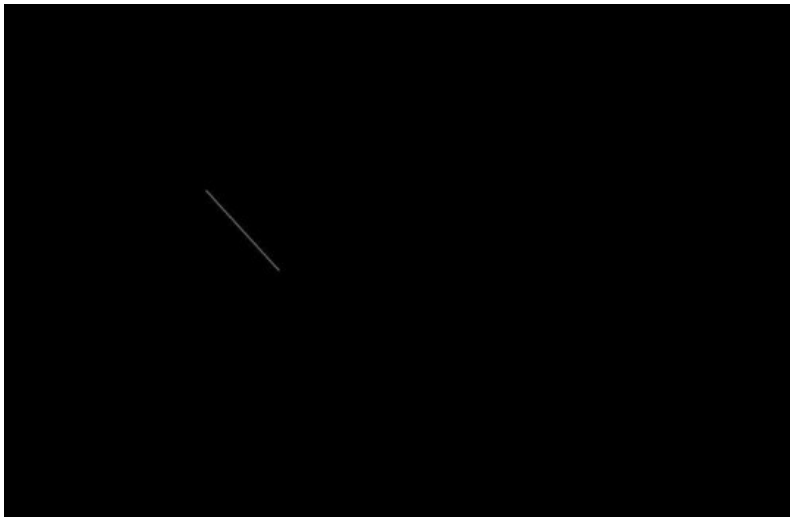
Question 1: Write a program to implement DDA and Bresenham's line drawing algorithm.

```
#include<iostream>
#include<graphics.h> using namespace
std;  void drawline(int x0, int x1, int y0,
int y1)
{
        int dy,dx,x,y,dE,dNE,d;
        dx=x1-x0;
        dy=y1-y0;
        x=x0;
        y=y0;
        d=2*dy-dx;
        dE=2*dy;
                dNE=2*(dy-dx);
while(x<x1){
                if(d<=0){
                        putpixel(x,y,7);
        x=x+1;
                                        d=d+dE;
                        delay(100);
                                        }
                                else{
                        putpixel(x,y,RED);
                        x=x+1;
                        y=y+1;
                                        d=d+dNE;
                        delay(100);
                }
```

```
        }
}

int main(){
        int x0,y0,x1,y1;
        int window1 = initwindow(800,800);
        cout<<"Enter the co-ordinate of first point : ";
        cin>>x0>>y0;

         cout<<"Enter the co-ordinate of second point : ";
        cin>>x1>>y1;
        drawline(x0,x1,y0,y1);
                        closegraph(window1);
        return 0; }
```

