Math 461 - Sec. 0601 - Fall 2002 **Instructor: Ricardo H. Nochetto**

MATLAB Project # 0 – HOMEWORK INSTRUCTIONS

This project teaches you how to use MATLAB and present homework. There are two important kind of files that we will be using throughout the course in the MATLAB Projects: the **M-files** and the **diary files**. 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:\math461\matlab**, then to run the script in that file you have to type the following:

```
>> cd c:\math461\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
```

The **diary files** 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.

You will have to use the diary files to hand in the MATLAB projects. Since I will want the diary files to contain the commands used in the M-files for performing the required task, you will have to include the line `echo on` at the beginning of the 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.

(4) If you didn't do so before, insert the `delete` and `diary` commands into the M-file (see example below).

(5) Now run the M-file to produce the final solution. Send the diary file to the 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 in a separate M-file, and the results saved in a diary file. A printout of the diary file should be handed in. 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 both MATLAB commands 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?