RAMANUJAN COLLEGE

UNIVERSITY OF DELHI

CORE- COMPUTER GRAPHICS

PRACTICAL FILE

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B.Sc. (H) Computer Science | VI Semester

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Q1 Write a program to implement Bresenham’s line drawing algorithm.

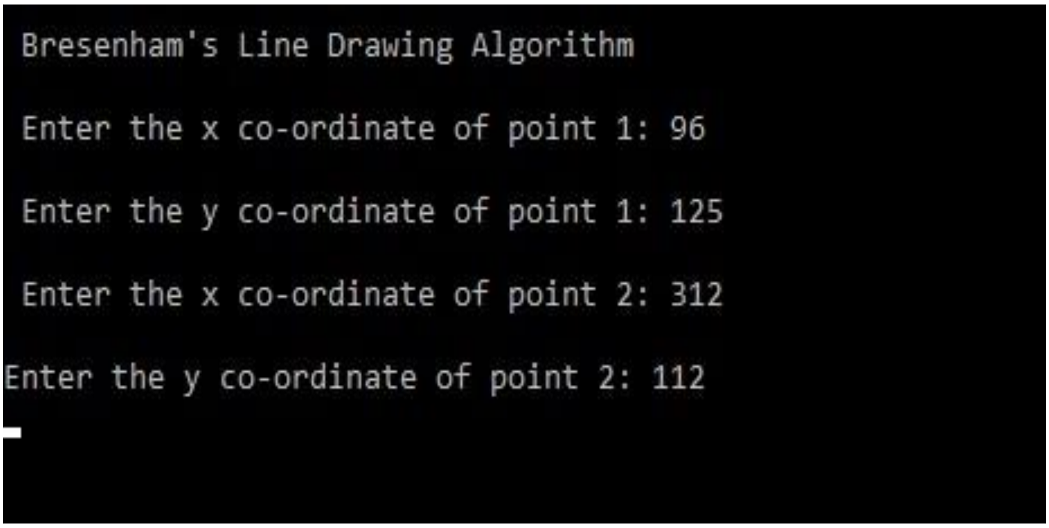
Code:-

```
#include<bits/stdc++.h>

#include<graphics.h> using

namespace std;


//Function to implement Bresenham's line drawing algorithm

void bresline(int x1,int y1,int x2,int y2)

{

        int dx,dy,P,x,y;


        int xmid=getmaxx()/2;     int

ymid=getmaxy()/2;


        dx=x2-x1;     dy=y2-y1;


        x=x1;           y=y1;


        P=2*dy-dx;


        while(x<=x2)

        {

                if(P>=0)

        {

      putpixel(x,y,YELLOW);          y=y+1;

      P=P+2*dy-2*dx;                  }

else             {
```

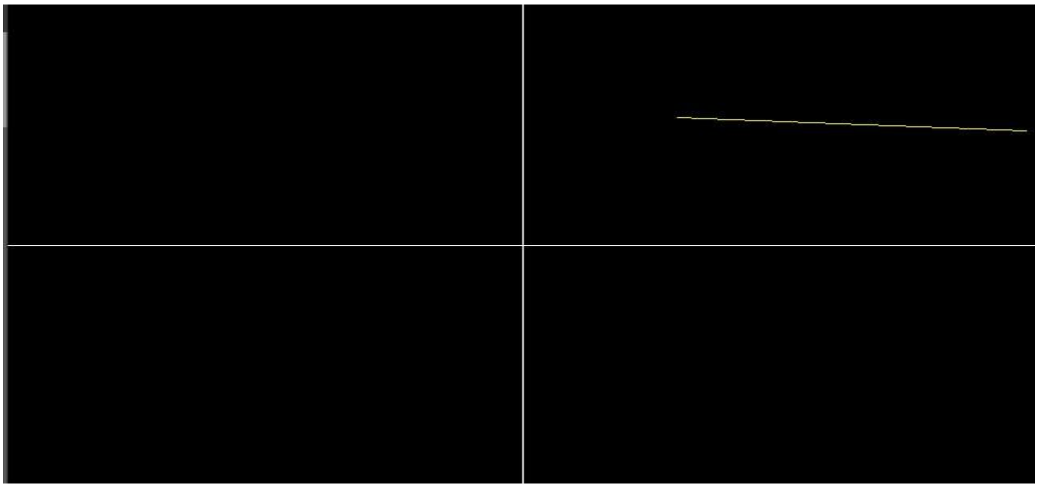
```
putpixel(x,y,YELLOW);
P=P+2*dy;}          x=x+1;
          }
          }

int main()
{
          int gdriver = DETECT,gmode;
initgraph(&gdriver,&gmode,"C:\\Dev-Cpp\\lib");
setbkcolor(BLACK);          cleardevice();         int x1,x2,y1,y2;
          cout<<" Bresenham's Line Drawing Algorithm \n\n";        cout<<" Enter
the x co-ordinate of point 1: ";
          cin>>x1;

          cout<<"\n Enter the y co-ordinate of point 1: ";
          cin>>y1;

          cout<<"\n Enter the x co-ordinate of point 2: ";      cin>>x2;

          cout<<"\nEnter the y co-ordinate of point 2: ";
          cin>>y2;

          cleardevice();

   int xmid = getmaxx()/2;
          int ymid = getmaxy()/2;   line(xmid , 0 , xmid ,
getmaxy());  line(0 , ymid , getmaxx() , ymid);
bresline(x1+xmid,ymid-y1,x2+xmid,ymid-y2);
```

```
        getch();
        closegraph();
        return 0;
}
```

OUTPUT



```
 Bresenham's Line Drawing Algorithm

 Enter the x co-ordinate of point 1: 96

 Enter the y co-ordinate of point 1: 125

 Enter the x co-ordinate of point 2: 312

Enter the y co-ordinate of point 2: 112
_
```



Q2.Write a program to implement mid-point circle drawing algorithm.

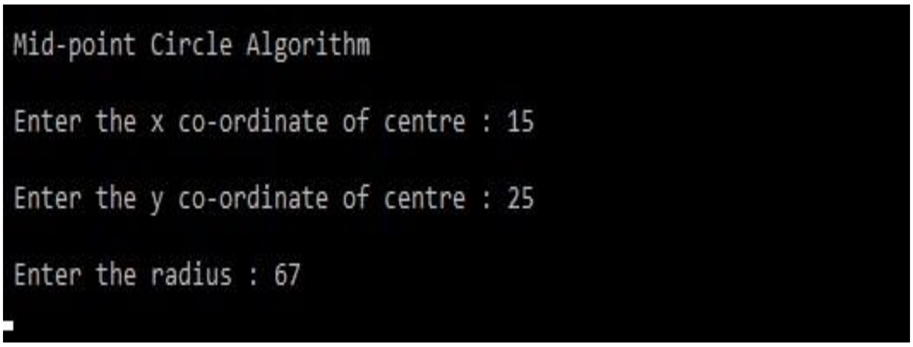
Code:-

```
#include<iostream>
#include<graphics.h>
#include<math.h>

using namespace std;
```

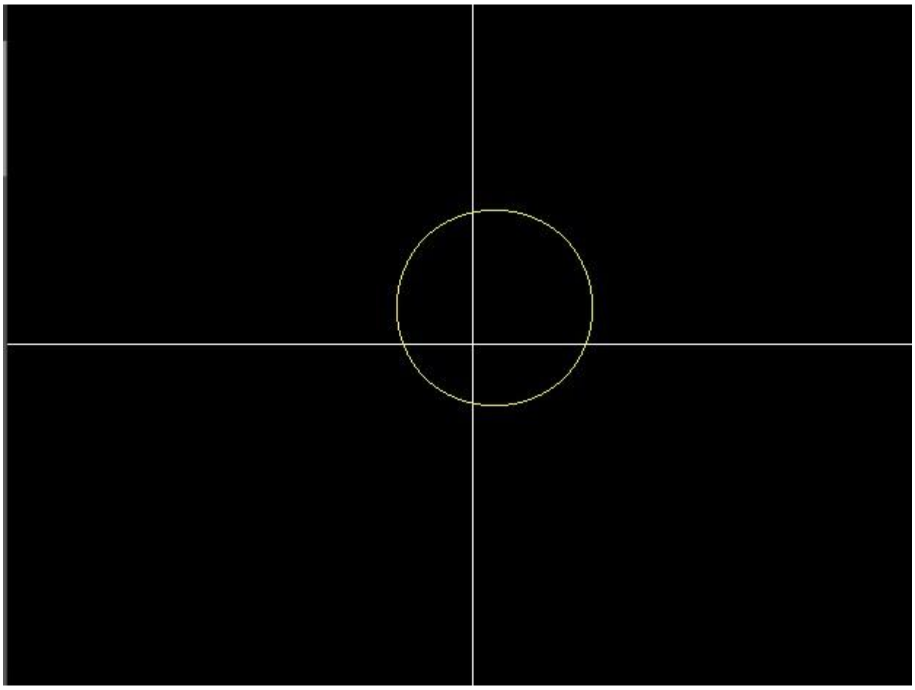
```
void circlePlotPoints (int, int, int, int); int xmid,

ymid;

void circleMidpoint(int xCenter, int yCenter, int radius)

{

          int x = 0;       int y =

radius;  int p = 1 - radius;



   //circlePlotPoints (x, y, xCenter, yCenter);

          while (x <= y)

          {

             circlePlotPoints (x, y, xCenter, yCenter);

                    if (p < 0)

                    {

                      p += (2*x)+1;

                    }



                    else

          {           p +=(2*(x-y))+1;

  y--;

       }       x++ ;

          }

  }


void circlePlotPoints(int x, int y, int xCenter, int yCenter){

          putpixel (xCenter + x, yCenter + y, YELLOW);         putpixel

(xCenter - x, yCenter + y, YELLOW);    putpixel (xCenter + x, yCenter -

y, YELLOW);          putpixel (xCenter - x, yCenter - y, YELLOW);

putpixel (xCenter + y, yCenter + x, YELLOW);  putpixel (xCenter - y,
yCenter + x, YELLOW);    putpixel (xCenter + y, yCenter - x, YELLOW);

putpixel (xCenter - y, yCenter - x, YELLOW);

}



int main()

{

        int x , y;

   float r;

   int gd = DETECT , gm;

        initgraph(&gd, &gm, (char*)"");


        cout<<" Mid-point Circle Algorithm \n\n";


        cout<<" Enter the x co-ordinate of centre : ";

        cin>>x;


        cout<<"\n Enter the y co-ordinate of centre : ";

        cin>>y;


        cout<<"\n Enter the radius : ";   cin>>r;


        xmid = getmaxx()/2;        ymid =

getmaxy()/2; line(xmid , 0 , xmid ,

getmaxy());  line(0 , ymid , getmaxx() ,

ymid);          circleMidpoint(x + xmid , ymid

- y , r);
```

```
   getch();    closegraph();
return 0;


}
```

