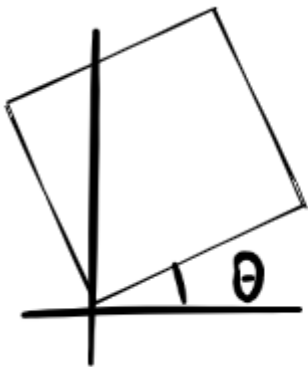# Transformation

## scale(缩放)

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

## shear(切变)



$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} 1 & a \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

## rotation(旋转)



$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} c\theta & -s\theta \\ s\theta & c\theta \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}$$

## homogeneous coordinates(齐次坐标)

(because translation is not linear transform)

affine map(仿射变换)= linear map + translation(平移) 👉 转换为齐次坐标

$$2D \quad P = \begin{pmatrix} x \\ y \\ 1 \end{pmatrix}$$

$$\begin{pmatrix} x' \\ y' \\ w' \end{pmatrix} = \begin{pmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} x \\ y \\ 1 \end{pmatrix} = \begin{pmatrix} x + t_x \\ y + t_y \\ 1 \end{pmatrix}$$

$$2D \quad V = \begin{pmatrix} x \\ y \\ 0 \end{pmatrix}$$

$$P - P = V \qquad P + V = P$$

$$V + V = V$$

**composing transforms**

**3D transformations**

同理