Homework Assignments: HW # 4
CMSE 823: Numerical Linear Algebra

1. Read Lectures 7, 8, 9 and 10 in the textbook.

2. Given an arbitrary matrix $A \in C^{m,n}$, construct the QR decomposition by using the following three different procedures:

   (a) the classical Gram-Schmidt method;

   (b) the modified Gram-Schmidt method;

   (c) the Householder transform based method.

   You may implement these methods in Matlab. Each method should return Q and R matrices in a suitable format, where $Q \in C^{m,n}$ is a matrix with orthonormal columns, and $R \in C^{n,n}$ is an upper triangular matrix. Since later on we will use these methods for other purposes, please write these programs with a user friendly interface.

   In this project we are going to carry out some numerical comparisons for these three methods.

   Case 1. Let

$$Z = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 7 \\ 4 & 2 & 3 \\ 4 & 2 & 2 \end{pmatrix}$$

   Compute the three reduced QR decomposition of Z. You may also calibrate your results by using Matlab's built-in command $[Q, R] = qr(Z, 0)$. Compare these methods and comment on differences that you observe.

   Case 2. Let

$$A = \begin{pmatrix} 0.70000 & 0.70711 \\ 0.70001 & 0.70711 \end{pmatrix}$$

   Compute the three reduced QR decomposition of A. Check the orthogonality of the resulting Q by computing the matrix norm of the difference between $Q' * Q - I$. You may also calibrate your results by using Matlab's built-in command $[Q, R] = qr(A, 0)$. Compare these methods and comment on differences that you observe.

3. What to turn in: you should write a short description (README file) of how to run the codes that you have written and email a tar ball of all the files to He Lyu at **lyuhe@msu.edu**. To make your email indicate that it is a CMSE 823 project, please put "**823 Homework**" in the subject line.

Due date: Thursday, Feb. 6. In class