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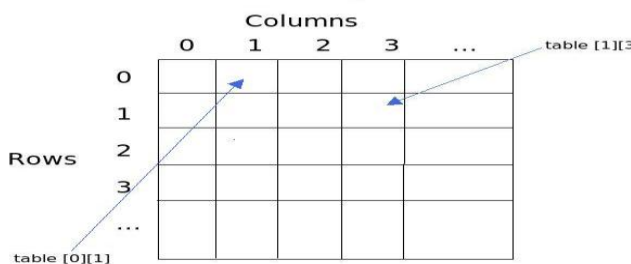# Learn C programming
Lesson 5: Arrays (2D)

5.1-Declaration of a 2D array

2D-dimensional arrays have rows and columns (**m** by **n** arrays), like matrices: specify rows, then columns.

- **float   sequence[MAXROW][MAXCOL]** *matrix MAXROW X MAXCOL of float.*
- **int x[3][2]** → *matrix 3X2 of integers (3 rows & 2 columns).*
- **char alpha[2][4]**→ *matrix 2X4 of characters (2 rows & 4 columns).*

int a[3][4];

	Column 0	Column 1	Column 2	Column 3
Row 0	a[0][0]	a[0][1]	a[0][2]	a[0][3]
Row 1	a[1][0]	a[1][1]	a[1][2]	a[1][3]
Row 2	a[2][0]	a[2][1]	a[2][2]	a[2][3]

Column subscript

Array name

Row subscript

a) **Declaration with initialization**
   int   array[3][3] = {1, 2, 3, 4, 5};
Or

```
int array[3][3];
array[0][0] = 1;  array[0][1] = 2 ;  array[0][2] = 3 ;
array[1][0] = 4 ; array[1][1] = 5;   array[1][2] = 0 ;
array[2][0] = 0;  array[2][1] = 0;   array[2][2] = 0;
```

int   y[3][4]= { {1, 2, 3,2}, {4, 5, 6,2},{7, 8, 9,2}};
Or

```
int  y[3][4] ;
y[0][0]= 1;   y[0][1]= 2;   y[0][2]= 3;   y[0][3]= 2;
y[1][0]= 4;   y[1][1]= 5 ;  y[1][2]= 6;   y[1][3]= 2;
y[2][0]= 7;   y[2][1]= 8;   y[2][2]= 9;   y[2][3]= 2;
```

a) **Array of characters:**
char name[2][8]={{'g','o','o','d'},{'m','o','o','r','n','i','n', 'g'}};
char   name[2][8]={'g','o','o','d','   ','m','o','o','r','n','i','n','g'};

b) **Declaration of multidimensional array**
int x[3][2][4]   3D array of integer numbers
float x[3][2][4][1]   4D array of real numbers

5.2.Input 2D array

Here is an example of how you declare a 2-dimensional array and how to use it. This example uses 2 loops because it has to go through both rows and columns.

```
int   A[3][3], i, j;
for (i = 0;i < 3; i++)
{
   for (j = 0;j < 3; j++)
     {   A[i][j] = 0;
     }
}
```

Example 1:

```
#include<stdio.h>
int main()
{ int i, j, a[3][3];
for(i=0;i< 3; i++)
{
for(j=0;j < 3; j++)
      {
printf("enter the element of the matrix
A[%d][%d] \n",i , j);
scanf("%d", &a[i][j]);
      }
}
return 0;   }
```

5.3. Output 2D array
Example 2:

```
#include<stdio.h>
int main()
{int i, j;
int a[3][3]={{1, 2, 3},{ 4, 5, 6},{ 7, 8, 9}};
      for(i=0;i< 3; i++) {
      for(j=0;j < 3; j++) {
printf("A[%d][%d]=%d \n",i , j, a[i][j]);  }}
      for(i=0;i< 3; i++) {
      for(j=0;j < 3; j++) {
printf("  %d   ", a[i][j]); }
      printf("\n"); }
return 0;   }
```

Example 3:

```
#include<stdio.h>
int main()
{char
name[2][8]={{'g','o','o','d'},{'m','o','o','r','n','i','n','g'}};
   int i,j;
   for(i=0;i<2;i++)
   {
   for(j=0;j<8;j++)
   {
           printf("%c", name[i][j]);
   }
     printf("\n");
   } return 0;}
```

