RAMANUJAN COLLEGE

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BSC(H) COMPUTER SCIENCE

ROLL NO. – 20201459

EXAMINATION ROLL NO. – 20016570026

COMPUTER GRAPHICS PRACTICAL

SEMESTER – VI

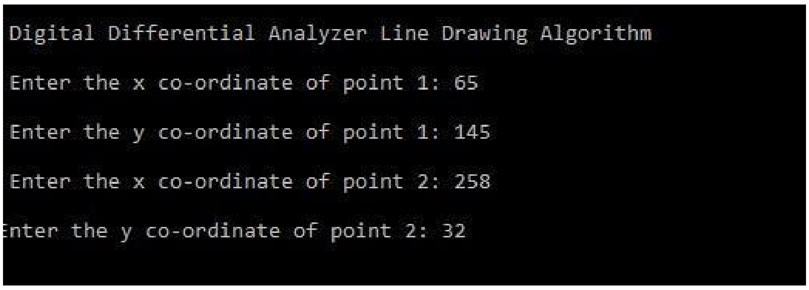
YEAR - III

Q1 Write a program to implement Digital Differential Analyzer line drawing algorithm.

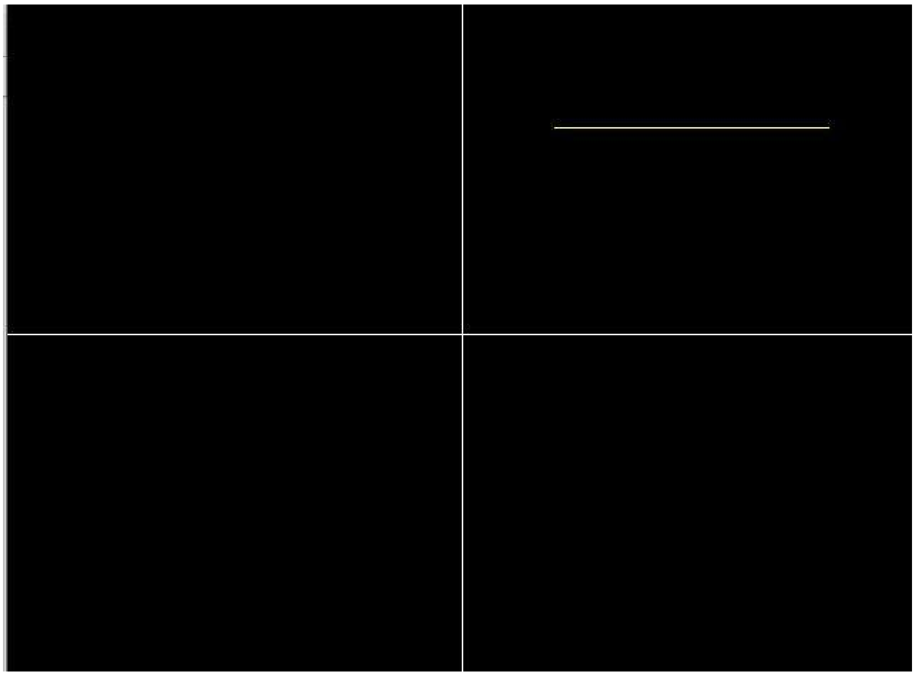
```
#include<iostream>

#include<graphics.h>

#include<windows.h>


using namespace std; int

xmid,ymid;


//Function to implement DDA line drawing algorithm void

dda(int x1,int y1,int x2,int y2)

{

        int dx,dy,steps,xinc,yinc;


        dx=x2-x1;

dy=y2-y1;


        xmid=getmaxx()/2;

ymid=getmaxy()/2;


        if(abs (dx) > abs(dy) )

        {

                steps =abs(dx);

        }
```

```
          else
          {
                    steps=abs(dy);
          }

 xinc = dx/(float) steps;  yinc =
dy/(float)steps;

          for(int k=0;k<steps; k++)
          {
  putpixel(x1,y1,YELLOW);   x1+= xinc;
y1+= yinc;
          }
}

int main()
{
          int gd = DETECT , gm;
          initgraph(&gd, &gm,"C:\\Dev-Cpp\\lib");

          int x1,y1,x2,y2;
          cout<<" Digital Differential Analyzer 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;


          xmid=getmaxx()/2;
   ymid=getmaxy()/2;      line(xmid , 0
, xmid , getmaxy());         line(0 , ymid
, getmaxx() , ymid);


          dda(x1+xmid ,ymid-y1,x2+xmid,ymid-y2);


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

OUTPUT



```
Digital Differential Analyzer Line Drawing Algorithm

Enter the x co-ordinate of point 1: 65

Enter the y co-ordinate of point 1: 145

Enter the x co-ordinate of point 2: 258

Enter the y co-ordinate of point 2: 32
```



Q2 Write a program to implement Bresenham’s line drawing algorithm.

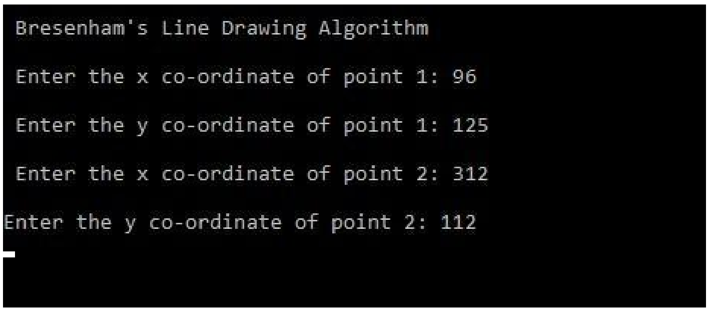
```
#include<bits/stdc++.h>

