Introduction of Transformations

Computer Graphics provide the facility of viewing object from different angles. The architect can study building from different angles i.e.

1. Front Evaluation

2. Side elevation

3. Top plan

A Cartographer can change the size of charts and topographical maps. So if graphics images are coded as numbers, the numbers can be stored in memory. These numbers are modified by mathematical operations called as Transformation.

The purpose of using computers for drawing is to provide facility to user to view the object from different angles, enlarging or reducing the scale or shape of object called as Transformation.

Two essential aspects of transformation are given below:

1. Each transformation is a single entity. It can be denoted by a unique name or symbol.

2. It is possible to combine two transformations, after connecting a single transformation is obtained, e.g., A is a transformation for translation. The B

transformation performs scaling. The combination of two is C=AB. So C is obtained by concatenation property.

There are two complementary points of view for describing object transformation.

1. **Geometric Transformation:** The object itself is transformed relative to the coordinate system or background. The mathematical statement of this viewpoint is defined by geometric transformations applied to each point of the object.

2. **Coordinate Transformation:** The object is held stationary while the coordinate system is transformed relative to the object. This effect is attained through the application of coordinate transformations.

An example that helps to distinguish these two viewpoints:

The movement of an automobile against a scenic background we can simulate this by

o Moving the automobile while keeping the background fixed-(Geometric Transformation)

o We can keep the car fixed while moving the background scenery-(Coordinate Transformation)

Types of Transformations:

1. Translation

2. Scaling

3. Rotating

4. Reflection

5. Shearing

Translation

It is the straight line movement of an object from one position to another is called Translation. Here the object is positioned from one coordinate location to another.

Translation of point:

To translate a point from coordinate position (x, y) to another $(x_1\ y_1)$, we add algebraically the translation distances T_x and T_y to original coordinate.

$x_1 = x + T_x$

$y_1 = y + T_y$

The translation pair (T_x, T_y) is called as shift vector.

Translation is a movement of objects without deformation. Every position or point is translated by the same amount. When the straight line is translated, then it will be drawn using endpoints.

For translating polygon, each vertex of the polygon is converted to a new position. Similarly, curved objects are translated. To change the position of the circle or ellipse its center coordinates are transformed, then the object is drawn using new
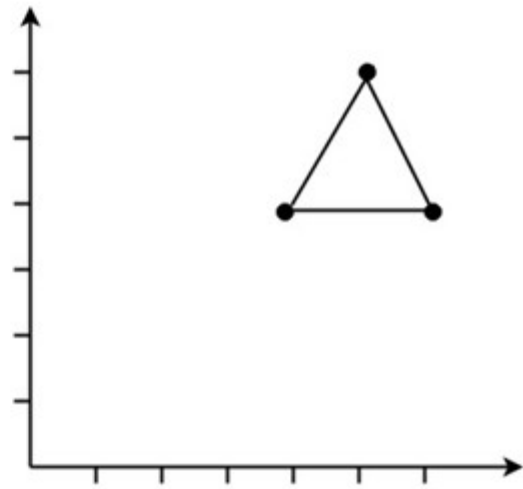
coordinates. Let P is a point with coordinates (x, y). It will be translated as (x^1 y^1).
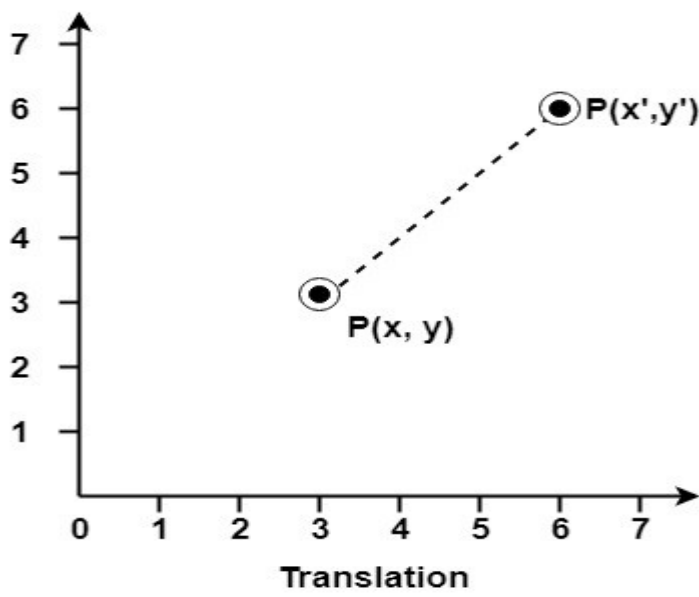
Translation

Translation of Polygon
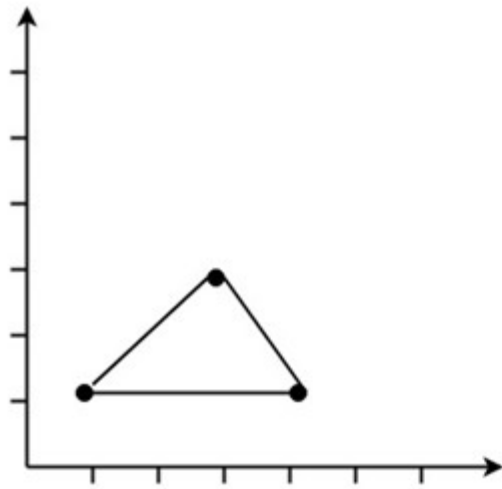
Original Position

Polygon after Translation

Matrix for Translation:

$$\begin{vmatrix} 1 & 0 & 1 \\ 0 & 1 & 0 \\ t_x & t_y & 1 \end{vmatrix} \quad \text{Or} \quad \begin{vmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{vmatrix}$$