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CODE:

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/*
 *
 *@Rajvaibhav Rahane
 */

/*
 *      Program to perform 2D Matrix operations
 *      implements functions
 *          create,
 *          add,multiply,subtract 2 Matrices,
 *          find Transpose and print
 */
#include<iostream>
using namespace std;

typedef struct Matrix{
    int *matrix;
    int rows,columns;
}Matrix;

Matrix createMatrix(int rows,int columns){
    Matrix m;
    m.matrix=new int[rows*columns];
    m.rows=rows;
    m.columns=columns;
    cout<<"Enter Elements:\n";
    for(int i=0;i<rows;i++){
        for(int j=0;j<columns;j++){
            cin>>*((m.matrix+i*columns) + j);
        }
    }
    return m;
}

void printMatrix(Matrix m){
    for(int i=0;i<m.rows;i++){
        for(int j=0;j<m.columns;j++){
            cout<<*((m.matrix+i*m.columns)+ j)<<" ";
        }
        cout<<endl;
    }
}

Matrix getSumOfMatrices(Matrix m1,Matrix m2){
    Matrix sumMatrix;
    sumMatrix.matrix=NULL;
    if(m1.rows==m2.rows && m1.columns==m2.columns){
        sumMatrix.matrix=new int[m1.rows*m1.columns];
        sumMatrix.rows=m1.rows;
        sumMatrix.columns=m1.columns;

        for(int i=0;i<sumMatrix.rows;i++){
            for(int j=0;j<sumMatrix.columns;j++){

                *((sumMatrix.matrix+i*sumMatrix.columns)+j)=*((m1.matrix+i*m1.columns)+j)+*((m2.matrix+i*m2.columns)+j);
            }
        }
        return sumMatrix;
    }
}
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        else{
            cout<<"Cannot Add Matrices\n";
        }
        return sumMatrix;
    }
Matrix getDifferenceOfMatrices(Matrix m1,Matrix m2){
    Matrix differenceMatrix;
    differenceMatrix.matrix=NULL;
    if(m1.rows==m2.rows && m1.columns==m2.columns){
        differenceMatrix.matrix=new int[m1.rows*m1.columns];
        differenceMatrix.rows=m1.rows;
        differenceMatrix.columns=m1.columns;

        for(int i=0;i<differenceMatrix.rows;i++){
            for(int j=0;j<differenceMatrix.columns;j++){

                *((differenceMatrix.matrix+i*differenceMatrix.columns)+j)=*((m1.matrix+i*m1.columns)+j)-
                *((m2.matrix+i*m2.columns)+j);
            }
        }
        return differenceMatrix;
    }
    else{
        cout<<"Cannot Subtract Matrices\n";
    }
    return differenceMatrix;
}
Matrix getProductOfMatrices(Matrix m1,Matrix m2){
    Matrix productMatrix;
    productMatrix.matrix=NULL;
    if(m1.columns==m2.rows){
        productMatrix.rows=m1.rows;
        productMatrix.columns=m2.columns;
        productMatrix.matrix=new int[productMatrix.rows*productMatrix.columns];
        for(int i=0;i<productMatrix.rows;i++){
            for(int j=0;j<productMatrix.columns;j++){
                *((productMatrix.matrix+i*productMatrix.columns)+j)=0;
                for(int k=0;k<m1.columns;k++){

                    *((productMatrix.matrix+i*productMatrix.columns)+j)+=((m1.matrix+i*m1.columns)+k)*((m2.matrix+k*m2.columns)+j));
                }
            }
        }
        return productMatrix;
    }
    else{
        cout<<"Cannot Multiply Matrices\n";
    }

    return productMatrix;
}
Matrix getTransposeOfMatrix(Matrix m){
    Matrix transposeMatrix;
    transposeMatrix.matrix=NULL;
    if(m.rows==m.columns){
        int temp;
        transposeMatrix=m;
        for(int i=0;i<transposeMatrix.rows-1;i++){
            for(int k=i+1;k<m.rows;k++){
                temp=*((transposeMatrix.matrix+i*transposeMatrix.columns)+k);
                //swap elements
            }
        }
    }
}

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        *((transposeMatrix.matrix+i*transposeMatrix.columns)+k)=*((transposeMatrix.matrix+k*transposeMatrix.columns)+i
    );

        *((transposeMatrix.matrix+k*transposeMatrix.columns)+i)=temp;

    }

    }
    return transposeMatrix;
}
else{
    cout<<"Cannot Find Transpose of given Matrix\n";
}
return transposeMatrix;
}
int main(){
    int rows,columns;
    cout<<"enter rows and columns";
    cin>>rows>>columns;

    Matrix m1=createMatrix(rows,columns);                //create matrix m1
    printMatrix(m1);

    cout<<"enter rows and columns";
    cin>>rows>>columns;

    Matrix m2=createMatrix(rows,columns);                //create matrix m2
    printMatrix(m2);

    Matrix productMatrix=getProductOfMatrices(m1,m2);    //find m1*m2
    if(productMatrix.matrix!=NULL){
        cout<<"Product Matrix\n";
        printMatrix(productMatrix);
    }

    Matrix sumMatrix=getSumOfMatrices(m1,m2);            //find m1+m2
    if(sumMatrix.matrix!=NULL){
        cout<<"Sum Matrix\n";
        printMatrix(sumMatrix);
    }

    Matrix differencematrix=getDifferenceOfMatrices(m1,m2); //find m1-m2
    if(differencematrix.matrix!=NULL){
        cout<<"Difference Matrix\n";
        printMatrix(differencematrix);
    }

    Matrix transposeMatrix=getTransposeOfMatrix(m1);    //find transpose of m1
    if(transposeMatrix.matrix!=NULL){
        cout<<"Transpose Matrix\n";
        printMatrix(transposeMatrix);
    }

    return 0;
}

```

Output:



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rajrahane@visraj-lenovo-g500: ~/Desktop/c++/Lab1/FDS
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A screenshot of a Windows desktop environment. On the left side, there is a vertical taskbar containing icons for various applications: a blue icon with a white 'd', a gear icon, a red pencil icon, a black monitor icon, a folder icon, the Microsoft Edge browser icon, a white document icon, another white document icon, and a small application icon at the bottom. The main area of the screen is occupied by a black terminal window with green text. The text shows the execution of a C++ program that performs matrix addition, subtraction, and transposition on two 3x3 matrices. The user's input is shown in green, and the program's output is in white. The terminal title bar indicates the path is Desktop\c++\Lab1\FDS.

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rojahane@vswraj-lenovo-p500: ~/Desktop/c++/Lab1/FDS
g++ example.cpp -std=c++980 -fpermissive -lm -o ex
enter rows and columns:
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Enter Elements:
1
2
3
4
5
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7
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1 2 3
4 5 6
7 8 9
enter rows and columns:
3
Enter Elements:
4
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4 5 6
7 8 9
10 11 12
Product Matrix
48 54 60
111 126 141
174 198 222
Sum Matrix
5 7 9
11 13 15
17 19 21
Difference Matrix
-3 -3 -3
-3 -3 -3
-3 -3 -3
Transpose Matrix
```