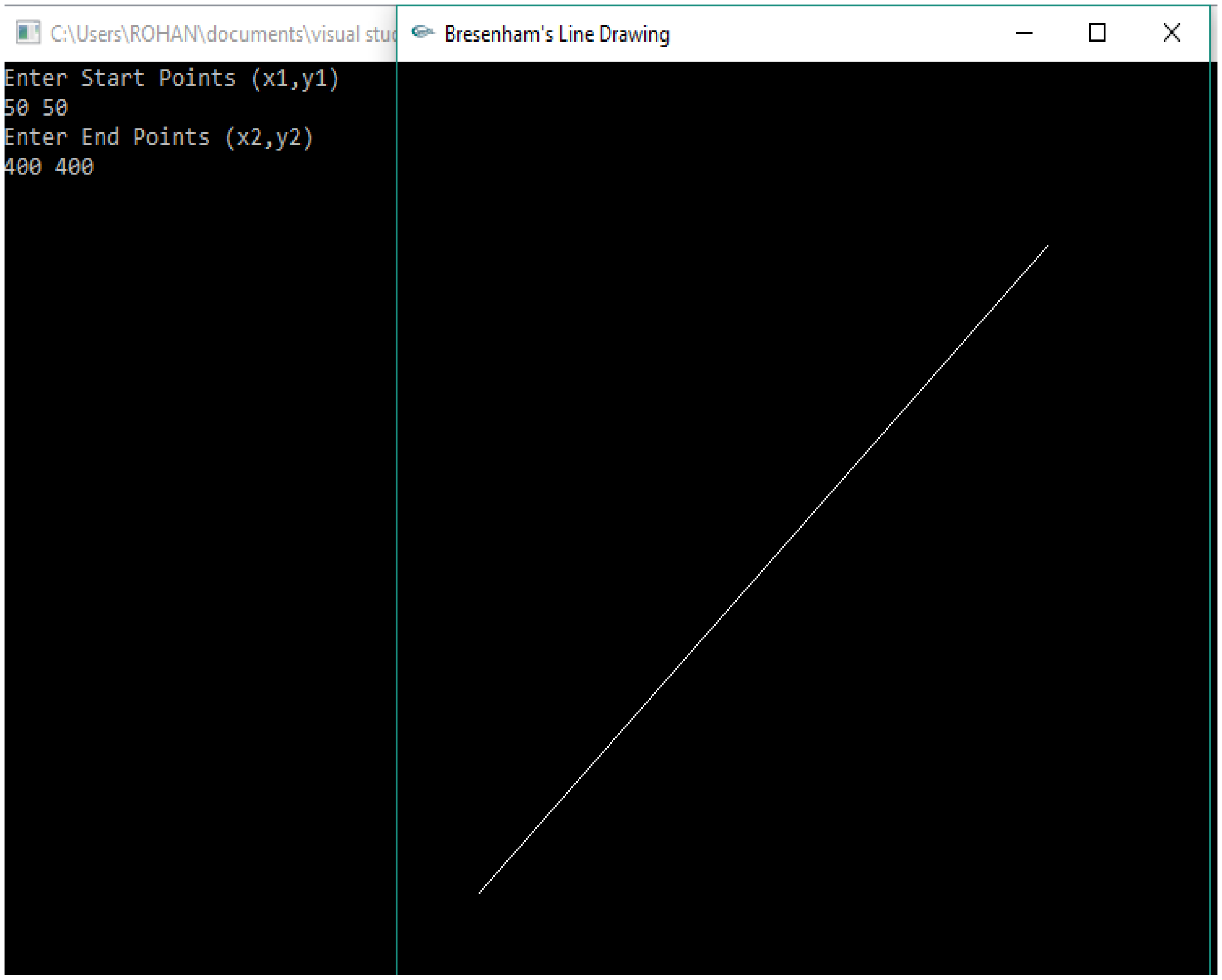
1. **Implement Brenham's line drawing algorithm for all types of slope.**

```
#include<GL/glut.h>
#include<stdio.h>

int x1, y1, x2, y2;

void draw_pixel(int x, int y)
{
      glColor3f(1.0,0.0,0.0);
      glBegin(GL_POINTS);
      glVertex2i(x, y);
      glEnd();
}

void brenhams_line_draw(int x1, int y1, int x2, int y2)
{
      int dx=x2-x1,dy=y2-y1;
      int p=2*dy*dx;
      int twoDy=2*dy;
      int twoDyMinusDx=2*(dy-dx);          // paranthesis are required
      int x=x1,y=y1;

      if(dx<0)
      {
            x=x2;
            y=y2;
            x2=x1;
      }
      draw_pixel(x, y);
      while(x<x2)
      {
            x++;
            if(p<0)
                  p+=twoDy;
            else
            {
                  y++;
                  p+=twoDyMinusDx;
            }
            draw_pixel(x, y);
      }
}
void myInit()
{
      glClearColor(0.0,0.0,0.0,1.0);
      glMatrixMode(GL_PROJECTION);
      glLoadIdentity();
      gluOrtho2D(0.0, 500.0, 0.0, 500.0);
      glMatrixMode(GL_MODELVIEW);
}
void display()
{
      glClear(GL_COLOR_BUFFER_BIT);
      brenhams_line_draw(x1, y1, x2, y2);
      glFlush();
}
void main(int argc, char **argv)
{
      printf( "Enter Start Points (x1,y1)\n");
      scanf("%d %d", &x1, &y1);
      printf( "Enter End Points (x2,y2)\n");
      scanf("%d %d", &x2, &y2);

      glutInit(&argc, argv);
      glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB);
      glutInitWindowSize(500, 500);
      glutInitWindowPosition(0, 0);
      glutCreateWindow("Bresenham's Line Drawing");
      myInit();
      glutDisplayFunc(display);
      glutMainLoop();
}
```

