



Biyani Institute of Science and Management
I Internal Examination Sept. 2019
MCA (III Semester)



Subject- Computer Graphics

MM: 20

Set:B Answer Key

Time: 1 ½Hrs

[I] Answer the following questions in one line only (2*1=2)

Q.1 Write rotational transformation equation in clock wise direction in matrix form.

Ans: $x_n = x \cos a + y \sin a$

$y_n = -x \sin a + y \cos a$

Q.2 What do you mean by scaling.

Ans: Scaling means change in size.

[II] Answer the following questions in 50 words (2*3=6)

Q.1 Rotate a triangle whose corners are (10,20),(30,20)and (20,40) by 90 degree.

Ans: $x_n = -y$

$y_n = x$

X	y	x_n	y_n
10	20	-20	10
30	20	-20	30
20	40	-40	20

Q.2 Write properties of scale transformation.

Ans:

- 1.If $s_x = s_y = 1$ then no change
- 2.If $s_x = s_y$ then uniform change
- 3.If $s_x > 1$ and $s_y > 1$ then object enlarge
4. If $s_x < 1$ and $s_y < 1$ then object reduce

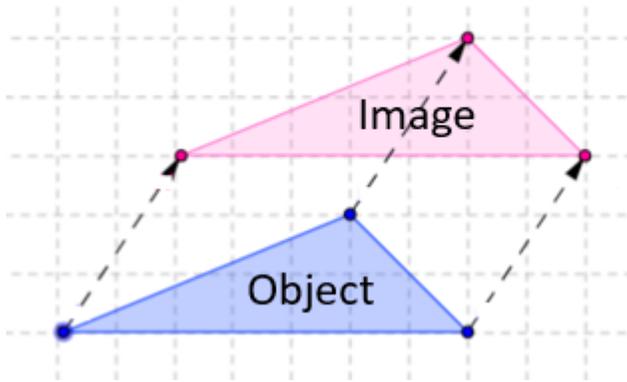
[III] Answer the following questions in 150 words. (2*6=12)

Q.1 What is translation transformation? Explain in detail with example and also write its properties.

Ans: In a translation transformation all the points in the object are moved in a straight line in the same direction. The size, the shape and the orientation of the image are the same as that of the original object. Same orientation means that the object and image are facing the same direction.

Example:

Translation

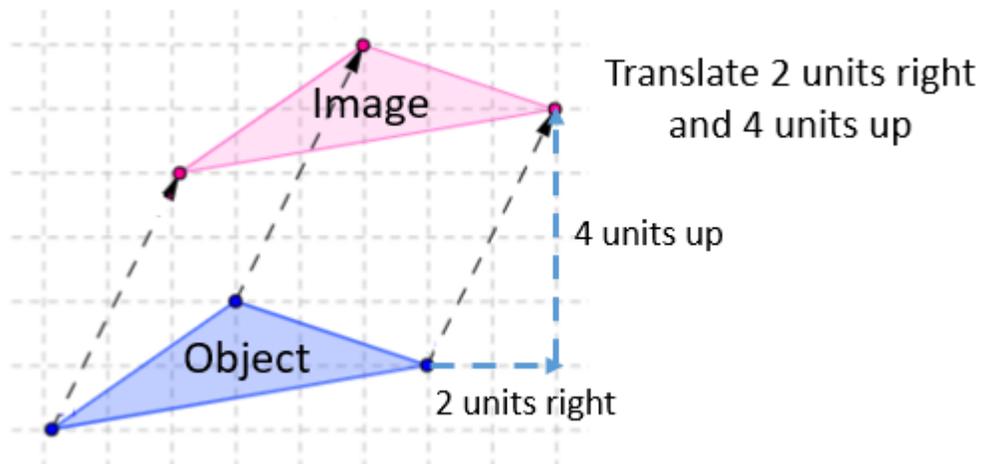


Every point in the object is moved the same direction and the same distance to form the image

We describe a translation in terms of the number of units moved to the right or left and the number of units moved up or down.

Example:

Move the object 2 units to the right and 4 units up.



The translation can be represented by a column vector as .

The top number represents the right and left movement. A positive number means moving to the right and a negative number means moving to the left.

The bottom number represents up and down movement. A positive number means moving up and a negative number means moving down.

In the following figure, triangle ABC is being translated to triangle $A'B'C'$.

The translation is represented by the column vector .

In general, a translation can be represented by a **column matrix or column vector** where a is the number of units to move right or left along the x -axis and b is the number of units to move up or down along the y -axis.