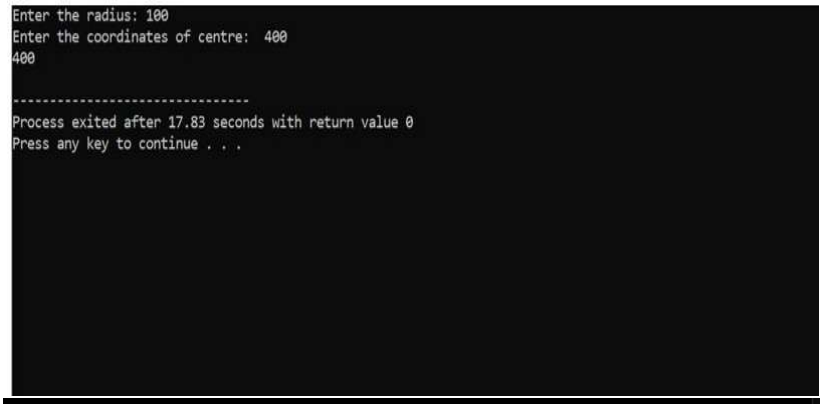


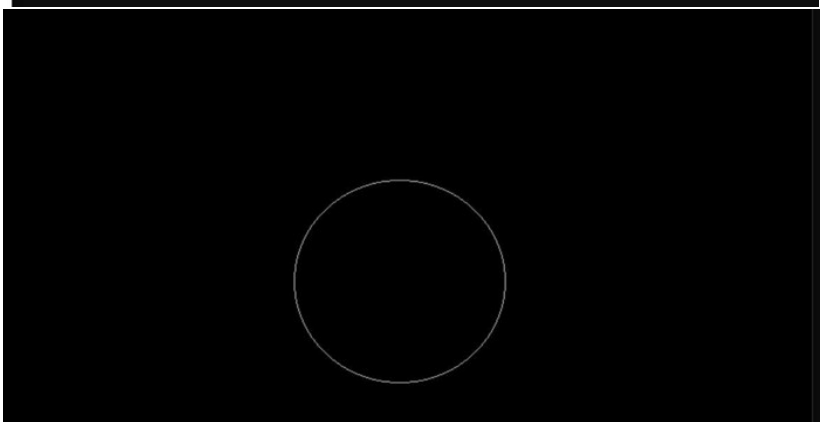
```
Enter the co-ordinate of first point : 200
200
Enter the co-ordinate of second point : 400
400

--------------------------------
Process exited after 33.03 seconds with return value 0
Press any key to continue . . .
```

Question 2: Write a program to implement mid-point circle drawing algorithm.

```
#include<iostream>
#include<graphics.h> using
namespace std;
void drawline(int rad,int c1,int c2)
{
        int x,y,dE,dNE,d;
        x=0;
        y=rad;
        d=1-rad;
        while(y>x){
                if(d<0){
        putpixel(x+c1,y+c2,7);
        putpixel(-x+c1,y+c2,7);
                putpixel(x+c1,-y+c2,7);
                putpixel(-x+c1,-y+c2,7);
                        putpixel(y+c1,x+c2,7);
                        putpixel(y+c1,-x+c2,7);
                        putpixel(-y+c1,x+c2,7);
                        putpixel(-y+c1,-x+c2,7);
                        d=d+2*x+3;
                x=x+1;
                        delay(100);

                }
                  else{
                        putpixel(x+c1,y+c2,7);
                        putpixel(-x+c1,y+c2,7);
                        putpixel(x+c1,-y+c2,7);
                        putpixel(-x+c1,-y+c2,7);
                        putpixel(y+c1,x+c2,7);
                        putpixel(y+c1,-x+c2,7);
                        putpixel(-y+c1,x+c2,7);
                        putpixel(-y+c1,-x+c2,7);
                        d=d+2*(x-y)+5;
                        x=x+1;
                y=y-1;
                        delay(100);
                        }
        }
}

int main(){
```

```
        int radius,c1,c2;          int
window1 = initwindow(800,800);
        cout<<"Enter the radius: ";
        cin>>radius;

        cout<<"Enter the coordinates of centre:  ";
        cin>>c1>>c2;
        drawline(radius,c1,c2);
        closegraph(window1);
        return 0; }
```





Question 3: Write a program to clip a line using Cohen and Sutherland line clipping algorithm.

```
#include<iostream>

#include<graphics.h> using

namespace std;

int
xmin=100,ymin=300,xmax=500,ymax=
500; const int Left =1;  const

int Right = 2; const int Top
```

