ICS Project Report (Sem1)

**TITLE: MATRIX OPERATIONS   
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**OBJECTIVE**

This program will perform multiple operations on a matrix ,including addition , subtracting, multiplication, transpose, finding the determinant, calculating the trace, the cofactor and adjoint matrices, and outputting the result to a file. The user will be asked to enter matrices to be operated on ,performed, and then output to a file called result.txt.

**DESCRIPTION**

The program performs several matrix operations. Here is a list of the operations implemented:  
  
Matrix Addition: Adds two matrices that have the same dimensions.  
Matrix Subtraction: Subtract one matrix from another, assuming that the two matrices have the same dimensions.  
Matrix Multiplication: Multiplies two matrices, provided the number of columns in the first matrix equals the number of rows in the second matrix.  
Matrix Determinant: Computes the determinant of a square matrix.  
Matrix Transposition: It is the method that changes rows of a matrix into columns.  
Matrix Trace: It calculates the sum of the diagonal elements of any square matrix.  
Matrix Cofactor: It's the method to calculate the cofactor of a square matrix  
Matrix Adjoint: It calculates the adjoint of a matrix by transposing the cofactors.  
 **CORE ICS CONCEPTS IMPLEMENTATION**  
The program follows a structured approach first by taking the user's input for the type of the operation then it performs the relevant matrix operation.  
  
Input Handling:  
  
First, the program asks the user which matrix operation is to be performed. It uses scanf to read in the input.  
If matrices are needed for the matrix operations, the program asks for the size of the matrices to be fed along with their corresponding elements. The elements are then stored in dynamically allocated arrays (A and B).  
The program then asks for the particular operation to be performed on the matrix, such as finding a determinant or performing matrix transposition.  
Matrix Operations:  
  
Addition:  
The addition function takes two matrices ptr1 and ptr2, adds them element-wise, and stores the result in the third matrix ptr3.  
The result is written to the file result.txt.

Subtraction:  
Almost like addition but instead of addition operation it subtracts corresponding elements.  
Print result to result.txt

Multiplication:  
The multiplication operation verifies if the number of columns of the first matrix is equal to the number of rows of the second matrix. If so, proceed with the multiplication operation through computation of the dot product of rows and columns.  
The result is stored in ptr3 and then printed to result.txt.

Determinant:  
The determinant function uses the recursion to determine the determinant of a matrix. It uses the simple formula for the determinant for the 2x2 matrix. For greater than a 2x2 matrix, it uses the cofactor expansion method. In case the given matrix is not square, the program will print out an error message.

Transpose:

The transposingthematrix() function swaps rows and columns to obtain the transpose of the matrix. The result is printed to result.txt.

Trace:  
The traceofmatrix() function computes the sum of the diagonal elements of the matrix.  
The result is printed to result.txt.

Cofactor Matrix:  
The findcofactor() function calculates the cofactor matrix by recursively calculating the minor matrices and applying the appropriate sign.

Adjoint Matrix:  
The findadjoint() function generates the adjoint matrix by transposing the cofactor matrix.

File Output:  
All results, whether it's the determinant, transpose, trace, or matrix elements, are written to the file result.txt.  
This output file stores each result as it is calculated, allowing the user to review the outcomes later.  
  
  
  
**KEY FUNCTIONS**  
  
addition(): Adds two matrices.  
subtraction(): Subtracts two matrices.  
multiplication(): Multiplies two matrices.  
determinant(): Calculates the determinant of a matrix.  
transposingthematrix(): Calculates the transpose of a matrix.  
traceofmatrix(): Calculates the trace of a matrix.  
findcofactor(): Calculates the cofactor matrix.  
findadjoint(): Calculates the adjoint of a matrix.  
  
**LIBRARIES USED**  
  
#include <stdio.h>

#include <stdlib.h>

#include <string.h>

**MEMORY HANDLING**  
Matrices are dynamically allocated. It has been ensured that memory allocation to the matrices is performed according to the size requested by the user using malloc().  
Once operations are performed, free() is used to clean out all the allocations so there is no memory leak.

**ERROR HANDLING**  
It prints an error message in case there are incompatible dimensions for that type of operation, such as multiplying two incompatible dimension matrices.  
If it is impossible to open the file result.txt, an error message is printed, and the program is ended.  
The program also controls before computing determinant of a matrix or cofactor matrix whether a matrix is square.

**CONCLUSION**  
This program offers a complete set of matrix operations. It allows the user to interactively perform matrix manipulations, from very basic operations such as addition and multiplication to more advanced calculations involving the determinant, trace, cofactor, and adjoint matrices. It stores these results in a file for later reference. The dynamic memory allocation ensures flexibility in handling matrices of all sizes, and structured approach allows making the code modular and easy to extend.