

University of Mila
Faculty of Science and Technology
Department of Process Engineering

Practical Work 05

Course: Introduction to Programming

Level: 1st Year ST - ENG & LMD

Semester 02

By:

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Academic Year: 2025/2026

Exercise 01: Matrix Input and Display

Question: Write a C program to store elements in an $m \times n$ matrix and print (display) them in different orders.

Steps to print matrix elements in a C program:

- Read the dimensions **m** (rows) and **n** (columns) of the matrix from the user.
- Declare a 2D array (matrix), such as `mat`.
- Use nested loops to read each matrix element from the user.
- Using different loop structures, print the matrix in:
 - **Row-major order:** traversing rows first, then columns
 - **Column-major order:** traversing columns first, then rows
 - **Diagonal orders:** printing main diagonal elements (if the matrix is square)

Exercise 02: Identity Matrix

Question: Write a C program to create an identity matrix.

Steps to create an identity matrix in a C program:

- Read the size **n** of the square matrix from the user.
- Check if it is a square matrix (rows = columns).
- Declare a matrix, such as `I`.
- Use nested loops:
 - If $i == j$ (diagonal elements), set $I[i][j] = 1$
 - Otherwise, set $I[i][j] = 0$
- Print the resulting identity matrix.

Notation: An **Identity Matrix (I)** is a square matrix (size $n \times n$) in which all elements on the main diagonal are 1's and all other elements are 0. It is denoted by I_n .

A key property of the identity matrix is that when multiplied by any compatible matrix, it leaves the original matrix unchanged: $A \times I = I \times A = A$.

Exercise 03: Matrix Addition and Subtraction

Given the following matrices:

$$A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} \quad \text{and} \quad B = \begin{pmatrix} 10 & 20 & 30 \\ 40 & 50 & 60 \\ 70 & 80 & 90 \end{pmatrix}$$

Question: Write a C program to input two matrices A and B and compute their addition and subtraction, if possible.

Note: Matrix addition and subtraction are only possible when both matrices have the same dimensions.

Exercise 04: Matrix Multiplication and Scalar Operations

Given:

$$A = \begin{pmatrix} 0 & 1 \\ 2 & 3 \\ 4 & 5 \end{pmatrix}_{3 \times 2}, \quad B = \begin{pmatrix} 6 & 7 & 8 \\ 3 & 2 & 1 \end{pmatrix}_{2 \times 3}, \quad V = \begin{pmatrix} 10 \\ 5 \\ 4 \end{pmatrix}_{3 \times 1}$$

Question 1: Write a C program to multiply and display the product of two matrices A and B, if possible.

Question 2 (Optional): Write a C program to calculate $2 \times A$ and $(-1) \times B$ and display the resulting matrices.

Question 3 (Optional): Write a C program to multiply and display the product of matrix B and vector V.

Important Notes:

- Matrix multiplication $A \times B$ is possible if the number of columns of A equals the number of rows of B.
- For scalar multiplication, each element of the matrix is multiplied by the scalar value.
- Matrix-vector multiplication follows the same rules as matrix multiplication.