**OUTPUT** :



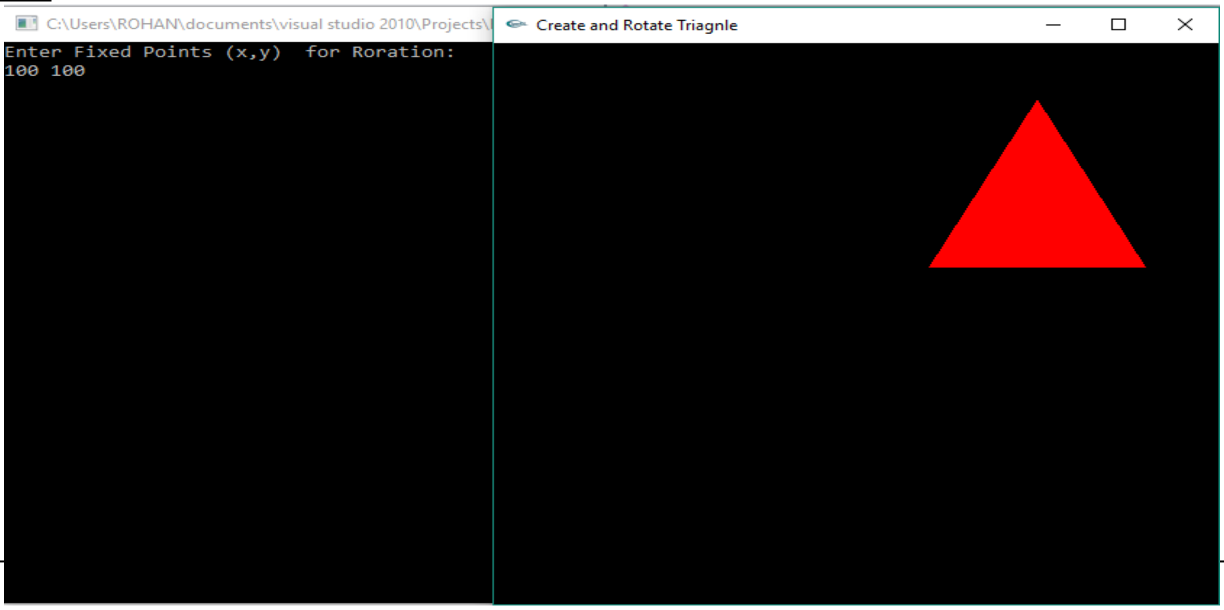
```
Enter Start Points (x1,y1)
50 50
Enter End Points (x2,y2)
400 400
```

