Transformation

Transformation is the process by which we can change the shape, Size, position and direction of any object.
Two way of Transformation:

- ❖ Geometric Transformation
- ❖ Co-ordinate Transformation

Geometric Transformation: Object is transformed but co-ordinate is not transformed.
There are five types also:

- ❖ Translation
- ❖ Scaling
- ❖ Rotation
- ❖ Mirror reflection

Translation

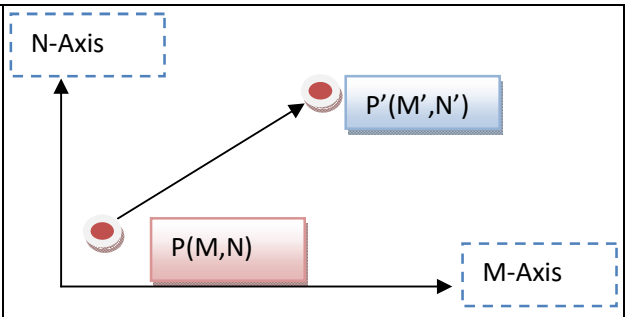
An object is displaced a given distance & direction from its original position.

from this figure, you can write that

New Point : P'(M',N')
Original Point : P(M,N)
Where $M'=M+T_M$,$N'=N+T_N$

We can write it as −

P' = P + T



Example : In 2-D previous point are required as new point are (12,6) and translation vector is 3i+4j.

Answer:

New Object : (12,6)

Changes: (3,4)

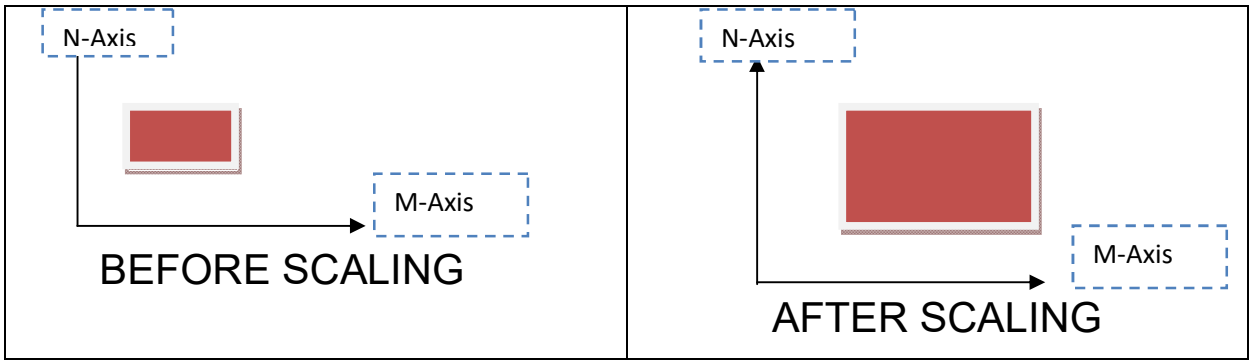
i.e. M'==12,N'=6,T_M=3,T_N=4

M'=M+T_M,M=9

N'=N+T_N,N=2

Scaling

- Process of changing the size.
- Process of expending or composing of an object.



The original coordinates: M, N

The scaling factors are (S_M, S_N)

The produced coordinates are M′, N′.

This can be mathematically represented as −

M' = M. S_M and N' = N. S_N

Example : Given a square object with coordinate points A(0, 4), B(4, 4), C(4, 0), D(0, 0). Apply the scaling parameter 3 towards M axis and 4 towards N axis and obtain the new coordinates of the object.

Answer-

Given-

- Original coordinates of the square = A (0, 4), B(4, 4), C(4, 0), D(0, 0)
- Scaling factor along M axis = 3
- Scaling factor along N axis = 4

For Coordinates A(0, 4)

Applying the scaling equations, we have-

M' = M. S_M = 0 x 3 = 0

N' = N. S_N = 4 x 4 = 16

Thus, New coordinates of corner A after scaling = (0, 16).

For Coordinates A(4, 4)

Applying the scaling equations, we have-

M' = M. S_M = 4 x 3 = 12

N' = N. S_N = 4 x 4 = 16

Thus, New coordinates of corner A after scaling = (12, 16).

For Coordinates A(4, 0)

Applying the scaling equations, we have-

M' = M. S_M = 4 x 3 = 12

N' = N. S_N = 4 x 0 = 0

Thus, New coordinates of corner A after scaling = (12, 0).

For Coordinates A(0, 0)

Applying the scaling equations, we have-

M' = M. S_M = 0 M 3 = 0

N' = N. S_N = 0x 4 = 0

Thus, New coordinates of corner A after scaling = (0, 0).

Thus, New coordinates of the square after scaling = A (0,16), B(12, 16), C(12, 0), D(0, 0).

