This homework has six (6) questions. Please answer each part as completely as possible. Unsupported work will receive no credit, and partially completed work will receive partial credit. You are encouraged to work together and refer to your notes and textbook, but all solutions must be written up independently. Good luck to you all!

1. *Bretscher* Section 2.1, Exercise 42.

2. The trace of a square matrix \[
\begin{bmatrix}
a & b \\
c & d
\end{bmatrix}
\] is the sum \(a + d\) of the diagonal entries. What can you say about the trace of a 2x2 matrix representing a projection? Reflection? Rotation?

3. Is rotation by angle \(\theta\) an invertible transformation of \(\mathbb{R}^2\)? If so, find the matrix representation of the inverse; if not, explain why not.

4. Is reflection across a line \(L\) through the origin an invertible transformation of \(\mathbb{R}^2\)? If so, find the matrix representation of the inverse; if not, explain why not.

5. Is projection onto a line \(L\) through the origin an invertible transformation of \(\mathbb{R}^2\)? If so, find the matrix representation of the inverse; if not, explain why not.

6. Find the matrix representation \(A\) for the linear transformation \(T_1 : \mathbb{R}^2 \to \mathbb{R}^2\) that rotates \(\mathbb{R}^2\) by \(\frac{\pi}{3}\) radians and the matrix representation \(B\) for the linear transformation \(T_2 : \mathbb{R}^2 \to \mathbb{R}^2\) that reflects \(\mathbb{R}^2\) across the horizontal axis. Compute the matrix products \(AB\) and \(BA\). Discuss why these products disagree from a geometrical perspective.