SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

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DEPARTMENT OF CSE

23ITT101-PROGRAMMING IN C AND DATA STRUCTURES

I YEAR - II SEM

UNIT 3 – ARRAYS AND INTRODUCTION TO DATA STRUCTURES

TOPIC – Two - Dimensional Arrays

Two Dimensional Arrays

Definition

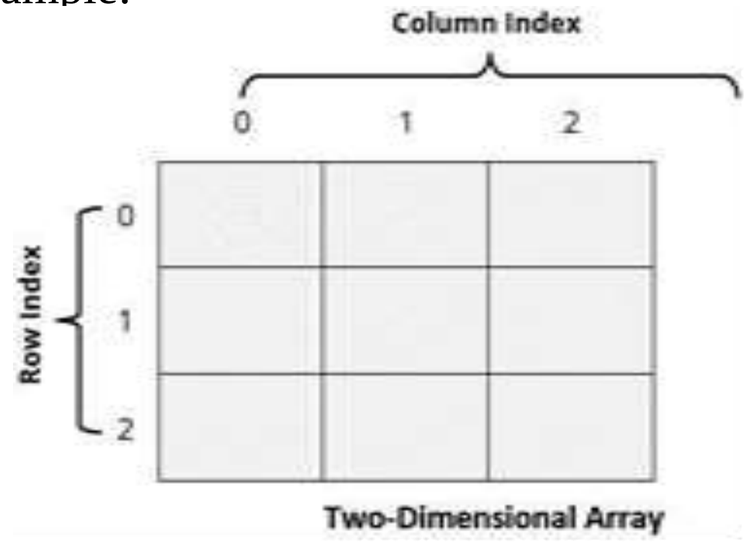
Two dimensional arrays are used in a situation where a table of values need to store in an array.

Two Dimensional array Declaration

Syntax:

datatype arrayname [row size][column size];

Example:



TWO-DIMENSIONAL ARRAYS

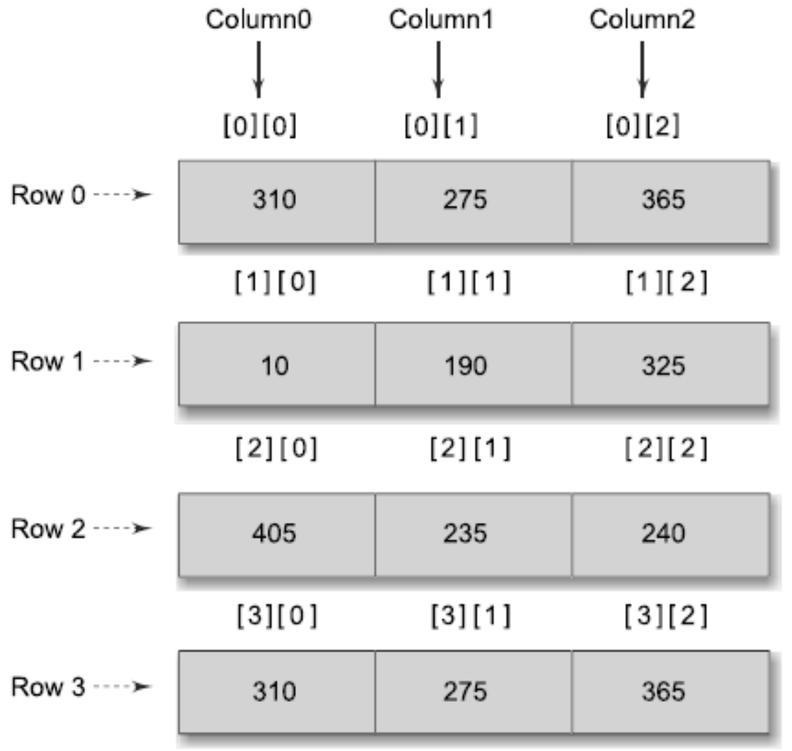
- So far we have discussed the array variables that can store a list of values.
- There could be situations where a table of values will have to be stored