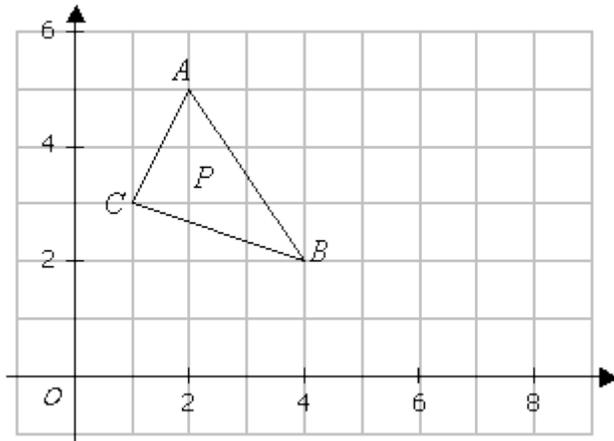
The matrix equation representing a translation is:

$$\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} a \\ b \end{pmatrix}$$

where $\begin{pmatrix} a \\ b \end{pmatrix}$ is the translation matrix and $\begin{pmatrix} x' \\ y' \end{pmatrix}$ is the image of $\begin{pmatrix} x \\ y \end{pmatrix}$.

Example:

The triangle P is mapped onto the triangle Q by the translation $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$.



- Find the coordinates of triangle Q .
- On the diagram, draw and label triangle Q .

Solution:

a)

$$A' = \begin{pmatrix} 2 \\ 5 \end{pmatrix} + \begin{pmatrix} 4 \\ -1 \end{pmatrix} = \begin{pmatrix} 6 \\ 4 \end{pmatrix}$$

$$B' = \begin{pmatrix} 4 \\ 2 \end{pmatrix} + \begin{pmatrix} 4 \\ -1 \end{pmatrix} = \begin{pmatrix} 8 \\ 1 \end{pmatrix}$$

$$C' = \begin{pmatrix} 1 \\ 3 \end{pmatrix} + \begin{pmatrix} 4 \\ -1 \end{pmatrix} = \begin{pmatrix} 5 \\ 2 \end{pmatrix}$$

Q.2 Explain reflection transformation and all its cases in detail with example.

Ans: In a reflection transformation, all the points of an object are reflected or flipped on a line called the axis of reflection or line of reflection.

A reflection is a transformation that acts like a mirror: It swaps all pairs of points that are on exactly opposite sides of the line of reflection.

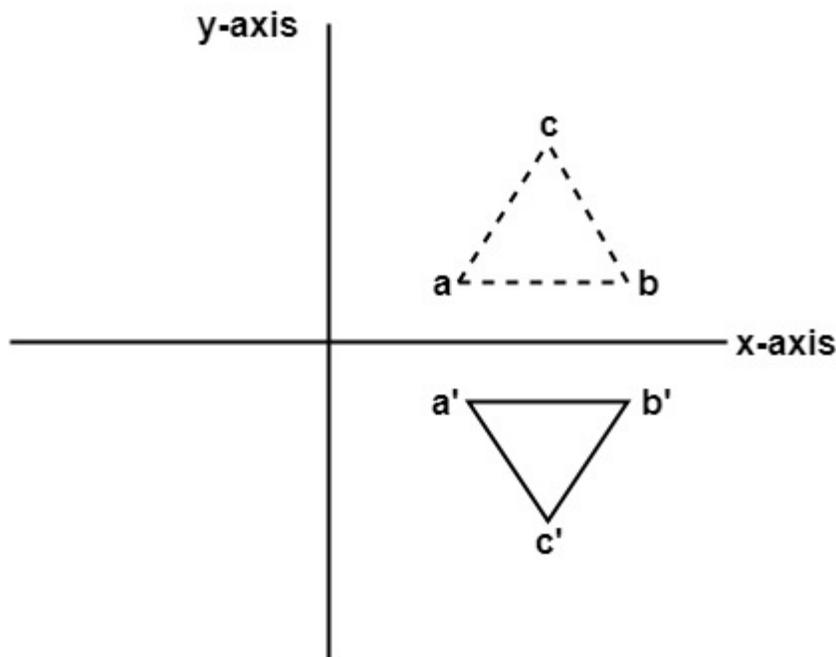
Reflection types:

1. Reflection about the x-axis
2. Reflection about the y-axis
3. Reflection about an axis perpendicular to xy plane and passing through the origin
4. Reflection about line $y=x$

1. Reflection about x-axis: The object can be reflected about x-axis with the help of the following matrix

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

In this transformation value of x will remain same whereas the value of y will become negative. Following figures shows the reflection of the object axis. The object will lie another side of the x-axis.