Rotation

Object is rotated Ø about origin Ø positive for counterclockwise otherwise negative.

The original coordinate P (M,N) as-

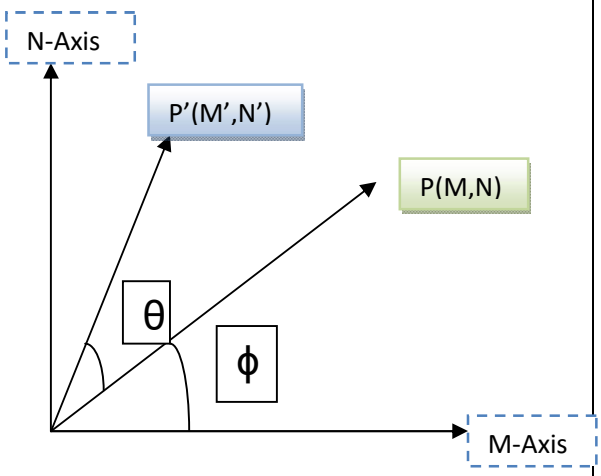
$$M=r\cos\phi$$
$$N=r\sin\phi$$

New co-ordinate point P' (M′,N′) as−

$$M'=r\cos(\phi+\theta)=r\cos\phi\cos\theta-r\sin\phi\sin\theta....(1)$$
$$N'=r\sin(\phi+\theta)=r\cos\phi\sin\theta+r\sin\phi\cos\theta.....(2)$$

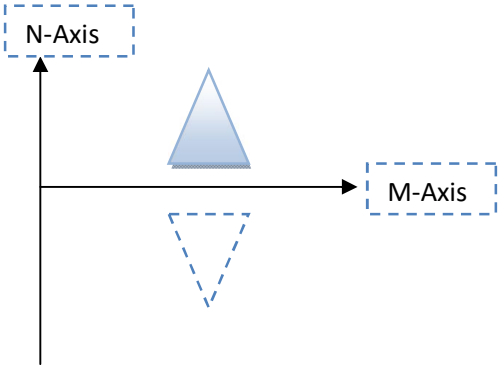
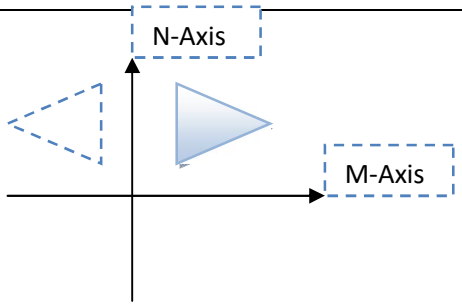
Calculate equation 3 and 4 , we will get

$$M'=M\cos\theta-N\sin\theta$$
$$N'=M\sin\theta+N\cos\theta$$



Mirror Reflection

- In this reflection the size of the object does not change.
- The mirror image can be either about M-axis or N-axis.

About M-aixs: Original point : M,N New reflected point : M',N' M'=M N'=-N	
About N-aixs: Original point : M,N New reflected point : M',N' M'=-M N'=N	

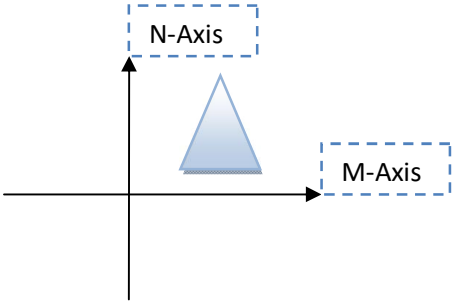
Composite Transformation

- Performing more than one transformation can be combined.
- This process of combining is called concatenation.
- Example :Suppose we want to perform rotation about an arbitrary point, then we can perform it by the sequence of three transformations

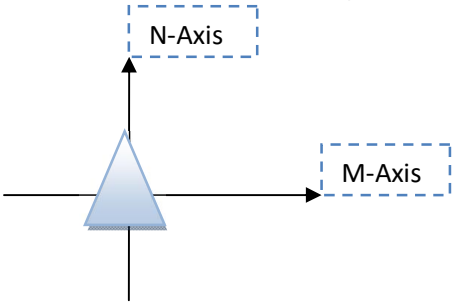
1. Translation
2. Rotation
3. Reverse Translation

Example: the sequence of three transformations

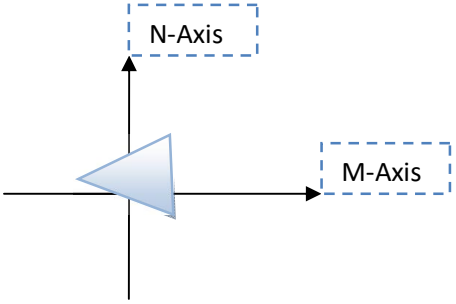
(a) Original position of object.



(b) Object Translate to origin.



(c) Object rotation to origin.



(d) Object retranslated to original position.