OUTPUT



```
Mid-point Circle Algorithm

Enter the x co-ordinate of centre : 15

Enter the y co-ordinate of centre : 25

Enter the radius : 67
```



Q3 Write a program to implement Cohen-Sutherland Line Clipping algorithm.

Code:-

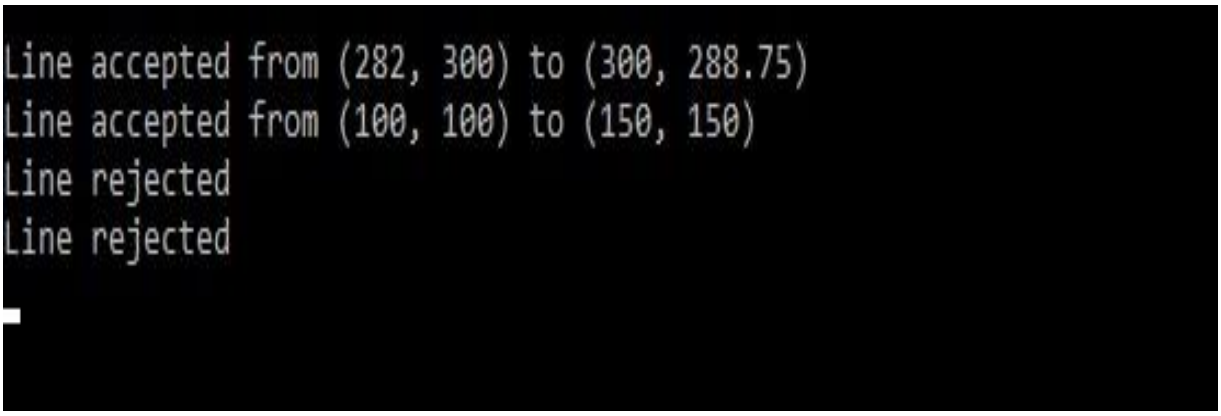
```
#include <iostream>

#include<graphics.h>

#include<math.h> using

namespace std;
```

```
float x_mid, y_mid;


// Defining region codes const int TOP =
1;    // 0001 const int BOTTOM = 2; //
0010 const int RIGHT = 4;  // 0100 const
int LEFT = 8;   // 1000


// Defining x_max, y_max and x_min, y_min for clipping rectangle.
const int x_max = 300; const int
y_max = 300; const int x_min = 80;
const int y_min = 80;


// Function to compute region code for a point(x, y).
int ComputeOutCode(double x, double y)
{
   // Point initialized as being inside the clipping window.
   int code = 0;


   if (y > y_max)         code |= TOP;
else if (y < y_min)             code |=
BOTTOM;     if (x > x_max)
code |= RIGHT;      else if (x <
x_min)             code |= LEFT;


   return code;
}
//  Implementing Cohen-Sutherland algorithm.
void CohenSutherlandLineClipAndDraw(double x1, double y1, double x2, double y2)
{
        // Initialize line as outside the clipping window.
    bool accept = false, done = false;

    // Compute region codes for P1, P2.     int code1 =
ComputeOutCode(x1, y1);     int code2 =
ComputeOutCode(x2, y2);

    do
        {
      if (!(code1 | code2))
                {
        // Trivial accept and exit.
        accept = true;            done =
true;          break;
      }
      else if (code1 & code2)
                {
        // If both endpoints are outside clipping window, so trivial reject.           break;
      }       else
                {
        /*      Failed both tests, so calculate the line segment to clip:               from
an outside point to an intersection with clip edge.
                        */
        double x, y;
                        int code_out;

        // At least one endpoint is outside the clip rectangle, pick it.
        code_out =(code1 != 0)? code1 : code2;
        // Now, find intersection point.
        // Using formulas: y = y1 + slope * (x - x1), x = x1 + (1 / slope) * (y - y1).
        if (code_out & TOP)
                {
          // Point is above the clipping window.           x =
x1 + (x2 - x1) * (y_max - y1) / (y2 - y1);           y = y_max;
        }
        else if (code_out & BOTTOM)
                {
          // Point is below the clipping window.           x =
x1 + (x2 - x1) * (y_min - y1) / (y2 - y1);           y = y_min;
        }
        else if (code_out & RIGHT)
                {
          // Point is to the right of clipping window.           y
= y1 + (y2 - y1) * (x_max - x1) / (x2 - x1);           x = x_max;
        }
        else if (code_out & LEFT)
                {
          // Point is to the left of clipping window.           y =
y1 + (y2 - y1) * (x_min - x1) / (x2 - x1);           x = x_min;
        }
        // Now we move outside point to intersection point to clip.
        if (code_out == code1)
                {
          x1 = x;           y1 =
y;
          code1 = ComputeOutCode(x1, y1);
        }     else
```

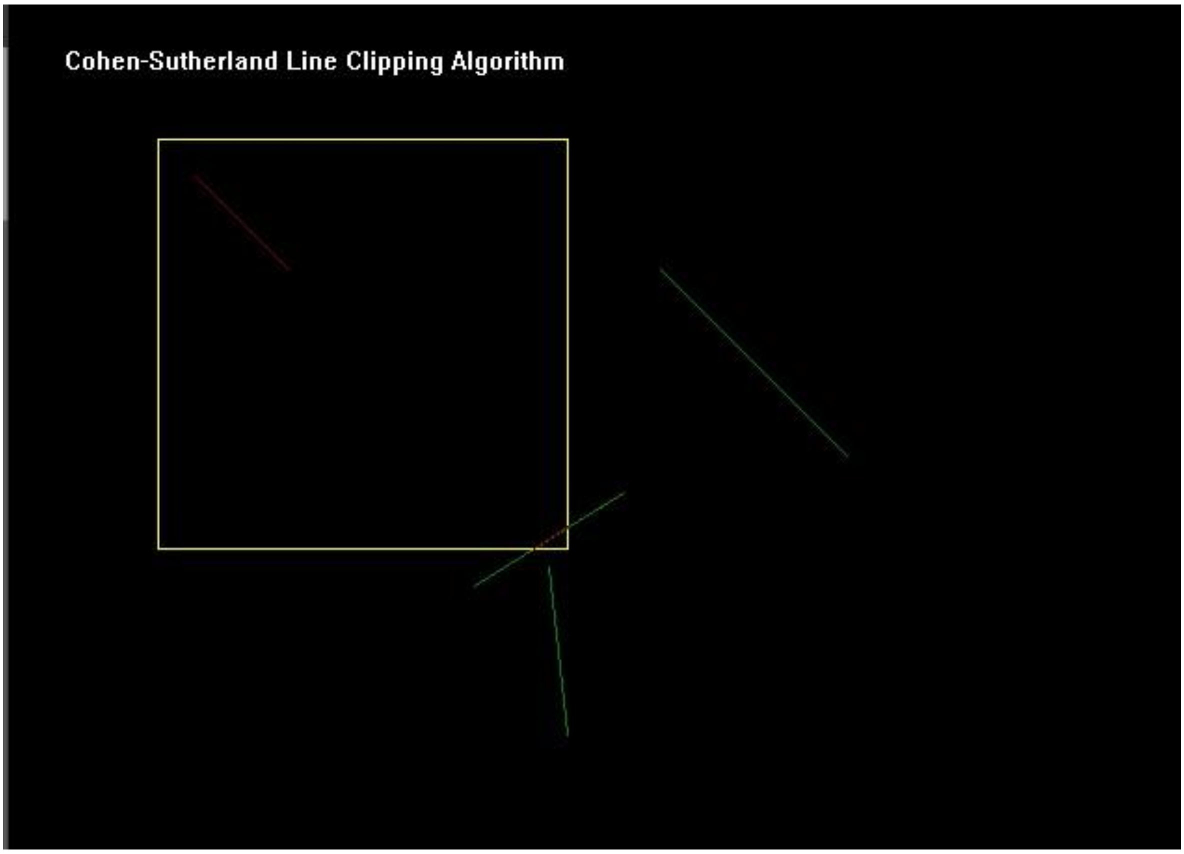
```
                        {
        x2 = x;             y2 =
y;
        code2 = ComputeOutCode(x2, y2);
      }
    }
  } while(done == false);     if (accept)
      {
    // Drawing the clipped line.
            cout << "Line accepted from (" << x1 << ", " << y1 << ") to (" << x2
<< ", " << y2 << ")" << endl;        setcolor(RED);
            line(x1, y1, x2, y2);
  }
  else
    cout << "Line rejected" << endl;
}

// Driver code int main()
{
      int gd = DETECT, gm;        initgraph(&gd, &gm,
(char*)"");

      float X = getmaxx(), Y = getmaxy();      float
x_mid = X / 2;        float y_mid = Y / 2;

      setcolor(WHITE);
      outtextxy(30, 30, "Cohen-Sutherland Line Clipping Algorithm");
```

```
        // Drawing Window using Lines          setcolor(YELLOW);
   line(x_min, y_min, x_max, y_min);     line(x_max, y_min,
x_max, y_max);     line(x_max, y_max, x_min, y_max);
line(x_min, y_max, x_min, y_min);


        setcolor(GREEN);
   // First Line segment
   // P1 = (250, 320), P2 = (330, 270)     line(250, 320,
330, 270);
   CohenSutherlandLineClipAndDraw(250, 320, 330, 270);


   // Second Line segment
   // P1 = (80, 80), P2 = (150, 150)     CohenSutherlandLineClipAndDraw(100, 100, 150,
150);


   // Third Line segment
   // P1 = (290, 310), P2 = (320, 500)
setcolor(GREEN);     line(290, 310, 300, 400);
   CohenSutherlandLineClipAndDraw(290, 310, 320, 400);


   // Fourth Line segment
   // P1 = (450, 450), P2 = (500, 500)
setcolor(GREEN);     line(350, 150, 450, 250);
   CohenSutherlandLineClipAndDraw(350, 150, 450, 250);


        getch();       closegraph();


   return 0;
}
```

