CL-1002 Programming Fundamentals	LAB 07 Two Dimensional Arrays and Nested Loops IN C

Learning Objectives

- Nested Loops
- Two Dimensional Arrays
- Multi-Dimensional Arrays

NESTED LOOPS

C supports nesting of loops in C. Nesting of loops is the feature in C that allows the looping of statements inside another loop. Let's observe an example of nesting loops in C.

Any number of loops can be defined inside another loop, i.e., there is no restriction for defining any number of loops. The nesting level can be defined at n times. You can define any type of loop inside another loop; for example, you can define 'while' loop inside a 'for' loop.

Syntax:

```
Outer_loop
{
  Inner_loop
  {
     // inner loop statements.
  }
    // outer loop statements.
}
```

Note: Outer_loop and Inner_loop are the valid loops that can be a 'for' loop, 'while' loop or 'do-while' loop.

Example 1: for loop

```c
#include <stdio.h>
int main()
{
   int n=4;
   int i,j;
   for(i=1;i<=n;i++)  // outer loop
   {
       printf("%d\n",i);
       for(j=1;j<=3;j++)  // inner loop
       {
           printf("\t%d\n",j); // printing the value.
       }
   }
}
```

Example 2: while loop

```c
#include <stdio.h>
int main()
{
   int k=1; // variable initialization
   char c='a';
   int i=1;
   while(i<=3) // outer loop
   {
      printf("%d\n",i);
      int j=1;
      while(j<=3)  // inner loop
       {
          printf("\t%c",c);  // printing the value of c.
          j++;
       }
       i++;
       printf("\n\n");
   }
}
```

Example 3: Do While Loop

```c
#include <stdio.h>
int main()
{    int i=1;
    do            // outer loop
    {
        printf("%d\n",i);
        int j=1;
        do        // inner loop
        {
            printf("\t%d",j);
            j++;
        }   while(j<=3);
      printf("\n");
      i++;
    }while(i<=3);
}
```

Simple Example: Suppose we have an array A of m rows and n columns. We can store the user input data into our array A and can Print Array A in the following way:

```c
#include<stdio.h>
int main()
{
    int rows=3;int cols=3;
    int A[rows][cols];
    int i,j;
    //Suppose we have an array A of m rows and n columns.
    //We can store the user input data into our array A in the following way:
    printf("Give Input Array:");
    for(i =0; i<rows;i++){
        for(j=0;j<cols;j++){
            scanf("%d", &A[i][j]);
        }
    }
    // printing 2D input Array
    printf("\n");
    for(i =0; i<rows;i++){
        printf("Row %d: ",i);
        for(j=0;j<cols;j++){
            printf(" %d\t", A[i][j]);
        }
        printf("\n");
    }
}
```

OUTPUT:

```
Give Input Array:
1 2 3
4 5 6
7 8 9

Row 0:  1       2       3
Row 1:  4       5       6
Row 2:  7       8       9
```

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.

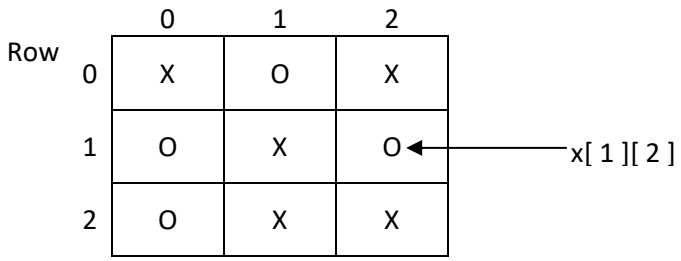
MEMORY REPRESENTATION

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

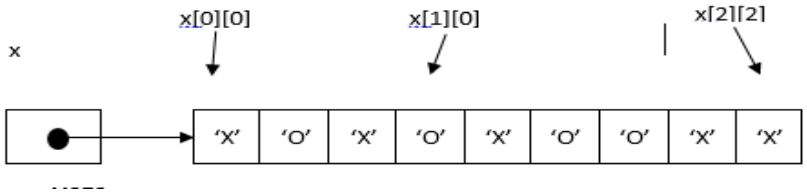
Array x

Row \ Column	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



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
```