1. For each transformation $T : \mathbb{R}^2 \to \mathbb{R}^2$, find the corresponding matrix A.
   (a) T rotates by $\frac{\pi}{3}$ counter-clockwise and then reflects over the line $y = x$
   (b) T reflects over the line $y = x$ and then rotates by $\frac{\pi}{3}$ counter-clockwise
   (c) What is the image of $\mathbf{x} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$ under each transformation?

2. Let $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 0 \\ 3 & 4 \end{bmatrix}$, and $C = \begin{bmatrix} 2 & -4 \\ 3 & -6 \end{bmatrix}$
   (a) Compute AC and BC
   (b) What interesting property of matrix multiplication does this example demonstrate?

Let $A = \begin{bmatrix} 1 & 0 & 3 \\ 2 & 2 & 3 \\ 0 & 4 & -7 \end{bmatrix}$, $B = \begin{bmatrix} 3 & -2 & 4 \\ 7 & 12 & 8 \\ 16 & 2 & 3 \end{bmatrix}$, $E_1 = \begin{bmatrix} 1 & 0 & 0 \\ -2 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, $E_2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \frac{1}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Feel free to use *Mathematica* for these problems.

1. Find A^{-1} and B^{-1}
2. Compare the following products:

$$A^{-1}B^{-1}, \quad B^{-1}A^{-1}, \quad (AB)^{-1}, \quad (BA)^{-1}$$

3. Compare $(AB)^T$, A^TB^T, and B^TA^T
4. Find $\left(A^T\right)^{-1}$
5. Compare A, E_1A, and E_2E_1A