Matlab Homework 1
MATH461 Spring 2015
Due March 26

This is a written assignment like all the other ones. The only difference is that in each problem you will have to use Matlab. You will print out your log in Matlab and attach it to your work that you submit (instructions below).

The department provides free Matlab tutoring. You can learn more about this here. This document should also be useful to get started.

Whenever you use a new Matlab command, you can learn about it by using the help command. For example type

```
>> help rref
```

to learn about the `rref` command.

As instructed above, you should hand in your printed output. You can use the `diary` command to save your work: type

```
>> diary problem1.txt
```

and Matlab will save all your subsequent work to `problem1.txt`. Whenever you wish to stop saving, you may type

```
>> diary off
```

You should then edit the file problem1 (with your favorite text editor) to include your name, the problem numbers, and add any additional information helpful to solving the problem. Then print your file.

Some basic commands. You can enter a matrix into Matlab as follows:

```
>> A=[1 2 3;4 5 6;7 8 9]
```

Some useful commands to generate matrices include `diag, eye, ones, zeros`. Use the help command to see how each of these commands are used. We will often generate matrices with random entries. You can generate a 4×5 matrix with random entries between 0 and 1 by typing

```
>> A=rand(4,5)
```

The command `randi` can be used to generate random integers. For instance, you can generate a 4×6 random matrix with integer entries between 3 and 11 with the command

```
>> A=randi([3,11],4,6)
```

To make sure that a result is omitted in your printout, put a semicolon to the end of the command:

```
>> A=randi([3,11],4,5);
```

Use this to reduce the size of your final printout. The (i, j)–entry of a matrix A is `A(i,j)`. For instance

```
>> A(2,3)
```

will return the entry on the second row and third column of A. You can also use
`>> A(:,3)`
to get the third column of A. Finally, you can carry out various matrix operations easily. Typing `A+B, A-B` or `A*B` will return the sum, difference and product of two matrices, as defined in class. Take a minute to play around with the above commands.

Problem 1. *Generate a random 4×5 matrix A with integers entries between -4 and 4. Put the matrix into reduced echelon form using the command* ***rref.*** *Are the columns of A linearly independent? Do the columns of A span $\mathbb{R}^4$?*

Problem 2. *Generate a random vector b in $\mathbb{R}^4$ with entries between -3 and 3 (a vector is also a 4×1 matrix). Generate a 4×5 matrix A with integer entries between -3 and 3. Assisted by the* ***rref*** *command, find all solutions of $Ax = b$ (note that you can easily define the augmented matrix for this system by typing* `[A b]`*).*

Problem 3. *Generate two 5×5 random matrices A and B with integer values between -5 and 5 and test whether $AB = BA$ (you may want to compute $AB - BA$ and see if you get the zero matrix).*

Problem 4. *For this problem you need to find a polynomial*

$$p(t) = a_0 + a_1 t + a_2 t^2 + a_3 t^3 + a_4 t^4 + a_5 t^5$$

such that $p(0) = 1$, $p(1) = 3$, $p(2) = 3$, $p(3) = -1$, $p(4) = 1$, $p(5) = 4$. If you set up the problem correctly, then the coefficients $a_0, a_1, a_2, a_3, a_4, a_5$ will solve a linear system. Use Matlab to solve this system.

Problem 5. *Generate a random 8×8 matrix A with integer values between 0 and 4. Check if the matrix is invertible. If not, generate another matrix until you get an invertible one. Find the inverse of this matrix (The command* ***inv*** *inverts a matrix, however you can also use the commands* ***rref*** *and* ***diag*** *in a clever way to solve this problem). Finally, verify that $AA^{-1} = I_8$.*

Problem 6. *The matrix*

$$\begin{bmatrix} 4 & -2 & 5 & -5 \\ -9 & 7 & -8 & 0 \\ -6 & 4 & 5 & 3 \\ 5 & -3 & 8 & -4 \end{bmatrix}$$

determines a linear transformation $T : \mathbb{R}^4 \to \mathbb{R}^4$. Is T a one-to-one mapping? If not, find all x such that $T(x) = 0$.

Problem 7. *Generate two random 6×6 matrices A and B with integer values between -3 and 3. You can use the* ***det*** *command to calculate the determinants of A and B. Verifty that $det(AB) = det(A)det(B)$ and that $det(A + B) \neq det(A) + det(B)$.*

Problem 8. *Generate a random 6×6 matrix A and a random vector $b \in \mathbb{R}^6$, both with entries between -2 and 2. Check that A is invertible using your favourite method. If it is not, then generate a new matrix until you get an invertible one. Solve the system $Ax = b$ in two different ways: first using* ***rref*** *and then by computing $x = A^{-1}b$. You should get the same answer!*