## 2. Create and rotate a triangle about the origin and a fixed point.

```
#include<GL/glut.h>
#include<stdio.h>

int x,y;
int rFlag=0;

void draw_pixel(float x1,float y1)
{
      glColor3f(0.0,0.0,1.0);
      glPointSize(5.0);
      glBegin(GL_POINTS);
      glVertex2f(x1,y1);
      glEnd();
}

void triangle()
{
      glColor3f(1.0,0.0,0.0);
      glBegin(GL_POLYGON);
         glVertex2f(100,100);
         glVertex2f(250,400);
         glVertex2f(400,100);
      glEnd();
}

float th=0.0;
float trX=0.0,trY=0.0;
void display()
{
      glClear(GL_COLOR_BUFFER_BIT);
      glLoadIdentity();

      if(rFlag==1) //Rotate Around origin
      {
            trX=0.0;
            trY=0.0;
            th+=0.1;
            draw_pixel(0.0,0.0);
      }
      if(rFlag==2) //Rotate Around Fixed Point
      {
            trX=x;
            trY=y;
            th+=0.1;
            draw_pixel(x,y);
      }
      glTranslatef(trX,trY,0.0);
      glRotatef(th,0.0,0.0,1.0);
      glTranslatef(-trX,-trY,0.0);
        triangle();
      glutPostRedisplay();
      glutSwapBuffers();
}
```

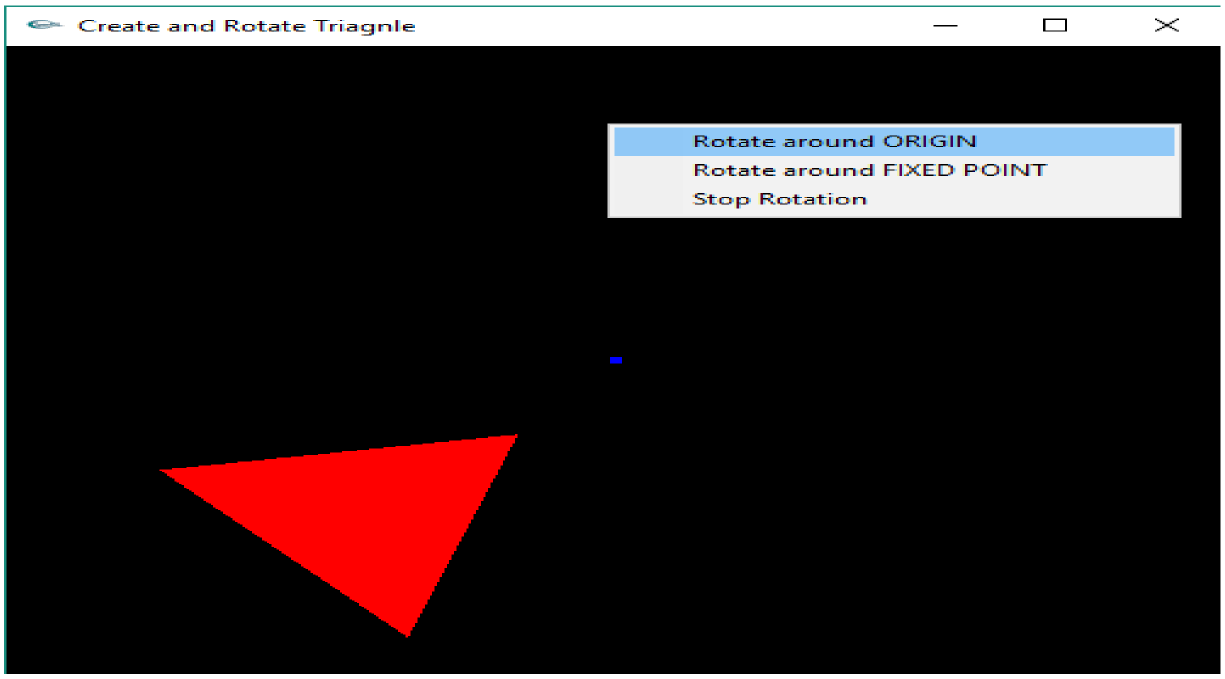
```
void myInit()
{
	glClearColor(0.0,0.0,0.0,1.0);
	glMatrixMode(GL_PROJECTION);
	glLoadIdentity();
	gluOrtho2D(-500.0, 500.0, -500.0, 500.0);
	glMatrixMode(GL_MODELVIEW);
}


void rotateMenu (int option)
{
	if(option==1)
		rFlag=1;
	if(option==2)
		rFlag=2;
	if(option==3)
		rFlag=3;
}
void main(int argc, char **argv)
{
	printf( "Enter Fixed Points (x,y) for Roration: \n");
	scanf("%d %d", &x, &y);
	glutInit(&argc, argv);
	glutInitDisplayMode(GLUT_DOUBLE|GLUT_RGB);
	glutInitWindowSize(500, 500);
	glutInitWindowPosition(0, 0);
	glutCreateWindow("Create and Rotate Triangle");
	myInit();
	glutDisplayFunc(display);
	glutCreateMenu(rotateMenu);
	glutAddMenuEntry("Rotate around ORIGIN",1);
	glutAddMenuEntry("Rotate around FIXED POINT",2);
	glutAddMenuEntry("Stop Rotation",3);
	glutAttachMenu(GLUT_RIGHT_BUTTON);
	glutMainLoop();
}
```

