MACM 316 - Computing Assignment 2

- Read the *Guidelines for Assignments* first.

- Submit a one-page PDF report to Canvas and upload you Matlab scripts (as m-files). Do not use any other file formats.

- Keep in mind that Canvas discussions are open forums.

- You must acknowledge any collaborations/assistance from colleagues, TAs, instructors etc.

Failure of Gaussian Elimination with Partial Pivoting

There are several well-known examples of matrices for which Gaussian elimination with partial pivoting fails to give an accurate result. The file `mymat.m` on Canvas constructs one such matrix. The goal of this assignment is to compare the accuracy and efficiency of partial pivoting and complete pivoting for this matrix.

Download the files `mymat.m`, `GaussElim.m` (which performs Gaussian elimination with partial pivoting) and `gecp.m` (which performs Gaussian elimination with complete pivoting) from Canvas. The syntax for each is presented in the box below.

```
A = mymat(n);
z = GaussElim(A,b);
z = gecp(A,b);
```

You'll need to construct a system to solve using both methods. Create a random vector x and set $b = Ax$. You now have a right-hand side vector and an exact solution.

We are interested in how the accuracy and efficiency of each algorithm changes with respect to n, the size of the matrix. Run the codes for several values of n. Since x is random, you should also run the codes over several trials at each n and take an average of your results.

Provide figures of the time and error as functions of n. To calculate the time each method takes, use `tic` to start a timer and `t = toc;` to stop the timer and store the elapsed time in the variable `t`. For the error, use the largest absolute error of all the elements:

$$E_n = \max_{1 \leq k \leq n} |x_k - z_k|.$$

Recall the operation count for Gaussian elimination. How does this relate to the plot of time versus n? Can you estimate the number of operations by which complete pivoting and partial pivoting differ?

What can you say about the accuracy of the methods? Take a look at the matrix that `mymat.m` constructs. Can you explain why partial pivoting fails? Comment on the effects of the number of trials used for each n.