MATH 3423: Adv Linear Alg & Optimization
$\boxed{\text{Test 1}}$

Let

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

and let

$$b = \text{np.random.randint}(10, \text{size}=(5)).$$

1. Find the QR Factorization of A and use it to solve $Ax = b$.

2. From the SVD Factorization of A find the Pseudo-Inverse A^+ and use it to solve $Ax = b$.

3. Find the Singular Values of A.
   [1 Point] What is the Rank of A?

4. Find the Eigenvalues and the corresponding Eigenvectors of $A^T A$.
   [1 Point] What do you know about the Eigenvalues of AA^T and why they are all real numbers?

5. Solve $A^T Ax = A^T b$ using the PLU Factorization.

6. Solve $A^T Ax = A^T b$ using the LDL^T Factorization.

7. Solve $A^T Ax = A^T b$ using the Cholesky Factorization.

8. Solve $A^T Ax = A^T b$ using the QR Factorization.

9. Solve $A^T Ax = A^T b$ using the SVD Factorization.

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