	Item1	Item2	Item3
Salesgirl #1	310	275	365
Salesgirl #2	210	190	325
Salesgirl #3	405	235	240
Salesgirl #4	260	300	380

- Consider the following data table, which shows the value of sales of three items by four sales girls:
- The table contains a total of 12 values, three in each line.
- We can think of this table as a matrix consisting of **four rows** and **three columns**.
- Each row represents the values of sales by a particular salesgirl
- Each column represents the values of sales of a particular item.
- In mathematics, we represent a particular value in a matrix by using two subscripts such as vij.
- Here **v** denotes the entire matrix and vij refers to the value in the **ith** row and **jth** column.
- For example, in the above table v23 refers to the value 325.

DECLARATION OF TWO-DIMENSIONAL ARRAYS

- C allows us to define such tables of items by using two-dimensional arrays.
- The table discussed above can be defined in C as
  v[4][3]
- Two-dimensional arrays are declared as follows:
  type array_name [row_size][column_size];
- Note that unlike most other languages, which use one pair of parentheses with commas to separate array sizes, C places each size in its own set of brackets.



Representation of a two-dimensional array in memory

Two Dimensional array Initialization

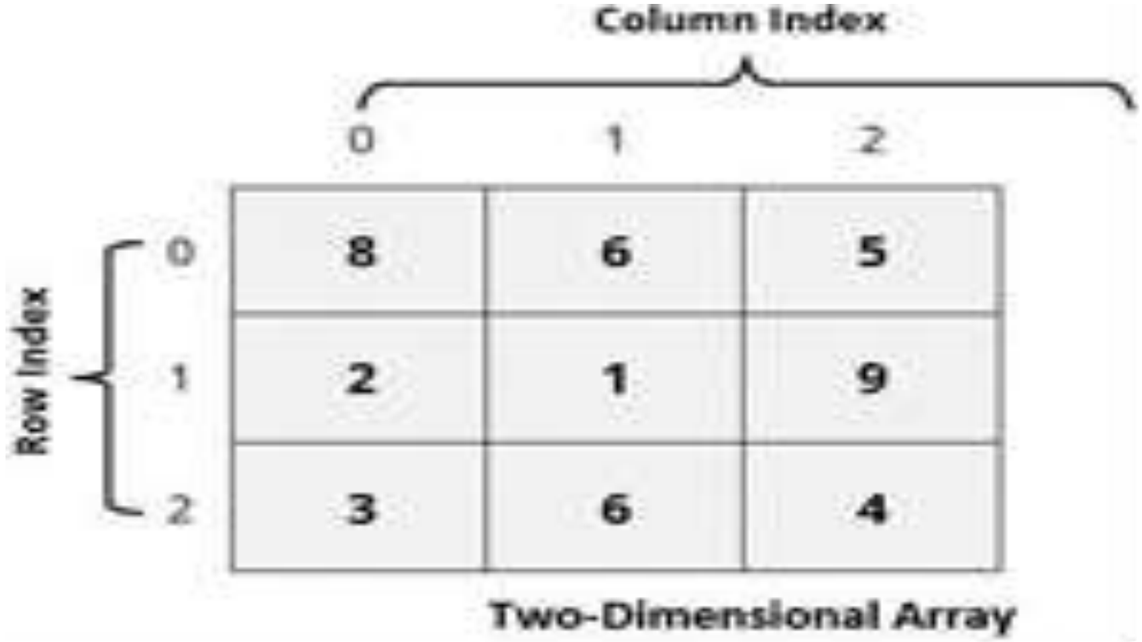
Two Dimensional array Initialization

Syntax:

datatype arrayname [row size][column size]={list of values};

Example

int a[3][3]={8,6,5,2,1,9,3,6,4};