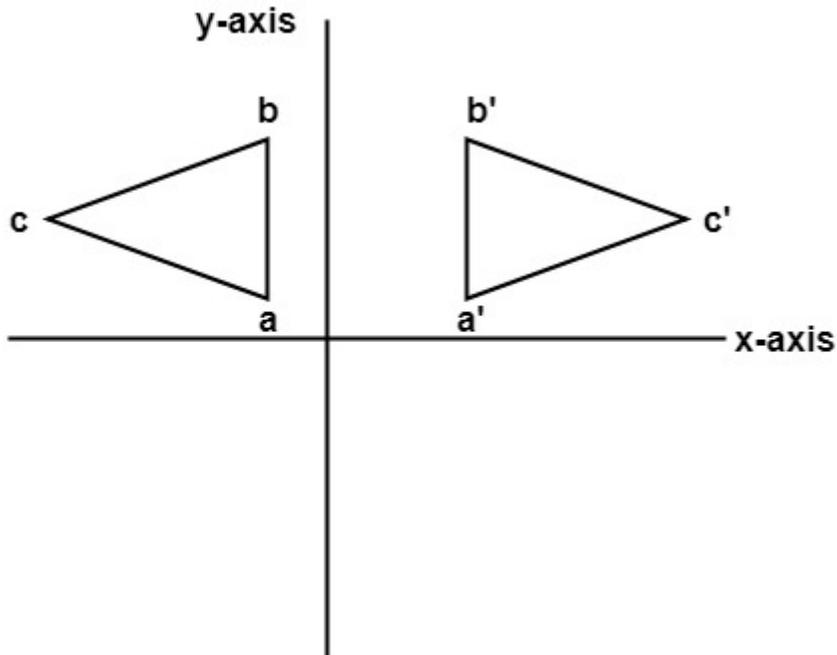


2. Reflection about y-axis: The object can be reflected about y-axis with the help of following transformation matrix

$$\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

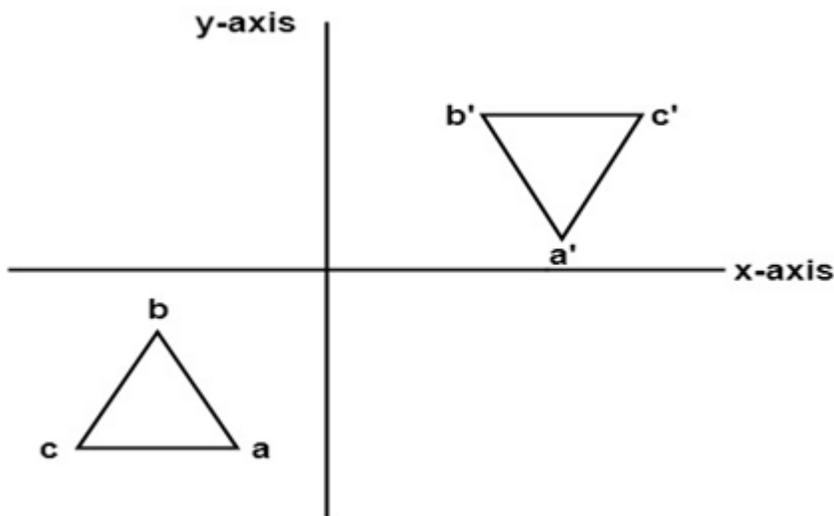
Here the values of x will be reversed, whereas the value of y will remain the same. The object will lie another side of the y-axis.

The following figure shows the reflection about the y-axis



3. Reflection about an axis perpendicular to xy plane and passing through origin:
 In the matrix of this transformation is given below