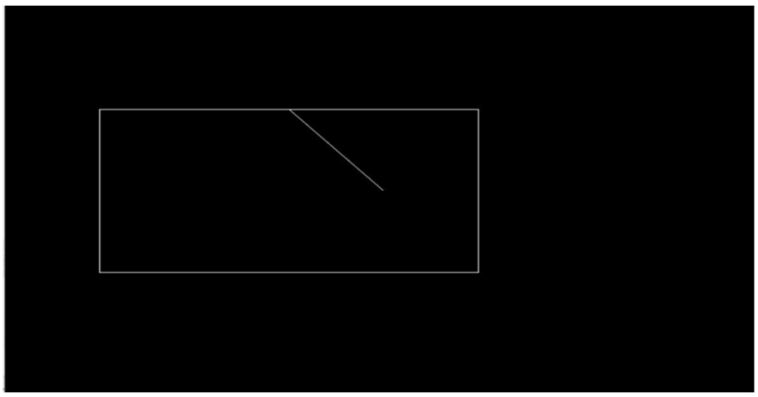
```
=8; const int Bottom =4;  int
computecode(int x, int y){

        int
code=0;
        if(x<xmin)

 code|= Left;
        else
if(y<ymin)
 code|= Bottom;
        if(x>xmax
)
 code|= Right;
        else
if(y>ymax)
  code|= Top;
        return code;
}

void clip(int x0,int x1,int y0,int y1){
            int code1,
    code2,outc1;    int
accept, flag=0;
        code1 =
computecode(x0,y0);
        code2 =
computecode(x1,y1);
        double m= (y1-
y0)/(x1-x0);
        if(code1&code2){

        accept=false;

        }
```

```
else{
 do{
        if(code1==code2){
                        accept=true;
        flag=1;
    } else{
  int x,y;
  outc1=code1?code1:code2;
  if(outc1&Top){
       x=x0+(1/m)*(ymax-y0);

       y=ymax;
            }
  else if(outc1 & Bottom){
       x=x0+(1/m)*(ymin-y0);
            y=ymin;
       }
  else if(outc1 & Left){
         y=y0+m*(xmin-x0);

  x=xmin;          } else
  if(outc1 & Right){

         y=y0+m*(xmax-x0);
          x=xmax;
        }

   if(outc1==code1){
                x0=x; y0=y;
          code1= computecode(x0,y0);
        }
```

```
  else{
            x1=x; y1=y;       code2=
  computecode(x1,y1);
           }
   }
  }
while(!flag); // do-while end
           }

           if(accept){                    cleardevice();
           line(x0,y0,x1,y1);
           rectangle(xmin,ymin,xmax,ymax);
           }

}
int main(){
           int window1 =
initwindow(800,800);

           int x0,x1,y0,y1;
           cout<<"Enter the co-ordinate of first point : ";
           cin>>x0>>y0;

           cout<<"Enter the co-ordinate of second point : ";
           cin>>x1>>y1;

           line(x0,y0,x1,y1);
           rectangle(xmin,ymin,xmax
,ymax);            delay(7000);
           clip(x0,x1,y0,y1);
```

```
        system("pause");
        return 1;
}
```

```
Enter the co-ordinate of first point : 90
90
Enter the co-ordinate of second point : 400
400
Press any key to continue . . .
```



Question 4: Write a program to clip a polygon using Sutherland Hodgeman algorithm.

```
#include<iostream>

#include<graphics.h>

#define round(a)
((int)(a+0.5)) using namespace
std;

int
xmin=100,xmax=500,ymin=100,ymax=500,arr[20],
m;

int k;  void clipleft(int x1,int y1,int

x2,int y2){

        if(x2-x1)

            m=(y2-y1)/(x2x1);

        else

            m=10000;
```

```
        if(x1>=xmin && x2>=xmin){
                arr[k]=x2;
        arr[k+1]=y2;
                k+=2;
        }
        if(x1<xmin &&x2>=xmin){
                arr[k]=xmin;

        arr[k+1]=y1+m*(xmin-x1);
                arr[k+2]=x2;
        arr[k+3]=y2;
        k+=4;
        }
        if(x1>=xmin && x2<xmin){
                arr[k]=xmin;
                arr[k+1]=y1+m*(xmin-x1);
                k+=2;
        }
}

void cliptop(int x1,int y1,int x2,int y2){
    if(y2-y1)
          m=(x2-x1)/(y2-y1);
     else
          m=10000;

        if(y1<=ymax && y2<=ymax){
 arr[k]=x2;
          arr[k+1]=y2;
```

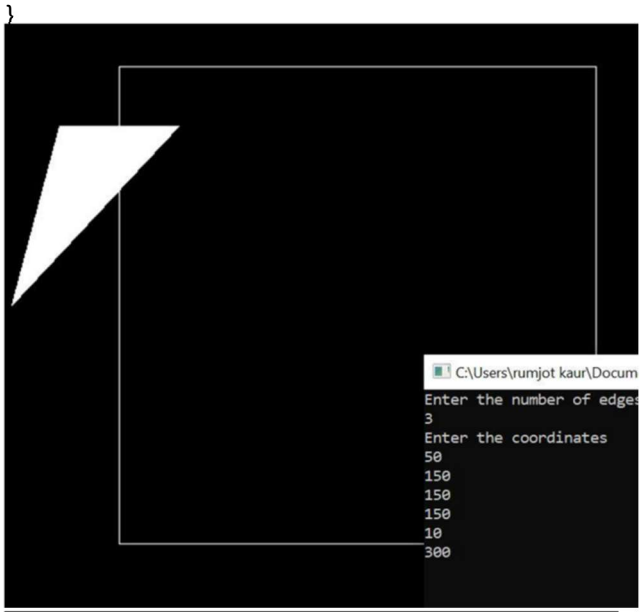
```
                k+=2;
        }
        if(y1>ymax && y2<=ymax){
                arr[k]=x1+m*(y
        max-y1);
                arr[k+1]=ymax;
                arr[k+2]=x2;
                arr[k+3]=y2;
                k+=4;
        }
        if(y1<=ymax && y2>ymax){
                arr[k]=x1+m*(y
        max-y1);
                arr[k+1]=ymax;
                k+=2;
        }
}

void clipright(int x1,int y1,int x2,int y2){
        if(x2-x1)           m=(y2-
y1)/(x2-x1);
        else

m=10000;

        if(x1<=xmax && x2<=xmax){
                arr[k]=x2;
                                arr[k+1]=y2;
                k+=2;
        }
        if(x1>xmax &&x2<=xmax){
                arr[k]=xmax;
```

