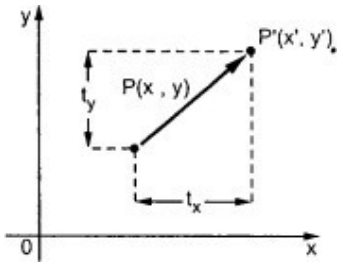
Aim: To implement 2D Transformations: Translation, Scaling, Rotation.

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 denotestranslation 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

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

Program:

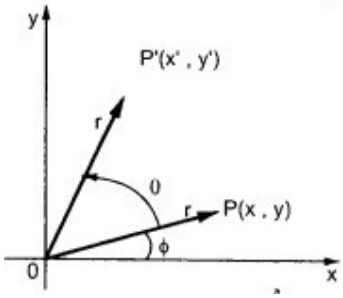
```
#include<stdio.h>
#include<conio.h>
#include<graphics.h>
#include<math.h>

void main()
{
int gd =DETECT,gm,ch,sx,sy,tx,ty,nx1,nx2,ny1,ny2;
double r,t;
```

```
initgraph(&gd,&gm,"C:\\TURBOC3\\BGI");
line(100,100,200,100);
printf("Transition ");

 printf("enter trans factor \n");
    scanf("%d%d",&tx,&ty);
    nx1=100+tx;
    ny1=100+ty;
    nx2=200+tx;
    ny2=100+ty;
    line(nx1,ny1,nx2,ny2);
    getch();
    closegraph();
}
```

Output –

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

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

Program:

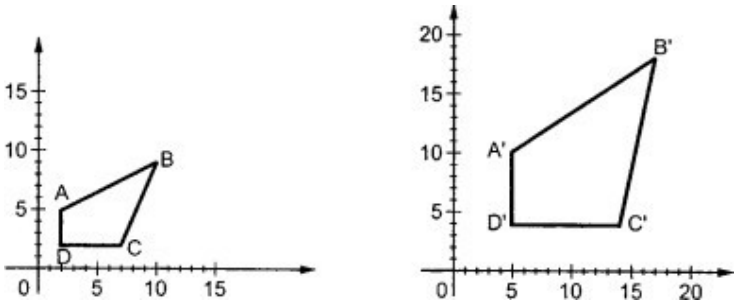
```
#include<stdio.h>
#include<conio.h>
#include<graphics.h>
#include<math.h>

void main()
{
int gd =DETECT,gm,ch,sx,sy,tx,ty,nx1,nx2,ny1,ny2;
double r,t;
initgraph(&gd,&gm,"C:\\TURBOC3\\BGI");
line(100,100,200,100);
printf("Rotation ");

 printf("enter angle");
   scanf("%lf",&r);
   t=(3.14*r)/180;
   nx1=(int)(100+(200-100)*cos(t)-(100-100)*sin(t));
   ny1=(int)(100+(200-100)*sin(t)+(100-100)*cos(t));
   line(100,100,nx1,ny1);
   getch();
   closegraph();
}
```

Output:

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>
#include<math.h>

void main()
{
int gd =DETECT,gm,ch,sx,sy,tx,ty,nx1,nx2,ny1,ny2;
double r,t;
initgraph(&gd,&gm,"C:\\TURBOC3\\BGI");
line(100,100,200,100);
printf("Scaling ");

 printf("enter scaling factor \n");
   scanf("%d%d",&sx,&sy);
   nx1=100+sx;
   ny1=100+sy;
   nx2=200+sx;
   ny2=100+sy;
   line(nx1,ny1,nx2,ny2);
   getch();
   closegraph();
}
```

Output –

Conclusion: Comment on :

1. Application of transformation:
   2D transformations are fundamental in computer graphics and image processing.
   Translation: Used for moving objects within an image or on a screen, such as dragging and dropping icons.
   Scaling: Applied for resizing objects, zooming in/out, or adjusting the size of elements.
   Rotation: Essential for tasks like rotating images, elements, or shapes.

2. Difference noted between methods:
   Translation: Involves changing the coordinates of an object by adding/subtracting values to its x and y coordinates.
   Scaling: Adjusts the size of an object by multiplying its coordinates by scale factors.

Rotation: Rotates objects around a specified point (often the origin) by changing their angles.

3. Application t different object:
   Translation: Useful for moving text, images, or any graphical element on a screen.
   Scaling: Applied to images, fonts, and icons to control their size.
   Rotation: Commonly used for rotating images, graphics, and shapes to achieve desired orientations