C-60 → Two Dimensional Arrays

2D - Array Program 5

* write a program to print multiplication of 2 matrices :-

Matrix Multiplication:

$$
\begin{array}{ccc}
0 & 1 & 2 \\
\end{array}
\begin{bmatrix}
1 & 2 & 3 \\
1 & 2 & 3 \\
1 & 2 & 3 \\
\end{bmatrix}
\times
\begin{array}{ccc}
0 & 1 & 2 \\
\end{array}
\begin{bmatrix}
1 & 2 & 3 \\
1 & 2 & 3 \\
1 & 2 & 3 \\
\end{bmatrix}
$$

3×3 3×3   (3×3) same 3×3
  C   R

* Multiply 1 Row in 1st matrix with 1 column of 2nd matrix and put in 1st Row of 3rd matrix.

* Size of resultant will be Row of 1st × Colum of 2nd

$$
\begin{bmatrix}
a[0,0] \times b[0,0] + a[0,1] \times b[1,0] + a[0,2] b[2,0] \\
a[1,0] \times b[0,1] + a[1,1] \times b[1,1] + a[1,2] \times b[2,1] \\
a[2,0] \times b[0,2] + a[2,1] \times b[1,2] + a[2,2] \times b[2,2]
\end{bmatrix}
$$

$C[i][j]$ ⇒
$$
\begin{bmatrix}
C[0][0] & C[0][1] & C[0,2] \\
C[1][0] & C[1,1] & C[1,2] \\
C[2][0] & C[2,1] & C[2,2]
\end{bmatrix}
$$

$C[i][j] \Rightarrow (a[0][0]b[0][j] + a[0][1]b[1][j] + a[0][2]b[2][j])$ $(a[0][0]b[0][0] + a[0][1]b[1][0] + a[0][2]b[2][0])$

$(a[0][1] \times b[1][0])$

$\Rightarrow \begin{bmatrix} (1+2+3) & (2+4+6) & (3+6+9) \\ (1+2+3) & (3+6+9) \\ (1+2+3) & (3+6+9) \end{bmatrix}$

$\Rightarrow \begin{pmatrix} 6 & 12 & 18 \\ 6 & 12 & 18 \\ 6 & 12 & 18 \end{pmatrix}$

Matrix will be $m \times q$

$\rightarrow C \rightarrow m \times q$

$A_{m \times n} \times B_{p \times q} \Rightarrow n = P \Rightarrow C_{m \times q}$

```c
void main()
{
    int a[100][100], b[100][100], c[100][100], i, j, k,
    int sum, m1, n1, m2, n2;

    printf("Enter the number of rows & columns
            for 1st matrix:");
    printf("Enter the number of rows & columns
            for 2nd matrix:");
    scanf("%d %d", &m1, &n1);
    scanf("%d %d", &m2, &n2);

    if(n1==m2)
    {
        printf("Matrix multiplication can be done:");

        for(i=0; i<m1; i++)
        {
            for(j=0; j<n1; j++)
            {
                printf("Enter value for a[%d][%d]:", i, j);
                scanf("%d", &a[i][j]);
            }
        }

        for(i=0; i<m2; i++)
        {
            for(j=0; j<n2; j++)
            {
                printf("Enter value for b[%d][%d]:", i, j);
                scanf("%d", &b[i][j]);
            }
        }
```

```c
printf(" First matrix:\n");
for(i=0; i<m1; i++)
{
    for(j=0; j<n1; j++)
    {
        printf("%d\t", a[i][j]);
    }
    printf("\n");
}
printf(" Second matrix:\n");
for(i=0; m2; i++)
{
    for(j=0; n2; j++)
    {
        printf("%d\t", b[i][j]);
    }
    printf("\n");
}
printf(" Matrix multiplication:\n");
for(i=0; i<m1; i++)
{
    for(j=0; j<n2; j++)
    {
        sum=0;
        for(k=0; k<n1; k++)
        {
            sum = sum + a[i][k] * b[k][j];
        }
        C[i][j] = sum;
        printf("%d\t", C[i][j]);
    }
    printf("\n");
}
}
```

else
printf (" Matrix multiplication cannot be done ...");
getch();
3

Output ①

Enter the number of rows & columns for
1st matrix : 4 2
Enter the number of rows & columns for
2nd matrix : 2 3

