MAT 240 – FALL 2015

What to turn in: For this project you will need to turn in a printout of your *published* m-file.

Use a YourName_MATH240_Proj2.m file to save your code in an .m file. Use the command PUBLISH(FILE,FORMAT) (or similar) to publish your work in word or pdf format (while you are at it, play to see what other formats you can get). Make sure that you have enough comments and results shown so that another person (me or the TA) can understand what you are doing). Use %% notation to differentiate in cells the problems in this homework. This way you can even run/debug one problem at a time.

Please apply the instructions from Project 1 about working in teams and labeling your project.

Remember to use the command l*ookfor* *&% when trying to find the MATLAB command whose description contains *&%.

MATLAB PROJECT 2:

The goals of this project are: (1) to learn more about how to quickly generate matrices using MATLAB functions; (2) practice different ways of computing the inverse and the determinant of a matrix; (3) practice your understanding of the standard matrix of a linear transformation; (4) interpret and explain the results generated by MATLAB.

PROBLEM 1: Use MATLAB commands to efficiently (i.e. without keying each entry) enter the matrix: $S = \begin{bmatrix} 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 2 & 0 & 1 \\ 0 & 0 & 0 & 7 & 0 \\ 0 & 0 & 0 & 0 & 5 \\ 0 & 0 & 0 & 0 & 0 \end{bmatrix}$. **Hint**: Try help *diag* and represent S as the sum of two matrices having non-zero entries on different diagonals.

Compute S^k for k=2,3,4,5,6.

Describe in words what happens when computing S^k**.** Using this reasoning, what do you expect S^{11} to be?

PROBLEM 2: Let $A = \begin{bmatrix} 2 & 4 & 6 \\ 4 & 5 & 6 \\ 3 & 3 & 1 \end{bmatrix}$.

Find the first and second column of A^{-1} without computing the third column. Display the result as a matrix with entries rational (not decimal) fractions. **Hint**: You could obtain the reduced echelon form for an augmented matrix or solve two different systems. For the required format, search for the correct syntax using “help format”.

PROBLEM 3: Suppose a linear transformation *T* has the property that *T*([1;2])=[5;7], and *T*([2;1])=[3;4] where [1;2] is, as in MATLAB, the column vector with entries 1 and 2. Let A denote the standard matrix of *T*.

a) The information above tells you that there are matrices *U* and *V* such as $A * U = V$. Define *U* and *V*. **Hint**: read the problem until the end.
b) Using inv(*U*), *V* and matrix multiplication, compute *A*.
c) Verify that you have the correct *A* by computing in MATLAB $A *$ [1;2] and $A *$ [2;1].
d) Compute the expression $\det\ A \cdot \det U - \det V$. What general fact does this calculation illustrates?
e) Compute $\det\,(A + U) - \ (\det A + \det U)$. What general fact does this calculation illustrates?

PROBLEM 4: Let A_n be the $n \times n$ matrix with 0 on the main diagonal and 1 elsewhere.

1) For $n = 4{,}5{,}6$
   a) Use Matlab pre-programmed matrices (*eye*, *ones*, *zeros*) and matrix operations, efficiently input A_n .
   b) Compute ${A_n}^{-1}$ and display the result with rational entries.
2) Propose a general form for ${A_n}^{-1}$, expressed in terms on n.
3) Check your theory for $n = 7$.

PROBLEM 5: The actual color a viewer sees on a screen is influenced by the specific type and amount phosphors on the screen. So each computer screen manufacturer must convert between the (R, G, B) data and an international CIE standard for color, which uses three primary colors, called X, Y and Z. A typical conversion for short persistence phosphors is
$\begin{bmatrix} .61 & .29 & .150 \\ .35 & .59 & .063 \\ .04 & .12 & .787 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}$. A computer program will send a stream of color information to the screen using standard CIE data (X, Y, Z).

a) Find the equation that converts (X,Y, Z) data to the (R, G, B) data needed for the screen’s electron gun.
b) Check your results: Taking $(R, G, B) = (1, 2, 3)$, compute the corresponding (X, Y, Z) using the given transformation, then use the transformation you’ve obtained at (a) to transform (X, Y, Z) into (R_n, G_n, B_n). If $(R_n, G_n, B_n) = (R, G, B)$, the transformation you’ve obtained at (a) is correct.