0 <sup>th</sup> element of 0 <sup>th</sup> 1D Array
4> $**a$	10	int	—
5> $***a$	Error	?	Referring illegal location
6> $***\&a$	10	int	—
7> $\&a+1$	118	int( $\&a$ )[],	BA of next contiguous entire 2D Array
8> $a+1$	106	int(*[])	—
9> $*(a+1)$	106	int *	—
10> $*(+a+1)$	40	int	—
11> $*a+1$	102	int *	—
12> $**a+1$	11	int	—
13> $*(a+2)+1$	114	int *	—

$a[0] = ?$   $*(\alpha + 0)$

$\star a$

Question:

$a[1][1] = ?$

$\Rightarrow \frac{a[1][1]}{*(\alpha + 1)[1]}$

$*(\star(\alpha + 1) + 1)$

$*(\star(\underline{100} + 1) + 1) \rightarrow 0^{th} \text{ ID}$

$*(\star(\underline{106}) + 1) \rightarrow 1^{st} \text{ ID}$

$*(\underline{106} + 1) \rightarrow 0^{th} \text{ 1st ID}$

$\star(108) \Rightarrow 50$

$a[2] =$

$\begin{matrix} 0 & \left[ \begin{matrix} 0 & 1 & 2 \\ 10 & 20 & 30 \\ 40 & 50 & 60 \\ 70 & 80 & 90 \end{matrix} \right] \\ 1 & \\ 2 & \end{matrix}$

Question:

$a[2][1] = ?$

$*(\alpha + 2)[1]$

$*(\star(\alpha + 2) + 1)$

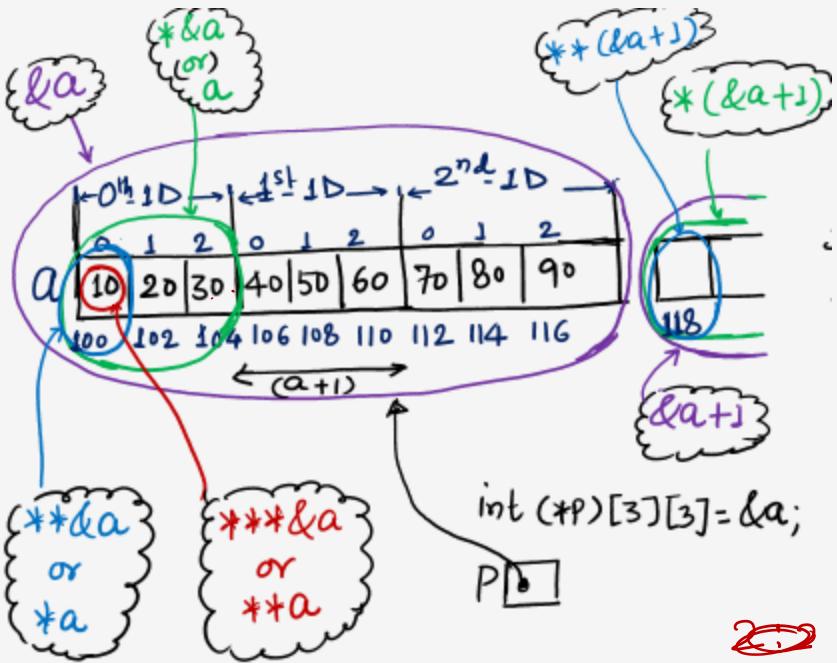
$*(\star(\underline{100} + 2) + 1)$

$*(\star(\underline{112}) + 1)$

$\star(\underline{112} + 1)$

$\star(114)$

$= 80$



`int(*P)[3][3] = &a; //D&I`

`Pf("%d", P+1); = ?` 118

Question 1

$$Pf("%d", \underline{\underline{*(&a+1)-a}}); \\ \frac{118 - 100}{6} = \underline{\underline{3}} \\ \text{Ans}$$

