ENCMP 100 – Computer Programming for Engineers
Assignment #1
Due: Monday, Jan. 30 2017 at 6:00pm MST

Objective

This assignment is designed to provide you with an introduction to MATLAB. You will create your own M-file to perform some basic matrix manipulations, and write a program to aid you in your final ENCMP100 mark calculation.

Marking Scheme

You will get a total of 50 points for completing the following:

TASK	POINTS
Part A: Correct display of data	15
Part B: Correct calculation of final mark	25
Quality of code - 5 marks each for the submission	10
TOTAL	50

Breakdown for Quality of Code:

- Complete file header (see under the Submission heading for an example)
- Design (appropriate use and naming of variable
- Comments in the code
- Layout (indentation / spacing)

Submission

- Filename naming convention Assign1A_<UofA_ID_Number>.m
  Ex. U of A ID Number: 1234567 filename for assignment #1 is Assign1A_1234567.m
- Submit only your **.m** file under Assignment 1 section in your eClass/Moodle account.
- The assignment is due on Monday, Jan. 30 2017 at 6:00 pm MST.
- A sample header is provided below, which must be included in all assignments:

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Course: ENCMP 100
% Assignment: 1A
% Name: Joe MacDonald
% CCID: jmac
% U of A ID: 1234567
%
% Acknowledgements:
% I received help from Jason Smith on matrix multiplication
%
% Description:
% This program will show some basic matrix manipulations.
%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

NOTE: When including the header from above, please change the details to contain your information. Also this header information must be included in all assignment, failure to do so will result in a failing assignment mark.

Background

The simplest way to define a matrix is to use a list of numbers. For example, the statement `x = [1 2 3 4]` will return the row vector:

```
x =
     1     2     3     4
```

A new row is indicated by a semicolon. An example of a matrix containing both rows and columns is created with the statement `y = [1 2 3 4; 2 3 4 5; 3 4 5 6]`, which returns:

```
y =
     1     2     3     4
     2     3     4     5
     3     4     5     6
```

The colon operator is very powerful for defining new matrices and modifying existing ones. When a colon is used in a matrix reference in place of a specific index number, the colon represents the entire row or column. For example, the statement `a = y(:,1)` will equate matrix `a` to column 1 of matrix `y`.

MATLAB contains many built-in functions to create and manipulate/analyze matrices. These include `sum, max, min, mean, median`, and `mode`, as well as many matrix algebra functions.

MATLAB supports two types of operations between arrays, known as array operations and matrix operations.

Array operations are operations that are performed between arrays on an element-by-element basis. For example, if

$\mathbf{A} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $\mathbf{B} = \begin{bmatrix} -1 & 3 \\ -2 & 1 \end{bmatrix}$ then $\mathbf{A} + \mathbf{B} = \begin{bmatrix} 0 & 5 \\ 1 & 5 \end{bmatrix}$ and $\mathbf{A}.*\mathbf{B} = \begin{bmatrix} -1 & 6 \\ -6 & 4 \end{bmatrix}$.

Note: The number of rows and columns in both arrays must be the same.

Array operations may also occur between an array and a scalar. For example, if

$\mathbf{A} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then $\mathbf{A} + 4 = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$.

Matrix operations, in contrast, follow the normal rules of linear algebra, such as matrix multiplication. In linear algebra, the product $\mathbf{C} = \mathbf{AB}$ is defined by the equation

$$C(i,j) = \sum_{k=1}^{n} A(i,k)B(k,j)$$

For example, if $\mathbf{A} = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $\mathbf{B} = \begin{bmatrix} -1 & 3 \\ -2 & 1 \end{bmatrix}$ then $a * b = \begin{bmatrix} -5 & 5 \\ -11 & 13 \end{bmatrix}$ and is represented in MATLAB by the expression `A*B`. Recall that matrix multiplication is not commutative – the order in which matrices are multiplied is important. For example, the result of `B*A` is $\begin{bmatrix} 8 & 10 \\ 1 & 0 \end{bmatrix}$.

Note: The number of columns in matrix a must be equal to the number of rows in matrix b.

Important: MATLAB uses a special symbol to distinguish array operations from matrix operations. A period is used before the symbol to indicate an array operation. For example,

- The MATLAB form for array multiplication is `A .* B`
- The MATLAB form for matrix multiplication is `A * B`

Assignment Description:

Part A: Basic Operations with Matrices

In this portion of the assignment you will be asked to create two arrays, perform some manipulations on the arrays and print the results to the screen.

