EEL3834 - Programming for Electrical Engineers
Fall 2025
Programming Assignment 3 – Matrix Calculator
Due: 09/28/2025 @ 11:59 PM
To be done individually

Overview

In this assignment, you will implement a Matrix Calculator that supports basic operations on 2D arrays/lists. You will practice working with arrays in C++ and lists in Python, while reinforcing function overloading, const-correctness, and argument passing rules.

You will build a program that:

- Stores two matrices entered by the user.
- Allows the user to choose an operation: addition, subtraction, transpose, or scalar multiplication.
- Outputs the result in a formatted way.

Functional Requirements

C++

- void printMatrix(const int matrix[][MAX], int rows, int cols);
    - Prints a matrix in row/column form.
    - Must be const-correct.
- void inputMatrix(int matrix[][MAX], int rows, int cols);
    - Prompts the user to fill in a matrix with integers.
    - Assumes the user separates numbers in a row with spaces.
- Overloaded functions for matrix operations:
    - addMatrices(const int A[][MAX], const int B[][MAX], int rows, int cols)
    - subtractMatrices(const int A[][MAX], const int B[][MAX], int rows, int cols)
    - transposeMatrix(const int A[][MAX], int rows, int cols)
    - scalarMultiply(const int A[][MAX], int rows, int cols, int scalar)

Python

- def print_matrix(matrix):
    - Prints a matrix in row/column form.
- def input_matrix(rows, cols):

    - Prompts the user to enter values row by row.
    - Assumes the user separates numbers in a row with spaces.
- Functions with keyword and default arguments:
    - def add_matrices(A, B)
    - def subtract_matrices(A, B)
    - def transpose_matrix(A)
    - def scalar_multiply(A, scalar=2) (default multiplier is 2 if not specified)

Math Background

Matrix Addition

- Each element in the result is the sum of corresponding elements:
- Example:

$$\textbf{1. Matrix Addition:} \quad A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}, \quad B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$$

$$A + B = \begin{bmatrix} 1+5 & 2+6 \\ 3+7 & 4+8 \end{bmatrix} = \begin{bmatrix} 6 & 8 \\ 10 & 12 \end{bmatrix}$$

Matrix Subtraction

- Each element in the result is the difference of corresponding elements
- Example:

$$\textbf{2. Matrix Subtraction:} \quad A - B = \begin{bmatrix} 1-5 & 2-6 \\ 3-7 & 4-8 \end{bmatrix} = \begin{bmatrix} -4 & -4 \\ -4 & -4 \end{bmatrix}$$

Matrix Transpose

- Rows become columns and columns become rows

$$\textbf{3. Matrix Transpose:} \quad A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \quad \Rightarrow \quad A^T = \begin{bmatrix} 1 & 4 \\ 2 & 5 \\ 3 & 6 \end{bmatrix}$$

Scalar Multiplication

- Every element is multiplied by the scalar c

4. Scalar Multiplication: $c = 3, \quad A = \begin{bmatrix} 2 & -1 \\ 0 & 3 \end{bmatrix}$

$$c \times A = 3 \times \begin{bmatrix} 2 & -1 \\ 0 & 3 \end{bmatrix} = \begin{bmatrix} 6 & -3 \\ 0 & 9 \end{bmatrix}$$

Input Validation Requirements

- **Numeric Check**:
    1. If the user enters non-numeric input where a number is expected, print:
       Invalid input! Please enter a number.
- **Range Check**:
    1. For rows/cols, accept only integers 1–5.
    2. For menu choices, accept only 1–4.
- **Looping Until Valid**:
    1. Keep prompting until the user provides valid input.
- **Try Again Prompt**:
    1. Only accept "y" or "n" (case-insensitive).
    2. For invalid responses, show:
       Invalid input! Please enter 'y' for yes or 'n' for no.

Libraries

- **Allowed** (doesn't mean you have to use any or all of these):
    - C++: <iostream>, <cstdlib>, <ctime>, <string>sys, string, iostream, and others as needed.
    - Python: sys, string
- **Not Allowed**:
    - Any external libraries or advanced matrix/linear algebra helpers. (Make sure you are doing the matrix math yourself!)

Sample Run 1: (red is user input, blue is where a new line should be in your print flow)

Welcome to the Matrix Calculator!

Enter number of rows (1–5): 0

Invalid input! Please enter a number between 1 and 5.

Enter number of rows (1–5): abc

Invalid input! Please enter a number.

Enter number of rows (1–5): 3

Enter number of columns (1–5): 6

Invalid input! Please enter a number between 1 and 5.