#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;
        }
```

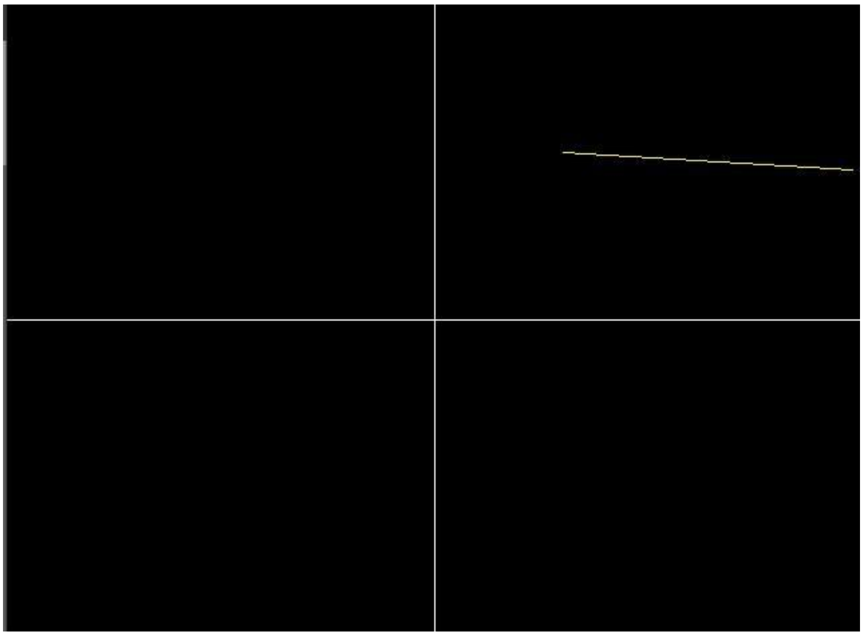
```
          }

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
_
```



Q3 Write a program to implement mid-point circle drawing algorithm.

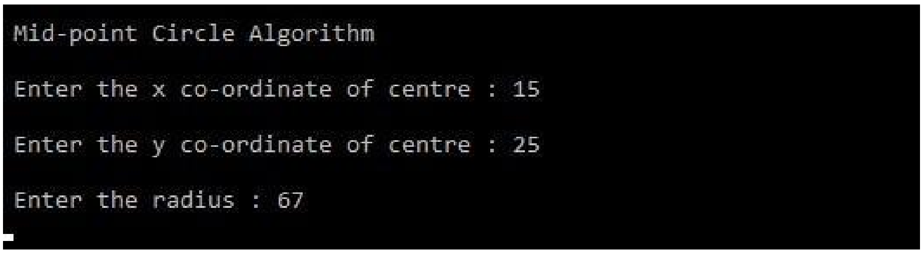
```
#include<iostream>

#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
```

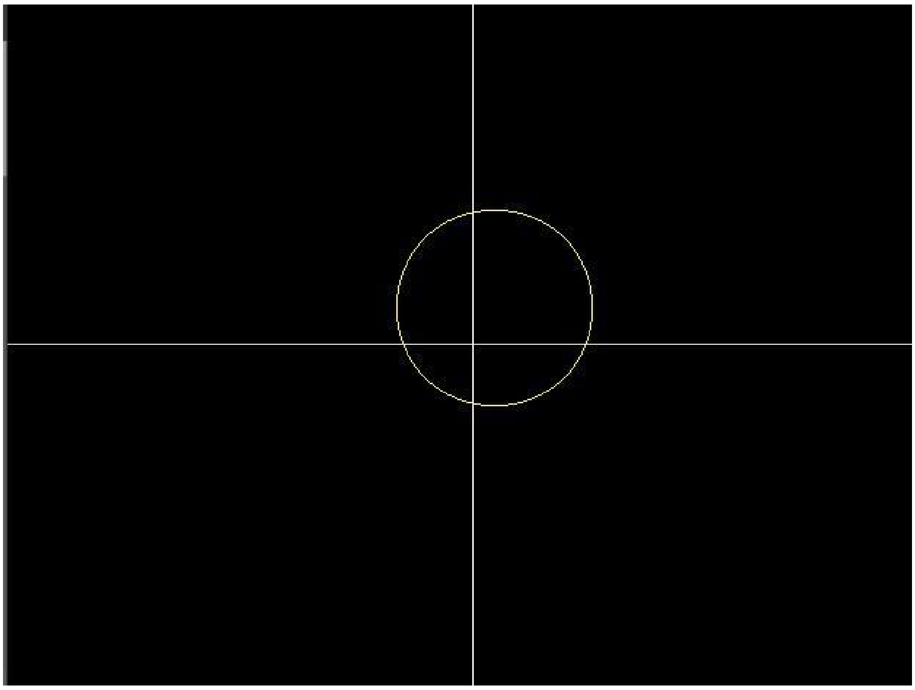
```
(xCenter + x, yCenter - y, YELLOW);    putpixel (xCenter - x,
yCenter - y, YELLOW);     putpixel (xCenter + y, yCenter + x,
YELLOW);  putpixel (xCenter - y, yCenter + x, YELLOW);
        putpixel (xCenter + y, yCenter - x, YELLOW);
putpixel (xCenter - y, yCenter - x, YELLOW);
}



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
```



Q4 Write a program to implement Ellipse mid-point drawing algorithm.

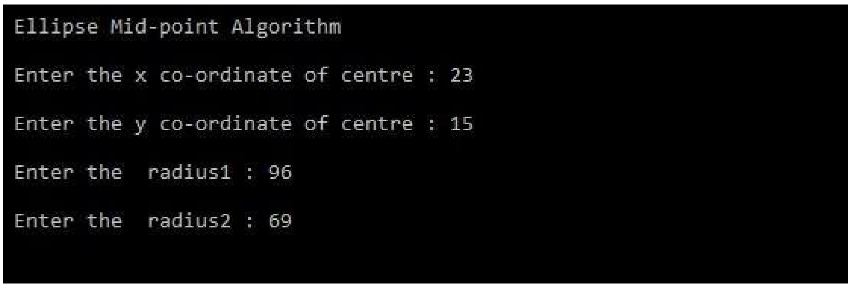
```
#include<iostream>

#include<graphics.h>

#include<math.h>


using namespace std;

#define ROUND(a) ((int) (a+0.5))


void ellipsePlotPoints(int, int, int, int);


