MATLAB Assignments - Exploration for MATH 1554

MATLAB #1 - Exploration 3:
Now you're ready to start your homework. Remember to separate each numbered problem with a "%%" comment header, just like in the `test_demo.m` file. Problems marked with a (*) require some written explanation to answer: for these, include your explanation a comments in the corresponding section (remember: "%" comments out a line).

1. **A simple calculation:** What is 21 + 45? To find this, simply enter the command "`21 + 45`". Running this section will return the correct answer in the command line.

2. **A linear system with no free variables:** Consider the linear system

$$\begin{aligned} x_1 + 2x_2 + x_3 &= 221 \\ 2x_1 - 3x_2 + 4x_3 &= 144 \\ 2x_1 - 2x_2 + 8x_3 &= 433 \end{aligned}$$

   You'll solve this linear system in a few ways:

   (a) First, enter the coefficient matrix for this system as the variable "A", and the right-hand side as the column vector "b". Next, enter the command "`A \ b`", which outputs the (in this case, unique) solution to this linear system.

   (b) (*) Second, enter the augmented matrix as the variable "`M`". In the next line, run the command `rref(M)`, which outputs the row reduced echelon form of `M`. Note that there are no free variables. Explain, in words, why in this case we have that the last column of `M` is the (unique) solution to the original linear system. If you did everything right, you should find that this solution is the same as that you found in part (a).

3. (*) **Another linear system:**

   Consider the linear system

$$\begin{aligned} 2x_1 - 7x_2 &= -81 \\ -x_1 + 8x_2 &= 90 \\ -4x_1 + 7x_2 &= 85 \end{aligned}$$

   Note that there are three equations in only two unknowns. Can such a system be consistent? Check by solving the above system using MATLAB: take the RREF of the augmented matrix; if consistent, write the solution values of x_1, x_2 in the comments, and it not consistent, explain why. Why is the solution NOT the augmented column of the RREF in this case?

4. **A linear system with a free variable:** Using only what we have so far, MATLAB does not provide parametric solutions to an underdetermined system of equations. To see this, consider the linear system consisting of the first two equations in the linear system in the previous Problem 2. Enter the backslash command `A \ b` (for appropriate A, b) to a single solution. On the other hand, we know from class that, if such a system is consistent, there must be infinitely many solutions: provide an explanation as to why this is true.

   (*) At best, using the tools at our disposal, we will have to read the set of solutions off of the RREF. For this, enter the appropriate augmented matrix and take its RREF using MATLAB. Based on this, identify vectors `v`, `w` (that is, declare them in your Matlab script) so that a general solution is of the form $v + aw$, where a is any real number.

For your Gradescope submission we need a .pdf file from the MATLAB PUBLISH button (either publish straight to .pdf - or publish first to .html then put it in a browser and print to .pdf from the browser), but only after you have completed and verified the below:

- All your code compiles correctly using the RUN command, and
- all required comments (using %) and headers (using %%) are present.

Please read the MATLAB intro file carefully at `https://people.math.gatech.edu/~sbarone7/MATLAB_intro.pdf` including the portion at the end about submitting your MATLAB work to Gradescope. See the file `https://people.math.gatech.edu/~sbarone7/test_demo_submission.pdf` for an example of the kind of file we want to see in Gradescope.

NOTE: **Any submission other than a .pdf as described above will be penalized.**