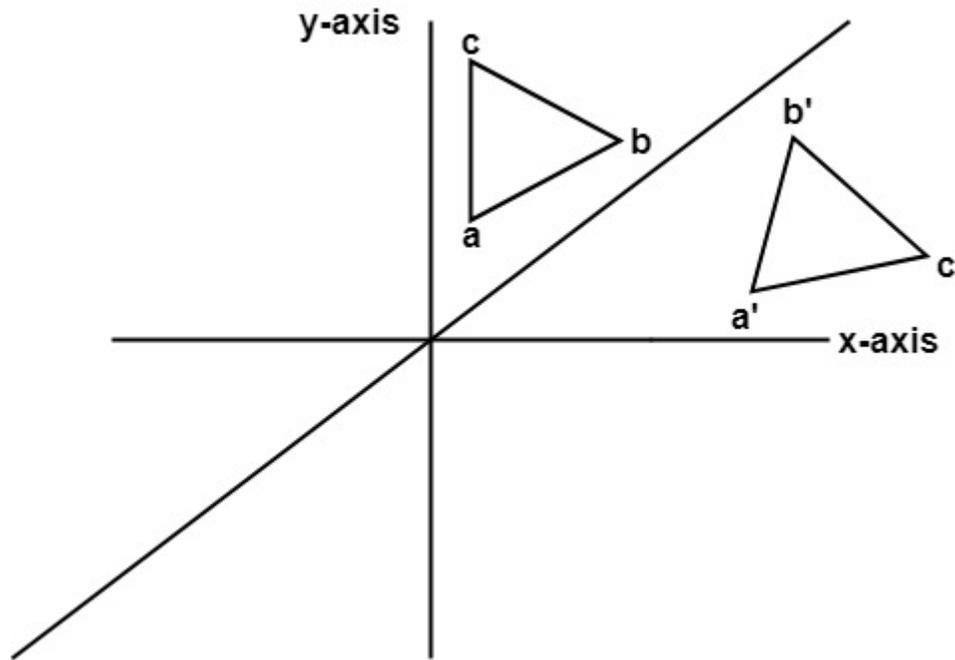
$$\begin{bmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$



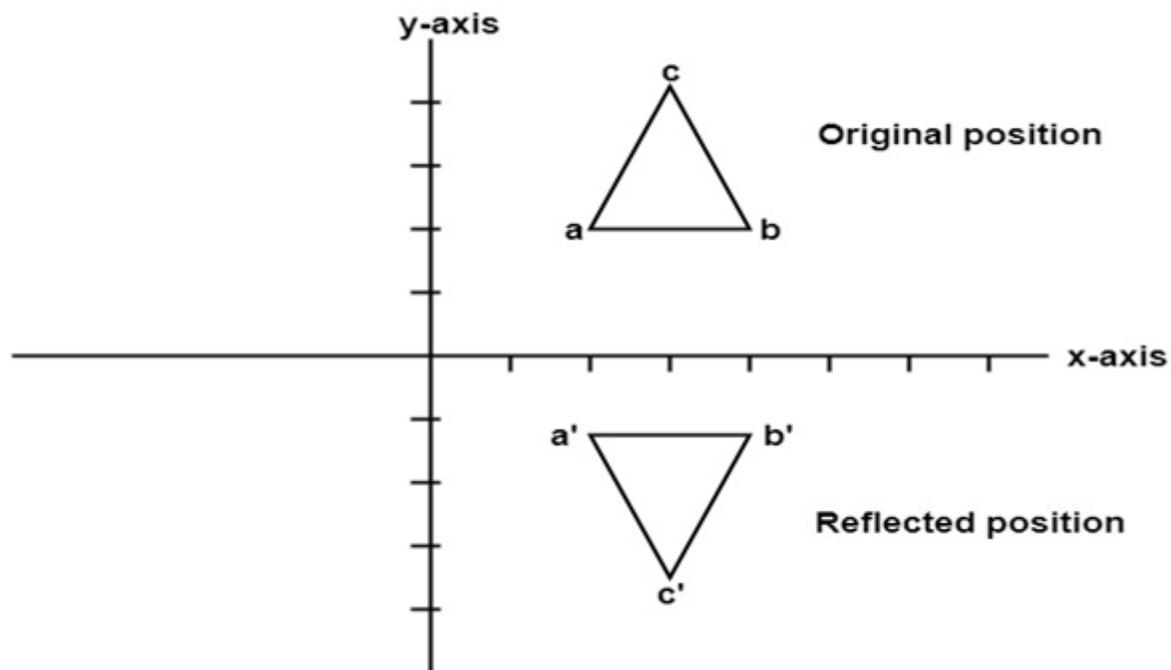
In this value of x and y both will be reversed. This is also called as half revolution about the origin.

4. Reflection about line $y=x$: The object may be reflected about line $y = x$ with the help of following transformation matrix

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$



First of all, the object is rotated at 45° . The direction of rotation is clockwise. After it reflection is done concerning x-axis. The last step is the rotation of $y=x$ back to its original position that is counterclockwise at 45° .



The matrix for reflection about x axis $\begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$