//Function plotting points of Ellipse
```

```
void ellipseMidpoint (int xCenter, int yCenter, int Rx, int Ry)
{
   int Rx2 = Rx*Rx;
int Ry2 = Ry*Ry;     int
twoRx2 = 2*Rx2;
int twoRy2 = 2*Ry2;
   int p;     int x = 0;
int y = Ry;     int px =
0;     int py = twoRx2
*y;


   ellipsePlotPoints(xCenter, yCenter, x, y);

   p = ROUND(Ry2 - (Rx2 * Ry) + (0.25 * Rx2));

   while (px < py)
   {
    x++;      px +=
twoRy2;

          if (p < 0)
    {
             p += Ry2 + px;
```

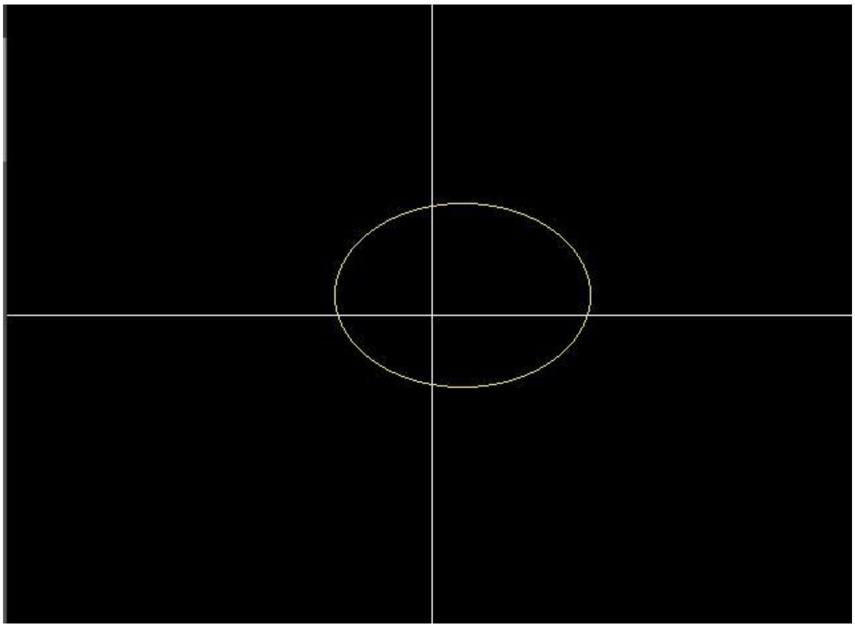
```
  }

     else
     {
     y--;
    py -= twoRx2;
p += Ry2 + px - py;
     }
  ellipsePlotPoints(xCenter, yCenter, x,y);
 }
/* Region 2 */
  p = ROUND (Ry2*(x+0.5)*(x+0.5) + Rx2*(y-1)*(y-1) - Rx2*Ry2);
while (y > 0)
     {
    y--;
    py -= twoRx2;

      if (p > 0)
    {
               p += Rx2 - py;
      }

      else
      {
       x++;          px +=
twoRy2;        p += Rx2
- py + px;
     }

     ellipsePlotPoints(xCenter, yCenter, x, y);
     }
  }

void ellipsePlotPoints (int xCenter, int yCenter, int x, int y)
{
         putpixel (xCenter + x, yCenter + y, YELLOW);
putpixel (xCenter- x, yCenter + y, YELLOW);   putpixel
(xCenter+ x, yCenter - y, YELLOW);       putpixel (xCenter -
x, yCenter - y, YELLOW);

}

int main()
{
         int x , y,xmid,ymid;
    float r,r2;     int gd = DETECT , gm;
initgraph(&gd, &gm, (char*)"");
```

```
cout<<" Ellipse Mid-point 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  radius1 : ";
cin>>r;

        cout<<"\n Enter the  radius2 : ";
cin>>r2;

        xmid = getmaxx()/2;    ymid =
getmaxy()/2;      line(xmid , 0 , xmid ,
getmaxy());        line(0 , ymid , getmaxx() ,
ymid);     ellipseMidpoint(x + xmid , ymid -
y , r,r2);     getch();     closegraph();     return
0;

}
```

OUTPUT



```
Ellipse Mid-point Algorithm

Enter the x co-ordinate of centre : 23

Enter the y co-ordinate of centre : 15

Enter the  radius1 : 96

Enter the  radius2 : 69
```



Q5 Write a program to implement Cohen-Sutherland Line Clipping algorithm.

