Reading assignments don’t have to be turned in.

1. **Reading assignment.** Finish reading chapters 4, 5 and 6 in Dym’s book.

2. **Reading assignment.** Read the proof of the Jordan decomposition theorem in the class notes. Make sure you can supply the missing details.

3. Verify that if $X$ diagonalizes
   \[
   \begin{pmatrix}
   1 + \epsilon & 1 \\
   0 & 1 - \epsilon
   \end{pmatrix},
   \quad
   0 < \epsilon < 0.5,
   \]
   then \( \|X\|_1 \|X^{-1}\|_1 = \kappa_1(X) \geq 1/(2\epsilon) \).

4. Show that there is no non-singular $X$ such that
   \[
   X \begin{pmatrix}
   \lambda & 1 \\
   0 & \lambda
   \end{pmatrix} X^{-1}
   \]
   is diagonal.

5. Let $L_{A,B}$ be the linear operator
   \[
   L_{A,B}(X) = AXB^H,
   \]
   where $A$, $B$ and $X$ are matrices of suitable sizes. Find the eigenvalues of $L_{A,B}$ in terms of the eigenvalues of $A$ and $B$.

6. Let $L_{A,B}$ be the linear operator
   \[
   L_{A,B}(X) = AX + XB^H,
   \]
   where $A$, $B$ and $X$ are matrices of suitable sizes. Find the eigenvalues of $L_{A,B}$ in terms of the eigenvalues of $A$ and $B$.

7. Show that the eigenvalues of $AB$ are the same as the eigenvalues of $BA$ except for some eigenvalues at 0. This is true even if $A$ and $B$ are not square matrices. **Hint:** This is a bit tricky. A famous short proof is available in the text book.