1. Answer the following questions with "true" or "false."

   (a) If B is obtained from A by interchanging two rows, then B is similar to A.

   (b) If A and B are diagonalizable $n \times n$ matrices, then $A + B$ is diagonalizable.

   (c) If A and B are diagonalizable $n \times n$ matrices, then AB is diagonalizable.

   (d) If Q is a 3×3 orthgonal matrix with only 0 and 1 as entries, then $Q^3 = I$.

   (e) Let $\mathbf{v}_1$ and $\mathbf{v}_2$ be orthogonal, and let P be an orthogonal projection matrix for some vector space V. Then $P\mathbf{v}_1$ and $P\mathbf{v}_2$ are orthogonal.

2. Give matrices S and J such that $A = SJS^{-1}$ and J is in Jordan canonical form.

$$A = \begin{pmatrix} 2 & -1/2 & 1/2 \\ 1 & 0 & 0 \\ -1 & 1 & 1 \end{pmatrix}$$

3. Give matrices T and L such that $B = TLT^{-1}$ and L is in Jordan canonical form.

$$B = \begin{pmatrix} -3/2 & 3/2 & 0 \\ -15/2 & 3/2 & 0 \\ 25/4 & -3/4 & -2 \end{pmatrix}$$

4. Consider the matrix

$$C = \begin{pmatrix} 1 & a & \\ a & 1 & a \\ & a & 1 \end{pmatrix}.$$

   For which values of a is $\det C < 0$? For which values of a is C singular?

5. Give the orthogonal projection of e^x onto P_2 with respect to the inner product

$$\langle f, g \rangle = \int_0^1 f(x)\overline{g(x)}\, dx.$$