Aim: To implement 2D Transformations: Translation, Scaling, Rotation.

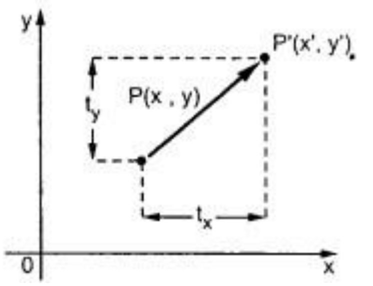
Objective:

To understand the concept of transformation, identify the process of transformation and application of these methods to different object and noting the difference between these transformations.

Theory:

1) Translation –

Translation is defined as moving the object from one position to another position along straight line path. We can move the objects based on translation distances along x and y axis. tx denotes translation distance along x-axis and ty denotes translation distance along y axis.



Consider (x,y) are old coordinates of a point. Then the new coordinates of that same point (x',y') can be obtained as follows:

x' = x + tx

y' = y + ty

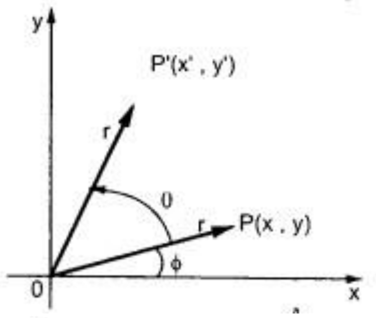
We denote translation transformation as P. we express above equations in matrix form as:

P' = P + T , where

$$P = \begin{bmatrix} x \\ y \end{bmatrix} \quad P' = \begin{bmatrix} x' \\ y' \end{bmatrix} \quad T = \begin{bmatrix} t_x \\ t_y \end{bmatrix}$$

2) Rotation –

A rotation repositions all points in an object along a circular path in the plane centered at the pivot point. We rotate an object by an angle theta. New coordinates after rotation depend on both x and y.



$$x' = x\cos\theta - y\sin\theta$$
$$y' = x\sin\theta + y\cos\theta$$

The above equations can be represented in the matrix form as given below

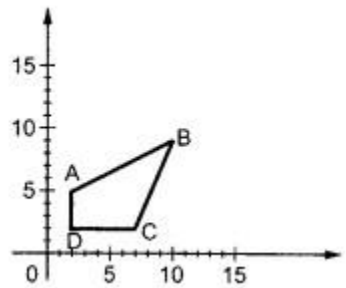
$$[x' \;\; y'] = [x \;\; y]\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$
$$P' = P \cdot R$$

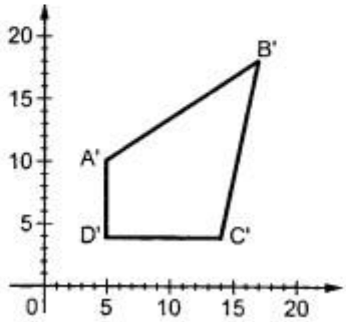
where R is the rotation matrix and it is given as

$$R = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$$

3) Scaling -

scaling refers to changing the size of the object either by increasing or decreasing. We will increase or decrease the size of the object based on scaling factors along x and y-axis.





If (x, y) are old coordinates of object, then new coordinates of object after applying scaling transformation are obtained as: x' = x * Sx y' = y * Sy

Sx and Sy are scaling factors along x-axis and y-axis. we express the above equations in matrix form as:

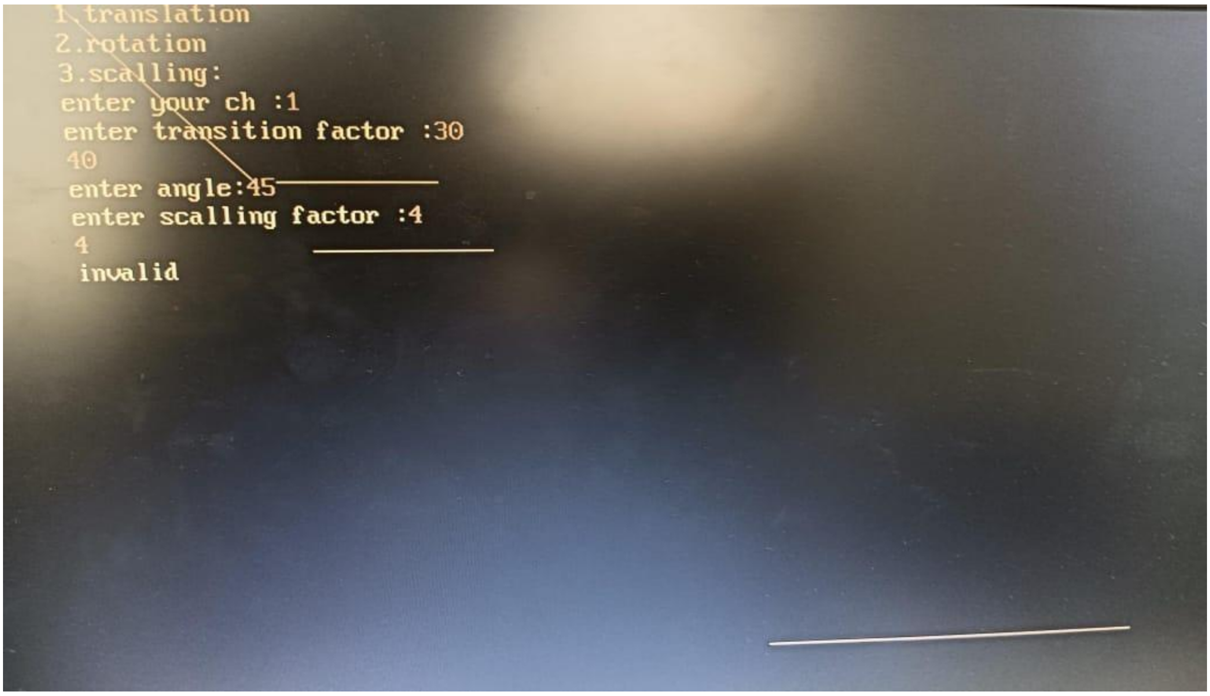
$$[x' \ y'] = [x \ y]\begin{bmatrix} S_x & 0 \\ 0 & S_y \end{bmatrix}$$
$$= [x \cdot S_x \quad y \cdot Sy]$$
$$= P \cdot S$$

Program:

```
#include<stdio.h>
#include<conio.h>
#include<graphics.h>
void main()
{
int
gd=DETECT,t,r,gm,ch,sx,sy,tx,ty,nx1,nx2,ny1,ny2;
initgraph(&gd,&gm,""); line(100,100,200,100);
printf("1.translation,2.rotation,3.scalling:");
printf("enter your ch :"); scanf ("%d",&ch);
switch(ch) { case 1:printf("enter transition factor :");
scanf("%d %d",&tx,&ty); nx1=100+tx; nx1=100+ty;
nx2=200+tx; nx2=100+ty; line(nx1,ny1,nx2,ny2);
getch() case 2:printf("enter angle:"); scanf("%lf",r);
t=(3.14*r)/180; nx1=(int)(100+(100*cos(t)-(0));
ny1=(int)(100+(100*sin(t)-(0));
line(100,100,nx1,ny1); getch(); case 3:printf("enter
scalling factor :"); scanf("%d %d",&sx,&sy);
nx1=100*sx; nx1=100*sy; nx2=200*sx;
nx2=100*sy;

line(nx1,ny1,nx2,ny2);
getch();
default:printf("invalid");
} getch();
closegraph()
;
}
```

Output:



Conclusion: Comment on :

1. Application of transformation
2. Difference noted between methods
3. Application t different object