Question 2

$$Pf("%d", \underline{\underline{*(*(&a+1) - \underline{\underline{*a}})}}); \\ \text{Break for 10 mins} \quad \frac{118 - 100}{2} = \underline{\underline{9}} \\ \underline{\underline{2:10}} \\ \text{Ans}$$

Question: Consider the following C-program

```
#include <stdio.h>
```

```
int main() {
```

```
    int a[4][5] = {{0, 1, 2, 3, 4},
```

```
                  {6, 7, 8, 9, 10},
```

```
                  {11, 12, 13, 14, 15},
```

```
                  {16, 17, 18, 19, 20}};
```

```
    printf("%d\n", *(*(a + *a + 2) + 3));
```

```
    return(0);
```

What is the O/p Printed 19 ?

$$*(\underline{\underline{*(a+3)}} + 3) \Rightarrow \underline{\underline{a[3][3]}}$$

~~\*C~~

~~xC~~

$\underline{\underline{*(\underline{\underline{a+3}})[3]}}$

$\underline{\underline{*(*(\underline{\underline{a+3}}) + 3)}}$

GATE

Question:

main()

{ int a[5][3] = {10, 20, 30, ..., 150};

printf("%d", ((a == a[0]) && (a[0] == \*a)));

}

(100 == 100) && (100 == 100)

What is the output it prints?

a) 1

b) 0

c) Compile time error

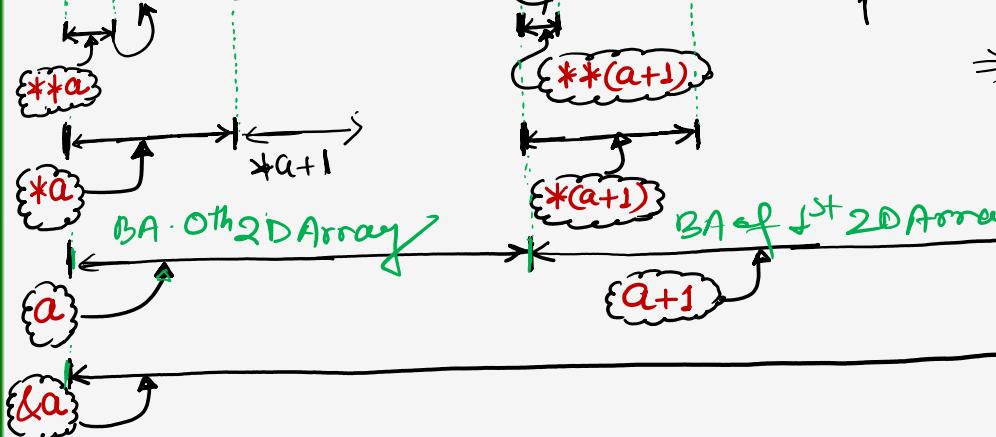
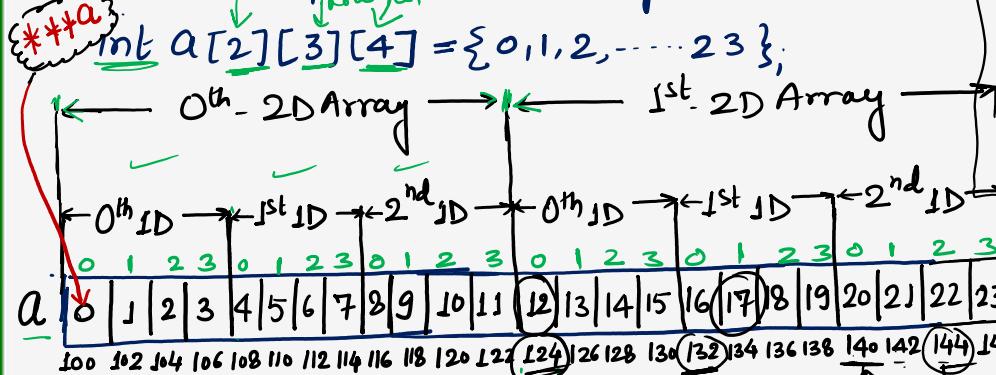
d) Runtime error

$$\begin{aligned} a[0] \\ \Rightarrow *(&0+0) \\ = * \underline{\underline{0}} \end{aligned}$$