**OUTPUT :**

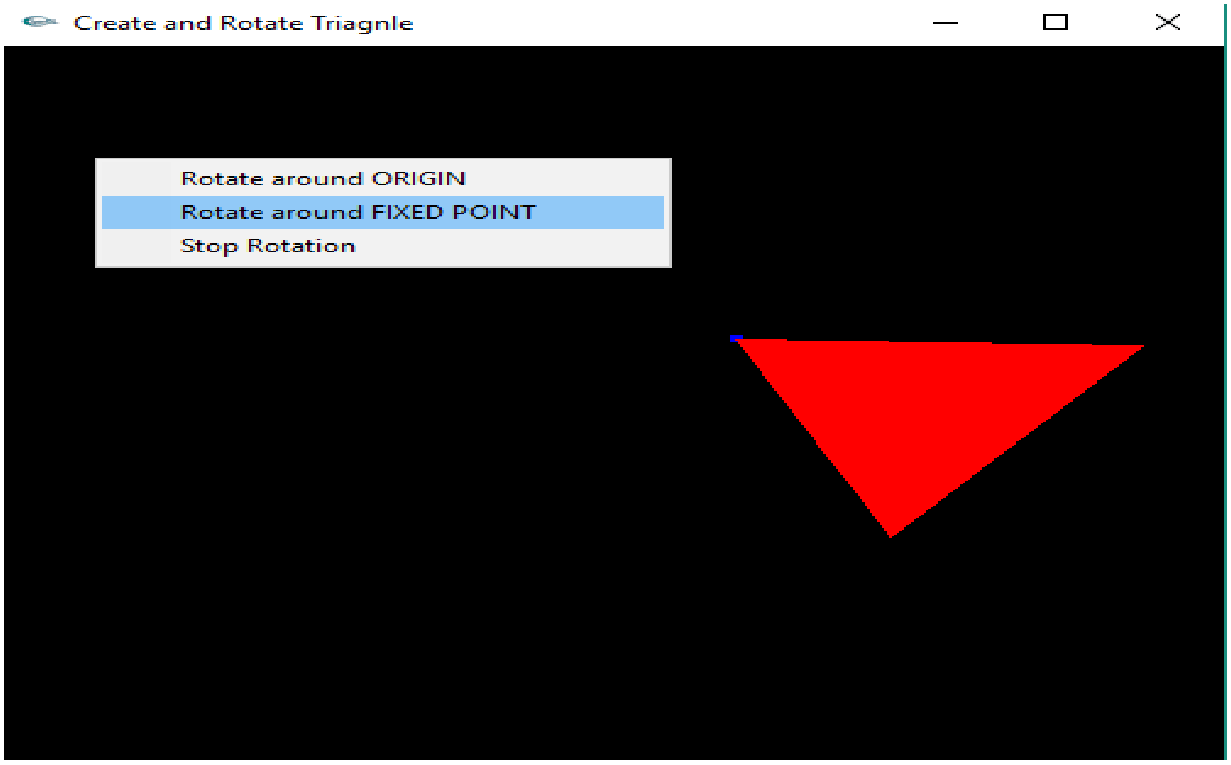

C:\Users\ROHAN\documents\visual studio 2010\Projects\
Create and Rotate Triagnle

```
Enter Fixed Points (x,y)  for Roration:
100 100
```