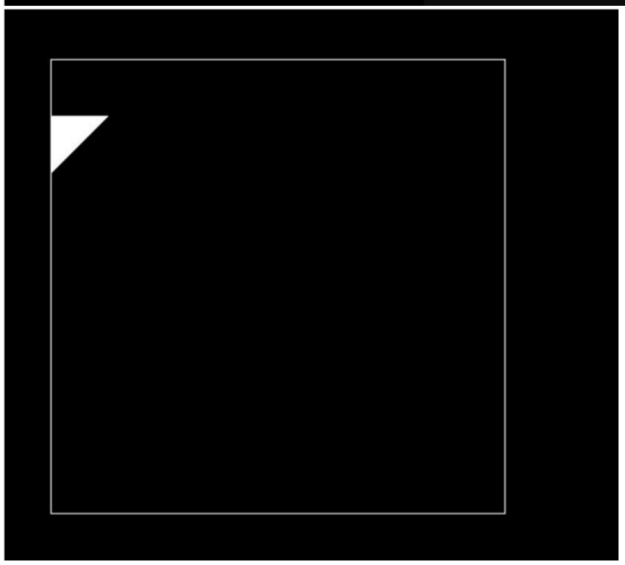
```
            arr[k+1]=y1+m*(xmax-x1);
arr[k+2]=x2;

                    arr[k+3]=y2;
                    k+=4;
            }
            if(x1<=xmax && x2>xmax){
                    arr[k]=xmax;
                    arr[k+1]=y1+m*(xmax-x1);
                    k+=2;
            }
}

void clipbottom(int x1,int y1,int x2,int y2){      if(y2-y1)
             m=(x2-x1)/(y2-y1);
     else
             m=10000;

            if(y1>=ymin && y2>=ymin){
            arr[k]=x2;

                    arr[k+1]=y
            2;      k+=2;
            }
            if(y1<ymin && y2>=ymin){
                    arr[k]=x1+m*(ymin-
            y1);    arr[k+1]=ymin;
                    arr[k+2]=x2;
                    arr[k+3]=y2;
                    k+=4;
            }
```

```
        if(y1>=ymin && y2<ymin){
                arr[k]=x1+m*(ymin-y1);
                arr[k+1]=ymin ;
                k+=2;
        }
}

int main(){
        int polyy[20];
        int window1 = initwindow(800,800);
        int n,i;        cout<<"Enter the number
of edges"<<endl;
        cin>>n;
        cout<<"Enter the
coordinates"<<endl;
for(i=0; i<2*n;i++)             cin>>polyy[i];
        polyy[i]=polyy[0];
        polyy[i+1]=polyy[1];

rectangle(xmin,ymax,xmax,ymin);
fillpoly(n,polyy);
        delay(7000);
cleardevice();
        k=0;
        for(i=0;i<2*n;i+=2)
  clipleft(polyy[i],polyy[i+1],polyy[i+2],polyy[i+3]);
        n=k/2;
                for(i=0;i<k;i+
        +)
        polyy[i]=arr[i];    polyy[i]=polyy[0];
```

```
            polyy[i+1]=polyy[1];


            k=0;

            for(i=0;i<2*n;i+=2)


            cliptop(polyy[i],polyy[i+1],polyy[i+2],polyy[i+3])
;                       n=k/2;

            for(i=0;i<k;i++)

            polyy[i]=arr[i];  polyy[i]=polyy[0];

            polyy[i+1]=polyy[1];


            k=0;    for(i=0;i<2*n;i+=
            2)

            cliprright(polyy[i],polyy[i+1],polyy[i+2],polyy[i+3])
            ;

            n=k/2;

            for(i=0;i<k;i++)    polyy[i]=arr[i];
            polyy[i]=polyy[0];
            polyy[i+1]=polyy[1];


            k=0;    for(i=0;i<2*n;i+=
            2)

 clipbottom(polyy[i],polyy[i+1],polyy[i+2],polyy[i+3]);


            for(i=0;i<k;i++)

polyy[i]=arr[i];


   rectangle(xmin,ymax,xmax,ymin);

   if(k)
fillpoly(k/2,polyy
);


            system("pause"
);          return 1;
```

