Multidimensional Arrays in C / C++

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Array- Basics

- In C/C++, we can define multidimensional arrays in simple words as an array of arrays. Data in multidimensional arrays are stored in tabular form (in row-major order).
- The general form of declaring N-dimensional arrays:

data_type array_name[size1][size2]....[sizeN];

data_type: Type of data to be stored in the array.

Here data_type is valid C/C++ data type

array_name: Name of the array

size1, size2,... ,sizeN: Sizes of the dimensions

Examples:

Two dimensional array:

int two_d[10][20];

Three dimensional array:

int three_d[10][20][30];

Size of multidimensional arrays

- The total number of elements that can be stored in a multidimensional array can be calculated by multiplying the size of all the dimensions.

For example:

The array **int x[10][20]** can store total (10*20) = 200 elements.
Similarly array **int x[5][10][20]** can store total (5*10*20) = 1000 elements.

Two-Dimensional Array

- Two – dimensional array is the simplest form of a multidimensional array. We can see a two – dimensional array as an array of one – dimensional array for easier understanding.

- The basic form of declaring a two-dimensional array of size x, y:

Syntax:

data_type array_name[x][y];

data_type: Type of data to be stored. Valid C/C++ data type.

Initializing Two – Dimensional Arrays:

- We can declare a two-dimensional integer array say ‘x’ of size 10,20 as:

int x[10][20];

- Elements in two-dimensional arrays are commonly referred to by x[i][j] where i is the row number and ‘j’ is the column number.
- A two – dimensional array can be seen as a table with ‘x’ rows and ‘y’ columns where the row number ranges from 0 to (x-1) and column number ranges from 0 to (y-1).

	Column 0	Column 1	Column 2
Row 0	x[0][0]	x[0][1]	x[0][2]
Row 1	x[1][0]	x[1][1]	x[1][2]
Row 2	x[2][0]	x[2][1]	x[2][2]

First Method:

int x[3][4] = {0, 1 ,2 ,3 ,4 , 5 , 6 , 7 , 8 , 9 , 10 , 11}

- The above array has 3 rows and 4 columns. The elements in the braces from left to right are stored in the table also from left to right. The elements will be filled in the array in order, the first 4 elements from the left in the first row, the next 4 elements in the second row, and so on.

Better Method:

int x[3][4] = {{0,1,2,3}, {4,5,6,7}, {8,9,10,11}};

- This type of initialization makes use of nested braces. Each set of inner braces represents one row. In the above example, there is a total of three rows so there are three sets of inner braces.

Accessing Elements of Two-Dimensional Arrays:

- Elements in Two-Dimensional arrays are accessed using the row indexes and column indexes.

Example:

```
int x[2][1];
```

- The above example represents the element present in the third row and s

Note: In arrays, if the size of an array is N. Its index will be from 0 to N-1. Therefore, for row index 2 row number is 2+1 = 3.
To output all the elements of a Two-Dimensional array we can use nested for loops. We will require two for loops. One to traverse the rows and another to traverse columns.