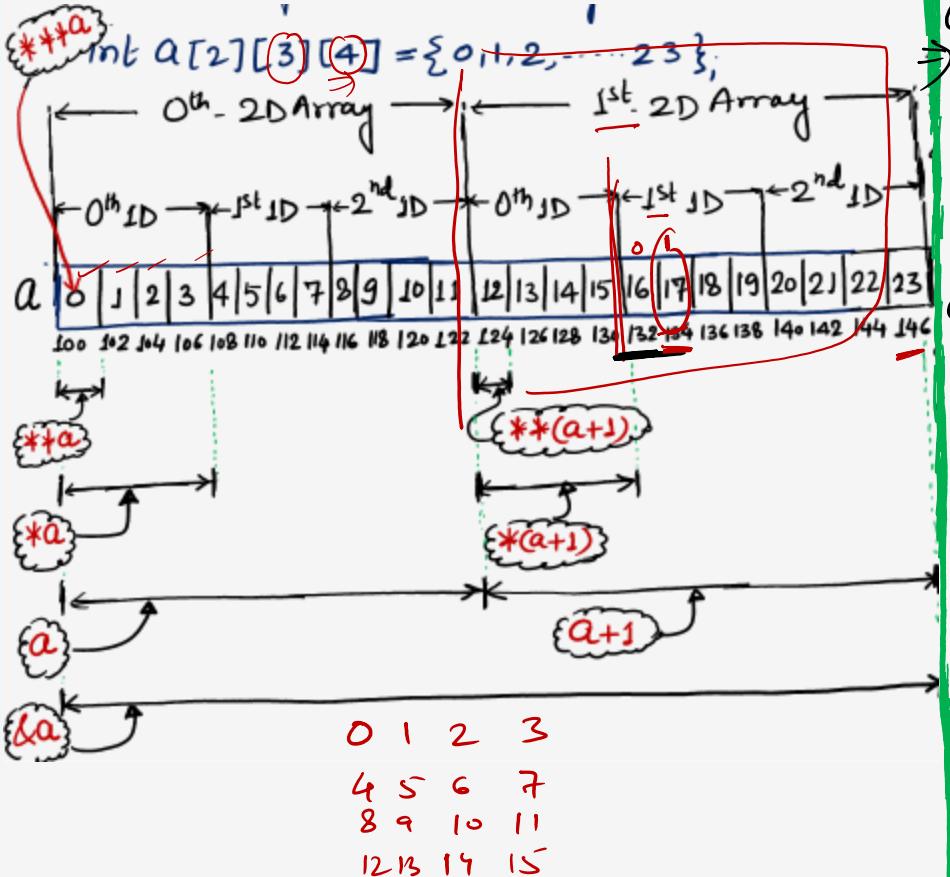


3D-Array :- 3D Array will be stored in the memory

in the form of multiple 2D Arrays



Expression	Print value	Type	Meaning
1> &a	100	int(*)[][]	
2> a	100	int(*)[][],	
3> *a	100	int(*)[]	
4> *a	100	int *	
5> *a	0	int	
6> *a	Error	?	Refer illegal loc next
7> &a+1	148	int(*)[][]	
8> a+1	124	int(*)[][],	
9> *(a+1)	124	int(*)[]	
10> *(a+1)	124	int *	
11> *a+1	108	int(*)[]	
12> *a+1	102	int *	
13> *(a+1)+1	132	int(*)[]	
14> *(a+1)+2	144	int *	



