# UNIT 2

Chapter 1: 2D Transformation

* **INTRODUCTION TO TRANSFORMATION**

In computer graphics we often require to transform the coordinates of an object (position, orientation and size). One can view object transformation in two complementary ways:

(i) **Geometric transformation**: Object transformation takes place in relatively stationary coordinate system or background.

(ii) **Coordinate transformation**: In this view point, coordinate system is transformed instead of object.

On the basis of preservation, there are three classes of transformation

· **Rigid body**: Preserves distance and angle. Example –translation and rotation

· **Conformal**: Preserves angles. Example- translation, rotation and uniform scaling

· **Affine**: Preserves parallelism, means lines remains lines.

Example- translation, rotation, scaling, shear and reflection

In general there are four attributes of an object that may be transformed

(i) Position (translation)

(ii) Size (scaling)

(iii)Orientation (rotation)

(iv) Shapes (shear)

(v)Objects (Reflection)

* **TRANSFORMATION MATRIX**
* Transformation matrix is a basic tool for transformation.
* A matrix with n m dimensions is multiplied with the coordinate of objects. Usually 3 3 or 4 4 matrices are used for transformation.
* For example consider the following matrix for rotation operation



**TYPES OF TRANSFORMATION IN TWO –DIMENSIONAL GRAPHICS**

In 2D transformations, only planar coordinates are used. For this purpose a 2x2 transformation matrix is utilized. In general,

2D transformation includes following types of transformations:

I. Identity transformation

II. Scaling

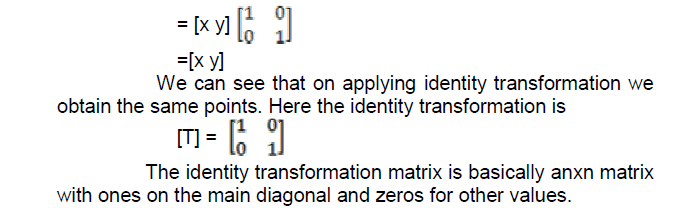
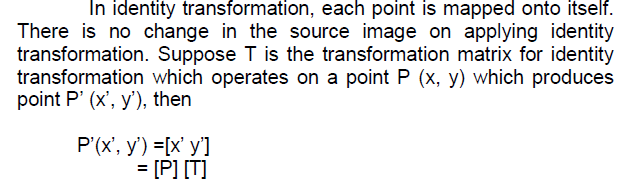
III. Reflection

IV. Shear transformation

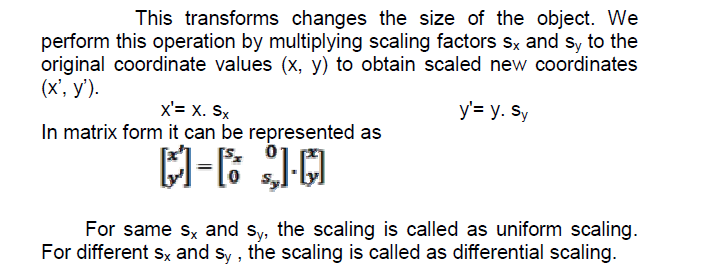
V. Rotation

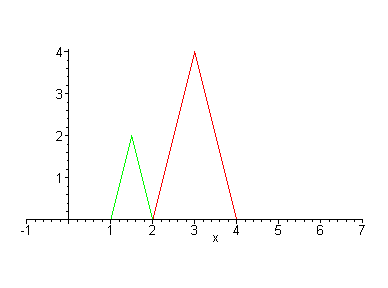
VI. Translation

* **IDENTITY TRANSFORMATION**



* **SCALING TRANSFORMATION**





1. **Scaling in X direction**

* Consider a case where

Scaling factor in x direction is given by

Transformation point

y]

1. **Scaling in Y direction**

* Consider a case where 1

Scaling factor in y direction is given by

Transformation point

ySy]

1. **Scaling in X and Y both direction**

* Consider a case where

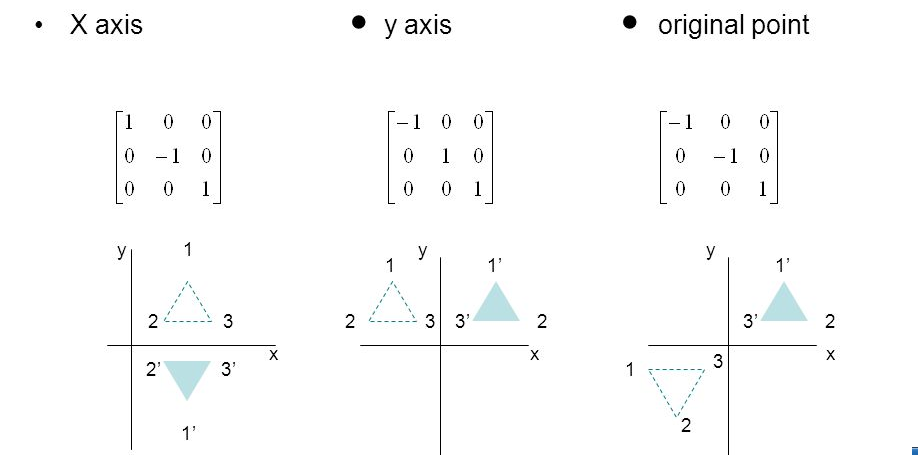
Scaling factor in x and y direction is given by

Transformation point

ySy]

Sy

* **REFLECTION TRANSFORMATION**
* Reflection is a transformation that converts each point in the plane to its mirror image with respect to the plane in space.