```
#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.
```

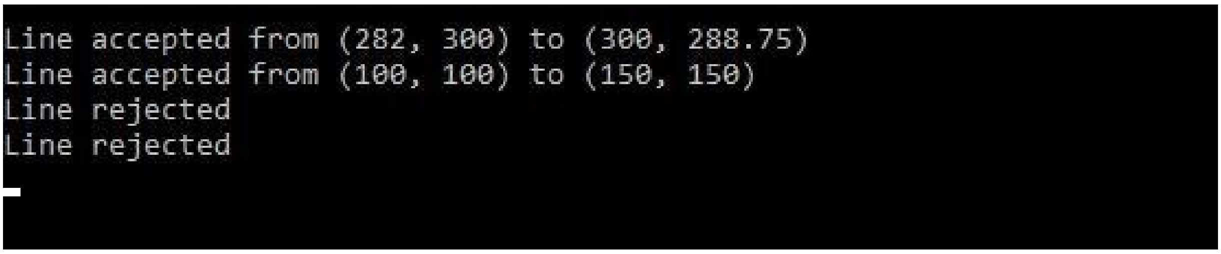
```
           accept = true;
done = true;
break;
       }
       else if (code1 & code2)
                    {
           // If both endpoints are outside clipping window, so trivial reject.
break;
       }
else
                    {
           /*      Failed both tests, so calculate the line segment 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)
                          {
```

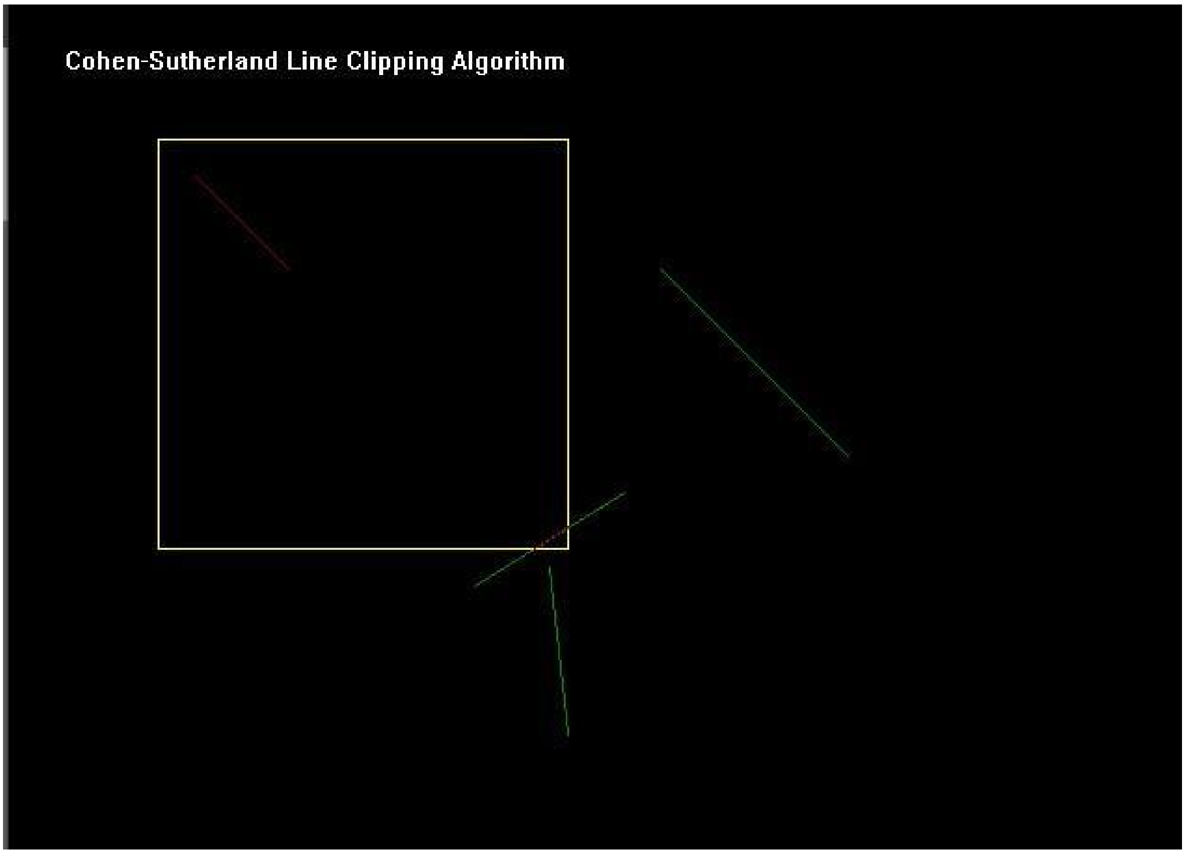
```
              x1 = x;
y1 = y;
              code1 = ComputeOutCode(x1, y1);
           }
else
                              {
              x2 = x;
y2 = y;
              code2 = ComputeOutCode(x2, y2);
           }
       }
   } while(done == false);
if (accept)
          {
       // Drawing the 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
```



Cohen-Sutherland Line Clipping Algorithm

Q6 Write a program to implement Sutherland Hodgeman Clipping program.

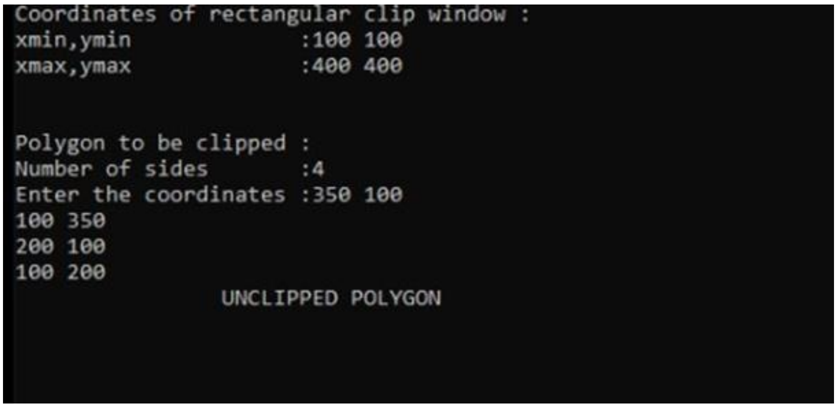
```
#include<iostream>

#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)
   {
```

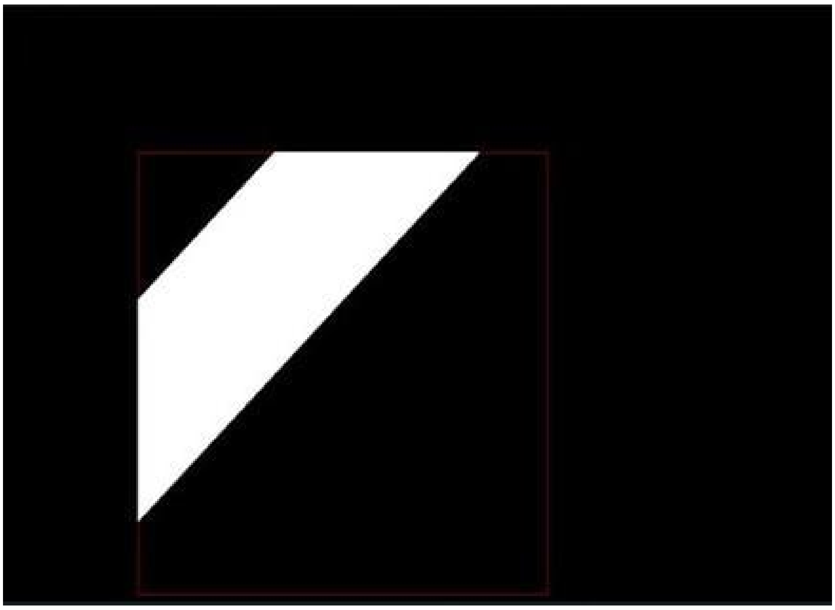
```
arr[k]=x1+m*(ymin-y1);
arr[k+1]=ymin;
arr[k+2]=x2;
arr[k+3]=y2;        k+=4;
   }
   if(y1 >= ymin  && y2 < ymin)
   {

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
```



Q7 Write a program to implement Scan-Line Polygon fill algorithm.