OUTPUT



```
Line accepted from (282, 300) to (300, 288.75)
Line accepted from (100, 100) to (150, 150)
Line rejected
Line rejected
```



Q4 Write a program to implement Sutherland Hodgeman Clipping program.

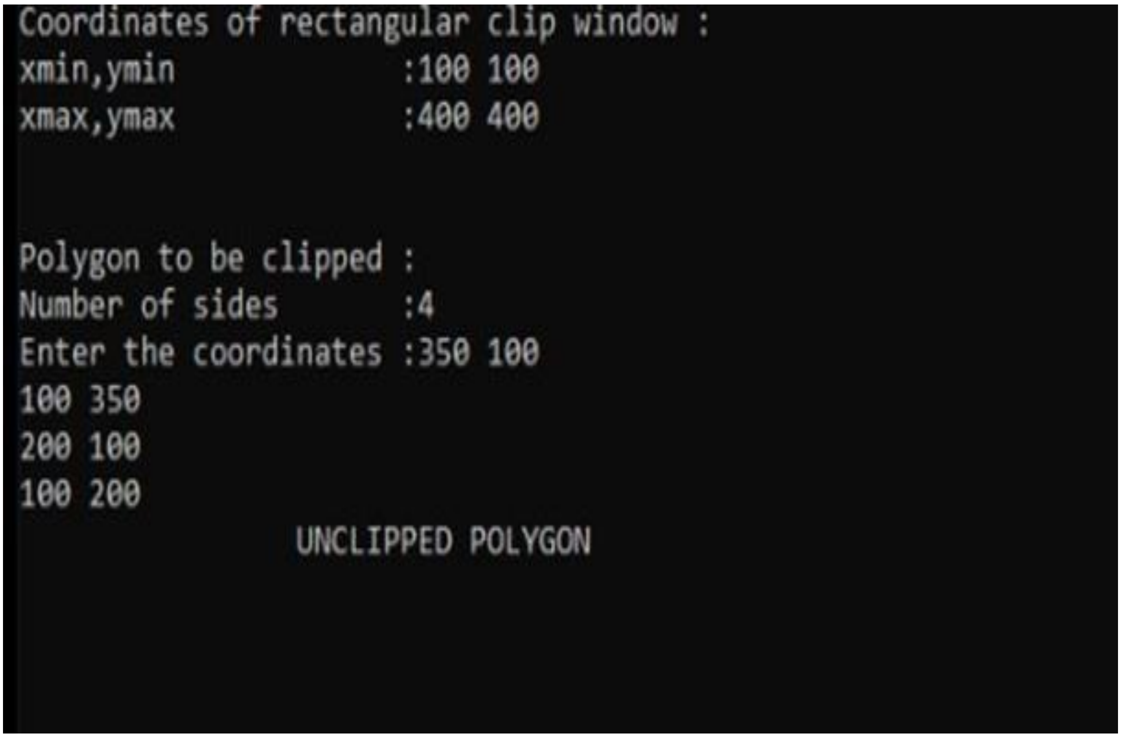
Code:-

```
#include<iostream>

#include<conio.h> #include<graphics.h>

using namespace std; #define round(a)

((int)(a+0.5)) int k;
```

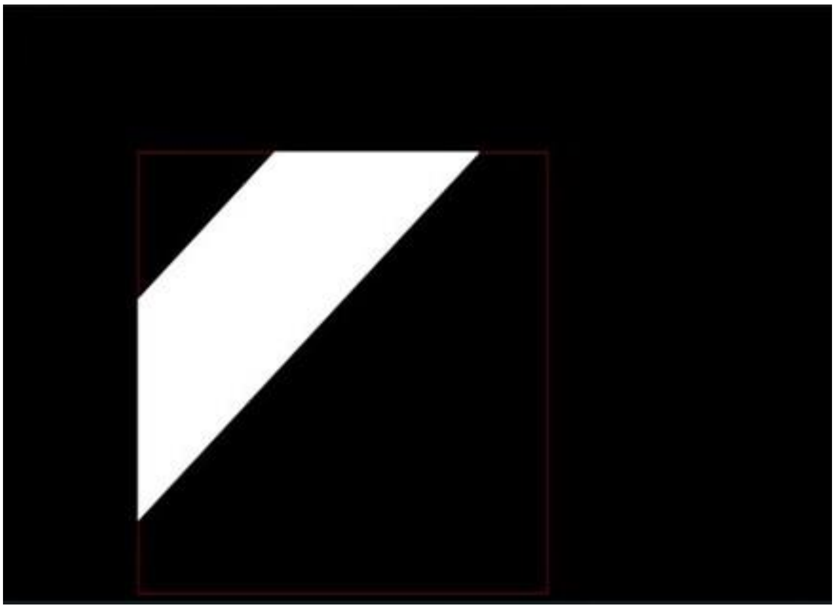
```
float xmin,ymin,xmax,ymax,arr[20],m; void clipl(float
x1,float y1,float x2,float y2) {     if(x2-x1)        m=(y2-
y1)/(x2-x1);     else        m=100000;     if(x1 >= xmin
&& x2 >= xmin)
   {
       arr[k]=x2;        arr[k+1]=y2;
k+=2;
   }
   if(x1 < xmin && x2 >= xmin)
   {
       arr[k]=xmin;
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 clipt(float x1,float y1,float x2,float y2)
{     if(y2-y1)        m=(x2-x1)/(y2-y1);     else
m=100000;     if(y1 <= ymax && y2 <=
ymax)
   {
       arr[k]=x2;        arr[k+1]=y2;
k+=2;
   }
   if(y1 > ymax && y2 <= ymax)
   {
      arr[k]=x1+m*(ymax-y1);
arr[k+1]=ymax;       arr[k+2]=x2;
arr[k+3]=y2;       k+=4;
   }
   if(y1 <= ymax  && y2 > ymax)
   {
      arr[k]=x1+m*(ymax-y1);
arr[k+1]=ymax;       k+=2;

   }
}

void clipr(float x1,float y1,float x2,float y2)
{    if(x2-x1)       m=(y2-y1)/(x2-x1);    else
m=100000;    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 clipb(float x1,float y1,float x2,float y2)

{     if(y2-y1)        m=(x2-x1)/(y2-y1);     else

m=100000;     if(y1 >= ymin && y2 >=

ymin)

    {

        arr[k]=x2;        arr[k+1]=y2;

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 gd=DETECT,gm,n,poly[20];     initgraph(&gd,&gm,(char*)"");     float
xi,yi,xf,yf,polyy[20];
```

```
   cout<<"Coordinates of rectangular clip window :\nxmin,ymin           :";
cin>>xmin>>ymin;    cout<<"xmax,ymax           :";    cin>>xmax>>ymax;
   cout<<"\n\nPolygon to be clipped :\nNumber of sides      :";    cin>>n;
   cout<<"Enter the coordinates :";    int i;
   for(i=0;i < 2*n;i++)
                 cin>>polyy[i];
   polyy[i]=polyy[0];
   polyy[i+1]=polyy[1]; for(i=0;i <
   2*n+2;i++)
         poly[i]=round(polyy[i]);

   setcolor(RED);
   rectangle(xmin,ymax,xmax,ymin);
cout<<"\t\tUNCLIPPED POLYGON";
setcolor(WHITE);    fillpoly(n,poly);
         getch();
   cleardevice();    k=0;
for(i=0;i < 2*n;i+=2)
 clipl(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)
 clipt(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)
 clipr(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)
 clipb(polyy[i],polyy[i+1],polyy[i+2],polyy[i+3]);     for(i=0;i < k;i++)
                   poly[i]=round(arr[i]);
   if(k)
                   fillpoly(k/2,poly);
   setcolor(RED);
   rectangle(xmin,ymax,xmax,ymin);     cout<<"\tCLIPPED
POLYGON";
   getch();    closegraph();
}
```

OUTPUT



```
Coordinates of rectangular clip window :
xmin,ymin              :100 100
xmax,ymax              :400 400


Polygon to be clipped :
Number of sides        :4
Enter the coordinates :350 100
100 350
200 100
100 200
                UNCLIPPED POLYGON
```



Q5 Write a program to implement Scan-Line Polygon fill algorithm.