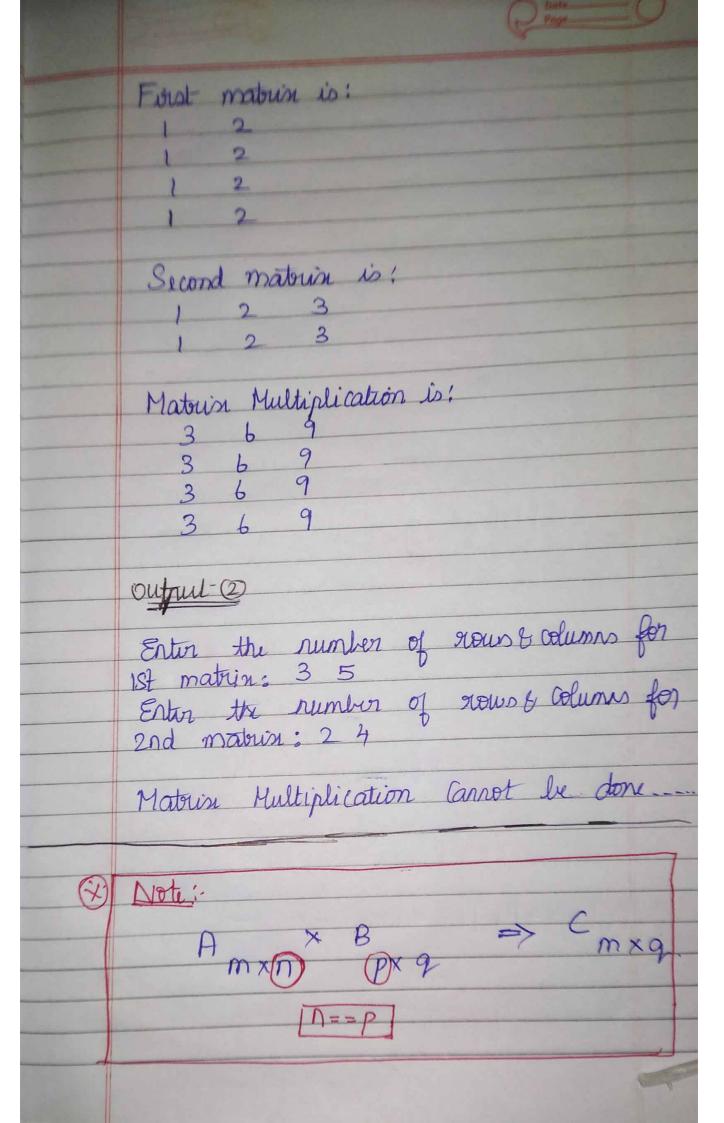Matrix multiplication can be done...

Enter value of a[0][0] : 1
Enter value of a[0][1] : 2
Enter value of a[1][0] : 1
Enter value of a[1][1] : 2
Enter value of a[2][0] : 1
Enter value of a[2][1] : 2
Enter value of a[3][0] : 1
Enter value of a[3][1] : 2
Enter value of b[0][0] : 1
Enter value of b[0][1] : 2
Enter value of b[0][2] : 3
Enter value of b[1][0] : 1
Enter value of b[1][1] : 2
Enter value of b[1][2] : 3

First matrix is:

```
1    2
1    2
1    2
1    2
```

Second matrix is:

```
1    2    3
1    2    3
```

Matrix Multiplication is:

```
3    6    9
3    6    9
3    6    9
3    6    9
```

output - ②

Enter the number of rows & columns for
1st matrix: 3 5
Enter the number of rows & columns for
2nd matrix: 2 4

Matrix Multiplication Cannot be done......

Ⓧ Note:-

$$A_{m \times \boxed{n}} \times B_{\boxed{p} \times q} \Rightarrow C_{m \times q}$$

$$\boxed{n == p}$$

CODE 1:

```c
#include <stdio.h>
#include <stdlib.h>
#define N 100
/** 5 - 2D ARRAY PROGRAM **/
/** PRINT PROGRAM TO MULTIPLY TWO MATRICES IN C **/
/** RULE: Column of first matrix should be equal to Row of Second matrix **/
int main()
{
    int a[N][N],b[N][N],c[N][N],i,j,k,m,n,p,q,sum;
    printf("Enter rows & columns for first matrix:");
    scanf("%d %d",&m,&n);
    printf("Enter rows & columns for second matrix:");
    scanf("%d %d",&p,&q);
    if(n==p)
    {
        printf("Matrix multiplication can be done....\n");
        for(i=0; i<m; i++)
        {
            for(j=0; j<n; j++)
            {
                printf("Enter value of a[%d][%d]:",i,j);
                scanf("%d",&a[i][j]);
            }
        }

        for(i=0; i<p; i++)
        {
            for(j=0; j<q; j++)
            {
                printf("Enter value of b[%d][%d]:",i,j);
                scanf("%d",&b[i][j]);
            }
        }

        printf("\nFirst Matrix:\n");
        for(i=0; i<m; i++)
        {
            for(j=0; j<n; j++)
            {
                printf("%d\t",a[i][j]);
            }
            printf("\n");
        }
```

```c
            printf("\nSecond Matrix:\n");
            for(i=0; i<p; i++)
            {
                for(j=0; j<q; j++)
                {
                    printf("%d\t",b[i][j]);
                }
                printf("\n");
            }

            printf("\nMatrix  Multiplication:\n");
            for(i=0; i<m; i++)
            {
                for(j=0; j<q; j++)
                {
                    sum=0;
                    for(k=0; k<n; k++)
                    {
                        sum=sum+a[i][k]*b[k][j];
                    }
                    c[i][j]=sum;
                    printf("%d\t",c[i][j]);

                }
                printf("\n");
            }

        }
    else
        printf("Matrix multiplication cannot be done...\n");

    getch();

}
```

```
Enter rows & columns for first matrix:4 2
Enter rows & columns for second matrix:2 3
Matrix multiplication can be done....
Enter value of a[0][0]:1
Enter value of a[0][1]:2
Enter value of a[1][0]:1
Enter value of a[1][1]:2
Enter value of a[2][0]:1
Enter value of a[2][1]:2
Enter value of a[3][0]:1
Enter value of a[3][1]:2
Enter value of b[0][0]:1
Enter value of b[0][1]:2
Enter value of b[0][2]:3
Enter value of b[1][0]:1
Enter value of b[1][1]:2
Enter value of b[1][2]:3

First Matrix:
1       2
1       2
1       2
1       2

Second Matrix:
1       2       3
1       2       3
```

```
Matrix  Multiplication:
3       6       9
3       6       9
3       6       9
3       6       9
```