

GATE 2015 – Q.62

Important Relations for Quick Revision

2-D Array and Pointer Arithmetic

1. 1-D Array: Basic Pointer Relation

For `int a[3] = {10, 20, 30};`

Array indexing starts from 0. In most expressions, the array name `a` is converted to a pointer to its first element `a[0]`.

Array element	Value	Pointer relation
<code>a[0]</code>	10	<code>a</code> or <code>a + 0</code>
<code>a[1]</code>	20	<code>a + 1</code>
<code>a[2]</code>	30	<code>a + 2</code>

Key relation: $*(a + i) = a[i]$ for valid array indices.

2. 2-D Array Used in the Question

`unsigned int x[4][3];`

The array has 4 rows and 3 columns. For a 2-D array, `x` points to Row 0. Pointer arithmetic with `x` moves row by row.

Expression	Points to	Row contents
<code>x</code> or <code>x + 0</code>	Row 0	{1, 2, 3}
<code>x + 1</code>	Row 1	{4, 5, 6}
<code>x + 2</code>	Row 2	{7, 8, 9}
<code>x + 3</code>	Row 3	{10, 11, 12}

Important distinction: in the 1-D case, `a + 1` moves to the next element. In this 2-D case, `x + 1` moves to the next complete row.

3. Memory Addresses

Given: address of `x` = 2000 (decimal), and each unsigned int occupies 4 bytes.

The 12 integer elements are stored contiguously, row by row. Therefore, consecutive elements differ in address by 4 bytes.

Element address	Address
<code>&x[0][0]</code>	2000
<code>&x[0][1]</code>	2004
<code>&x[0][2]</code>	2008
<code>&x[1][0]</code>	2012
<code>&x[1][1]</code>	2016
<code>&x[1][2]</code>	2020
<code>&x[2][0]</code>	2024
<code>&x[2][1]</code>	2028
<code>&x[2][2]</code>	2032
<code>&x[3][0]</code>	2036
<code>&x[3][1]</code>	2040
<code>&x[3][2]</code>	2044

4. Important Relation for $x + 3$

$x + 3$ points to Row 3. Therefore, $x + 3$ has the same starting address as $\&x[3]$. The starting address of Row 3 is the address of its first element.

$x + 3 = \&x[3]$ and $\&x[3]$ has starting address 2036

5. Dereferencing: Important Concept

$*(x + 2)$ gives $x[2]$, i.e. Row 2. Remember that $x[2]$ is the array $\{7, 8, 9\}$; it is not simply the value 7.

When an array such as $x[2]$ is used in a context that requires a pointer, it is converted to a pointer to its first element:
 $x[2] \rightarrow \&x[2][0]$.

6. Quick Revision – Relations to Remember

- $a + 0 \rightarrow a[0]; \quad a + 1 \rightarrow a[1]; \quad a + 2 \rightarrow a[2]$
- $*(a + i) = a[i]$ (for valid indices)
- $x \rightarrow \text{Row } 0; \quad x + 1 \rightarrow \text{Row } 1; \quad x + 2 \rightarrow \text{Row } 2; \quad x + 3 \rightarrow \text{Row } 3$
- $x + 3 = \&x[3]$
- $\&x[3] = \&x[3][0]$ as a numerical starting address
- For $x[4][3]$, each row contains 3 unsigned int elements
- Each unsigned int occupies 4 bytes, so one complete row occupies $3 \times 4 = 12$ bytes
- Consecutive elements have addresses 4 bytes apart

Quick Revision Note – GATE 2015 Q.62

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