CL1002 INTRODUCTION TO COMPUTING

LAB 09

Multi-Dimensional ARRAYS IN C

NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES

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.

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

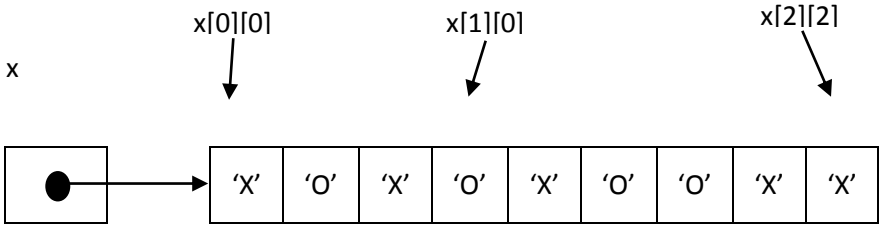
Column

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

Row	0	1	2	
0	X	O	X	
1	O	X	O	← x[1][2]
2	O	X	X	

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.

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.

STORING A STRING IN AN ARRAY OF CHARACTERS

The previous syntax display shows that individual characters can be stored in an array by writing each character in the initialization list. If the list is long, this can be done more easily by using a string instead of an initialization list.

char vowels[] = "Hello World";

EXAMPLE (TWO-DIMENSIONAL ARRAY)

```
//Program to display the transpose of given 2x2 matrix(2D array)

#include <stdio.h>

int main()
{

        int matrix[2][2], transpose[2][2], row, col;

       // Storing elements of the matrix
       printf("\nEnter elements of matrix:\n");
       for(row=0; row<2; row++)
          for(col=0; col<2; col++)
          {
             printf("Enter element a[%d][%d]: ",row,col);
             scanf("%d", &matrix[row][col]);
          }

       // Displaying the matrix[][]
       printf("\nEntered Matrix: \n");
       for(row=0; row<2; row++)
```

```
            for(col=0; col<2; col++)
            {
               printf("%d  ", matrix[row][col]);
               if (col == 1)
                  printf("\n\n");
            }

         // Finding the transpose of matrix
         for(row=0; row<2; row++)
            for(col=0; col<2; col++)
            {
               transpose[col][row] = matrix[row][col];
            }

         // Displaying the transpose of matrix
         printf("\nTranspose of Matrix:\n");
         for(row=0; row<2; row++)
            for(col=0; col<2; col++)
            {
               printf("%d  ",transpose[row][col]);
               if(col==1)
                  printf("\n\n");
            }

  return 0;
}
```

```
Enter elements of matrix:
Enter element a[0][0]: 1
Enter element a[0][1]: 2
Enter element a[1][0]: 3
Enter element a[1][1]: 4

Entered Matrix:
1  2

3  4


Transpose of Matrix:
1  3

2  4
```

```
// C program to store marks of two students for five subjects and display it.
#include <stdio.h>
const int students = 3;
const int sbjects = 5;
int main(){
  int marks[students][sbjects];
  // Using nested loop to store values in a 2d array
  for (int i = 0; i < students; ++i)  {
    for (int j = 0; j < sbjects; ++j)
    {
      printf("Student %d, Subject %d: ", i + 1, j + 1);
      scanf("%d", &marks[i][j]);
    }
  }
  printf("\nDisplaying marks: \n\n");
  // Using nested loop to display vlues of a 2d array
  for (int i = 0; i < students; ++i)
  {
    for (int j = 0; j < sbjects; ++j)
    {
      printf("Student %d, Subject %d = %d\n", i + 1, j + 1, marks[i][j]);
    }
  }
  return 0;
}
```

EXAMPLE (PASSING 2D ARRAY AS ARGUMENT)

```
#include <stdio.h>

void Display_Matrix(int a[][2], int m, int n)
{
   int row ,col;

   printf("\nEntered Matrix: \n");
   for(row=0; row<m; row++)
      for(col=0; col<n; col++)
      {
         printf("%d  ", a[row][col]);
         if (col == 1)
         printf("\n\n");
      }
}

int main()
{
   int a[2][2],row, col;

   // Storing elements of the matrix
   printf("\nEnter elements of matrix:\n");
   for(row=0; row<2; row++)
      for(col=0; col<2; col++)
      {
         printf("Enter element a[%d][%d]:",row,col);
         scanf("%d", &a[row][col]);
      }

   Display_Matrix(a,2,2);
   return 0;
}
```

```
Enter elements of matrix:
Enter element a00: 1
Enter element a01: 2
Enter element a10: 3
Enter element a11: 4

Entered Matrix:
1   2

3   4
```

LAB 08 EXERCISES

INSTRUCTIONS:

NOTE: Violation of any of the following instructions may lead to the cancellation of your submission.