Q-1)  $\text{Pf}(\%\text{d}, \underline{\ast(\&a+1)} - a);$   
 $\frac{148 - 100}{24} = 2$

Q-2)  $\text{Pf}(\%\text{d}, \underline{\ast\ast(\&a+1)} - \ast a);$   
 $\frac{148 - 100}{8} = \frac{48}{8} = 6$

Q-3)  $\text{Pf}(\%\text{d}, \underline{\ast\ast\ast(\&a+1)} - \underline{\ast\ast a});$   
 $\frac{148 - 100}{2} \Rightarrow \frac{48}{2} = 24$

2, 6, 24

Question:

$$a[1][1][1] = ?$$

$$\Rightarrow *(\alpha + 1)[1][1]$$

$$\Rightarrow *(*(\alpha + 1) + 1)[1]$$

$$\Rightarrow *(*(*(\alpha + 1) + 1) + 1)$$

$$*(*(*(\underline{1} \infty + 1) + 1) + 1)$$

$$*(*(\underline{1} 24 + 1) + 1)$$

$$*(\underline{1} 24 + 1) + 1$$

$$*(\underline{1} 32 + 1) + 1$$

$$*(1 32 + 1)$$

$$* 134 \Rightarrow 17$$



Question:

$a = \text{BA of } 0^{\text{th}} \text{ 2D Array}$

$a[1] - a[0]$

$*(\alpha+1) - *(\alpha+0)$

$*(\alpha+1) - *9$

$$\frac{112 - 100}{2} = \frac{12}{4} = 3$$

$$\cancel{**(\alpha+1)} - \cancel{**9} \Rightarrow 1$$

main(),  
{} int  $a[2][3][2]$

&lt;p

~~GATE~~

~~Question:-~~ What is the O/p of C-Code assume address of  $x$  is 2000 and int take 4 bytes

int main()

{

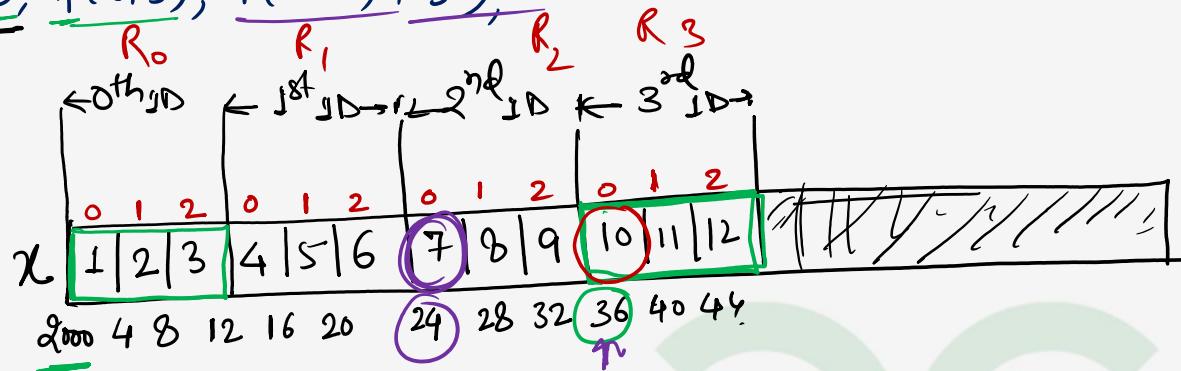
    unsigned int  $x[4][3] = \{ \{1, 2, 3\}, \{4, 5, 6\}, \{7, 8, 9\}, \{10, 11, 12\} \};$

Pf("%u.%u.%u",  $x+3$ ,  $\*(x+3)$ ,  $\*(x+2)+3$ );

}

- a) 2036, 2036, 2036  
 b) 2012, 4, 2204  
 c) 2036, 10, 10  
 d) 2012, 4, 6

(X)



$$2036, 2036, 2036 \frac{24}{36}$$

Thank You !

















Thank You !

