Math 451 PROJECT 2 **Due at 5 PM Friday, May 23rd**

The purpose of this project is to compare results from solving a system of equations by several different methods:

1. Row reducing the augmented matrix to upper triangular form and back-substituting, using the `rr` and `bs` function files that I have provided at the class web page.
2. Performing the LU-factorization process using the `h2oLU`, `fs` and `bs` function files provided at the web page.
3. Using *MATLAB*'s `rref` command, which reduces an augmented matrix to **reduced row echelon form** (look that up if you don't know what it means).
4. Using the inverse matrix for A. The *MATLAB* notation for this is `inv(A)`.
5. Using the *MATLAB* `\` command.

For each process you will generate a solution vector $\mathbf{x}$, the time taken to obtain the solution and the error $\|A\mathbf{x} - \mathbf{b}\|$. Call them `xk`, `timek` and `errork`, where k is the number of the process, as given above. You should do all of this first with the system from Exercise 7 of Exam 2 (the correct solution is $x_1 = -2$, $x_2 = 2$, $x_3 = 1$) to se that everything works as it should. Here are some things that might be helpful:

- If you have a matrix A, and a column vector $\mathbf{b}$ that has the same number of components as A has rows, `[A,b]` is the result of augmenting A with $\mathbf{b}$.
- You can apply an appropriate function to a matrix described by `[A,b]`. For example, you could call `rr([A,b])` to row-reduce the matrix of A augmented with vector $\mathbf{b}$ to upper triangular form.
- To time a process, insert the line `tic` right before the first line of the process, and something like `time=toc` right after the last line of the process. The time taken for the process will then be stored in the variable `time`.
- The standard magnitude of a vector $\mathbf{x}$, denoted by $\|\mathbf{x}\|$, that we have been using is often called the **2-norm** of the vector. The *MATLAB* command for this norm is `norm(x,2)`.

I will take a look at your script file once you get it working, if you wish. E-mail it to me sometime Tuesday, May 20th if you want me to do that.

Once you get your script file working properly, replace the A you were using to test it with a 100×100 matrix with random integers from one to nine, using the `randi` command, and replace the vector $\mathbf{b}$ with a vector having 100 components randomly selected from the integers from one to nine. Then add lines so that you can *Publish* your results in report form. Your report should be organized as follows:

- There should be a title, followed by your name.
- There should be the following sections:
  - A brief introduction, where you tell what the project is doing.
  - A section for each method. Each should have a heading, your code and your time and error results, *no more*.
  - A summary of results section, where you put all the results in a table.
  - A brief conclusion, where you discuss the best and worst results in terms of both time taken and error. This should include at least one result for how many times faster the best code is, and at least one result for how many times larger the worst error is compared one or two of the best.
- There should be table of contents after your name, with all of the above sections listed.

Additional information can be found in the class notes for 5/16.

Timeline:

- (Optional) Put together the *MATLAB*script file and e-mail it to me by 3-4 PM Tuesday, May 20th.
- Send me a draft of the published Word document by 8 AM Thursday, May 22nd - **a small portion of your grade will be based on getting this to me on time**.
- I should be able to get those back to you at class time on Thursday, for you to make needed changes.
- **A paper copy of the final draft is due at 5 PM Friday, May 23rd, along with the *MATLAB* script file, which you will e-mail me.**