Important: For the testing of this portion of the assignment, the automatic echoing of values in the command window must be suppressed. Please ensure you put a semicolon (;) at the end of each statement in order to suppress the echoing of values.

The program must perform the following steps:

1. Populate an array `A`. Display the array `A` contents to the command window with the title "`Matrix A:`". The array `A` should represent the following:

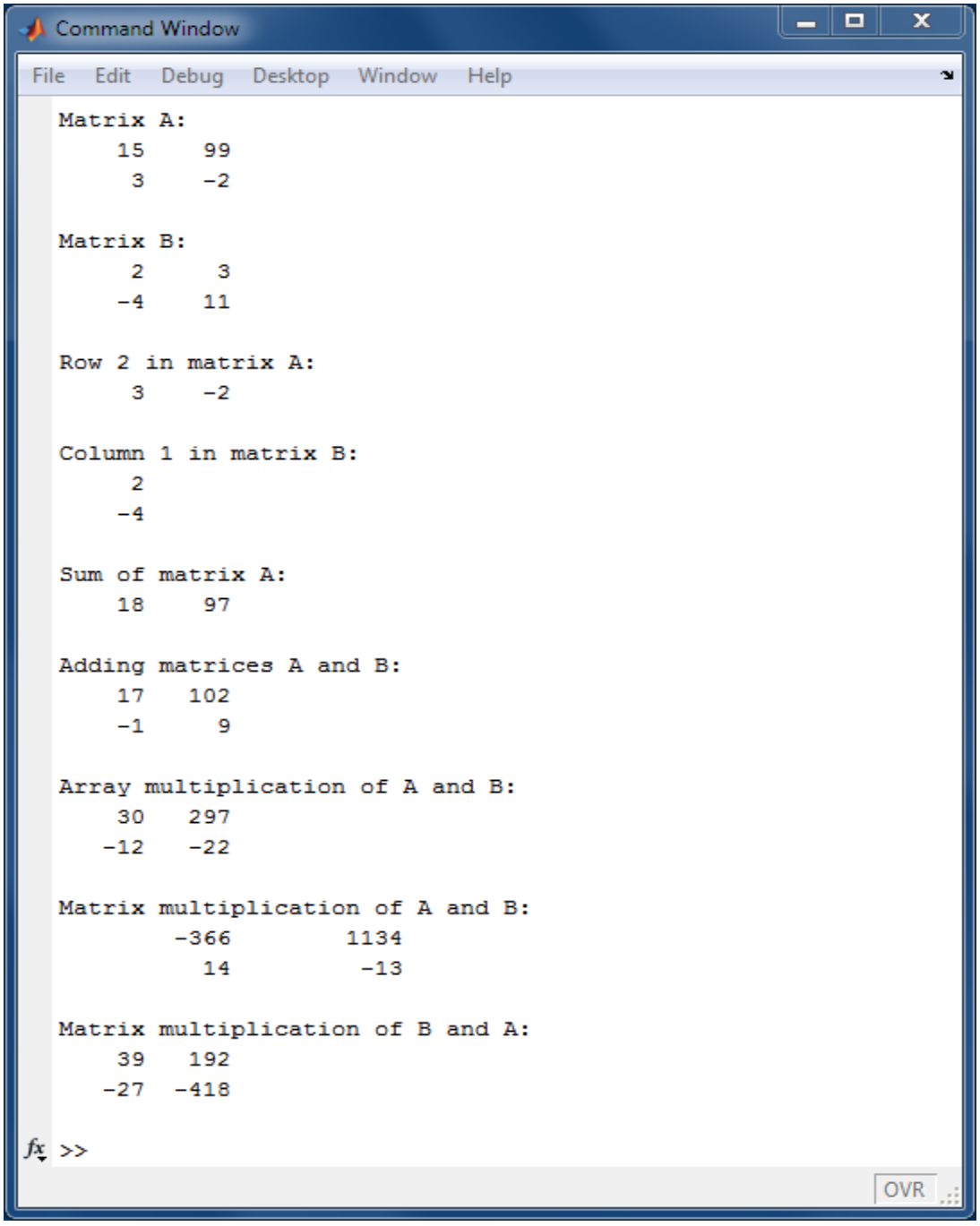
```
Matrix A:
    15    99
     3    -2
```