```
#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;
        }
```

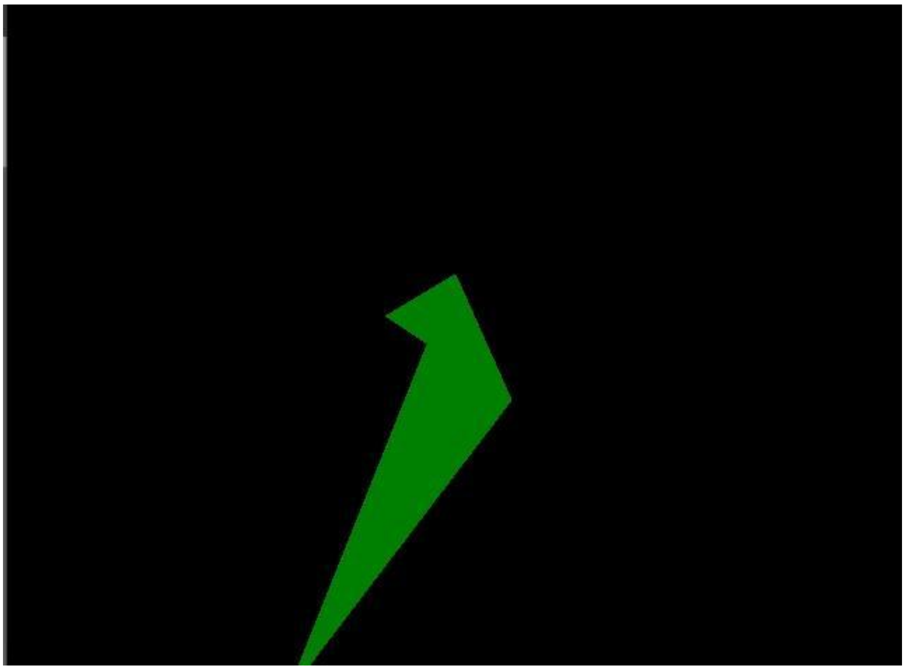
```
}

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



Q8 Write a program to apply various 2D transformations on 2D object (use homogeneous objects).

```
#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;
```

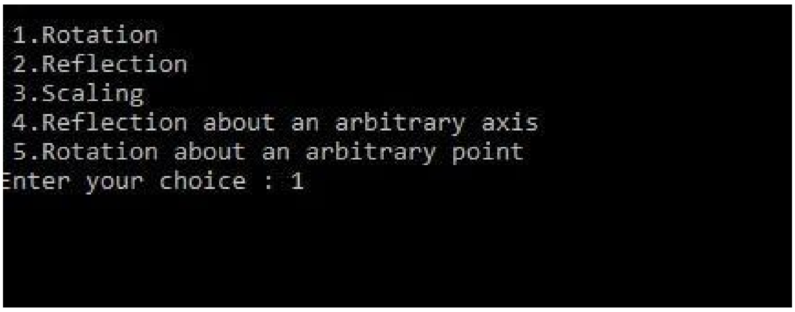
```
int
a[3][2]={{200,200},{200,100},{100,200}};
int t[2][2]={{0,-1},{-1,0}}; for( i = 0 ; i < 3 ;
i++){ for(j=0 ; j<2 ; j++){ c[i][j]=0;
}
} dda_line(a[0][0],a[0][1],a[1][0],a[1][1],YELLOW);
dda_line(a[1][0],a[1][1],a[2][0],a[2][1],YELLOW);
dda_line(a[2][0],a[2][1],a[0][0],a[0][1],YELLOW); for ( i=0;i<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);
}
```

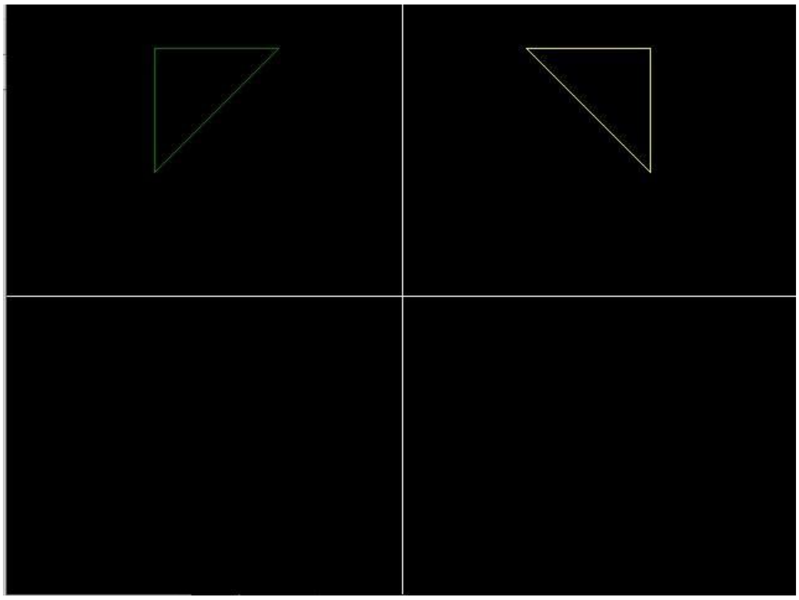
```
void rotation_arbitrary(){ int
xmid , ymid; xmid =
getmaxx()/2; ymid =
getmaxy()/2; line(xmid , 0 ,
xmid , getmaxy()); line(0 , ymid ,
getmaxx() , ymid);
int c[3][3] , i , j , k; int
l[1][3]={{200,200,1}};
int
a[3][3]={{200,200,1},{200,100,1},{100,200,1}};
int t[3][3]={{1,0,0},{0,1,0},{-133,-133,1}}; 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";
}
```

