

1. **Matrix multiplication:** Let

$$A = \begin{bmatrix} 1 & -1 \\ 3 & 2 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} 0 & 2 \\ -4 & 1 \end{bmatrix}.$$

What is  $AB$ ? What is  $BA$ ?

$$AB = \begin{bmatrix} 1 & -1 \\ 3 & 2 \end{bmatrix} \begin{bmatrix} 0 & 2 \\ -4 & 1 \end{bmatrix} = \begin{bmatrix} 4 & 1 \\ -8 & 8 \end{bmatrix}.$$

$$BA = \begin{bmatrix} 0 & 2 \\ -4 & 1 \end{bmatrix} \begin{bmatrix} 1 & -1 \\ 3 & 2 \end{bmatrix} = \begin{bmatrix} 6 & 4 \\ -1 & 6 \end{bmatrix}.$$

2. What is the dimension of a  $4 \times 2$  matrix times a  $2 \times 3$  matrix? Could you multiply them the other way around?

The “inner” dimensions (both 2 here) must match for matrix multiplication to be possible. The “outer” dimensions will be the dimensions of the multiplication result. So in this case, the result would be a  $4 \times 3$  matrix. We cannot multiply them the other way around.

3. **Rotate:** Let

$$\vec{y} = \begin{bmatrix} 0 \\ y \end{bmatrix}.$$

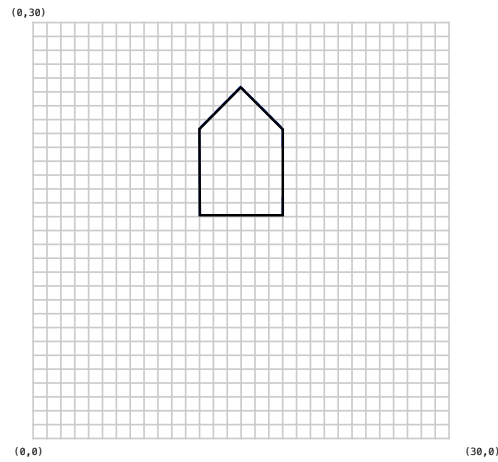
What are the new coordinates if  $\vec{y}$  is rotated  $\theta$  (counter-clockwise)?

$$\vec{y}' = \begin{bmatrix} -y \sin \theta \\ y \cos \theta \end{bmatrix}.$$

4. **Scale:** What scaling matrix could you use to get  $[2 \ 3]^T$  from  $[-5 \ 6]^T$ ?

$$\begin{bmatrix} -\frac{5}{2} & 0 \\ 0 & 2 \end{bmatrix} \begin{bmatrix} 2 \\ 3 \end{bmatrix} = \begin{bmatrix} -5 \\ 6 \end{bmatrix}$$

5. **Composition:** What transformations could we apply to the house below to rotate it 25 degrees about its center?



```
translate(15,20)
rotate(25 deg)
translate(-15,-20)
house()
```