}





Question 5: Write a program to fill a polygon using Scan line fill algorithm.

```
#include
<iostream>
#include
<graphics.h>
using
namespace
std;  int
main(){
        int i,j,n,k,x[20],y[20],ymin=10000,ymax=0,dy,dx,in_x[100],temp;
        float slope[100];
```

```
        int window1 =
initwindow(800,800);    cout<<"Enter the number of
vertices"<<endl;        cin>>n;
        cout<<"Enter the coordinates of edges"<<endl;
        for(i=0;i<n;i++){

        cin>>x[i]>>y[i];
        if(y[i]>ymax)
          ymax=y[i];
        if(y[i]<ymin)
          ymin=y[i];
        }
        x[n]=x[0];y[n]=y[0];

        for(i=0;i<n;i++)

line(x[i],y[i],x[i+1],y[i+1]);    delay(4000);
        for(i=0;i<n;i++){
                dy=y[i+1]y[i];
                dx=x[i+1]x[i];
                if(dy==0)

slope[i]=1.0;
        if(dx==0)

slope[i]=0.0;
        if(dy!=0 &&
dx!=0)
                  slope[i]=(float)dx/dy;


        }

        for(i=ymin;i<=ymax;i++){
                 k=0;
                for(j=0;j<n;j++){
  if((y[j]<=i && y[j+1]>i) || (y[j]>i && y[j+1]<=i)){
                                in_x[k]=(int)(x[j]+ slope[j]*(i-y[j]));
                                k++;                          }
                }
```

```
                    for(int m=0;m<k-1;m++){
          for(int l=0;l<k-1;l++){

                                    if(in_x[l]>in_x[l+1]){
                                                temp=in_x[l];
                    in_x[l]=in_x[l+1];
in_x[l+1]=temp;
              }
          }
    }


       setcolor(2);

       for(int
p=0;p<k;p+=2){

            line(in_x[p],i,
in_x[p+1],i);
            delay(100);
                    }
     }
     system("pause");
            return 1;
}
```


```
Enter the number of vertices
5
Enter the coordinates of edges
30 30
30 150
120 150
120 120
210 30
```

Question 6: Write a program to apply various 2D transformations on a 2D object (use homogenous Coordinates).