1) Create a folder and name it by your student id (k21-1234).
2) Paste the .c file for each question with the names such as Q1.c, Q2.c and so on into that folder.
3) Submit the zipped folder on google classroom.

QUESTION#1

Write a program that reads the numbers from user and store these numbers into an array of same size. Find and display the sum of all positive numbers and calculate the average.

QUESTION#2

Write a C program to read elements in a matrix and check whether matrix is Sparse matrix or not.

Logic: To check whether a matrix is sparse matrix we only need to check the total number of elements that are equal to zero. The matrix is sparse matrix if T ≥ ((m * n) / 2) where T defines total number of zero elements where m and n are rows and columns respectively.

$$\begin{bmatrix} 1 & 6 & 0 \\ 0 & 0 & 0 \\ 4 & 0 & 5 \end{bmatrix}$$

QUESTION#3

Write a program which takes a matrix of any size as user input and returns the maximum element of matrix as output. Your code should also show the entered matrix on the screen.

QUESTION#4

You are given a dataset which contains five subject marks of two students. For e.g. std1_marks [] = {60,75,85,95,49}, std2_marks [] = {59,70,65,45,39}. You are asked to find the covariance among both student's marks. Formula for covriance is

$$\operatorname{cov}(X,Y) = \frac{1}{n}\sum_{i=1}^{n}(x_i - x')(y_i - y').$$

QUESTION#5

You taking a square matrix as input from keyboard and then you transpose the same matrix after meeting the requirements you are also interested to find out whether original Matrix A and transpose of Matrix A are equal are not. If the answer is yes, then you print the matrix along with message "matrix is symmetric" otherwise you print the "matrix is asymmetric".

QUESTION#6

Write down a program which asks user to input his first name and last name in a separate array. After taking the input your program should be able to concatenate first name and last name and return it as full name. count down number of characters in the full name as well.

For example:
First name: Shoaib

Second name: Raza
Full name: Shoiab Raza

QUESTION#7

You are working part time job along with your three friends after university time. All of you sell six different products per day. At end of duty time each of you submit a report which contains the information like employee id of each of you, the id of the product which you sold and the total amount for the products which you have sold. After one month of your job your reporting officer wants you to you write a program which read the report at end of the month and summarize the total sale made by each employee for each product. Your program should display the processed information in the form of table where each row will represent the respective product and each column will be the representation for each employee. Your program should also print the total product sale and the total sale by particular employee.

QUESTION#8

You need to declare an array of 5 x 9 elements. In which first 1st column contains the StudentID and its respective 5 courses obtained marks in following 5 five columns for the semester. In rest of 4 columns total marks, obtained marks, and Percentage as shown in given table.

- Initialize the array with its default value.
- You need to take user input for the first 6 columns.
- Total marks, obtained marks, and Percentage columns will be filled by your program on the basis of required logic for each of the columns.

Std-id	C1-Marks	C2-Marks	C3-Marks	C4-Marks	C5-Marks	Total-marks	Obt-marks	percentage
1								
2								
3								
4								
5								

QUESTION#9

you appeared for entry test at FAST-NU. Your test contains an IQ based part in
which you IQ level is tested with following formula.
Iq_Score = 2 + (A + 0.5p).
You are required to write a program which generate a table for value of Iq_Score, A and p, where the values of variable A varies within range(1-to-7) and for each value of A, p value varies within range (4.5-to-13.5) in steps of 0.6.

QUESTION#10

FAST-NU enrolled more than 1200 students in undergrad program and planning to register more
students in coming year. To achieve the objective, they are looking for nearby land to be purchased.
They are able to find out the following 8 pieces of lands which are rectangle in shape.

```
//  Plot No.     length  width
    1,           150.6,  126.9,
    2,           354,    451.51,
    3,           172.23, 75.65,
    4,           73.33,  707.17,
    5,           415.15,  116.17,
    6,           415.15,  116.17,
    7,           415.15,  116.17,
    8,           415.15,  116.17,
```

write down a program to find the out the area of land pieces and also determine which land is largest.