MATH 3423: Adv Linear Alg & Optimization
Homework 2

Let A be a (5 x 3) randomly generated matrix

$$A = \text{np.random.randint}(-2, 5, \text{size} = (5, 3))$$

with integer elements in the interval [-2, 5); and let b a (5 x 1) randomly generated vector

$$b = \text{np.random.randint}(-2, 3, \text{size} = (5, 1))$$

with integer elements in the interval [-2, 3).

1. Find the LU factorization of $A^T A$ and AA^T and use each factorization to solve:
   $A^T A x = A^T b$ and $AA^T x = b$.

2. Find the LDL^T factorization of $A^T A$ and AA^T and use each factorization to solve:
   $A^T A x = A^T b$ and $AA^T x = b$.

3. Find the $Cholesky$ factorization of $A^T A$ and AA^T and use each factorization to solve:
   $A^T A x = A^T b$ and $AA^T x = b$.

4. Find the eigenvalues and the corresponding eigenvectors of $A^T A$ and AA^T. Use the QR factorization to find the eigenvales and compare your answers!

5. Find the QR factorization of A, $A^T A$, and AA^T. Use these factorizations to solve:
   $Ax = b$, $A^T A x = A^T b$, and $AA^T x = b$.

▶ E-Mail All Your Work In One Jupyter Notebook!