CL1002

INTRODUCTION TO COMPUTING

LAB 08

ARRAYS IN C

ARRAY

An array is a collection of data items of the same type.

SIGNIFICANCE OF ARRAY

Programming problems can be solved efficiently by grouping the data items together in main memory than allocating an individual memory cell for each variable.
For Example: A program that processes exam scores for a class, would be easier to write if all the scores were stored in one area of memory and were able to be accessed as a group. C allows a programmer to group such related data items together into a single composite data structure called array.

ONE-DIMENSIONAL ARRAYS

In one-dimensional array, the components are arranged in the form of a list.
SYNTAX:

```
element-type aname [ size ];  /* uninitialized */
element-type aname [ size ] = { initialization list }; /* initialized */
```

INTERPRETATION:

- The general uninitialized array declaration allocates storage space for array aname consisting of size memory cells.
- Each memory cell can store one data item whose data type is specified by element-type (i.e., double, int , or char).
- The individual array elements are referenced by the subscripted variables aname [0] , aname [1] , . . , aname [size −1] .
- A constant expression of type int is used to specify an array’s size . In the initialized array declaration shown, the size shown in brackets is optional since the array’s size can also be indicated by the length of the initialization list .
- The initialization list consists of constant expressions of the appropriate element-type separated by commas.
- Element 0 of the array being initialized is set to the first entry in the initialization list , element 1 to the second, and so forth.

MEMORY REPRESENTATION

All arrays consist of contiguous memory locations. The lowest address corresponds to the first element and the highest address to the last element.

double x[5] = { 5.0, 2.0, 3.0, 1.0, -4.5};

Array x

x[0]	x[1]	x[2]	x[3]	x[4]

x[0]	x[1]	x[2]	x[3]	x[4]
5.0	2.0	3.0	1.0	-4.5

EXAMPLE (1D ARRAY)

/* 1D Array 1st Example */

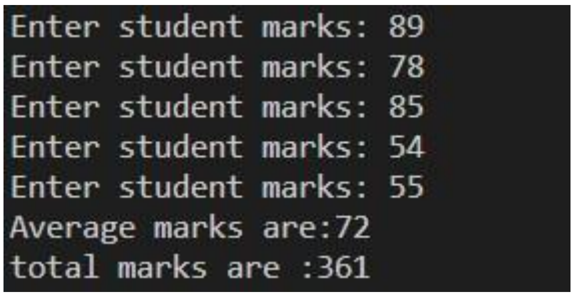
```
#include<stdio.h>
int main(){

        int avg, sum = 0;
        int i;
        int marks[5]; // array declaration

        for(i = 0; i<=4; i++){
                printf("Enter student marks: ");
                scanf("%d", &marks[i]); /* stores the data in array*/
                }
        for(i = 0; i<=4; i++)
                sum = sum + marks[i]; /* reading data from array */

                avg = sum/5;
                printf("Average marks are:%d\n", avg);
                printf("total marks are :%d\n", sum);
                return 0;

}
```

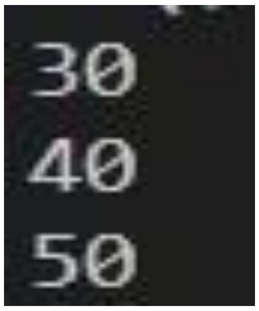


```
Enter student marks: 89
Enter student marks: 78
Enter student marks: 85
Enter student marks: 54
Enter student marks: 55
Average marks are:72
total marks are :361
```

<u>Example 02:</u>

```
#define size 5
#include <stdio.h>
int main(void)
{
int i;

/*
   int arrOfNumbers[5];
     arrOfNumbers[0] = 10;
     arrOfNumbers[1] = 20;
     arrOfNumbers[2] = 30;
     arrOfNumbers[3] = 40;
     arrOfNumbers[4] = 50;*/
     // 2nd alternattive
     //int arrOfNumbers[5] = {10,20,30,40,50};
     // 3rd alternative declaration
     //int arrOfNumbers[] = {10,20,30,40,50};
     // 4th alternative using macro
     int arrOfNumbers[size] = {10,20,30,40,50};
     for(i = 0; i < 5; i++)
     {
     /* The braces are not necessary; we use them to make the code
     clearer. */
     if(arrOfNumbers[i] > 20)
     printf("%d\n", arrOfNumbers[i]);
}
     return 0;}
```



```
30
40
50
```

Example 03

C does not check for index out of bound, it can be done by programmer itself.

```
#include <stdio.h>
int main(void)
{
    int i, j = 30, arrOfNumbers[3];
    for(i = 0; i < 4; i++)
            arrOfNumbers[i] = 100;
            printf("%d\n", j);
return 0;
} /* The program does not throw any error. It will print 30 once.
```

<u>Example 04</u>

```
#include <stdio.h>
int main(void)
{
    int i, arrOfNumbers[10] = {0};
    for(i = 0; i < 10; i++){
            arrOfNumbers[++i] = 20;
//          arrOfNumbers[i] = 20;
            printf("The elements of array are:\t%d\n",arrOfNumbers[i]);
    }


    return 0;
}
```

TWO-DIMENSIONAL ARRAYS

A two dimensional array is a collection of a fixed number of components arranged in rows and columns (that is, in two dimensions), wherein all components are of the same type.
Two-dimensional arrays are used to represent tables of data, matrices, and other two-dimensional objects.