Code:-

```
#include<iostream>

#include<graphics.h>

#include<math.h> using

namespace std;


const int WINDOW_HEIGHT = 1000;


typedef struct tdcPt

{

        int x;   int y;

}dcPt;


typedef struct tEdge

{

        int yUpper;

        float xIntersect, dxPerScan;        struct tEdge

*next;
```

```
}Edge;


// Vertices: Array of structures.

dcPt vertex[5] = {{200, 500}, {300, 250}, {270, 230}, {320, 200}, {360, 290}};


void insertEdge(Edge *list, Edge *edge)

{

 Edge *p, *q = list;  p = q->next;


        while (p != NULL)

        {

                if (edge->xIntersect < p->xIntersect)

p = NULL;               else

                {

q = p;

                        p = p->next;

                }

        }

 edge->next = q->next;  q->next = edge;

}


int yNext(int k, int cnt, dcPt *pts)

{

        int j;


        if ((k + 1) > (cnt - 1))

                j = 0;   else

j = k + 1; while(pts[k].y ==

pts[j].y)
```

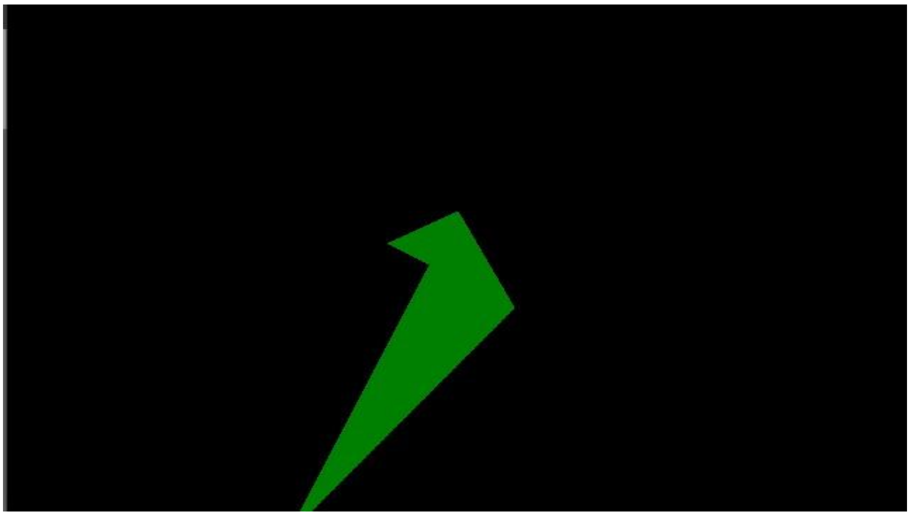
```
        {
                if ((j + 1) > (cnt - 1))
                        j = 0;
else                    j++;
        }
        return (pts[j].y);
}

void makeEdgeRec(dcPt lower, dcPt upper, int yComp, Edge *edge, Edge *edges[])
{
        edge->dxPerScan = (float) (upper.x - lower.x) / (upper.y - lower.y);       edge-
>xIntersect = lower.x;     if (upper.y < yComp)                edge->yUpper = upper.y -
1;      else
                edge->yUpper = upper.y;
        insertEdge(edges[lower.y], edge);
}

void buildEdgeList(int cnt, dcPt *pts, Edge *edges[])
{
        Edge *edge;         dcPt v1,
v2; int i, yPrev = pts[cnt - 2].y;


        v1.x = pts[cnt - 1].x; v1.y = pts[cnt - 1].y; for(int i = 0; i <
        cnt; i++)
        {
                v2 = pts[i];
 if (v1.y != v2.y)      // nonhorizontal line
                {
```

```
            edge = (Edge *) malloc (sizeof(Edge));
            if (v1.y < v2.y)                        // upgoing edge
                makeEdgeRec(v1, v2, yNext(i, cnt, pts), edge, edges);
else                                        // down-going edge
                makeEdgeRec(v2, v1 , yPrev, edge, edges);
        }
        yPrev = v1.y;
v1 = v2;
    }
}

void buildActiveList(int scan, Edge *active, Edge *edges[])
{
    Edge *p, *q;

  p = edges[scan]->next;
    while (p)
    {
  q = p->next;    insertEdge(active, p);
        p = q;
    }
}

void fillScan(int scan, Edge *active)
{
    Edge *p1, *p2 ;     int i;

 p1 = active->next;  while (p1)
    {
        p2 = p1->next;
 for(i = p1->xIntersect; i < p2->xIntersect; i++)    putpixel((int) i, scan,
GREEN);   p1 = p2->next;
    }
}

void deleteAfter(Edge *q)
{
    Edge *p = q->next;
    q->next = p->next; free(p);
}

void updateActiveList(int scan, Edge *active)
{
    Edge *q = active, *p = active->next;

    while (p)
    {
        if (scan >= p->yUpper)
        {
p = p->next;                        deleteAfter(q);
        }
        else
        {
            p->xIntersect = p->xIntersect + p->dxPerScan;
q = p;
p = p->next;
        }
    }
```

```
}


void resortActiveList(Edge *active)
{
          Edge  *q,  *p  =  active->next;  active-
>next = NULL;  while (p)
          {
q = p->next;
                    insertEdge(active, p);
                    p = q;
          }
}


void scanFill(int cnt, dcPt *pts)
{
          Edge *edges[WINDOW_HEIGHT], *active;    int i, scan;


          for (i = 0; i < WINDOW_HEIGHT; i++)
          {
 edges[i] = (Edge *) malloc (sizeof(Edge));;   edges[i]->next = NULL;
          }


 buildEdgeList(cnt, pts, edges);  active = (Edge *) malloc
(sizeof(Edge));;  active->next = NULL;


          for (scan = 0; scan < WINDOW_HEIGHT; scan++) {
           buildActiveList(scan, active, edges);   if (active->next)
                    {
```

```
 fillScan(scan,  active);      updateActiveList(scan,  active)  ;
resortActiveList(active);
                }
        }
        free(edges[WINDOW_HEIGHT]);       free(active);
}

int main()
{
        int gd = DETECT, gm;      initgraph(&gd, &gm,
(char*)"");

        float X = getmaxx(), Y = getmaxy();     float
x_mid = X / 2;       float y_mid = Y / 2;

        cleardevice();       scanFill(5,
vertex);
        getch();
        closegraph(); return 0;
}
```

OUTPUT:-



Q6 Write a program to apply various 2D transformations on 2D object (use homogeneous objects).

