

## CH Tutorial - 6

1. A (4, 1)  
B (5, 2)  
C (4, 3)

(a) Reflection about x Axis

$$\text{Reflection Matrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$A' = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ 1 \\ 0 \end{bmatrix} = \begin{bmatrix} 4 \\ -1 \\ 0 \end{bmatrix} = (4, -1)$$

$$B' = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 5 \\ 2 \\ 1 \end{bmatrix} = \begin{bmatrix} 5 \\ -2 \\ 1 \end{bmatrix} = (5, -2)$$

$$C' = (4, -3)$$

(b) Reflection about  $y = -x$

$$\text{Reflection Matrix} = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$A' = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} -1 \\ -4 \\ 1 \end{bmatrix} = (-1, -4)$$

$$B' = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 5 \\ 2 \\ 1 \end{bmatrix} = \begin{bmatrix} -2 \\ -5 \\ 1 \end{bmatrix} = (-2, -5)$$

$$C' = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ 3 \\ 1 \end{bmatrix} = \begin{bmatrix} -3 \\ -4 \\ 1 \end{bmatrix} = (-3, -4)$$

③ Rotate it about origin by  $270^\circ$

Rotation Matrix  $R = \begin{bmatrix} \cos 270 & -\sin 270 & 0 \\ \sin 270 & \cos 270 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$$A' = \begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 1 \\ -4 \\ 1 \end{bmatrix} = (1, -4)$$

$$B' = RB = (2, -5)$$

$$C' = RC = (3, -4)$$

④  $Shx = 2$

Shearing Matrix  $S = \begin{bmatrix} 1 & 2 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$$A' = SA = \begin{bmatrix} 1 & 2 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 4 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 6 \\ 1 \\ 1 \end{bmatrix} = (6, 1)$$

$$B' = SB = S \begin{bmatrix} 5 \\ 2 \\ 1 \end{bmatrix} = \begin{bmatrix} 9 \\ 2 \\ 1 \end{bmatrix} = (9, 2)$$

$$C' = SC = S \begin{bmatrix} 4 \\ 3 \\ 1 \end{bmatrix} = \begin{bmatrix} 8 \\ 3 \\ 1 \end{bmatrix} = (8, 3)$$

⑤  $Shy = 1.5$  and  $x_{ref} = 2$

Shearing Matrix  $S = \begin{bmatrix} 1 & 0 & 0 \\ Shy & 1 & -Shy \times x_{ref} \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 1.5 & 1 & -3 \\ 0 & 0 & 1 \end{bmatrix}$

$$A' = SA = S \begin{bmatrix} 4 \\ 1 \\ 1 \end{bmatrix} = \begin{bmatrix} 4 \\ 4 \\ 1 \end{bmatrix} = (4, 4)$$