SYNTAX:

element-type aname [$size_1$] [$size_2$]; /* uninitialized */

INTERPRETETION

Allocates storage for a two-dimensional array (aname) with size1 rows and size2 columns.
This array has size1*size2 elements, each of which must be referenced by specifying a row subscript (0 , 1 ,… size1-1) and a column subscript (0 , 1 ,…size2-1).
Each array element contains a character value.

MEMORY REPRESENTATION

char x[3][3] = {{'X', '0', 'X'}, {'0', 'X', '0'}, {'0', 'X', 'X'}};

Array x

Column

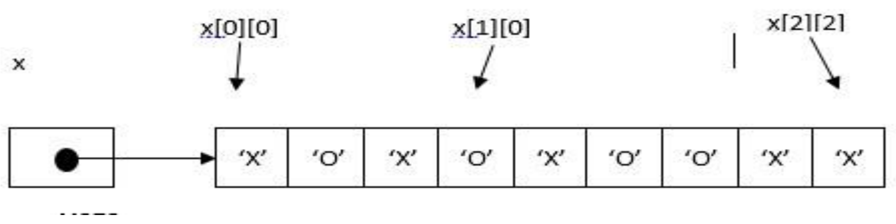
Row	0	1	2
0	x[0][0]	x[0][1]	x[0][2]
1	x[1][0]	x[1][1]	x[1][2]
2	x[2][0]	x[2][1]	x[2][2]

Column

	0	1	2
0	X	O	X
1	O	X	O
2	O	X	X

x[1][2]

Because memory is addressed linearly, a better representation is like:



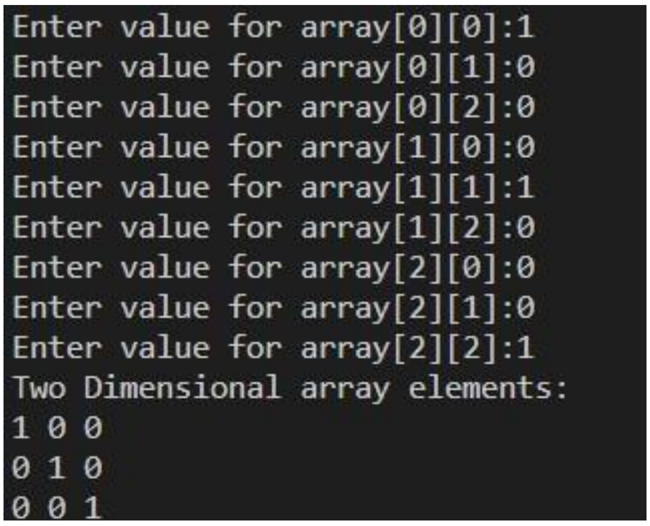
USES

Storing a table of data (not the only way).
Any kind of matrix processing, as a 2D array really is a matrix.

Example 01:

```c
#include<stdio.h>
int main(){
   /* 2D array declaration*/
   int array[3][3];
   /*Counter variables for the loop*/
   int i, j;
   for(i=0; i<3; i++) {
      for(j=0;j<3;j++) {
         printf("Enter value for array[%d][%d]:", i, j);
         scanf("%d", &array[i][j]);
      }
   }
   //Displaying array elements
   printf("Two Dimensional array elements:\n");
   for(i=0; i<3; i++) {
      for(j=0;j<3;j++) {
         printf("%d ", array[i][j]);
         if(j==2){
            printf("\n");
         }
      }
   }
   return 0;
}
```

Output:



```
Enter value for array[0][0]:1
Enter value for array[0][1]:0
Enter value for array[0][2]:0
Enter value for array[1][0]:0
Enter value for array[1][1]:1
Enter value for array[1][2]:0
Enter value for array[2][0]:0
Enter value for array[2][1]:0
Enter value for array[2][2]:1
Two Dimensional array elements:
1 0 0
0 1 0
0 0 1
```

MULTIDIMENSIONAL ARRAYS

Multidimensional array is a collection of a fixed number of elements (called components) arranged in n dimensions (n>=1).