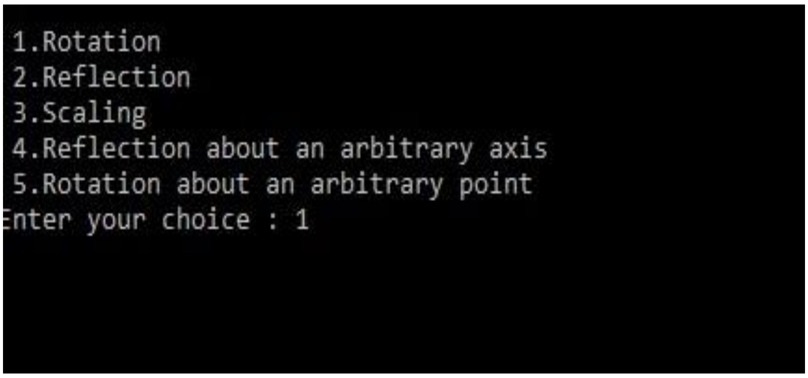
Code:-

```
#include<graphics.h>

#include<stdlib.h>

#include<stdio.h>

#include<iostream>

#include<conio.h>

#include<math.h> using

namespace std;


int mat[3][3];

void dda_line(int x1 , int y1 , int x2 , int y2 , int col){ int dx , dy

, st; dx = x2 - x1; dy = y2 - y1; float y , x , xinc , yinc; int xmid ,

ymid; xmid = getmaxx()/2; ymid = getmaxy()/2; if(abs(dx) >

abs(dy)){ st = abs(dx);

}

else{ st = abs(dy);

}

xinc = dx / st; yinc = dy / st; x =

x1; y = y1; for(int i=0 ; i<st ; i++){

x += xinc; y += yinc;

putpixel(ceil(x) + xmid , ymid - ceil(y),col);

}

}

void rotate(){ int xmid , ymid; xmid =

getmaxx()/2; ymid = getmaxy()/2;

line(xmid , 0 , xmid , getmaxy()); line(0 ,
ymid , getmaxx() , ymid); int c[3][2] ,l , m, i

, j , k;

int a[3][2]={{200,200},{200,100},{100,200}}; int

t[2][2]={{0,1},{-1,0}}; for( i = 0 ; i < 3 ; i++){ for(j=0 ; j<2

; j++){ c[i][j]=0;

}

}

dda_line(a[0][0],a[0][1],a[1][0],a[1][1],YELLOW);

dda_line(a[1][0],a[1][1],a[2][0],a[2][1],YELLOW);

dda_line(a[2][0],a[2][1],a[0][0],a[0][1],YELLOW); for ( i=0;i<3;i++){ for ( j=0;j<2;j++){ for (

k=0;k<2;k++){ c[i][j]=c[i][j]+(a[i][k]*t[k][j]);

}

}

}

dda_line(c[0][0],c[0][1],c[1][0],c[1][1],GREEN);

dda_line(c[1][0],c[1][1],c[2][0],c[2][1],GREEN);

dda_line(c[2][0],c[2][1],c[0][0],c[0][1],GREEN);

}

void reflection(){ int xmid , ymid; xmid =

getmaxx()/2; ymid = getmaxy()/2;

line(xmid , 0 , xmid , getmaxy()); line(0 ,

ymid , getmaxx() , ymid); int c[3][2] ,l , m, i

, j , k;

int a[3][2]={{200,200},{200,100},{100,200}}; int

t[2][2]={{0,-1},{-1,0}}; for( i = 0 ; i < 3 ; i++){ for(j=0 ; j<2

; j++){ c[i][j]=0;

}

} dda_line(a[0][0],a[0][1],a[1][0],a[1][1],YELLOW);

dda_line(a[1][0],a[1][1],a[2][0],a[2][1],YELLOW);
dda_line(a[2][0],a[2][1],a[0][0],a[0][1],YELLOW); for ( i=0;i<3;i++){ for ( j=0;j<2;j++){ for (
k=0;k<2;k++){ c[i][j]=c[i][j]+(a[i][k]*t[k][j]);
}
}
}
dda_line(c[0][0],c[0][1],c[1][0],c[1][1],GREEN);
dda_line(c[1][0],c[1][1],c[2][0],c[2][1],GREEN);
dda_line(c[2][0],c[2][1],c[0][0],c[0][1],GREEN);
}
void scaling(){ int xmid , ymid; xmid =
getmaxx()/2; ymid = getmaxy()/2; line(xmid , 0
, xmid , getmaxy()); line(0 , ymid , getmaxx() ,
ymid); int c[3][2] ,l , m, i , j , k; int
a[3][2]={{20,20},{20,10},{10,20}}; int
t[2][2]={{5,0},{0,5}}; for( i = 0 ; i < 3 ; i++){
for(j=0 ; j<2 ; j++){ c[i][j]=0;

}
}
dda_line(a[0][0],a[0][1],a[1][0],a[1][1],YELLOW);
dda_line(a[1][0],a[1][1],a[2][0],a[2][1],YELLOW);
dda_line(a[2][0],a[2][1],a[0][0],a[0][1],YELLOW); for (
i=0;i<3;i++){ for ( j=0;j<2;j++){ for ( k=0;k<2;k++){
c[i][j]=c[i][j]+(a[i][k]*t[k][j]);
}
}
}
dda_line(c[0][0],c[0][1],c[1][0],c[1][1],GREEN);
dda_line(c[1][0],c[1][1],c[2][0],c[2][1],GREEN);
dda_line(c[2][0],c[2][1],c[0][0],c[0][1],GREEN);
```

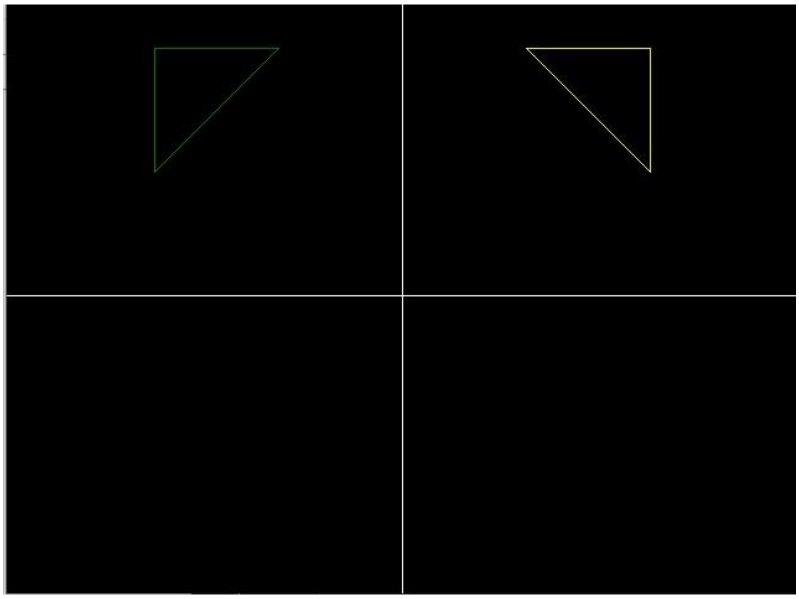
```
}
void multi(int a[3][3] , int b[3][3] ){
int i , j ,k; int c[3][3]; for( i = 0 ; i
< 3 ; i++){ for(j=0 ; j< 3 ; j++){
c[i][j]=0;
}
}
for ( i=0;i<3;i++){ for (
j=0;j<3;j++){ for ( k=0;k<3;k++){
c[i][j]=c[i][j]+(a[i][k]*b[k][j]);
}
}
}
for( i = 0 ; i < 3 ; i++){ for(j=0 ; j< 3 ;
j++){ mat[i][j]=c[i][j];
}
}
}
void reflection_arbitrary(){ int xmid , ymid; xmid =
getmaxx()/2; ymid = getmaxy()/2; line(xmid , 0 , xmid ,
getmaxy()); line(0 , ymid , getmaxx() , ymid); int
a[3][3]={{200,200,1},{200,100,1},{100,200,1}}; int
t[3][3]={{1,0,0},{0,1,0},{0,0,1}}; int r[3][3]={{-1,0,0},{0,-
1,0},{0,0,1}}; int ref[3][3]={{1,0,0},{0,-1,0},{0,0,1}}; int
rinv[3][3]={{-1,0,0},{0,-1,0},{0,0,1}}; int
tinv[3][3]={{1,0,0},{0,1,0},{0,1,1}};
dda_line(a[0][0],a[0][1],a[1][0],a[1][1],YELLOW);
dda_line(a[1][0],a[1][1],a[2][0],a[2][1],YELLOW);
dda_line(a[2][0],a[2][1],a[0][0],a[0][1],YELLOW); multi(t,r);
```

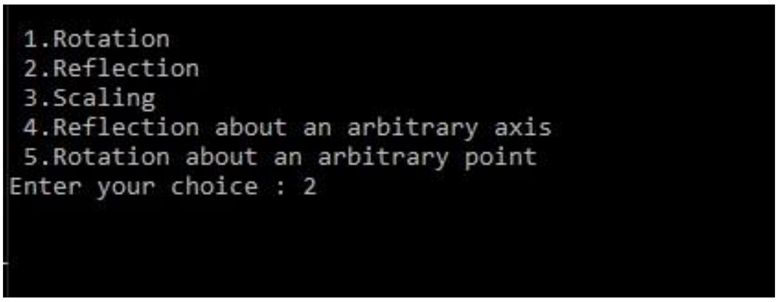
```
multi(mat,ref); multi(mat,rinv); multi(mat,tinv);
multi(a,mat);
dda_line(mat[0][0],mat[0][1],mat[1][0],mat[1][1],GREEN);
dda_line(mat[1][0],mat[1][1],mat[2][0],mat[2][1],GREEN);
dda_line(mat[2][0],mat[2][1],mat[0][0],mat[0][1],GREEN);
}
void rotation_arbitrary(){ int xmid , ymid;
xmid = getmaxx()/2; ymid = getmaxy()/2;
line(xmid , 0 , xmid , getmaxy()); line(0 ,
ymid , getmaxx() , ymid);
int c[3][3] , i , j , k; int
l[1][3]={{200,200,1}};
int a[3][3]={{200,200,1},{200,100,1},{100,200,1}}; int
t[3][3]={{1,0,0},{0,1,0},{-133,-133,1}}; int r[3][3]={{-
1,0,0},{0,-1,0},{0,0,1}}; int
tinv[3][3]={{1,0,0},{0,1,0},{133,133,1}};
dda_line(a[0][0],a[0][1],a[1][0],a[1][1],YELLOW);
dda_line(a[1][0],a[1][1],a[2][0],a[2][1],YELLOW);
dda_line(a[2][0],a[2][1],a[0][0],a[0][1],YELLOW); multi(t,r);
multi(mat,tinv);

for( i = 0 ; i < 3 ; i++){ for(j=0 ; j<3 ;
j++){ c[i][j]=0;
}
}
for ( i=0;i<3;i++){ for ( j=0;j<3;j++){ for (
k=0;k<3;k++){
c[i][j]=c[i][j]+(a[i][k]*mat[k][j]);
}
}
}
dda_line(c[0][0],c[0][1],c[1][0],c[1][1],GREEN);
dda_line(c[1][0],c[1][1],c[2][0],c[2][1],GREEN);
dda_line(c[2][0],c[2][1],c[0][0],c[0][1],GREEN);
}
int main()
{

int gdriver = DETECT , gmode , errorcode; initgraph(&gdriver,
&gmode, "C:\\TURBOC3\\BGI"); int n , m;
cout<<" 1.Rotation \n 2.Reflection \n 3.Scaling \n 4.Reflection about an arbitrary axis \n";
cout<<" 5.Rotation about an arbitrary point\n";
cout<<"Enter your choice : "; cin>>n;
switch(n){ case 1 : rotate();
break; case 2 : reflection();
break; case 3 : scaling(); break;
case 4 : reflection_arbitrary(); break;
case 5 : rotation_arbitrary(); break;
default : cout<<"Invalid Choice\n";
}
getch();
}
```