INITIALIZING TWO-DIMENSIONAL ARRAYS

- As Like the one-dimensional arrays, two-dimensional arrays may be initialized by following their declaration with a list of initial values enclosed in braces.
- For example, `int table[2][3] = { 0,0,0,1,1,1};`
- initializes the elements of the first row to zero and the second row to one.
- The initialization is done row by row.
- The above statement can be equivalently written as `int table[2][3] = {{0,0,0}, {1,1,1}};`
- by surrounding the elements of the each row by braces.
- We can also initialize a two-dimensional array in the form of a matrix as shown below:

```
int table[2][3] = {
                    {0,0,0},
                    {1,1,1}
                };
```

- Commas are required after each brace that closes off a row, except in the case of the last row.

INITIALIZING TWO-DIMENSIONAL ARRAYS

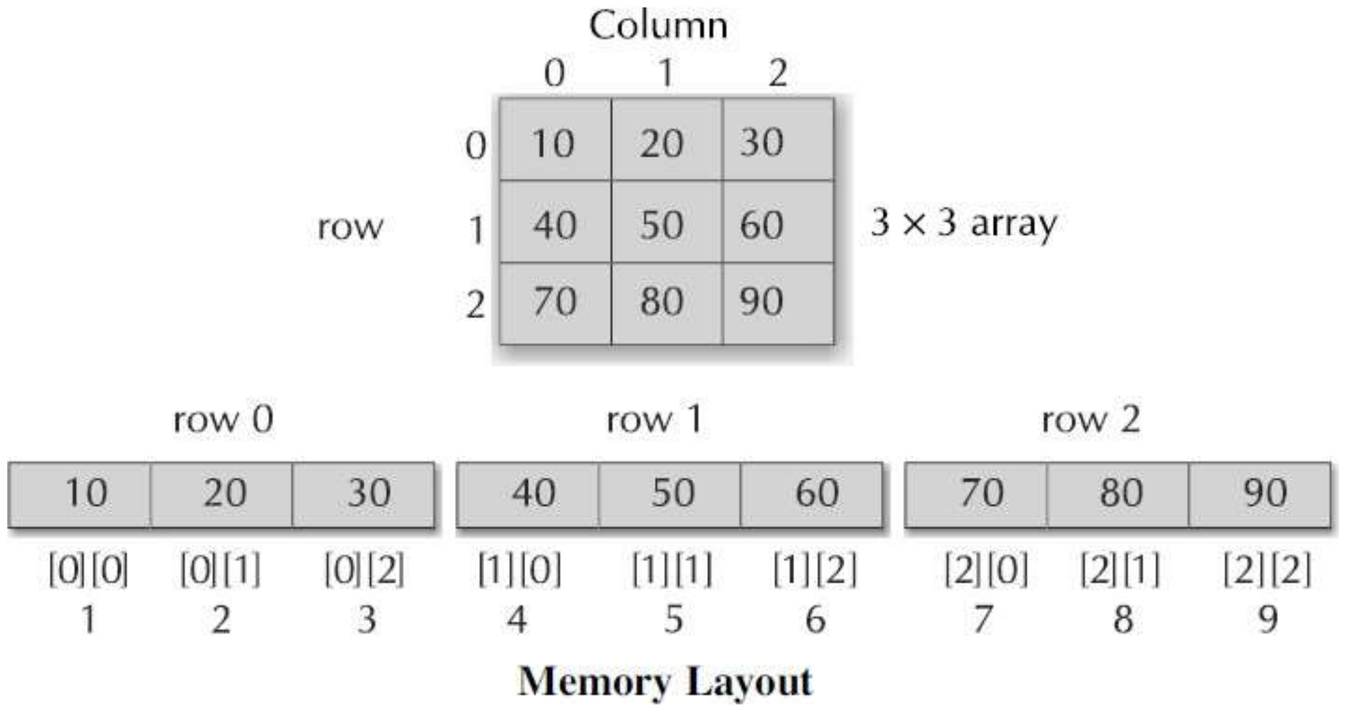
- When the array is completely initialized with all values, explicitly, we need not specify the size of the first dimension.
- That is, the statement
```
int table [ ] [3] = {
                        { 0, 0, 0},
                        { 1, 1, 1}
                    };
```
- is permitted.
- If the values are missing in an initializer, they are automatically set to zero.
- For instance, the statement
```
int table[2][3] = {
                        {1,1},
                        {2}
                    };
```
- will initialize the first two elements of the first row to one, the first element of the second row to two, and all other elements to zero.
- When all the elements are to be initialized to zero, the following short-cut method may be used.

```
int m[3][5] = { {0}, {0}, {0}};
```