1**.Reflection about X axis**

* Consider a case where

Reflection transformation matrix is given by

Transform point is given by (x’ y’)=P’[x’ y’]

=[P]



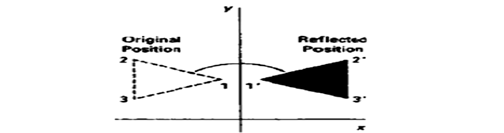
**2.Reflection about Y axis**

* Consider a case where

Reflection transformation matrix is given by

Transform point is given by (x’ y’)= P’[x’ y’]

= [P]



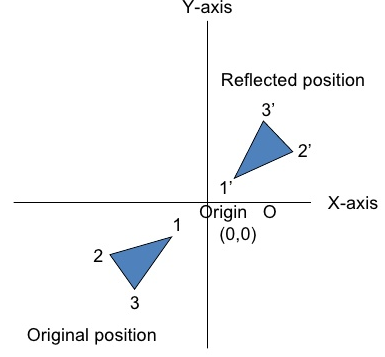
**3.Reflection about origin**

* Consider a case where

Reflection transformation matrix is given by

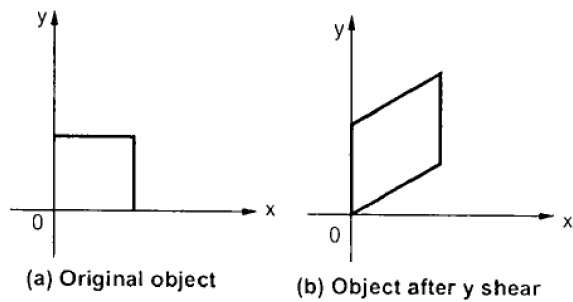
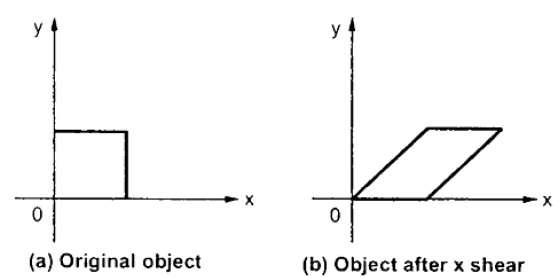
Transform point is given by (x’ y’)=P’[x’ y’]

=[P]



* **SHEAR TRANSFORMATIONS**
* shearing is a deformation of an object in which parallel phases remain parallel but are shifted in a direction parallel to them.

Where Shx and Shy are shearing factors.



**1.Shearing in positive X direction**

* Consider a case

=

**2. Shearing in negative X direction**

* Consider a case

=

**3.Shearing in positive Y direction**

* Consider a case

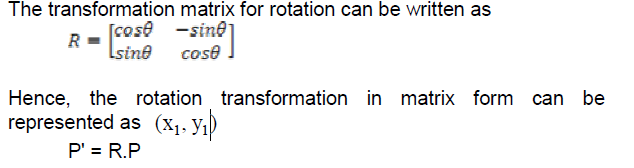
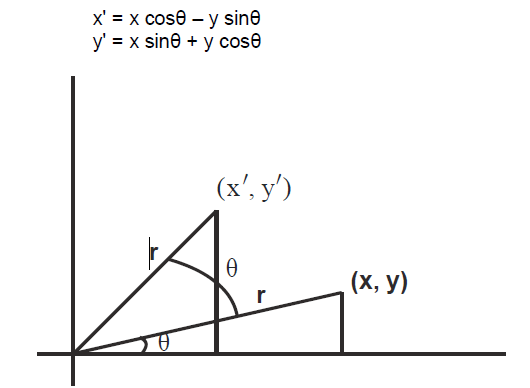
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**4.Shearing in negative Y direction**

* Consider a case

=

* **ROTATION TRANSFORMATION**
* Rotation can be performed in two ways: about origin or about an arbitrary point called as rotation point or pivot point.



Let point P (x, y) be any point in the co-ordinate system which makes an angle with x axis. Let point P(x, y) be rotated by an angle of to point P’(x’, y’). the distance of the point P and P’ from the origin be radius(r).

In

---------------equ 1

---------------equ 2

In

Y’…….from eqa 1 and 2

x’…….from eqa 1 and 2

Where.

Anticlock wise direction

clock wise direction

* **TRANSLATION TRANSFORMATION**