OUTPUT

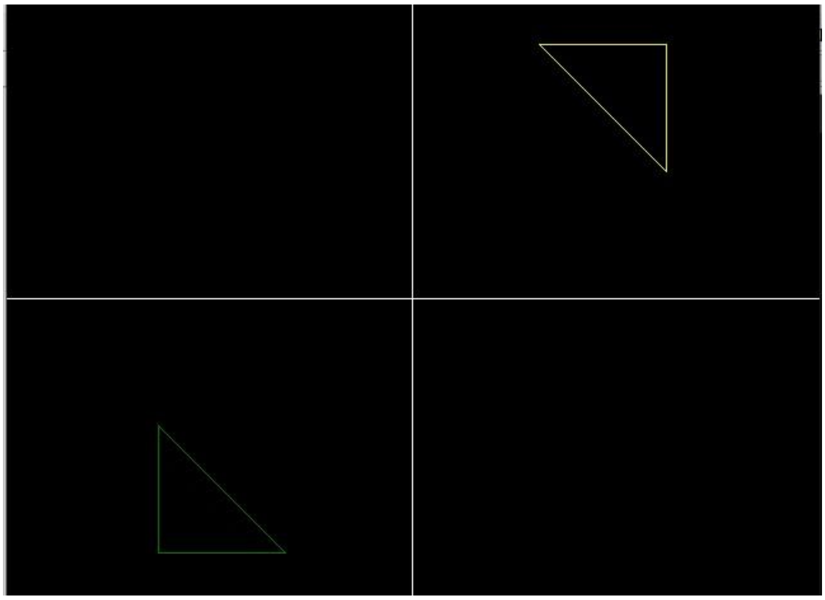


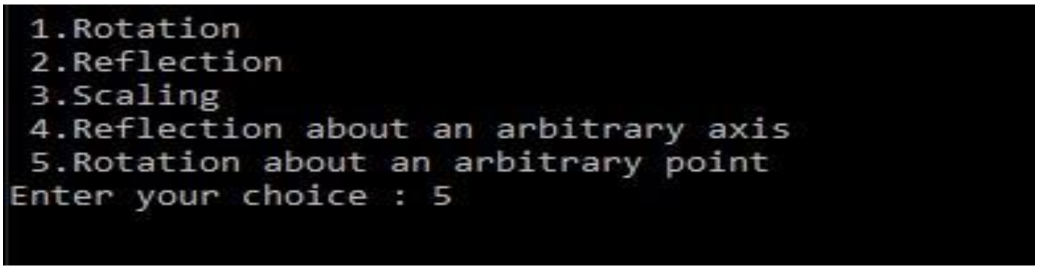
```
 1.Rotation
 2.Reflection
 3.Scaling
 4.Reflection about an arbitrary axis
 5.Rotation about an arbitrary point
Enter your choice : 1
```



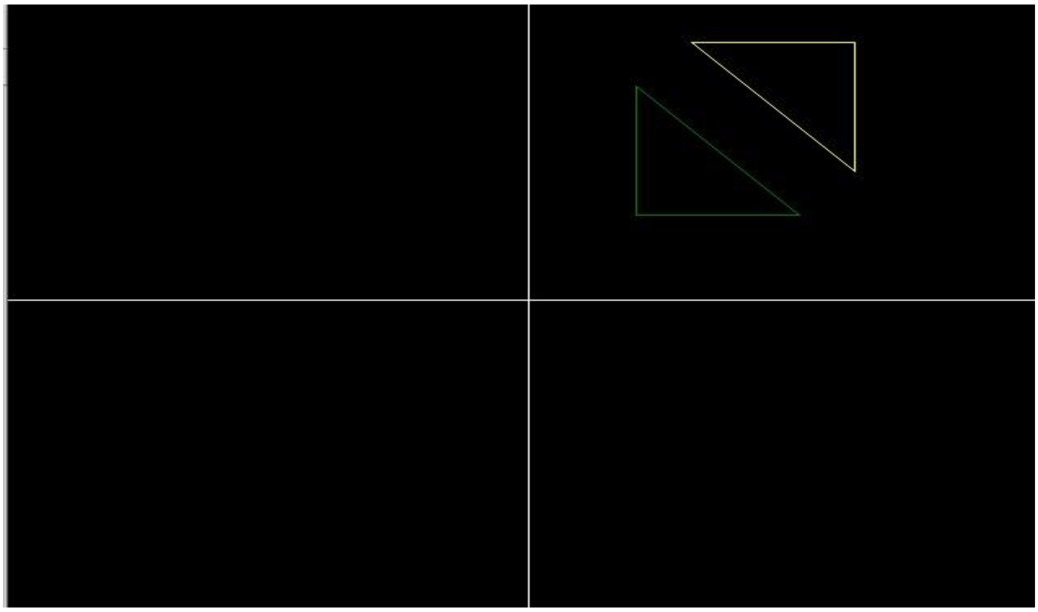


```
 1.Rotation
 2.Reflection
 3.Scaling
 4.Reflection about an arbitrary axis
 5.Rotation about an arbitrary point
Enter your choice : 2
```





```
 1.Rotation
 2.Reflection
 3.Scaling
 4.Reflection about an arbitrary axis
 5.Rotation about an arbitrary point
Enter your choice : 5
```



Q7 Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.

Code:-

```
#include<iostream>

#include<dos.h>

#include<stdio.h>

#include<math.h>

#include<conio.h>

#include<graphics.h>

#include<process.h> double

x1,x2,y1,y2; void draw_cube(double

edge[20][3]){

int i;

cleardevice(); for(i=0;i<19;i++){

x1=edge[i][0]+edge[i][2]*(cos(2.3562)); y1=edge[i][1]-
```

```
edge[i][2]*(sin(2.3562));
x2=edge[i+1][0]+edge[i+1][2]*(cos(2.3562));
y2=edge[i+1][1]-edge[i+1][2]*(sin(2.3562));
line(x1+320,240-y1,x2+320,240-y2);
}
line(320,240,320,25); line(320,240,550,240);
line(320,240,150,410);
}
void  translate(double  edge[20][3]){  int  a,b,c;
int i;
cout<<"Enter the Translation Factors : ";
cin>>a>>b>>c; cleardevice(); for(i=0;i<20;i++){
edge[i][0]+=a; edge[i][0]+=b; edge[i][0]+=c;
}
draw_cube(edge);
}
void rotate(double edge[20][3]){ int n; int i;
double temp,theta,temp1; cleardevice();
cout<<" 1.X-Axis \n 2.Y-Axis \n 3.Z-Axis \n";
cout<<"Enter your choice : "; cin>>n; switch(n){
case 1: cout<<" Enter The Angle "; cin>>theta;
theta=(theta*3.14)/180; for(i=0;i<20;i++){
edge[i][0]=edge[i][0]; temp=edge[i][1];
temp1=edge[i][2];
edge[i][1]=temp*cos(theta)-temp1*sin(theta);
edge[i][2]=temp*sin(theta)+temp1*cos(theta);
}
draw_cube(edge); break;
```

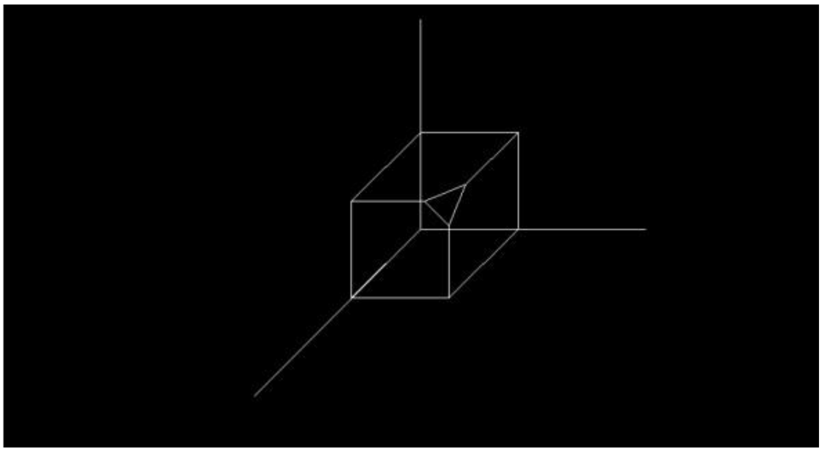
```
case 2: cout<<" Enter The Angle "; cin>>theta;
theta=(theta*3.14)/180; for(i=0;i<20;i++){
edge[i][1]=edge[i][1]; temp=edge[i][0];
temp1=edge[i][2];
edge[i][0]=temp*cos(theta)+temp1*sin(theta); edge[i][2]=-
temp*sin(theta)+temp1*cos(theta);
}
draw_cube(edge); break;
case 3: cout<<" Enter The Angle "; cin>>theta;
theta=(theta*3.14)/180; for(i=0;i<20;i++){
edge[i][2]=edge[i][2]; temp=edge[i][0];
temp1=edge[i][1];
edge[i][0]=temp*cos(theta)-temp1*sin(theta);
edge[i][1]=temp*sin(theta)+temp1*cos(theta);
}
draw_cube(edge); break;
}
}
void reflect(double edge[20][3]){ int n; int i;
cleardevice();
cout<<" 1.X-Axis \n 2.Y-Axis \n 3.Z-Axis \n"; cout<<"
Enter Your Choice : "; cin>>n; switch(n){ case 1:
for(i=0;i<20;i++){ edge[i][0]=edge[i][0]; edge[i][1]=-
edge[i][1]; edge[i][2]=-edge[i][2];
}
draw_cube(edge); break; case 2:
for(i=0;i<20;i++){
edge[i][1]=edge[i][1]; edge[i][0]=-
edge[i][0]; edge[i][2]=-edge[i][2];
```

```
}

draw_cube(edge); break; case 3:

for(i=0;i<20;i++){

edge[i][2]=edge[i][2]; edge[i][0]=-

edge[i][0]; edge[i][1]=-edge[i][1];

}

draw_cube(edge); break;

}

}

void perspect(double edge[20][3]){ int n; int i;

double p,q,r; cleardevice();

cout<<" 1.X-Axis \n 2.Y-Axis \n 3.Z-Axis\n"; cout<<"

Enter Your Choice : "; cin>>n; switch(n){ case 1:

cout<<" Enter P : "; cin>>p; for(i=0;i<20;i++){

edge[i][0]=edge[i][0]/(p*edge[i][0]+1);

edge[i][1]=edge[i][1]/(p*edge[i][0]+1);

edge[i][2]=edge[i][2]/(p*edge[i][0]+1);

}

draw_cube(edge); break; case 2: cout<<" Enter Q

: "; cin>>q; for(i=0;i<20;i++){

edge[i][1]=edge[i][1]/(edge[i][1]*q+1);

edge[i][0]=edge[i][0]/(edge[i][1]*q+1);

edge[i][2]=edge[i][2]/(edge[i][1]*q+1);

}

draw_cube(edge); break;

case 3: cout<<" Enter R : "; cin>>r;

for(i=0;i<20;i++){

edge[i][2]=edge[i][2]/(edge[i][2]*r+1); edge[i][0]=edge[i][0]/(edge[i][2]*r+1);

edge[i][1]=edge[i][1]/(edge[i][2]*r+1);
```

