Multidimensional array in CPP

A multi-dimensional array can be termed as an array of arrays that stores homogeneous data in tabular form. Data in multidimensional arrays are stored in row-major order.

The ***general form of declaring N-dimensional arrays*** is:

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

- **data_type**: Type of data to be stored in the array.
- **array_name**: Name of the array
- **size1, size2,… ,sizeN**: Sizes of the dimension

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];
```

Here, **data_type** is the type of data to be stored.

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 the column number ranges from 0 to (y-1). A two – dimensional array ‘x’ with 3 rows and 3 columns is shown below:

	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]

Initializing Two – Dimensional Arrays: There are various ways in which a Two-Dimensional array can be initialized.

1. **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.

2. **Second Method**:

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

3. **Third Method:**

```
int x[3][4];
for(int i = 0; i < 3; i++){
    for(int j = 0; j < 4; j++){
        cin >> x[i][j];
    }
}
```

Fourth Method(Dynamic Allocation):

```
int** x = new int*[3];
for(int i = 0; i < 3; i++){
    x[i] = new int[4];
    for(int j = 0; j < 4; j++){
        cin >> x[i][j];
    }
}
```

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.

```
// 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
```

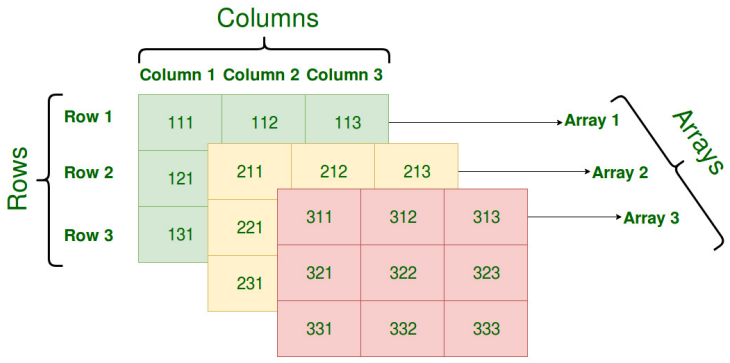
```
                << "][" << j << "]: ";
            cout << x[i][j]<<endl;
        }
    }

    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};
```

Method 2(Better):

```
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} }
 };
```

```
// 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
```