

#### 4-Reflection

If either the X or Y axis is treated as a mirror, the object has a mirror image or reflection. The reflected point Pnew is located the same distance from the mirror (the axis) as the original point P.

4-1:Reflection on the X axis

1	0	0
0	-1	0
0	0	1

OR  $X_{new} = X$   
 $Y_{new} = -Y$

4-2:Reflection on the Y axis

-1	0	0
0	1	0
0	0	1

OR  $X_{new} = -X$   
 $Y_{new} = Y$

4-3:Reflection on the origin

-1	0	0
0	-1	0
0	0	1

OR  $X_{new} = -X$   
 $Y_{new} = -Y$

4-4:Reflection on the line Y=X

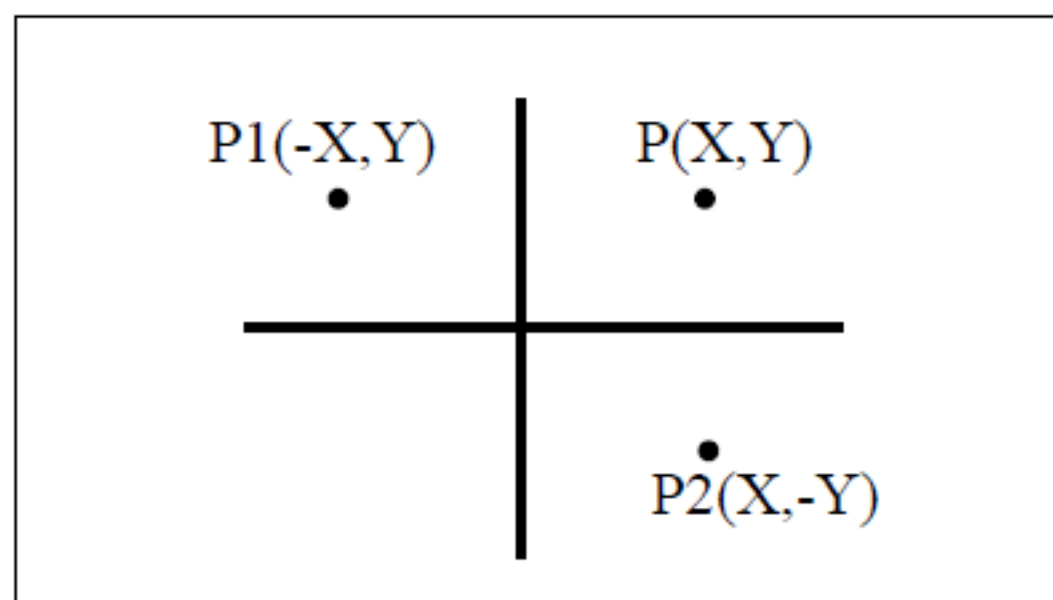
0	1	0
1	0	0
0	0	1

OR  $X_{new} = Y$   
 $Y_{new} = X$

4-5:Reflection on the line Y=-X

0	-1	0
-1	0	0
0	0	1

OR  $X_{new} = -Y$   
 $Y_{new} = -X$



Example 1: Reflect the point P(3,2) in :: a- X axis; b- Y axis;  
c-origin; d-line Y=X;

Solution : a-

$$\begin{bmatrix} 3 & 2 & 1 \end{bmatrix} * \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 3 & -2 & 1 \end{bmatrix}$$

b-

$$\begin{bmatrix} 3 & 2 & 1 \end{bmatrix} * \begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} -3 & 2 & 1 \end{bmatrix}$$

c-

$$\begin{bmatrix} 3 & 2 & 1 \end{bmatrix} * \begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

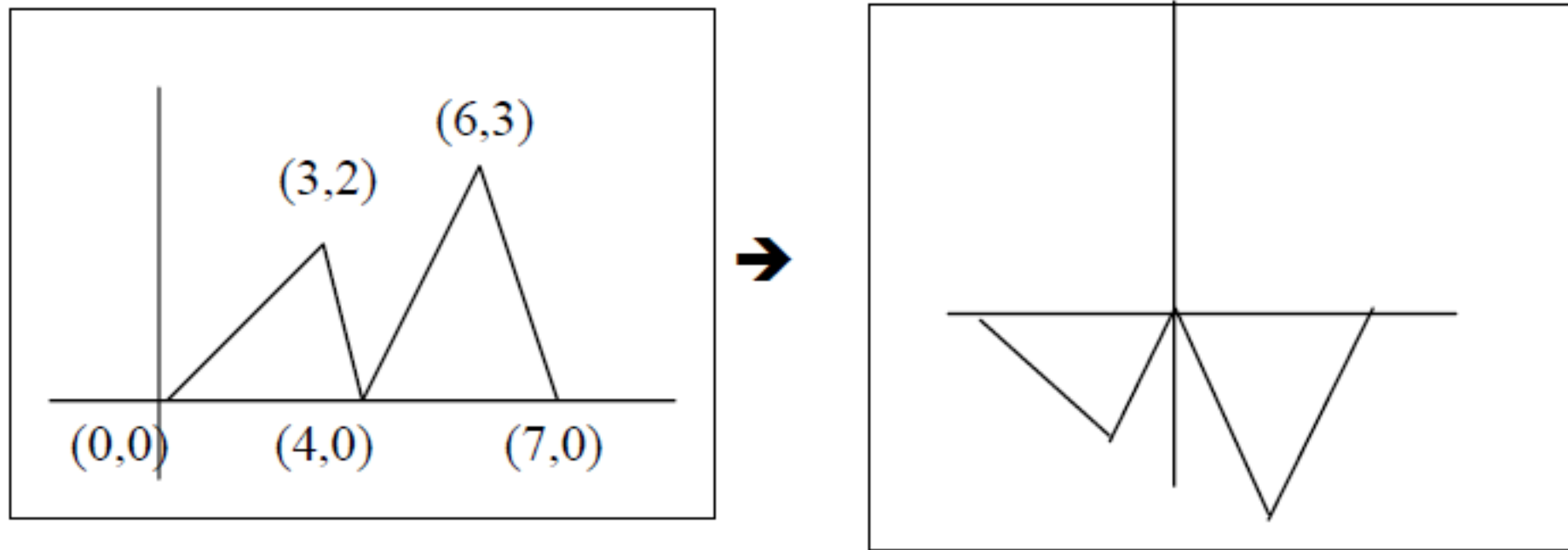
$$= \begin{bmatrix} -3 & -2 & 1 \end{bmatrix}$$

d-

$$\begin{bmatrix} 3 & 2 & 1 \end{bmatrix} * \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 3 & 1 \end{bmatrix}$$

Example 2: What (3\*3) matrix will change the center of the scene to the origin, and reflect the mountains in the lake? [the center of the scene is (4,0) ]



Solution:

First: Translate by  $TX = -4$

1	0	0
0	1	0
-4	0	1

Second: Reflection on X axis

1	0	0
0	-1	0
0	0	1

Now multiply the two matrices :

1	0	0	*	1	0	0
0	1	0		0	-1	0
-4	0	1		0	0	1

The single matrix that perform Translation and Reflection is



1	0	0
0	-1	0
-4	0	1

0	0	1	*	1	0	0	=	-4	0	1
3	2	1		0	-1	0		-1	-2	1
4	0	1		0	0	1		0	0	1
6	3	1		-4	0	1		2	-3	1
7	0	1						3	0	1