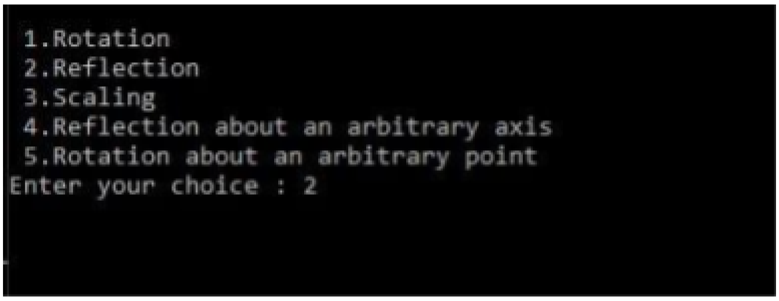
```
getch();
}
```

OUTPUT

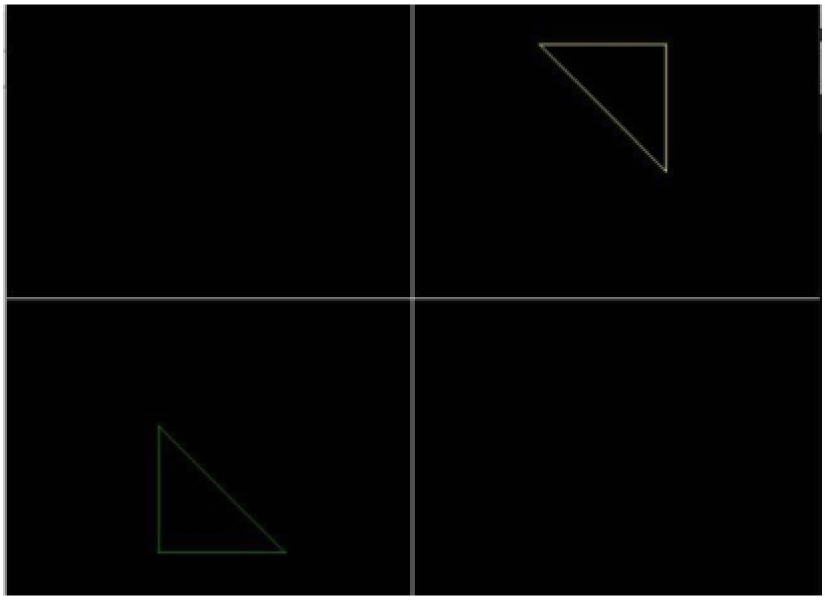


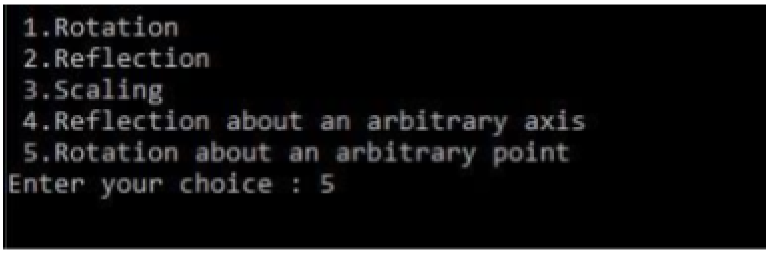
```
 1.Rotation
 2.Reflection
 3.Scaling
 4.Reflection about an arbitrary axis
 5.Rotation about an arbitrary point
Enter your choice : 1
```



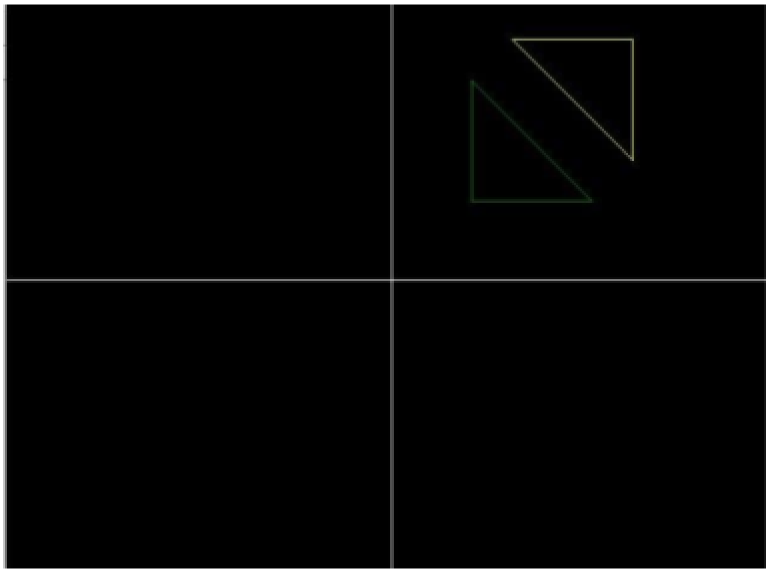


```
 1.Rotation
 2.Reflection
 3.Scaling
 4.Reflection about an arbitrary axis
 5.Rotation about an arbitrary point
Enter your choice : 2
```





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



Q9 Write a program to apply various 3D transformations on a 3D object and then apply parallel and perspective projection on it.

```
#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;
```

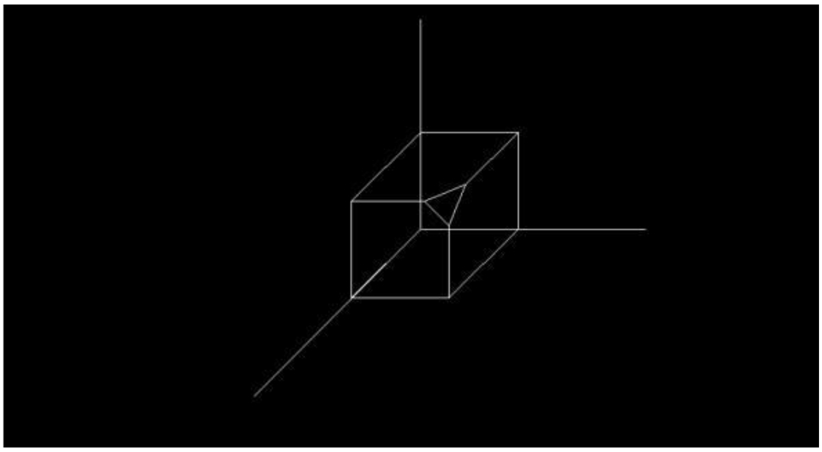
```
switch(n){ case 1: for(i=0;i<20;i++){
edge[i][0]=edge[i][0];
edge[i][1]=-edge[i][1];
edge[i][2]=-edge[i][2];
}
draw_cube(edge);
break; case 2:
for(i=0;i<20;i++){
edge[i][1]=edge[i][1];
edge[i][0]=-edge[i][0];
edge[i][2]=-edge[i][2];
}
draw_cube(edge);
break; case 3:
for(i=0;i<20;i++){
edge[i][2]=edge[i][2];
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();
```

