Matrix multiplication $\begin{pmatrix} 3 \\ 4 \end{pmatrix}$

$\begin{pmatrix} 1 & 2 \end{pmatrix}$

$\begin{pmatrix} 3 \\ 4 \end{pmatrix}$

$\begin{pmatrix} 2 & -1 \\ 1 & 2 \end{pmatrix}$

$\begin{pmatrix} 3 & 3 & 4 \\ 4 & 6 & 6 \end{pmatrix}$

$\begin{pmatrix} 2 & -1 \\ 1 & 2 \end{pmatrix}$

Identity matrix (for multiplication)?

Reflection across x-axis

Reflection across y-axis

Find a 2 by 2 matrix for reflection across y=x

Find a 2 by 2 matrix for 90° rotation around the origin

Matrix for a rotation around the origin

1. start with complex numbers: $(x+iy)(\cos\theta + i \sin\theta)$
2. find a matrix that will do the same thing
3. check that it works for 90° and 180°

Composition of transformations / Multiplication of matrices

Right to left!

Not commutative!

It would be convenient if we could calculate translations using matrix multiplication

We can!

$$\begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$ pre-image

translation matrix

$$\begin{bmatrix} x+v \\ y+w \\ 1 \end{bmatrix}$$ image after translation by vector (v,w)

What would reflection in the x-axis look like as a 3 by 3 matrix?

Create a matrix for a dilation (center at the origin, scaling factor k)

Use matrix multiplication to rotate (1,2) 33° around (-2,-1)