Problem 1. *A $n \times n$ matrix A has eigenvalues $0, 1, 2$. What is the possible rank of A? In which dimension A must be diagonalized? Is A invertible?*

Problem 2. *A diagonalized matrix A has the compact SVD $A = uv^T$ where $u, v \in \mathbb{R}^n$. Find its eigenvalues.*

Problem 3. *A diagonalized matrix A has eigenvalues $-1, 3$. What is the rank of $(A + I)(A - 3I)$?*

Problem 4. *A diagonalized matrix A satisfies $A^4 = I$, and A has three eigenvalues. What are the possible triples of eigenvalues?*

Problem 5. *Given a diagonalized invertible matrix A, $\exp(At)$ converges to a matrix as $t \to +\infty$. What is the limit matrix?*