2. Populate an array `B`. Display the array `B` contents to the command window with the title "`Matrix B:`". The array `B` should represent the following:

```
Matrix B:
     2     3
    -4    11
```

3. Select row 2 in matrix `A` using the colon operator. Display the output to the command window with the title "`Row 2 in matrix A:`".
4. Select column 1 in matrix `B` using the colon operator. Display the output to the command window with the title "`Column 1 in matrix B:`".
5. Use the built-in sum command to find the sum of each column in matrix `A`. Display the results to the command window with the title "`Sum of matrix A:`".
6. Add the matrices `A` and `B`. Display the results to the command window with the title "`Adding matrices A and B:`".
7. Find the array (element-by-element) multiplication of `A` and `B`. Display the results to the command window with the title "`Array multiplication of A and B:`".
8. Find the matrix multiplication of `A` and `B`. Display the results to the command window with the title "`Matrix multiplication of A and B:`".
9. Find the matrix multiplication of `B` and `A`. Display the results to the command window with the title "`Matrix multiplication of B and A:`".

Your results must match exactly with the screenshot below:



Part A Submission:
For part A of this assignment, please submit your solution to eClass under Assignment 1. With the following naming convention:

Assign1A_<UofA_ID>.m
Ex. U of A ID Number: 1234567 filename will be
Assign1A_1234567.m

Part B: Grade Calculator

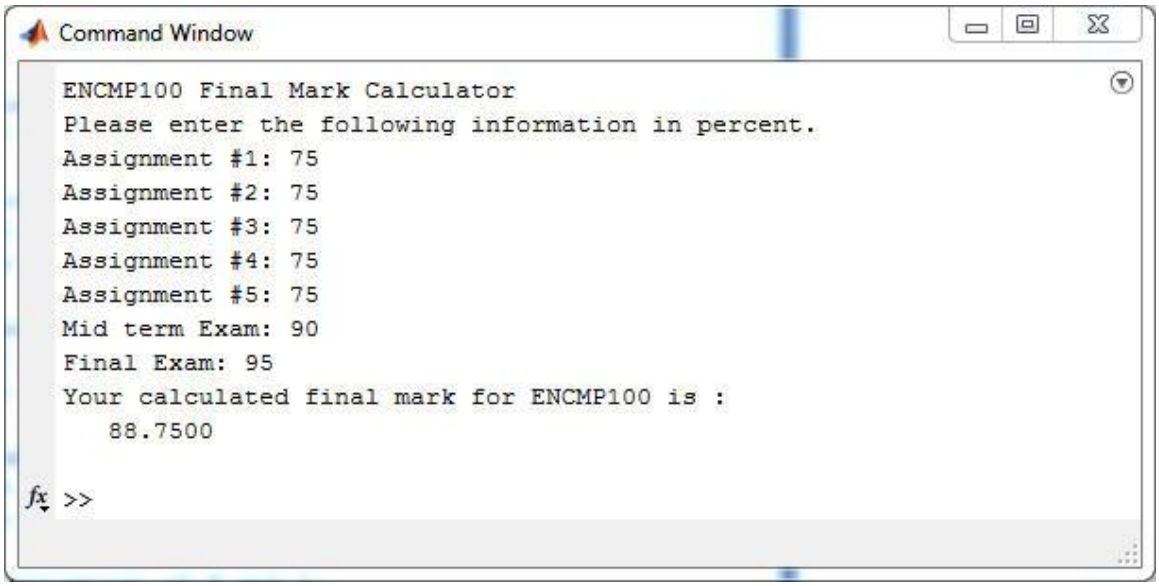
In this portion of the assignment, you are required to develop an m-file that calculates your final mark in terms of percent based on assignment, mid-term and final mark based on the course outline.

Your program should prompt a user to input their marks from their assignments, mid-term and final exam.

Next, calculate their final mark based on the ENCMP100 course outline.

Assignments 25%
Mid term 25%
Final 50%

Your program should print the results of this calculation to the command window, and your results should match the screenshot below.



Hints:

1. Type `help input` to learn about how to use the command `input` to prompt users for input and to record their entries from the command window.

Part B Submission:

For part B of this assignment, please submit your solution to eClass under Assignment 1B. With the following naming convention:

Assign1B_<UofA_ID>.m
Ex. U of A ID Number: 1234567 filename will be Assign1B_1234567.m