5.4. Calculation of 2D array
Example 4:
Write a program which subtract two matrices & store the results in the 3rd matrix.
The subtraction of two matrices:
The subtraction of two matrices can be defined as:

$$C=A-B$$

$$A=\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}; \quad B=\begin{bmatrix} 6 & 0 \\ 7 & 1 \end{bmatrix}; \quad C=\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}-\begin{bmatrix} 6 & 0 \\ 7 & 1 \end{bmatrix}=\begin{bmatrix} -5 & 2 \\ -4 & 3 \end{bmatrix}$$

```c
#include <stdio.h>
int main()
{      int A[10][10], B[10][10], C[10][10], i, j,  p, q;
    printf("enter the order of the matrixn\n");
    scanf("%d%d", &p, &q);
   printf("enter the elements of the matrix A\n");
        for(i=0;i < p; i++)
        { for(j=0;j < q; j++)
           { scanf("%d", &A[i][j]);
           }
        }
   printf("enter the elements of the matrix B\n");
        for(i=0;i < p; i++)
        {  for(j=0;j < q; j++)
          { scanf("%d", &B[i][j]);
           }
        }
   printf("the sum of the matrix A and B is\n");
        for(i=0;i < p; i++)
        {  for(j=0;j < q; j++)
           {  C[i][j]=A[i][j]-B[i][j];
           }
        }
        for(i=0;i < p; i++)
        {  for(j=0;j < q; j++)
          { printf("C[%d][%d]=%2d   ",i, j, C[i][j]);
           }
   printf(" \n");
        }return 0; }
```

Example 5: Consider a computing course in which the final mark awarded, is obtained from: two exams (EMD1 & EMD2), each one weighted at 20% and a synthesis exam with a weight of 60%. For the examiner's convenience, each component is marked as a real in the range of 0 to 20.

Write a program which will firstly ask the user to enter the number of students (*n*), then for each student the user enter the code number, and reads the 3 component marks, finally the program write out the final mark.

```c
#include<stdio.h>
int main()
{
int i, n;
float  Exam[200][5];
printf("enter the number of  students");
scanf("%d", &n);
for (i=0;i<n; i++)
{
printf("enter code number of student %d\n",i+1);
scanf("%f", &Exam[i][0]);
printf("enter the grade of EMD1\n");
scanf("%f", &Exam[i][1]);
printf("enter the grade of  EMD2\n");
scanf("%f", &Exam[i][2]);
printf("enter the grade of synthesis\n");
scanf("%f", &Exam[i][3]);
Exam[i][4]=0.2*(Exam[i][1]+Exam[i][2])+(0.6*Exam[i][3]);
}
for (i=0;i<n; i++)
{
printf("%2.1f    %2.4f\n", Exam[i][0], Exam[i][4]);}
return 0;
}
```

Example 6: An attendance sheet for a section of *N* students for 6 weeks is represented as a two-dimensional INTEGER array, with *1* indicating attendance and *0* absence. Write a program to find the number of absences for each students.

	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6
Student 1	1	1	0	1	....	....
Student 2	1	0	1	0	....	....
Student 3	0	0	1	1	....	....
....	....	....	....	....	....	....
Student N	....	....	....	....	....	....

```c
#include<stdio.h>
int main()
{ int i,j,N,abs;
 printf("Enter the Number of student\n");
 scanf("%d",&N);
 int attend[N][6],res[N];
  for(i=0;i<N;i++)
 {for(j=0;j<6;j++)
   {  printf("Enter the attendance of student %d for the week %d\n",i+1,j+1);
     scanf("%d",&attend[i][j]);          }}
 for(i=0;i<N;i++)
 {       abs=0;
  for(j=0;j<6;j++)
 {           if (attend[i][j]==0)  abs++; }
          res[i]=abs; }
 printf("Student#          NUMBER OF attendances\n");
 for(i=0;i<N;i++)
 {     printf("%d          %d\n",i+1, res[i]);        }
   return 0;}
```