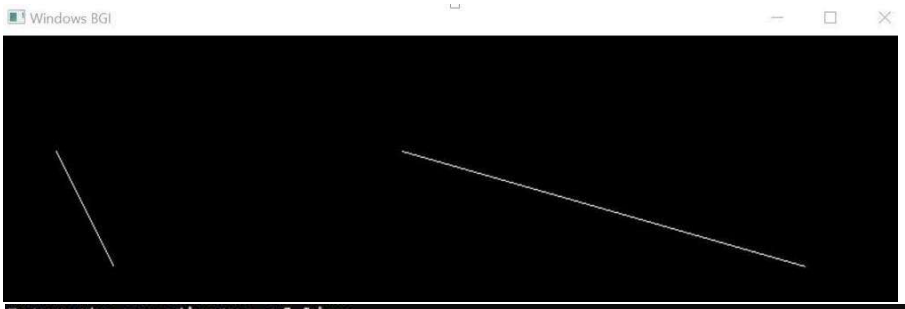
```
#include <iostream>

#include
<graphics.h>
#include<cmat
h> using
namespace
std;  int
main(){

        int tx=2,ty=5;     int window1 =

initwindow(800,800);

 int i,j,k;  float
P[2][3];

        cout<<"Enter the coordinates of line"<<endl;

        for(i=0;i<2;i++){
```

```
                    for(j=0;j<2;j++)
cin>>P[i][j];
                    P[i][j]=1;

          }

          line(P[0][0], P[0][1], P[1][0], P[1][1]);

          delay(700
0);               float
pp[2][3]={0};     int
ch;
          cout<<"Enter the 2d-transformation"<<endl;
   cout<<"1.translation \n 2. shearing \n 3.reflection \n 4.rotation \n 5.scaling \n
6.exit"<<endl;    cin>>ch;    switch(ch){          case 1: {
                    cout<<"Enter the translating factor"<<endl;
                      cin>>tx>>ty;
                      int T[3][3] = {{1,0,0},
                                  {0,1,0},
                                              {tx,ty,1}};
                                          for(i=0;i<2;i++){
                          for(j=0;j<3;j++)
          for(k=0;k<3;k++)
          pp[i][j]+=P[i][k]*T[k][j];
                          }

                      line(pp[0][0], pp[0][1], pp[1][0],
pp[1][1]);                  system("pause");
                    break;
                    }
                    case 2:{
                          int sh;
```

```
                    char ax;

        cout<<"Enter the
shearing axis"<<endl;

                    cin>>ax;
                    cout<<"Enter the shearing factor"<<endl;
                    if(ax=='x'){
                        cin>>sh;
                        int T[3][3]={{1,0,0},{sh,1,0},{0,0,1}};
                            for(i=0;i<2;i++){
                        for(j=0;j<3;j++)
            for(k=0;k<3;k++)
                                    pp[i][j]+=P[i][k]*T[k][j];
                      }
                       line(pp[0][0], pp[0][1], pp[1][0], pp[1][1]);
system("pause");
                   }
                   if(ax=='y'){
                        cin>>sh;
                        int T[3][3]={{1,sh,0},{0,1,0},{0,0,1}};
                            for(i=0;i<2;i++){
                        for(j=0;j<3;j++)
            for(k=0;k<3;k++)
                                    pp[i][j]+=P[i][k]*T[k][j];
                      }
                       line(pp[0][0], pp[0][1], pp[1][0], pp[1][1]);
system("pause");
                   }
        break;
```

```
                }
                case 3:{
                        int midx,midy,xn1,yn1,xn2,yn2;
                        char ax;
                        midx=getmaxx() / 2;
        midy=getmaxy() / 2;
        line(0,midy,midx*2,midy);
        line(midx,0,midx,midy*2);
  cout<<"Enter the axis for reflection"<<endl;          cin>>ax;
                    if(ax=='y'){
        xn1=(midx-P[1][0])+midx;
        yn1=P[0][1];
                        xn2=(midx-P[0][0])+midx;
                yn2=P[1][1];
                        }
                         if(ax=='x'){
                        yn1=(midy-P[1][1])+midy;
                xn1=P[0][0];
                        yn2=(midy-P[0][1])+midy;
                xn2=P[1][0];
  cout<<xn1<<" "<<yn1<<" "<<xn2<<" "<<yn2<<endl;
                        }
       line(xn1,yn1,xn2,yn2);
system("pause");
                        break;
                }
                case 4:{
                float theta;
                        cout<<"Enter the theta for rotation"<<endl;

        cin>>theta;
```

```
            float rx;
            rx=(theta*3.14)/180;
   float T[3][3]={{cos(rx),sin(rx),0},{-sin(rx),cos(rx),0},{0,0,1}};
                                for(i=0;i<2;i++){
            for(j=0;j<3;j++)                                    for(k=0;k<3;k++)
                        pp[i][j]+=P[i][k]*T[k][j];
                                    }
                                     line(pp[0][0], pp[0][1], pp[1][0], pp[1][1]);
system("pause");
                                break;
                        }
     case 5:{       int Sx,Sy;
                                cout<<"Enter the scaling factor for x-axis"<<endl;
                                cin>>Sx;
                                cout<<"Enter the scaling factor for y -axis"<<endl;
                                cin>>Sy;
                                int T[3][3]={{Sx,0,1},{0,Sy,1},{0,0,1}};
                                for(i=0;i<2;i++){
            for(j=0;j<3;j++)
            for(k=0;k<3;k++)
                        pp[i][j]+=P[i][k]*T[k][j];
                                    }
                                     line(pp[0][0], pp[0][1], pp[1][0], pp[1][1]);
      system("pause");
            break;
                        } }
     return 0;
}
```



