MATLAB Assignment 2

Due: November 28, 2007

Dr. S. Belyi Name ______________________

Linear Algebra MTH 3332 S.S.N. ______________________

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 #.

Sample Session:

```
% November 28, 2007
% MATLAB Project 2
% Name:  SERGEY BELYI
% Student ID #:  XXX-XXXX
% 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. If you have trouble printing your Matlab session you can save it as a text file and then print it, bring or e-mail it to me. My e-mail address is `sbelyi@troy.edu`. To save your project as a text file do the following: highlight all the work with the mouse. Go to the **Edit** menu and chose **Copy**. Close Matlab and open Notepad or Microsoft Word. Chose **Paste** from the **Edit** menu. Save the text file on your jump drive or e-mail it to me.

Problem 1. Let b_1, b_2, b_3, b_4, and b_5 be the first five digits of your student ID number. (For example: My Student ID # is 234-5698. This makes $b_1 = 2$, $b_2 = 3$, $b_3 = 4$, $b_4 = 5$, and $b_5 = 6$.) Use MATLAB to determine whether the given set is linearly independent or dependent.

$$S = \{(b_1, b_2, b_3, b_4, b_5), (0, 0, 2, 3, 1), (1, 2, 3, 4, 5), (2, 1, 0, 0, 0), (-1, -3, -5, 0, 0)\}.$$

Type your answer as a comment line.

Problem 2. Use MATLAB command to determine whether the set makes a basis in R^4

$$B = \{(b_1, 1, -3, 4), (b_2, 0, 0, 2), (b_3, 5, 3, 0), (b_4, 7, -3, -6)\},$$

where b_i are the same as in the Problem 1. Type your answer as a comment line.

Problem 3. Use MATLAB to find a subset of the given set of vectors that forms a basis for the span of the vectors:

$$S = \{(b_1, b_2, b_3, b_4, b_5), (1, 1, 0, 0, 1), (1, 1, 1, 1, 1), (1, 1, 2, 2, 1), (0, 0, 3, 3, 1), (0, 0, 0, 0, 1)\}$$

Problem 4. Let

$$A = \begin{bmatrix} b_1 & b_2 & b_3 & b_4 & b_5 \\ 0 & 2 & 3 & -1 & 2 \\ -1 & 4 & 3 & -1 & 5 \\ 2 & -4 & 0 & 0 & -6 \\ 0 & 0 & 0 & 1 & 1 \end{bmatrix}$$

where b_1, b_2, b_3, b_4, and b_5 are the first five digits of your student ID number. Find:
(a) the basis for the row space of A,
(b) use the MATLAB command **rank** to find the rank of A.

Problem 5. Let

$$D = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix}.$$

Use MATLAB to find a dimension for the nullspace of D. Then verify that the sum of the rank and nullity of D equals the number of columns.

Problem 6. Use the MATLAB command **norm(b)** to find:

(a) the length of the vector $\vec{b} = (b_1, b_2, b_3, b_4, b_5)$,

(b) the distance between the vectors $\vec{v} = (-3, 2, 4, -5, 0)$ and $\vec{b}$. Here b_1, b_2, b_3, b_4, and b_5 are the first five digits of your Student ID number.

Problem 7. The dot product of the vectors (written as *columns*) is given by the matrix product:

$$\vec{u} \cdot \vec{v} = \vec{u}^T \vec{v} = [u_1 \quad u_2 \quad ... \quad u_n] \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix}.$$

Let $\vec{b}$ be the same as in the Problem 6, $\vec{v} = (0, -3, 2, -1, 1)$ and $\vec{w} = (1, -1, 0, 0, 7)$. Use MATLAB to find the following:

(a) $\vec{b} \cdot \vec{v}$,

(b) $(\vec{b} \cdot \vec{v})\vec{w}$,

(c) $\vec{b} \cdot \vec{b}$ and $\|\vec{b}\|^2$.

Problem 8. The angle θ between two non-zero vectors is given by

$$\cos\theta = \frac{\vec{u} \cdot \vec{v}}{\|\vec{u}\|\|\vec{v}\|}.$$

Use the MATLAB to calculate the angle between $\vec{b}$ and $\vec{w}$, where $\vec{b}$ and $\vec{w}$ are defined in Problem 7. (Hint: use the built-in inverse cosine function **acos**).

Problem 9. You can find the orthogonal projection of the column vector $\vec{x}$ onto the column vector $\vec{y}$ by computing

$$\frac{\vec{x}^T \vec{y}}{\vec{y}^T \vec{y}} \vec{y}.$$

Use MATLAB to find the projection of the vector $\vec{b}$ onto the vector $\vec{w}$, where $\vec{b}$ and $\vec{w}$ are defined in Problem 7-8.

Problem 10. Use the MATLAB command **cross(u,v)** to find the cross product of the vector $\vec{u} = (u_1, u_2, u_3)$ and $\vec{v} = (v_1, v_2, v_3)$, where $\vec{u}$ and $\vec{v}$ are made from first three components of the vectors $\vec{b}$ and $\vec{w}$ are defined in Problem 7-9, respectively.

Type MATLAB **whos** *command to see your variables. Print your session and turn the print-out in by November 28, 2007. Save your session workplace as* `myname.mat`