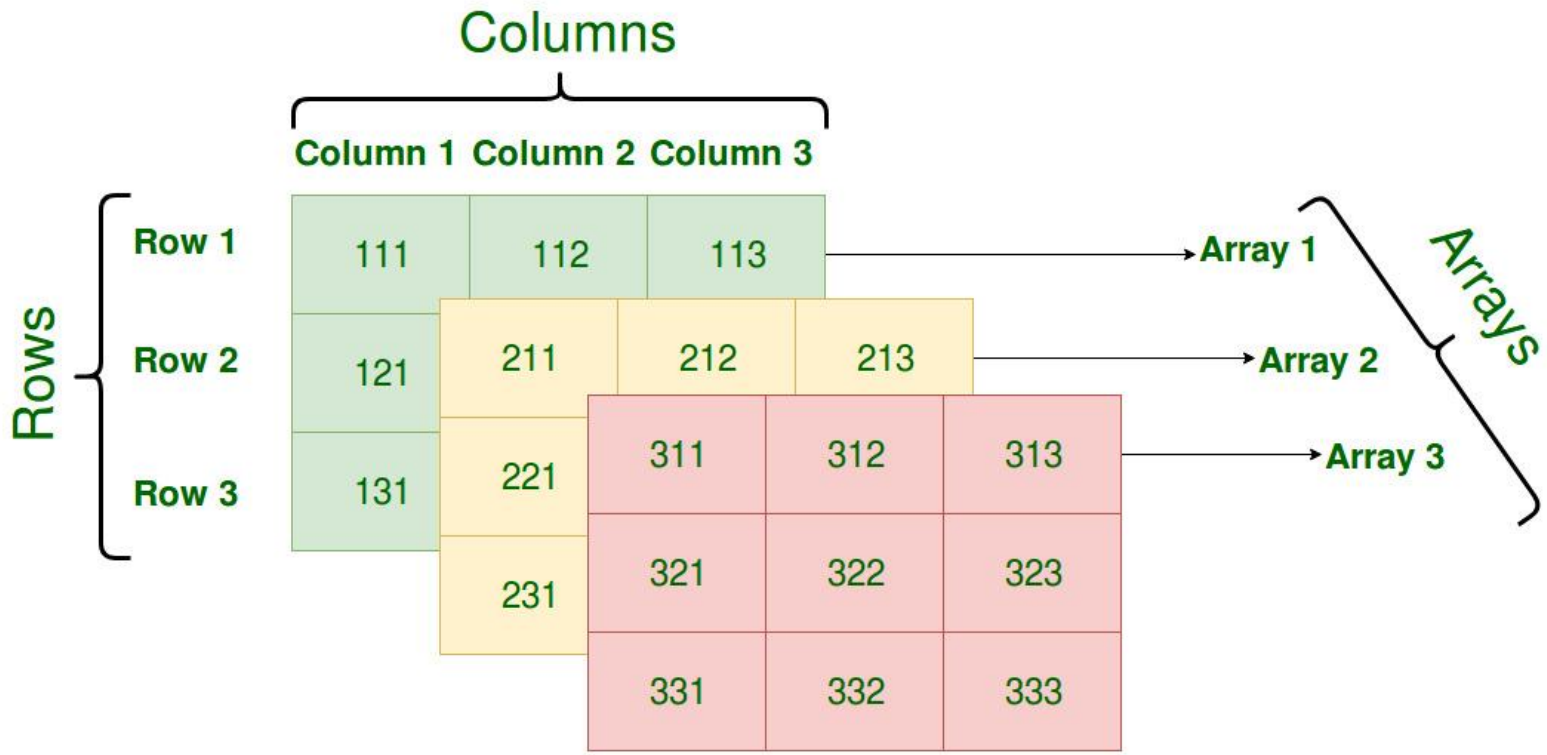
EXAMPLE

```cpp
// C++ Program to print the elements of a
// Two-Dimensional array
#include<iostream>
using namespace std;

int main()
{
    // an array with 3 rows and 2 columns.
    int x[3][2] = {{0,1}, {2,3}, {4,5}};

    // output each array element's value
    for (int i = 0; i < 3; i++)
    {
        for (int j = 0; j < 2; j++)
        {
            cout << "Element at x[" << i
                 << "][" << j << "]: ";
            cout << x[i][j]<<endl;
        }
    }

    return 0;
}
```

Output:

```
Element at x[0][0]: 0
Element at x[0][1]: 1
Element at x[1][0]: 2
Element at x[1][1]: 3
Element at x[2][0]: 4
Element at x[2][1]: 5
```

Three-Dimensional Array



Initializing Three-Dimensional Array:

Initialization in a Three-Dimensional array is the same as that of Two-dimensional arrays. The difference is as the number of dimensions increases so the number of nested braces will also increase.

Method 1:

```
int x[2][3][4] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10,
                  11, 12, 13, 14, 15, 16, 17, 18, 19,
                   20, 21, 22, 23};
```

Better Method:

```
int x[2][3][4] =
{
 { {0,1,2,3}, {4,5,6,7}, {8,9,10,11} },
  { {12,13,14,15}, {16,17,18,19}, {20,21,22,23} }
 };
```

Accessing elements in Three-Dimensional Arrays:

- Accessing elements in Three-Dimensional Arrays is also similar to that of Two-Dimensional Arrays. The difference is we have to use three loops instead of two loops for one additional dimension in Three-dimensional Arrays.

```cpp
// C++ program to print elements of Three-Dimensional
// Array
#include<iostream>
using namespace std;

int main()
{
    // initializing the 3-dimensional array
    int x[2][3][2] =
    {
        { {0,1}, {2,3}, {4,5} },
        { {6,7}, {8,9}, {10,11} }
    };

    // output each element's value
    for (int i = 0; i < 2; ++i)
    {
        for (int j = 0; j < 3; ++j)
        {
            for (int k = 0; k < 2; ++k)
            {
                cout << "Element at x[" << i << "][" << j
                     << "][" << k << "] = " << x[i][j][k]
                     << endl;
            }
        }
    }
    return 0;
}
```

Output:

```
Element at x[0][0][0] = 0
Element at x[0][0][1] = 1
Element at x[0][1][0] = 2
Element at x[0][1][1] = 3
Element at x[0][2][0] = 4
Element at x[0][2][1] = 5
Element at x[1][0][0] = 6
Element at x[1][0][1] = 7
Element at x[1][1][0] = 8
Element at x[1][1][1] = 9
Element at x[1][2][0] = 10
Element at x[1][2][1] = 11
```

CONCLUSION

- In similar ways, we can create arrays with any number of dimensions. However, the complexity also increases as the number of dimensions increases. The most used multidimensional array is the Two-Dimensional Array.

THANK YOU