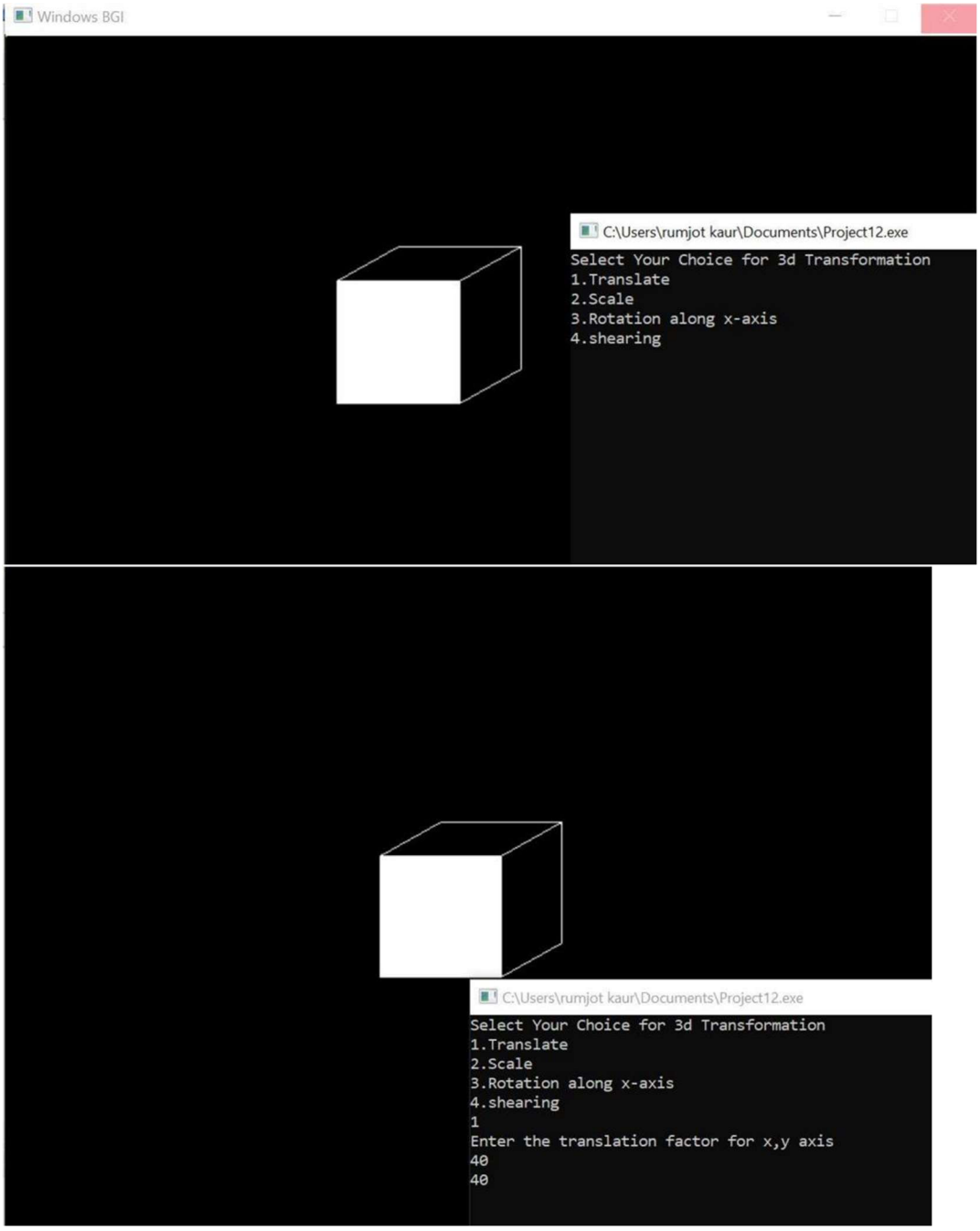

```
Enter the coordinates of line
50 100
100 200
Enter the 2d-transformation
1.translation
 2. shearing
 3.reflection
 4.rotation
 5.scaling
 6.exit
2
Enter the shearing axis
x
Enter the shearing factor
3
Press any key to continue . . .
```