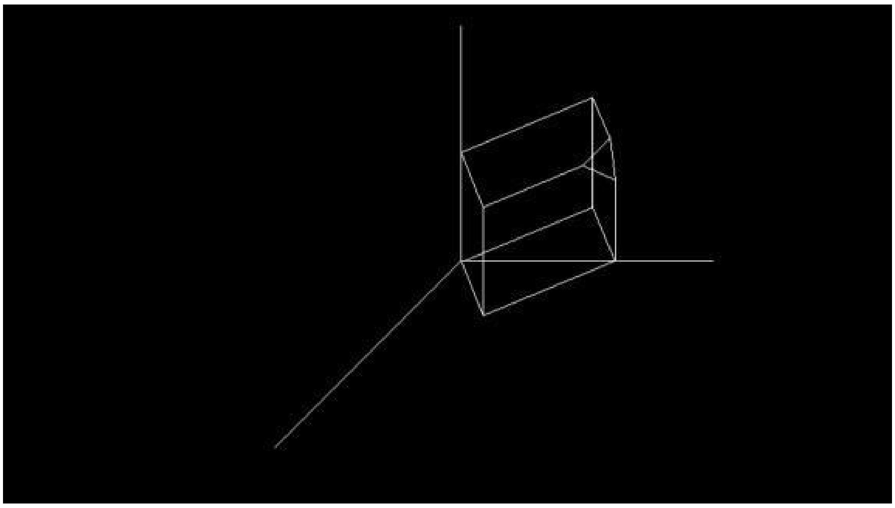
```
int gdriver = DETECT , gmode , errorcode;
initgraph(&gdriver, &gmode, "C:\\TURBOC3\\BGI");
int n;
double
edge[20][3]={100,0,0,100,100,0,0,100,0,0,100,100,0,0,100,0,0,0,100,
0,0,
100,0,100,100,75,100,75,100,100,100,100,75,100,100,0,100,100,75
,
100,75,100,75,100,100,0,100,100,0,100,0,0,0,0,0,0,100,100,0,100};
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

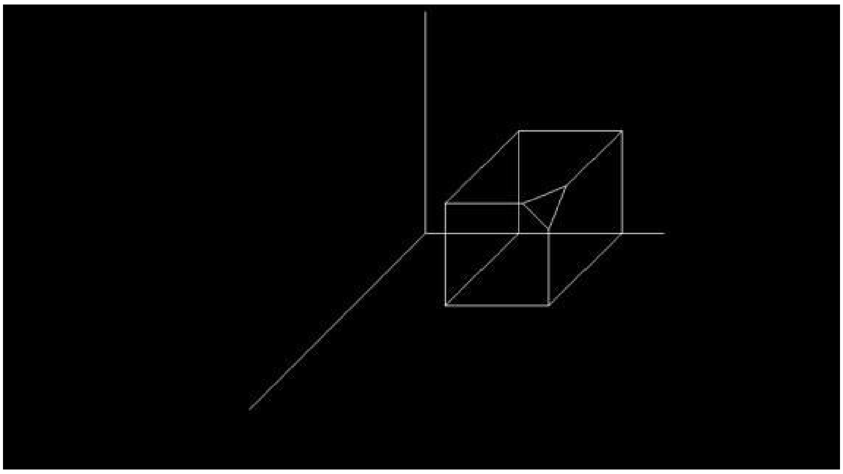
ORIGINAL CUBE:



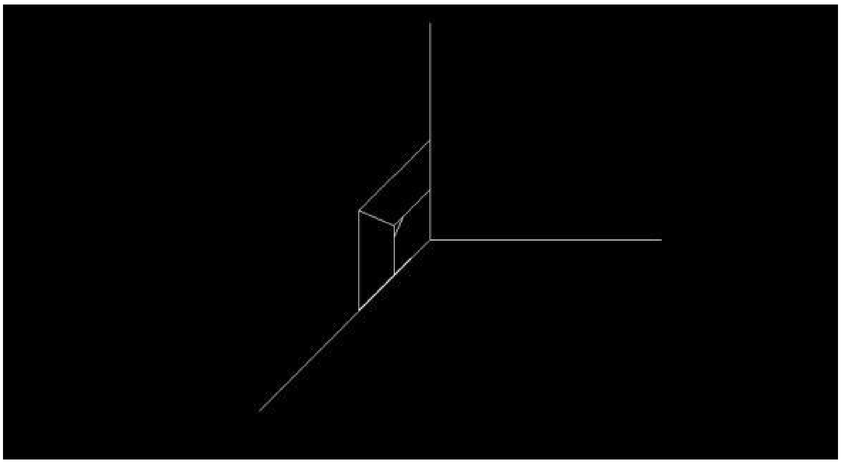
ROTATION ABOUT Y-AXIS BY AN ANGLE OF 45 DEGREE:



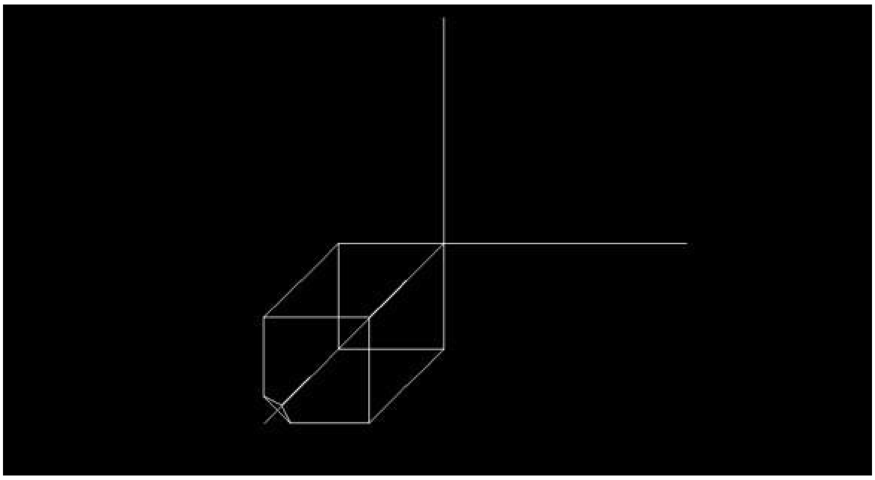
