Exercise 5: Transformation Composition

Name:

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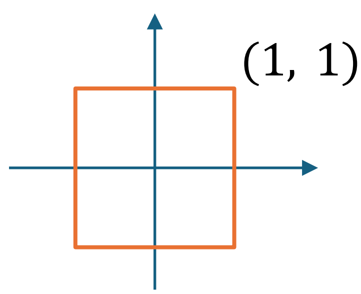
1. What transformation do these three matrices do?

$$M_1 = \begin{bmatrix} 0.5 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad M_2 = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 3 \\ 0 & 0 & 1 \end{bmatrix} \quad M_3 = \begin{bmatrix} \cos\frac{\pi}{4} & -\sin\frac{\pi}{4} & 0 \\ \sin\frac{\pi}{4} & \cos\frac{\pi}{4} & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

2. Assume you have a 2D square object. Initially the center of the square is at (0, 0), and the side length of the square is 2. We are applying a composited transformation $M_1 M_2 M_3$ (from question 1) to the square. Can you decompose this transformation into a sequence of local transformations and a sequence of global transformations? Draw diagrams to show the steps of decomposition similar to what I did in the lecture.



3. If we apply $M_1 * M_2$ from question 1 to the square described in question 2. What will be the final center of the rectangle after the transformation?

4. If we apply $M_2 * M_1$ from question 1 to the square described in question 2. What will be the final center of the rectangle after the transformation?

5. After a series of local transformations, the old local coordinate system of the object (bottom-left) is transformed to the new local coordinate system (top-right). Can you come up with a sequence of local transformations that have this result?