Assignment - 2

- 1. (a) (5 **points**) Use the Gaussian elimination method to find two matrices L, U such that A = LU where L is lower triangular and U is upper triangular.
 - (b) (5 **points**) Then solve the linear system Ax = b using the above matrices L and U. The code should work for any non-singular square matrix A. Use a proper A and b to verify the results.
- 2. (5 points) Find the conditional number of the following matrix for n = 3, 4, 5, 6 using the row-norm, column-norm and Euclidean-norm. Do not use the inbuilt norm function from the Matlab library. What do you observe in the results?

$$H_n = \begin{bmatrix} 1 & \frac{1}{2} & \frac{1}{3} & \dots & \frac{1}{n} \\ \frac{1}{2} & \frac{1}{3} & \frac{1}{4} & \dots & \frac{1}{n+1} \\ \vdots & & & \vdots \\ \frac{1}{n} & \frac{1}{n+1} & \dots & \dots & \frac{1}{2n-1} \end{bmatrix}.$$

3. (5 points) A tridiagonal system with n unknowns is given by,

$$a_i x_{i-1} + b_i x_i + c_i x_{i+1} = d_i; i = 1, 2, \dots, n$$

where $a_1 = c_n = 0$. Solve the above system using the following method which is a special case of Gaussian elimination method:

$$c'_{i} = \begin{cases} \frac{c_{i}}{b_{i}} & ; i = 1\\ \frac{c_{i}}{b_{i} - a_{i}c'_{i-1}} & ; i = 2, 3, \dots, n-1 \end{cases} \qquad d'_{i} = \begin{cases} \frac{d_{i}}{b_{i}} & ; i = 1\\ \frac{d_{i} - a_{i}d'_{i-1}}{b_{i} - a_{i}c'_{i-1}} & ; i = 2, 3, \dots, n. \end{cases}$$
$$x_{n} = d'_{n}$$
$$x_{i} = d'_{i} - c'_{i}x_{i+1} \qquad ; i = n-1, n-2, \dots, 1.$$

Instructions:

- Any descriptive answer should be written at the top of the code. Use '%' to comment inside the code.
- Make Matlab script for each of the above problems and submit only the '.m' file in gradescope.
- The final code should run without any error. Sample inputs required for the code should be specified by yourself.
- Code will be checked manually. Checker will only hit run, and he/she will not provide any input during checking. Everything should be specified in each code.
- Please do not take the risk of copying or sharing your code with classmates. Code similarity will be checked.
- For any clarification feel free to comments on team under this assignment posted.
- No partial marks will be given unless you use the correct method for each question. For example, use of general Gaussian elimination method in question 3 will be entitled a zero mark.

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