

Programming Assignment 10 - Due Wednesday 3 December

Problem: You have been hired by Igotsoft, Inc as a new software project engineer. Igotsoft is developing a new product that it hopes will rival and supplant MATLAB as an engineering tool for design and analysis. You have been assigned to the team in charge of developing the matrix handling portion of the software package.

Background: The basic matrix operations that you need to perform in this first round of development are

addition: $[C]_{M \times N} = [A]_{M \times N} + [B]_{M \times N}$
where $c_{i,j} = a_{i,j} + b_{i,j}$

note: matrix addition is only permitted if [A] and [B] have the same dimensions
a warning should be displayed if the addition cannot be performed

subtraction: $[C]_{M \times N} = [A]_{M \times N} - [B]_{M \times N}$
where $c_{i,j} = a_{i,j} - b_{i,j}$

note: matrix subtraction is only permitted if [A] and [B] have the same dimensions
a warning should be displayed if the subtraction cannot be performed

multiplication: $[C]_{M \times P} = [A]_{M \times N} [B]_{N \times P}$
where $c_{i,j} = \sum_{k=1}^{k=N} a_{i,k} b_{k,j}$

note: matrix multiplication is only permitted if [B]_{NxP} has the same number of rows as [A]_{MxN} has columns. The resulting matrix has dimension MxP.
a warning should be displayed if the multiplication cannot be performed

Assignment: Design and code a C program, called **pa10xxx.c** (where xxx are the group initials), that has the following functions:

- a) a function that will read a data file that contains a two-dimensional matrix. the first row of the data file will have the number of rows in the matrix followed by the number of columns in the matrix. the remainder of the file will contain the (real, floating point) matrix elements, row by row. the function should return the number of rows and columns in the matrix as well as the matrix.

What does this function need from the calling function to do its job?

(nothing - why?)

What does this function need from the user to do its job?

(1 thing - what?)

What will the function return to the calling program, if successful?

(3 things - what? what type of data?)

- b) A function that will display a menu and determine the user's choice from the menu. User's choices are:

Enter A to add two matrices

Enter S to subtract two matrices
Enter M to multiply two matrices
Enter N to move to next case or exit
Please enter your choice

Use an error check to assure that a proper choice is made. Return the user choice with the return statement.

What does this function need from the calling function to do its job?
(nothing - why?)

What will the function return to the calling program, if successful?
(1 thing - what?)

c) A function that will add two matrices.

What does this function need from the calling function to do its job?
(6 things - what are they?)

What will the function return to the calling program, if successful?
(3 things - what are they?)

The function should display an error message if it cannot add the two matrices.

d) A function that will subtract two matrices.

How does this function differ from the one that adds two matrices?

What does this function need from the calling function to do its job?
(6 things - what are they?)

What will the function return to the calling program, if successful?
(3 things - what are they?)

The function should display an error message if it cannot subtract the two matrices.

e) A function that will multiply two matrices.

How does this function differ from the one that adds two matrices?

What does this function need from the calling function to do its job?
(6 things - what are they?)

What will the function return to the calling program, if successful?
(3 things - what are they?)

The function should display an error message if it cannot multiply the two matrices.

f) A function that will display the original matrices, the mathematical operation (i.e., addition, subtraction, multiplication), and the results of the mathematical operation to the screen.

g) A function that will write the original matrices, the mathematical operation (i.e., addition, subtraction, multiplication), and the results of the mathematical operation to a file designated by the user.

Design and code a `main()` that performs the following:

- a) display the header/program description
- b) read a first set of matrix elements from a file
- c) read a second set of matrix elements from a file
- d) display a menu to the user asking for choice
- e) use a switch/case statement to perform choice
- f) display results to screen

g) write results to designated file
actions e through g should be placed inside a loop that allows the user to perform multiple calculations with the same data set, if desired
actions b through the loop including actions e through g should also be placed inside a loop that allows the user to work with different data sets, if desired.

Test your program with the following pairs of matrices

$$[A] = \begin{bmatrix} 1 & -3 & 5 \\ 0 & 2 & -1 \\ 4 & 2 & 3 \end{bmatrix} \quad \text{and} \quad [B] = \begin{bmatrix} 2 & 4 & 3 \\ -1 & 1 & 2 \\ -2 & -3 & 5 \end{bmatrix},$$

$$[C] = \begin{bmatrix} 1 & 4 \\ 0 & 1 \\ -3 & 3 \end{bmatrix} \quad \text{and} \quad [D] = \begin{bmatrix} 1 & -1 \\ 4 & -3 \\ 3 & 4 \end{bmatrix},$$

$$[E] = \begin{bmatrix} 4 & 0 \\ 5 & 3 \\ 0 & 1 \end{bmatrix} \quad \text{and} \quad [F] = \begin{bmatrix} 1 & -3 & 0 \\ -1 & 2 & 2 \end{bmatrix}.$$

Turn in:

1. An outline of your program approach.
2. A paper copy of your C program (pay attention to style).
3. A screen printout showing execution of the program for addition, subtraction, and multiplication for each pair of matrices.
4. A disk with your program (not project).

Programming Assignment 10 - Evaluation Criteria

Names _____

Criteria	Points Available	Points Awarded
Program Style		
header in each function	10	
purpose/goal state in headers	10	
meaningful variable names	10	
variables defined w/ comment	10	
whitespace/readability	10	
algorithm comments	10	
<u>Working Functions</u>		
no assignment statements in main	30	
display header function	10	
file reading function	20	
menu function	10	
matrix add function	20	
matrix subtract function	20	
matrix multiply function	30	
screen display function	20	
file report function	20	
Program Function		
pleasing user interface	40	
switch/case in main	30	
loops work in main	30	
	Total Pts:	/340