Enter number of columns (1–5): 2

(new line here)

Enter values for Matrix A (row 1 of 3, 2 integers separated by spaces):

1 x

Invalid input! Please enter a number.

Enter values for Matrix A (row 1 of 3, 2 integers separated by spaces):

1 2

Enter values for Matrix A (row 2 of 3, 2 integers separated by spaces):

3 4

Enter values for Matrix A (row 3 of 3, 2 integers separated by spaces):

5 6

(new line here)

Enter values for Matrix B (row 1 of 3, 2 integers separated by spaces):

7 8

Enter values for Matrix B (row 2 of 3, 2 integers separated by spaces):

9 10

Enter values for Matrix B (row 3 of 3, 2 integers separated by spaces):

11 12

(new line here)

Choose an operation:

1. Add

2. Subtract

3. Transpose A

4. Scalar Multiply A

Your choice: 0

Invalid input! Please enter a number between 1 and 4.

Your choice: five

Invalid input! Please enter a number.

Your choice: 1

Result of A + B:

8 10

12 14

16 18

(new line here)

Would you like to try again? (y/n): y

(new line here)

Welcome to the Matrix Calculator!

Enter number of rows (1–5): 2

Enter number of columns (1–5): 2

Enter values for Matrix A (row 1 of 2, 2 integers separated by spaces):

10 1

Enter values for Matrix A (row 2 of 2, 2 integers separated by spaces):

2 3

(new line here)

Enter values for Matrix B (row 1 of 2, 2 integers separated by spaces):

5 1

Enter values for Matrix B (row 2 of 2, 2 integers separated by spaces):

0 4

(new line here)

Choose an operation:

1. Add

2. Subtract

3. Transpose A

4. Scalar Multiply A

Your choice: 2

Result of A - B:

5 0

2 -1

(new line here)

Would you like to try again? (y/n): y

(new line here)

Welcome to the Matrix Calculator!

Enter number of rows (1–5): 2

Enter number of columns (1–5): 3

Enter values for Matrix A (row 1 of 2, 3 integers separated by spaces):

1 2 3

Enter values for Matrix A (row 2 of 2, 3 integers separated by spaces):

4 5 6

(new line here)

Enter values for Matrix B (row 1 of 2, 3 integers separated by spaces):

0 0 0

Enter values for Matrix B (row 2 of 2, 3 integers separated by spaces):

0 0 0

(new line here)

Choose an operation:

1. Add

2. Subtract

3. Transpose A

4. Scalar Multiply A

Your choice: 3

Result of A^T:

1 4

2 5

3 6

(new line here)

Would you like to try again? (y/n): y

(new line here)

Welcome to the Matrix Calculator!

Enter number of rows (1–5): 2

Enter number of columns (1–5): 2

Enter values for Matrix A (row 1 of 2, 2 integers separated by spaces):

2 -1

Enter values for Matrix A (row 2 of 2, 2 integers separated by spaces):

0 3

(new line here)

Enter values for Matrix B (row 1 of 2, 2 integers separated by spaces):

0 0

Enter values for Matrix B (row 2 of 2, 2 integers separated by spaces):

0 0

(new line here)

Choose an operation:

1. Add

2. Subtract

3. Transpose A

4. Scalar Multiply A

Your choice: 4

Enter scalar value: x

Invalid input! Please enter a number.

Enter scalar value: 3

Result of 3 * A:

6 -3

0 9

(new line here)

Would you like to try again? (y/n): maybe

Invalid input! Please enter 'y' for yes or 'n' for no.

Would you like to try again? (y/n): n

Thanks for using the Matrix Calculator. Goodbye!

Your grade will be subject to the following condition(s):

- Submission:

  The submission deadline is **11:59PM** on **09/28/2025**. You will be penalized in increments of 25% per day late (regardless of the time). Submit your code on Canvas

  Required submission files:

  - firstname_lastname_assignment3.py

  - firstname_lastname_assignment3.cpp

- Commenting:
  - There should be comments on key areas in your code explaining why you chose certain aspects and what they are doing, a good rule of thumb is you should have a couple of comments every 10 lines of code
- Correct Variable Naming:
  - Naming variables in relation to their purpose.
- Code working correctly/compiling
  - Please note: Although you can use whatever compiler you want, your assignment will be graded in the class compiler (VS code and Pycharm) so it must compile with these compilers, or you may lose points.
- Code print format is as shown in sample runs

*See rubric on canvas assignment for more details.