SYNTAX:

element-type aname [size 1] [size 2] … [size n]; /* storage allocation */

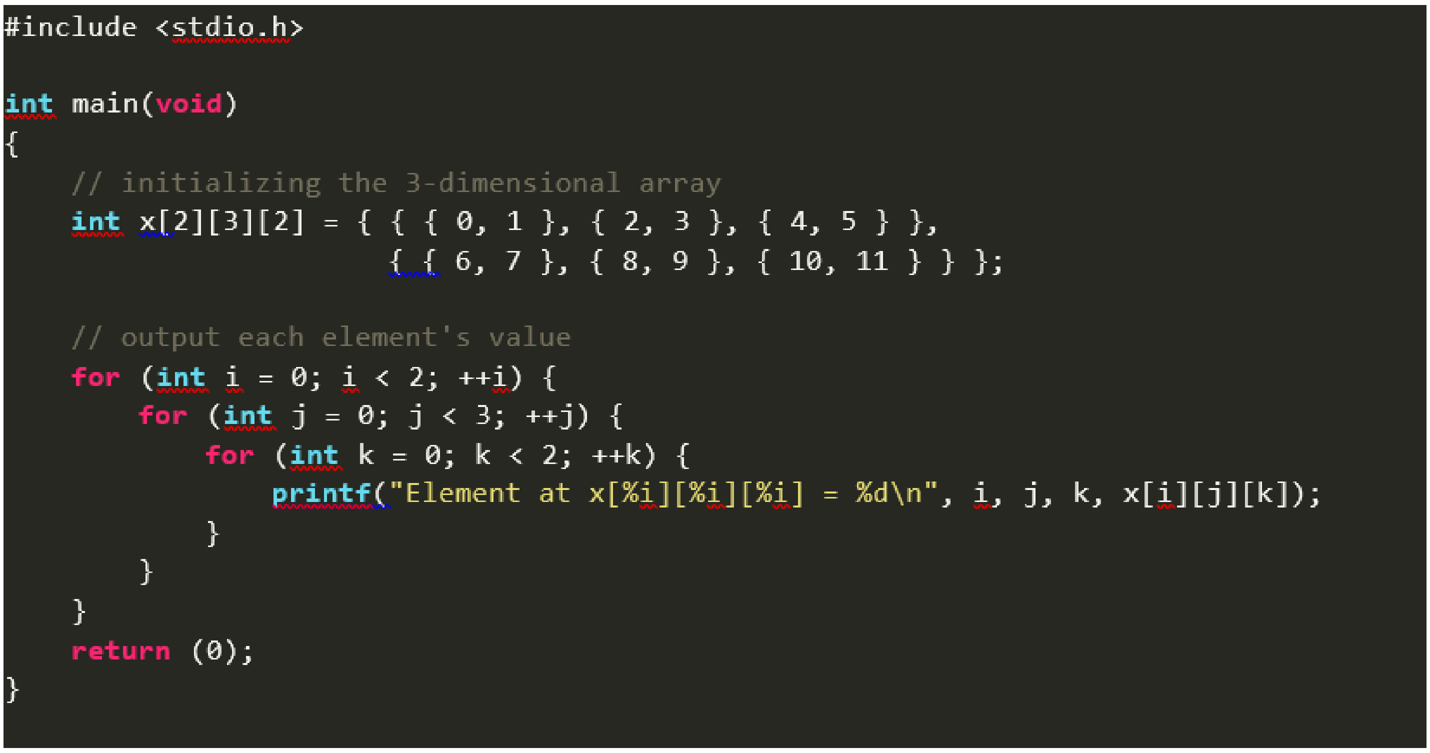
INTERPRETATION:

Allocates storage space for an array aname consisting of size 1 × size 2 × … × size n memory cells.
Each memory cell can store one data item whose data type is specified by element-type . The individual array elements are referenced by the subscripted variables aname [0][0] … [0] through aname [size 1 −1][size 2 −1] …[size n −1] .
An integer constant expression is used to specify each size i .

USES

With input data on temperatures referenced by day, city, county, and state, day would be the first dimension, city would be the second dimension, county would be the third dimension, and state would be the fourth dimension of the array. In any case, any temperature could be found as long as the day, the city, the county, and the state are known. A multidimensional array allows the programmer to use one array for all the data.

Example

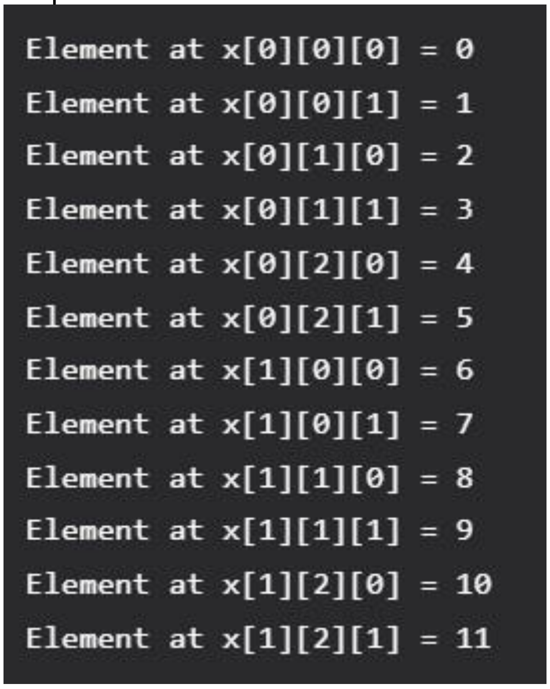


```c
#include <stdio.h>

int main(void)
{
    // 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) {
                printf("Element at x[%i][%i][%i] = %d\n", i, j, k, x[i][j][k]);
            }
        }
    }
    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
```