- The first element of each row is explicitly initialized to zero while other elements are automatically initialized to zero.

MEMORY LAYOUT

- The subscripts in the definition of a two-dimensional array represent rows and columns.
- This format maps the way that data elements are laid out in the memory



Memory Layout

MULTI-DIMENSIONAL ARRAYS

- C allows arrays of **three** or more dimensions.
- The exact limit is determined by the compiler.
- The general form of a multi-dimensional array is

  type array_name[s1][s2][s3]....[sm];
- where si is the size of the ith dimension.
- Some examples are:

  int survey[3][5][12];

  float table[5][4][5][3];
- **survey** is a three-dimensional array declared to contain 180 integer type elements.
- Similarly **table** is a four dimensional array containing 300 elements of floating-point type.

Multi Dimensional Array

```c
// C program to find the sum of two matrices of order 2*2

#include <stdio.h>
int main()
{
  float a[2][2], b[2][2], result[2][2];

  // Taking input using nested for loop
  printf("Enter elements of 1st matrix\n");
  for (int i = 0; i < 2; ++i)
    for (int j = 0; j < 2; ++j)
    {
      printf("Enter a%d%d: ", i + 1, j + 1);
      scanf("%f", &a[i][j]);
    }

  // Taking input using nested for loop
  printf("Enter elements of 2nd matrix\n");
  for (int i = 0; i < 2; ++i)
    for (int j = 0; j < 2; ++j)
    {
      printf("Enter b%d%d: ", i + 1, j + 1);
      scanf("%f", &b[i][j]);
    }

  // adding corresponding elements of two arrays
  for (int i = 0; i < 2; ++i)
    for (int j = 0; j < 2; ++j)
    {
```

Multi Dimensional Array

Output

```
Enter elements of 1st matrix
Enter a11: 2;
Enter a12: 0.5;
Enter a21: -1.1;
Enter a22: 2;
Enter elements of 2nd matrix
Enter b11: 0.2;
Enter b12: 0;
Enter b21: 0.23;
Enter b22: 23;

Sum Of Matrix:
2.2     0.5
-0.9    25.0
```

DYNAMIC ARRAYS

- **Static Arrays:**
- So far, we have created arrays at compile time.
- An array created at compile time by specifying size in the source code has a fixed size and cannot be modified at run time.
- The process of allocating memory at compile time is known as **static memory allocation**
- The arrays that receive static memory allocation are called **static arrays**.
- This approach works fine as long as we know exactly what our data requirements are.
- Consider a situation where we want to use an array that can vary greatly in size.
- We must guess what will be the largest size ever needed and create the array accordingly.

- **Dynamic Arrays:**
- In C it is possible to allocate memory to arrays at run time.
- This feature is known as **dynamic memory allocation** and the arrays created at run time are called **dynamic arrays**.
- Dynamic arrays are created using what are known as pointer variables and memory management functions malloc, calloc and realloc.
- These functions are included in the header file <stdlib.h>.

Applications of array

- Arrays are used to Store List of values
- Arrays are used to Perform Matrix Operations
- Arrays are used to implement Search Algorithms
- Arrays are used to implement Sorting Algorithms
- Arrays are used to implement Data structures