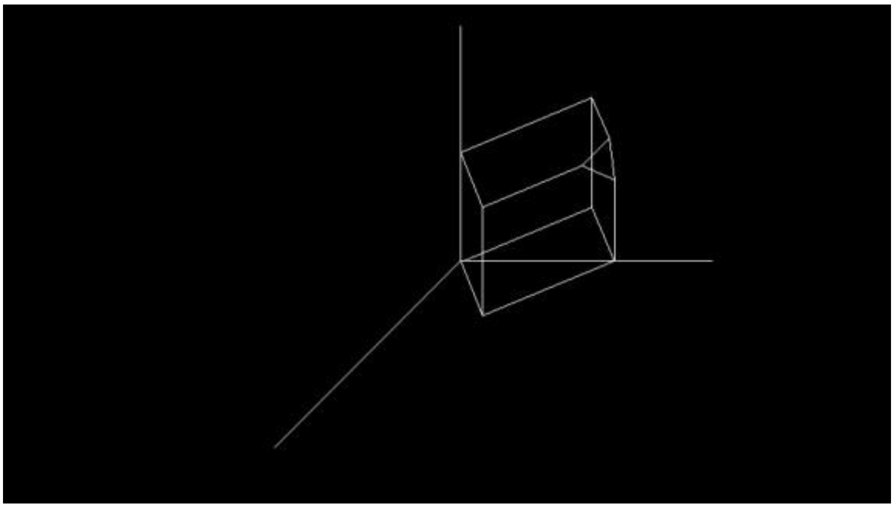
```
}
draw_cube(edge); break;
}
}
void main(){ clrscr();
int gdriver = DETECT , gmode , errorcode; initgraph(&gdriver,
&gmode, "C:\\TURBOC3\\BGI"); int n;
double
edge[20][3]={100,0,0,100,100,0,0,100,0,0,100,100,0,0,100,0,0,0,100,
0,0,
100,0,100,100,75,100,75,100,100,100,100,75,100,100,0,100,100,75,
100,75,100,75,100,100,0,100,100,0,100,0,0,0,0,0,0,100,100,0,100}; cout<<"
1.Draw Cube \n 2.Rotation \n 3.Reflection \n"; cout<<" 4.Translation \n
5.Perspective Projection \n"; cout<<" Enter Your Choice : ";

cin>>n; switch(n){ case 1: draw_cube(edge);
break; case 2: rotate(edge); break; case 3:
reflect(edge); break; case 4: translate(edge);
break; case 5: perspect(edge); break; default:
cout<<" Invalid Choice\n ";
}
getch();
}
```

OUTPUT

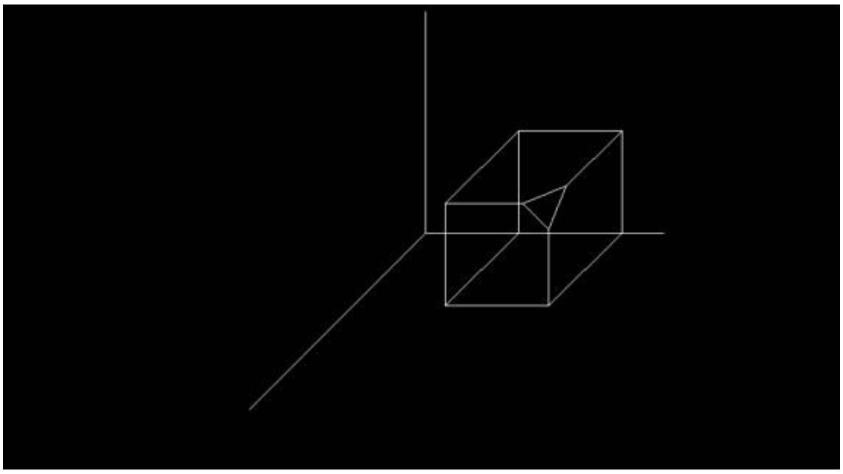
ORIGINAL CUBE:



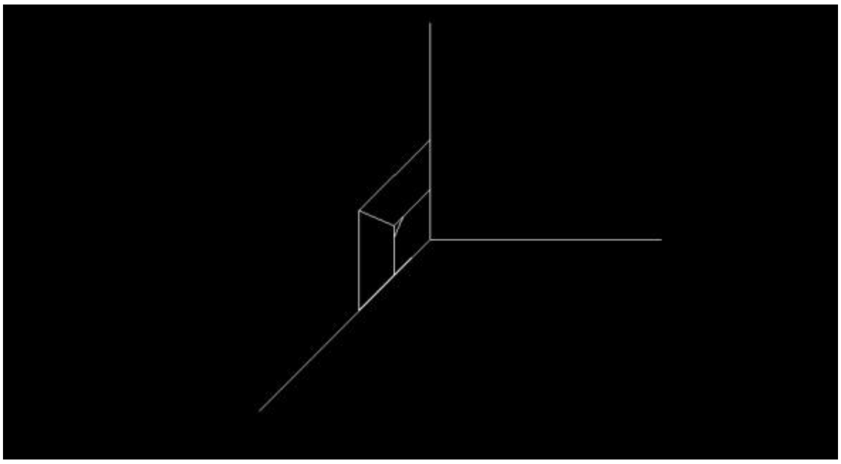
ROTATION ABOUT Y-AXIS BY AN ANGLE OF 45 DEGREE:



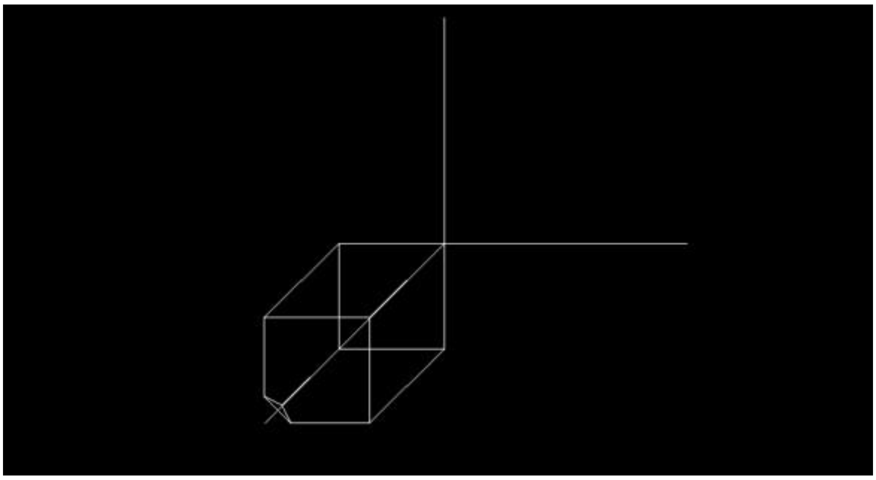
TRANSLATION FACTORS AS 20, 30, 40:



PERSPECTIVE PROJECTION ABOUT X-AXIS WHEN P=50:



REFLECTION ABOUT Z-AXIS:



