MATLAB Assignment 1

Due: October 12, 2007

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Linear Algebra   MTH 3331   Student ID #_____

Purpose: This assignment will test your knowledge of writing a simple MATLAB session using basic MATLAB matrix/vector functions.

Format: Your session should begin with a header containing the date, project number, your name, and Student ID number.

Sample Session:

```
% October 12, 2007
% MATLAB Project 1
% Name:  SERGEY BELYI
% Student ID#:  1234567
% Problem 1.
%
A=[1 2 3;4 5 6;7 8 9]
A=
1 2 3
4 5 6
7 8 9
B=A'
B=...
.............................
```

Notes: Comment your session well. Use % sign in the beginning of each comment line. In case if you need to save your workplace use **Save** option from the **File** menu. Use `myname.mat` file to store your data. You can use the MATLAB **load myname** command to retrieve the data saved later.

Problem 1. Consider the linear system:
$$x - 2y + 3z = b_1$$
$$-x + 3y = b_2$$
$$2x - 5y + 5z = b_3$$

Let b_1, b_2, and b_3 be the first three digits of your Student ID number. (For example: My Student ID# is 2349876. This makes $b_1 = 2$, $b_2 = 3$, and $b_3 = 4$.) Use the MATLAB command **rref** to solve the system.

Problem 2. Use the MATLAB command **rref** to determine which of the following matrices are row-equivalent to

$$X = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 9 & 10 & 11 & 12 \\ 5 & 6 & 7 & 8 \end{bmatrix}$$

$$A = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 0 & -1 & -2 \\ 0 & 1 & 2 & 3 \end{bmatrix}, \quad B = \begin{bmatrix} 1 & 3 & 2 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{bmatrix}, \quad C = \begin{bmatrix} 12 & 11 & 10 & 9 \\ 4 & 3 & 2 & 1 \\ 8 & 7 & 6 & 5 \end{bmatrix}$$

Type your answer as a comment line.

Problem 3. Enter the matrices

$$S = \begin{bmatrix} s_{11} & s_{12} & s_{13} \\ s_{21} & s_{22} & s_{23} \\ s_{31} & 1 & 2 \end{bmatrix} \quad \text{and} \quad T = \begin{bmatrix} -5 & 6 & 7 \\ 0 & -1 & 2 \\ 4 & 0 & -3 \end{bmatrix}$$

where matrix S is made of the digits of your Student ID#. Use MATLAB to find:

(a) $S + T$ (b) $4S - 5T$ (c) ST (d) $(TS)^T$

Problem 4. Write the following system of the linear equations in the form $AX = B$ and use the MATLAB command $A \backslash B$ to solve the system.

$$3x + 3y + 4z = b_1$$
$$x + y + 4z = b_2$$
$$2x + 5y + 4z = b_3$$

where b_1, b_2, and b_3 are the first three digits of your Student ID number.

Problem 5. Let $D = \begin{bmatrix} 1 & \frac{1}{8} \\ 0 & \frac{1}{10} \end{bmatrix}$. Use MATLAB to find D^2, D^7, and D^{15}.

Problem 6. Enter the matrices

$$F = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}, \quad G = \mathbf{zeros(2,2)}, \quad H = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

Use the MATLAB to form the block-matrix $\mathbf{M = [F \ G; G \ H]}$ and find the smallest value of n such that $M^n = M$.

Problem 7. Let S be the same 3×3 matrix as in the Problem 3. Use the MATLAB command **inv** to find the inverse of S. Is S a singular matrix? Then adjoin the identity matrix $I = \mathbf{eye(3)}$ to S to form the 3×6 matrix $\mathbf{L = [S \ I]}$. Row-reduce L with **rref** command to compute the inverse of S again. What do you observe?

Problem 8. Let S and T be the same 3×3 matrices as in the Problem 3. Use the MATLAB to calculate

(a) $S^{-1}T^{-1}$ (b) $(ST)^{-1}$ (c) $(S^{-1}T)^T$ (d) $((TS)^T)^{-1}$.

Problem 9. Let S and T be the same 3×3 matrices as in the Problem 3. Use the MATLAB command **det** to calculate the determinants of the following matrices:

(a) S (b) ST (c) $\mathbf{pascal(4)}$ (d) $\mathbf{hilb(8)}$.

Problem 10. Let real number t be your birthday. (For example if your birthday is October 12, 1975 then $t = 12$.) Use the MATLAB command **det** to calculate the determinant of the matrix:

$$A = \begin{bmatrix} \cos(t) & \sin(t) \\ -\sin(t) & \cos(t) \end{bmatrix}$$

Does the value of the determinant depend on t? Explain your answer.

Type MATLAB **whos** *command to see your variables. Print your session and turn the print-out in by October 12, 2007. Save your session workplace as* `myname.mat`