Question 7: Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.

```
#include<iostream>

#include<graphics.
h>
#include<cmath> using
namespace
std; int
maxx,maxy,midx,
midy;  int main(){

        int window1 =
initwindow(800,800);
        bar3d(270,200,370,300,50,5)
;       int ch,i,j,k;       int pp[4][4];

        cout<<"Select Your Choice for 3d Transformation\n";
cout<<"1.Translate\n2.Scale\n3.Rotation along x-
axis\n4.shearing\n";    cin>>ch;    cleardevice();    switch(ch){

        case 1:{

                int tx,ty;
```

```
                cout<<"Enter the translation factor for x,y axis"<<endl;
        cin>>tx>>ty;
                bar3d(270+tx,200+ty,370+tx,300+ty,50,5);
                        delay(7000);
                        cleardevice();
                        outtextxy(10,20,"Parallel projection side view");
                bar3d(0,200+ty,0,300+ty,50,5);

        delay(7000);
        delay(7000);
        break;
                }
case 2:{        int sx,sy;
                        cout<<"Enter the scaling factor for x,y axis"<<endl;
        cin>>sx>>sy;
                bar3d(270*sx,200*sy,370*sx,300*sy,50,5);
                delay(7000);                    cleardevice();
        outtextxy(10,20,"Parallel projection side view");
                        bar3d(0,200*sy,0,300*sy,50,5);

        delay(7000);
        break;
                }
case 4:{        int shx,shy;
  cout<<"Enter the shearing factor for x,y axis"<<endl;         cin>>shx>>shy;
  bar3d(270,200+(shy*270),370,300+(shy*50),50+(270*shx),5);
                delay(7000);
                        break;
                }
                case 3:{
```

```
                    int ang;
  cout<<"Enter the rotation angle"<<endl;
                    cin>>ang;
          ang=(ang*3.14)/180;
          int x1= 200*cos(ang)-50*sin(ang);
                    int y1=
50*cos(ang)+200*sin(ang);        int
x2=300*cos(ang)-500*sin(ang);
          int y2= 50*cos(ang)+300*sin(ang);
                    bar3d(x1,y1,x2,y2,50,5);
                    delay(7000);
                    break;


          }
          }
   return 0;
}
```



Question 8: Write a program to draw Hermite /Bezier curve.

```
#include <iostream>

#include

<graphics.h>

#include
```

```
<cmath> using
namespace std;
int main(){
   int i;
   double t,xt,yt;      int window1 =
initwindow(800,800);




   int ch;
   cout<<"Enter the 1 for Bezier Curve and 2 for hermite curve"<<endl;
   cin>>ch;     switch(ch){
    case 1:{       int
x[4]={400,300,400,450};
int y[4]={400,350,275,300};
                        outtextxy(50,50,"Bezier Curve");
                                for(t=0;t<=1;t=t+0.0005){
                        xt = pow(1-t,3)*x[0]+3*t*pow(1-
t,2)*x[1]+3*pow(t,2)*(1t)*x[2]+pow(t,3)*x[3];                    yt =
pow(1t,3)*y[0]+3*t*pow(1-t,2)*y[1]+3*pow(t,2)*(1-t)*y[2]+pow(t,3)*y[3];
                           putpixel (xt, yt,WHITE);
                                }

                                for (i=0; i<4; i++){
                            putpixel (x[i], y[i], YELLOW);
```

```
                    delay(4000);
                        }
                        break;
                }
                case 2:{
                        int x1[4]={200,100,200,250};
    int y1[4]={200,150,75,100};
                        outtextxy(50,50,"Hermite Curve");
        for(t=0;t<=1;t=t+0.00001){
  xt=x1[0]*(2*pow(t,3)-(3*t*t)+1)+x1[1]*(-2*pow(t,3)+(3*t*t))+x1[2]*(pow(t,3)-
(2*t*t)+t)+x1[3]*(pow(t,3)-(t*t));      yt=y1[0]*(2*pow(t,3)-(3*t*t)+1)+y1[1]*(-
2*pow(t,3)+(3*t*t))+y1[2]*(pow(t,3)-
(2*t*t)+t)+y1[3]*(pow(t,3)-(t*t));
                        putpixel (xt, yt,WHITE);
                    }

  for (i=0; i<4; i++){     putpixel (x1[i], y1[i],
YELLOW);
                    delay(9000);
                        }
                        break;
                }
        }
        return 4;
}
```


Bezier Curve