MATLAB Project # 0 – HOMEWORK INSTRUCTIONS

This project teaches you how to use MATLAB and present homework.

M-files. This is an important class of files that we will be using throughout the course in the MATLAB Projects. The M-files are text files that you can create with a text editor, and they contain commands to be interpreted by MATLAB. An example of an M-file to solve Problem 1 of this project is the following.

```
% Solution to
%     MATLAB Project 1
%     problem        1

format compact    % this command eliminates unnecessary blank lines
                  % from the output

% We first enter the matrices A and B
A = [1, -2, 3; 4, 5, 6; 7, 8, -10]
B = [-1, 7, 2; -5, 6, 1; 7, -8, 11]

% Now we compute A+B and 3*A
A+B
3*A

% As you already noticed, the symbol % is used to add comments.
```

An important aspect of M-files is that their names must end with "**.m**". For the M-file shown in the example, I would use the name **p0prob1.m**, but you can use the names you like! When you want MATLAB to follow the instructions in the M-file, you must type the filename without the extension **.m** in the MATLAB prompt, and you have to be working in the directory where the file is stored. To *go* to a directory we use the `cd` command. This will be better understood with an example: Suppose that the file **p0prob1.m** is in the directory **c:\math401\matlab**, then to run the script in that file you have to type the following:

```
>> cd c:\math401\matlab
>> p0prob1
```

and MATLAB will output

```
A =
     1    -2     3
     4     5     6
     7     8   -10
B =
    -1     7     2
    -5     6     1
     7    -8    11
ans =
     0     5     5
    -1    11     7
    14     0     1
ans =
     3    -6     9
    12    15    18
    21    24   -30
```

Presenting Results. You can present results by using the **publish** command or **M-books** (see handout), pasting MATLAB commands and graphics into a LATEX document, or simply using **diary files**. The latter are text files where MATLAB stores all what you see on the screen as you run commands and/or invoke M-files. Suppose that now we modify **p0prob1.m** adding the line `diary p0prob1.txt` at the beginning and the line `diary off` at the end. Then, as a result, when you invoke `p0prob1` at the MATLAB prompt, MATLAB will show on the screen the same as before, but at the same time, it will save that information on the file **p0prob1.txt**. If the diary file already existed, MATLAB would *append* the lines at the end. Including the command `echo on` at the beginning of the file. will record all commands used by the M-files in the diary file.

Here is a **summary of the steps used to prepare homework solutions**.

(1) Create an M-file in your current working directory to hold the solution. Include `echo on` near the top of the file so you can see which commands are producing what output when you run the M-file.

(2) Continue editing and running the M-file until you are confident that it contains the MATLAB commands that solve the problem.

(3) Add comments to your M-files to explain the method being used to solve the problem and to interpret the results. Give titles to your figures.

(4) Once the M-file is ready, publish the document or insert the `delete` and `diary` commands into the M-file (see example below).

(5) Now run the M-file to produce the final solution. Do not print intermediate calculations (the command ';' at the end of a line avoids printing). Send the diary file or published document to a printer. Collect the pages, staple them together and submit them.

To illustrate the results of this process, here is the final version of the M-file for problem 1.

file **p0prob1.m**

```
delete p0prob1.txt % we delete the file just in case it existed
diary p0prob1.txt
format compact
echo on

% Solution to
%     MATLAB Project 1
%     problem        1

% We first enter the matrices A and B
A = [1, -2, 3; 4, 5, 6; 7, 8, -10]
B = [-1, 7, 2; -5, 6, 1; 7, -8, 11]

% Now we compute A+B and 3*A
A+B
3*A

% The results MATLAB gave for A+B and 3*A agree with our definitions
% for adding matrices and multiplying by scalars.

echo off
diary off    % it is important to do this, otherwise MATLAB would
             % continue to add lines to the diary file
```

And the diary file **p0prob1.txt** will look like

file **p0prob1.txt**

```
% Solution to
%     MATLAB Project 1
%     problem        1

% We first enter the matrices A and B
A = [1, -2, 3; 4, 5, 6; 7, 8, -10]
A =
     1    -2     3
     4     5     6
     7     8   -10
B = [-1, 7, 2; -5, 6, 1; 7, -8, 11]
B =
    -1     7     2
    -5     6     1
     7    -8    11

% Now we compute A+B and 3*A
A+B
ans =
     0     5     5
    -1    11     7
    14     0     1
3*A
ans =
     3    -6     9
    12    15    18
    21    24   -30

% The results MATLAB gave for A+B and 3*A agree with our definitions
% for adding matrices and multiplying by scalars.

echo off
```

Final Note

Each problem should be worked out in a separate M-file, and the results published or saved in a diary file. A printout of the published document or the diary file should be handed in (one per student). Use comment lines in your M-file to make appropriate comments and to indicate the problem number. Use the `echo` command to display the commands in your M-files in the command window, and thus in the diary file.

Try the following 4 problems to practice MATLAB commands, the publish command and diary files. You will need both for MATLAB Project # 1, which will be graded.

Problem 1: Enter the matrices

$$A = \begin{bmatrix} 1 & -2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & -10 \end{bmatrix} \qquad \text{and} \qquad B = \begin{bmatrix} -1 & 7 & 2 \\ -5 & 6 & 1 \\ 7 & -8 & 11 \end{bmatrix}.$$

Compute $A + B$ and $3A$. Do the results agree with our definitions for adding matrices and multiplying matrices by scalars?

Problem 2: Enter the matrices

$$A = \begin{bmatrix} 1 & -2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & -10 \end{bmatrix}, \qquad B = \begin{bmatrix} -1 & 7 & 2 \\ -5 & 6 & 1 \end{bmatrix} \qquad \text{and} \qquad C = \begin{bmatrix} 7 \end{bmatrix}$$

Compute $A + B$, $A + C$, $C + B$. Do the results agree with our definitions for adding matrices? Why, or why not?

Problem 3: Enter the vectors (column matrices)

$$u = \begin{bmatrix} 1 \\ -9 \\ 8 \\ 11 \end{bmatrix} \qquad \text{and} \qquad v = \begin{bmatrix} -11 \\ 13 \\ -7 \\ 10 \end{bmatrix}.$$

Then compute the linear combinations $2u + 3v$ and $3u - 12v$.

Problem 4: Enter the matrices

$$x = \begin{bmatrix} 2 \\ 5 \\ -8 \\ 3 \end{bmatrix} \qquad \text{and} \qquad y = \begin{bmatrix} -4 \\ 23 \\ 7 \\ -10 \end{bmatrix}.$$

Then compute $x \cdot y$ by forming the matrix product `x'*y`. Explain why this matrix product gives the correct answer. What does the prime do? What happens if we type `x*y`? why? What is the result of typing `x*y'`?

Problem 5: Let

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & -5 \\ -1 & 3 & -3 \end{bmatrix}, \qquad B = \begin{bmatrix} 3 & 2 & 1 \\ -1 & 5 & -3 \\ 2 & 3 & -3 \end{bmatrix}, \qquad \text{and} \qquad C = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 10 \end{bmatrix}$$

(a) Compute AB and BA, using matrix multiplication in MATLAB. Are they the same? Did you expect them to be the same? Explain.

(b) Compute $(AB)C$ and $A(BC)$. Are they the same? Did you expect them to be the same? Why?