TRANSLATION FACTORS AS 20, 30, 40:



PERSPECTIVE PROJECTION ABOUT X-AXIS WHEN P=50:



REFLECTION ABOUT Z-AXIS:

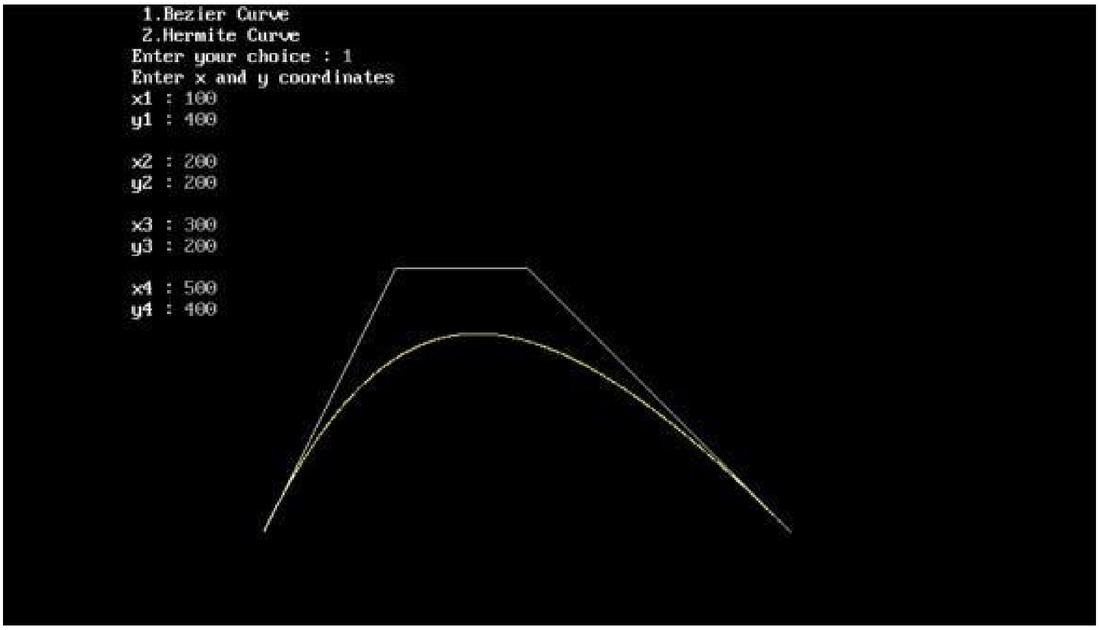


Q10 Write a program to draw Hermite/Bezier curve.

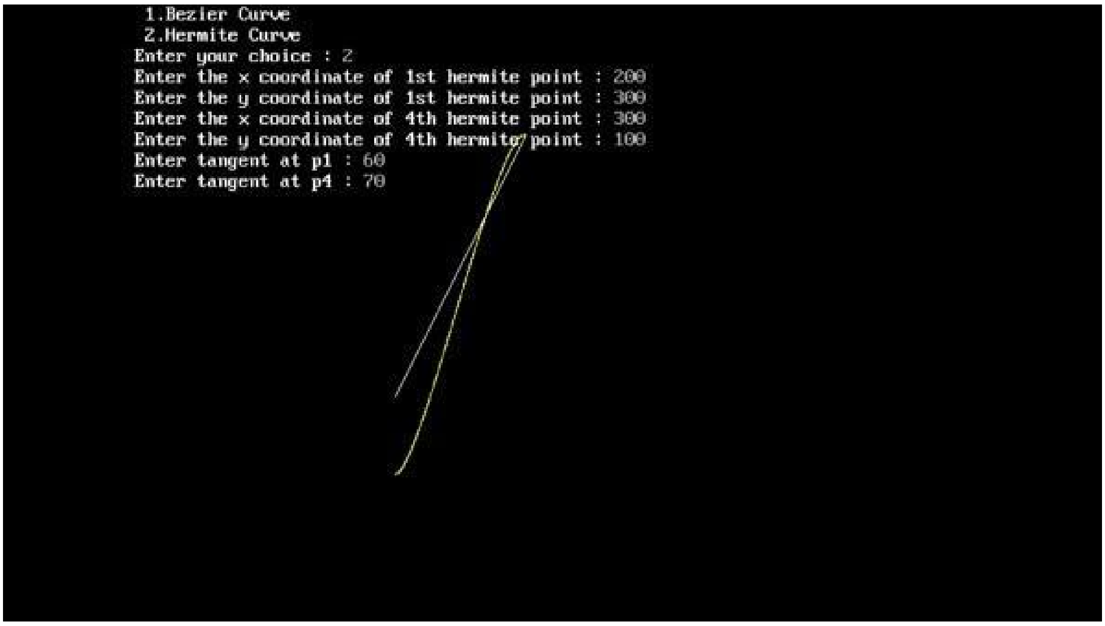
```
#include<iostream>
#include<conio.h>
#include<graphics.h> #include<math.h>
void bezier_curve(int x[4],int y[4]){ double
t;
for(t=0.0;t<1.0;t=t+0.0005){ double
xt=pow(1-t,3)*x[0]+3*t*pow(1-
t,2)*x[1]+3*pow(t,2)*(1-t)*x[2]+pow(t,3)*x[3];
double yt=pow(1-t,3)*y[0]+3*t*pow(1-
t,2)*y[1]+3*pow(t,2)*(1-t)*y[2]+pow(t,3)*y[3];
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
```