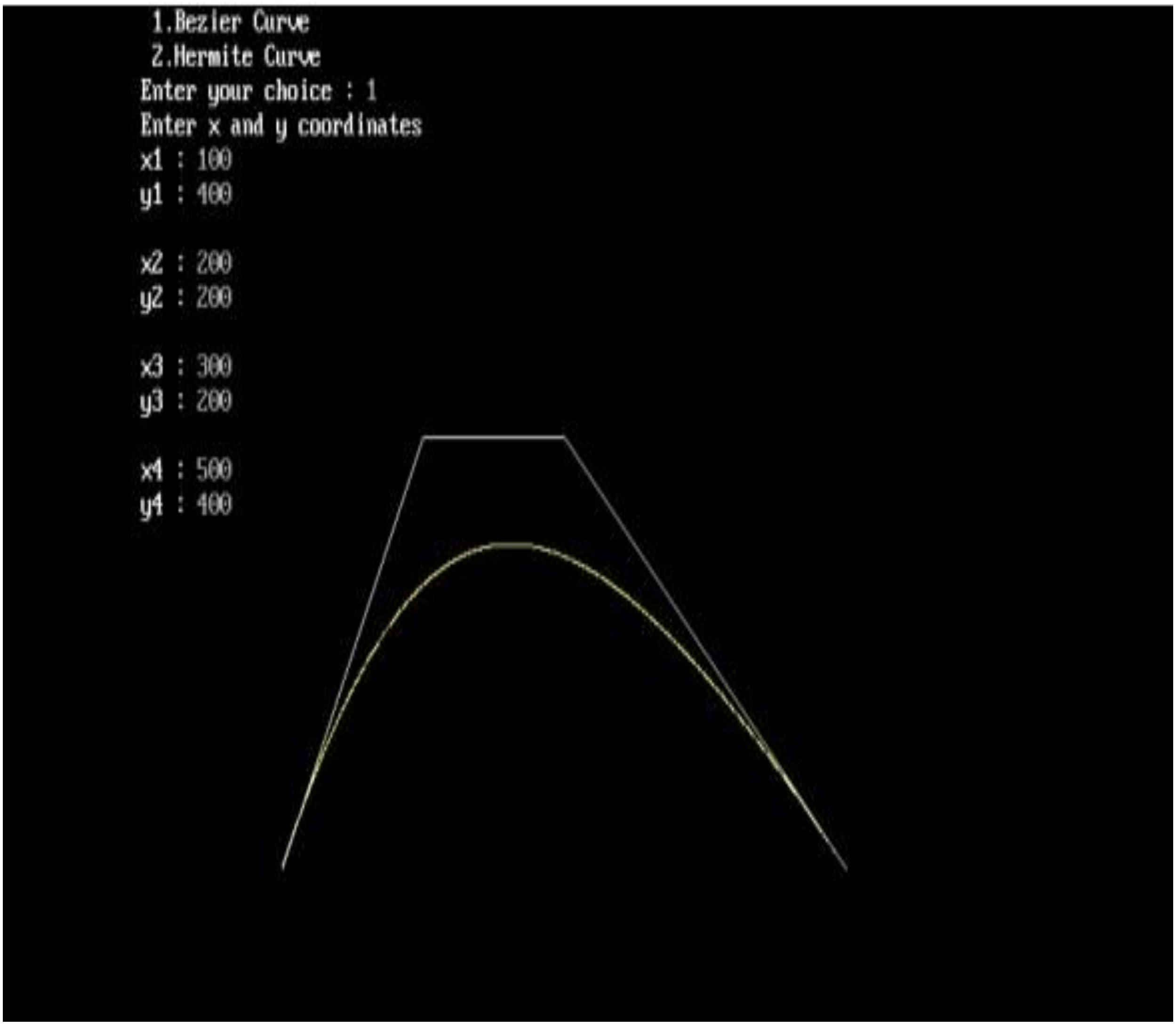
Q8 Write a program to draw Hermite/Bezier curve.

Code:-

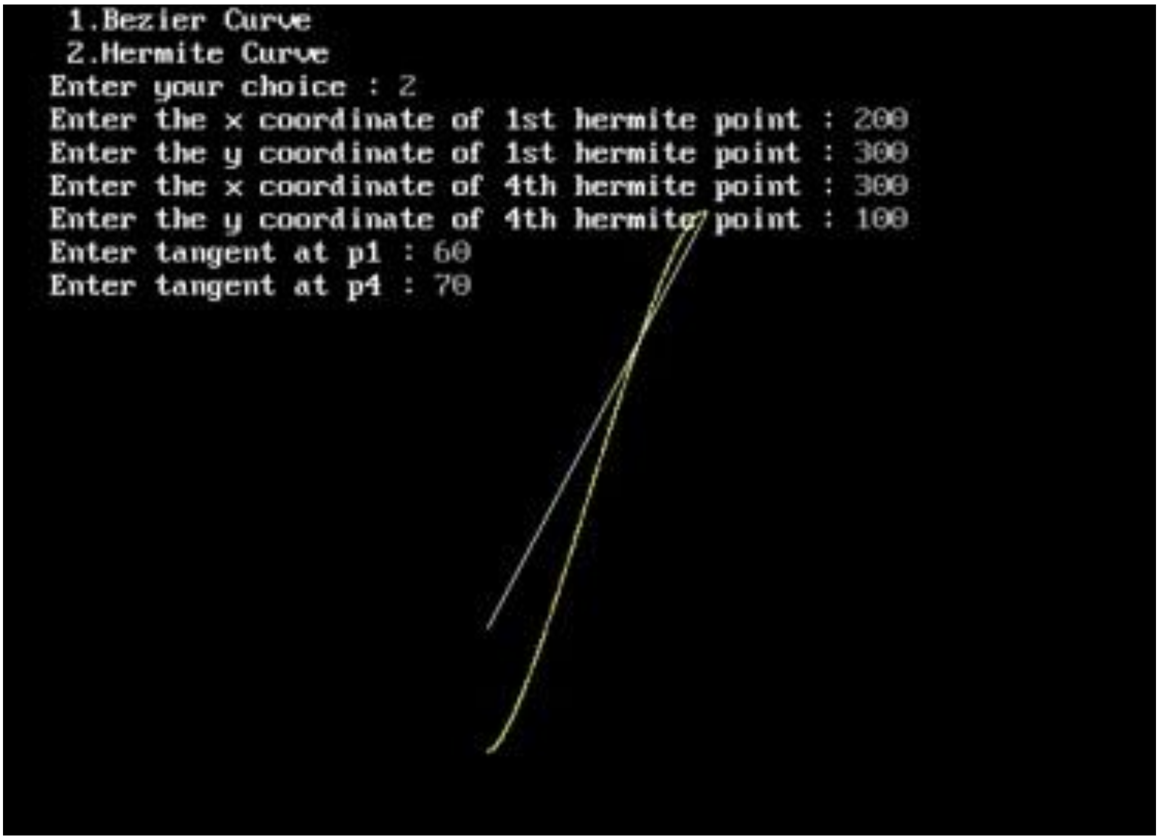
```
#include<iostream>

#include<conio.h>

#include<graphics.h> #include<math.h>

void bezier_curve(int x[4],int y[4]){ double t;

for(t=0.0;t<1.0;t=t+0.0005){ double xt=pow(1-

t,3)*x[0]+3*t*pow(1- t,2)*x[1]+3*pow(t,2)*(1-

t)*x[2]+pow(t,3)*x[3]; double yt=pow(1-

t,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,YELLOW);

}

for(int i=0;i<3;i++){ line(x[i],y[i],x[i+1],y[i+1]);

}
```

```
}
void hermite_curve(int x1,int y1,int x2,int y2,double t1,double t4){ float
x,y,t; for(t=0.0;t<=1.0;t+=0.001){
x=(2*t*t*t-3*t*t+1)*x1+(-2*t*t*t+3*t*t)*x2+(t*t*t-
2*t*t+t)*t1+(t*t*t-t*t)*t4;
y=(2*t*t*t-3*t*t+1)*y1+(-2*t*t*t+3*t*t)*y2+(t*t*t-
2*t*t+1)*t1+(t*t*t-t*t)*t4; putpixel(x,y,YELLOW);
}
putpixel(x1,y1,GREEN); putpixel(x2,y2,GREEN);
line(x1,y1,x2,y2);
}
voidmain()
{ clrscr();
int     gdriver=DETECT,gmode,errorcode;     int
x1,y1,x2,y2,n; double t1,t4;
initgraph(&gdriver,&gmode,"C:\\TURBOC3\\BGI"); int x[4],y[4];

int i;
cout<<"1.BezierCurve\n2.HermiteCurve\n";
cout<<"Enteryourchoice:"; cin>>n; if(n==1){
cout<<"Enterxandycoordinates\n";
for(i=0;i<4;i++){ cout<<"x"<<i+1<<":";
cin>>x[i]; cout<<"y"<<i+1<<":"; cin>>y[i];
cout<<endl;
}
bezier_curve(x,y);
}
elseif(n==2){
cout<<"Enterthexcoordinateof1sthermitepoint:"; cin>>x1;
cout<<"Entertheycoordinateof1sthermitepoint:"; cin>>y1;
cout<<"Enterthexcoordinateof4thhermitepoint:"; cin>>x2;

cout<<"Entertheycoordinateof4thhermitepoint:"; cin>>y2;

cout<<"Entertangentatp1:"; cin>>t1;

cout<<"Entertangentatp4:"; cin>>t4;

hermite_curve(x1,y1,x2,y2,t1,t4);

}

else{

cout<<"\nInvalidChoice";

}

getch();

}
```

OUPUT



```
 1.Bezier Curve
 2.Hermite Curve
Enter your choice : 1
Enter x and y coordinates
x1 : 100
y1 : 400

x2 : 200
y2 : 200

x3 : 300
y3 : 200

x4 : 500
y4 : 400
```



```
  1.Bezier Curve
  2.Hermite Curve
 Enter your choice : 2
 Enter the x coordinate of 1st hermite point : 200
 Enter the y coordinate of 1st hermite point : 300
 Enter the x coordinate of 4th hermite point : 300
 Enter the y coordinate of 4th hermite point : 100
 Enter tangent at p1 : 60
 Enter tangent at p4 : 70
```