

# Matrix Multiplication as Composition

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Want to describe multiple transformations.

Like rotation and a shear

→ This is called a composition.  
in cummulation is

$$\underbrace{\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}}_{\text{SHEAR}} \left( \underbrace{\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}}_{\text{ROTATION}} \begin{bmatrix} x \\ y \end{bmatrix} \right) = \begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

The diagram shows a handwritten equation representing the composition of a shear and a rotation. The first matrix,  $\begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix}$ , is labeled "SHEAR" with a bracket underneath. It is multiplied by a second matrix,  $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$ , which is labeled "ROTATION" with a bracket underneath. The second matrix is applied to a column vector  $\begin{bmatrix} x \\ y \end{bmatrix}$ . Arrows point from the variables  $x$  and  $y$  to their respective positions in the vector. The result of the composition is a new matrix  $\begin{bmatrix} 1 & -1 \\ 1 & 0 \end{bmatrix}$  multiplied by the same vector  $\begin{bmatrix} x \\ y \end{bmatrix}$ .