CAM2003C - Data Structures and Algorithms with C and C++

Lab Exercise: Multidimensional Arrays in C/C++

Solve the below problems in C/C++ and give the time and space complexities

Write a C program to demonstrate **Row-Major** and **Column-Major** storage.

```
#include <stdio.h>

#define ROWS 3

#define COLS 3


int main() {

   int arr[ROWS][COLS] = { {1,2,3}, {4,5,6}, {7,8,9} };

   printf("2D Array in Row-Major Order:\n");

   for(int i=0; i<ROWS; i++) {

      for(int j=0; j<COLS; j++) {

         printf("%d ", arr[i][j]);

      }

      printf("\n");

   }


   printf("\n2D Array in Column-Major Order (Simulated):\n");

   for(int j=0; j<COLS; j++) {

      for(int i=0; i<ROWS; i++) {

         printf("%d ", arr[i][j]);

      }

      printf("\n");

   }

   return 0;

}
```

WAP to solve the following 2D Array in C/C++

1) Create a Null Matrix of 3X3
2) Create an Identity Matrix of 4X4
3) Check that a matrix is Square or Not
4) Check that a matrix is Identity Matrix or Not.
5) Write a program to implement a 2D Array by defining its elements and display the elements of the 2D Array.
6) Write a program to implement a 2D Array by taking inputs from user and display the elements of the 2D Array.

Part A: 2D Arrays (Matrices)

Problem 1: Matrix Addition

Write a C/C++ program to:

- Take two matrices **A** and **B** of size m x n as input from the user.
- Compute and display the sum matrix **C = A + B**.

📌 *Hint: Use nested loops for traversal.*

Problem 2: Matrix Multiplication

Write a program that:

- Accepts two matrices **A (m x p)** and **B (p x n)**.
- Computes the matrix multiplication **C = A × B**.
- Print the resultant matrix **C**.

📝 *Verify matrix dimensions for multiplication validity (columns of A = rows of B).*

Problem 3: Transpose of a Matrix

Create a program to:

- Accept a matrix **A (m x n)**.
- Find its transpose **A**^{T} **(n x m)**.
- Display both the original and the transposed matrices.

Problem 4: Determinant of a 2x2 Matrix

Write a program to compute the determinant of a 2x2 matrix:

Determinant=a11a22−a12a21Determinant=a11a22−a12a21

Problem 5: Saddle Point of a Matrix

Find and print all saddle points in a matrix. A saddle point is the minimum element in its row but the maximum in its column.

✅ Part B: 3D Arrays

Problem 6: Traversal of a 3D Array

Declare and initialize a 3D array of size **2×3×4**. Write a program to:

- Display all elements of the array.
- Print the elements layer by layer.

Problem 7: Search in a 3D Array

Write a program that:

- Accepts a 3D array of size **3×3×3** from the user.
- Searches for a specific element entered by the user.
- Displays its position(s) (layer, row, column) if found.

Problem 8: Sum of All Elements in a 3D Array

Accept a 3D array of size **2×2×2** from the user. Write a program to calculate and print the sum of all elements.