**Rotation Around the ORIGIN**



**Rotation Around the FIXED POINT**

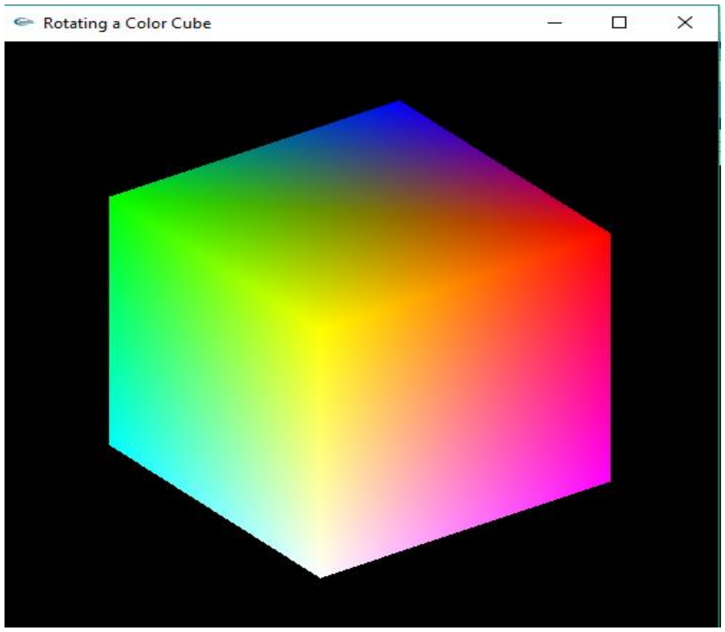


**3.Program to draw a color cube and spin it using OpenGL transformation matrices.**

```
#include <stdlib.h>
#include <GL/glut.h>
GLfloat vertices[][3] = {{-1,-1,-1},{1,-1,-1},{1,1,-1},{-1,1,-1},
                         {-1,-1,1},{1,-1,1}, {1,1,1},{-1,1,1}};
GLfloat colors[][3] = {{1,0,0},{1,1,0},{0,1,0},{0,0,1},
                       {1,0,1},{1,1,1},{0,1,1},{0.5,0.5,0.5}};


void polygon(int a, int b, int c , int d)
{
      glBegin(GL_POLYGON);
            glColor3fv(colors[a]);
            glVertex3fv(vertices[a]);
            glColor3fv(colors[b]);
            glVertex3fv(vertices[b]);
            glColor3fv(colors[c]);
            glVertex3fv(vertices[c]);
            glColor3fv(colors[d]);
            glVertex3fv(vertices[d]);
      glEnd();
}

void colorcube(void)
{
      polygon(0,3,2,1);
      polygon(0,4,7,3);
      polygon(5,4,0,1);
      polygon(2,3,7,6);
      polygon(1,2,6,5);
      polygon(4,5,6,7);
}

GLfloat theta[] = {0.0,0.0,0.0};
GLint axis = 2;

void display(void)
{
      glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
      glLoadIdentity();
      glRotatef(theta[0], 1.0, 0.0, 0.0);
      glRotatef(theta[1], 0.0, 1.0, 0.0);
      glRotatef(theta[2], 0.0, 0.0, 1.0);
      colorcube();
      glutSwapBuffers();
}

void spinCube()
{
      theta[axis] += 1.0;
      if( theta[axis] > 360.0 )
            theta[axis] -= 360.0;
      glutPostRedisplay();
}
```

```
void mouse(int btn, int state, int x, int y)
{
      if(btn==GLUT_LEFT_BUTTON && state == GLUT_DOWN) axis = 0;
      if(btn==GLUT_MIDDLE_BUTTON && state == GLUT_DOWN) axis = 1;
      if(btn==GLUT_RIGHT_BUTTON && state == GLUT_DOWN) axis = 2;
}

void myReshape(int w, int h)
{
    glViewport(0, 0, w, h);
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    if (w <= h)
        glOrtho(-2.0, 2.0, -2.0 * (GLfloat) h / (GLfloat) w,
            2.0 * (GLfloat) h / (GLfloat) w, -10.0, 10.0);
    else
        glOrtho(-2.0 * (GLfloat) w / (GLfloat) h,
            2.0 * (GLfloat) w / (GLfloat) h, -2.0, 2.0, -10.0, 10.0);
    glMatrixMode(GL_MODELVIEW);
}

void main(int argc, char *argv[])
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH);
    glutInitWindowSize(500, 500);
    glutCreateWindow("Rotating a Color Cube");
    glutReshapeFunc(myReshape);
    glutDisplayFunc(display);
    glutIdleFunc(spinCube);
    glutMouseFunc(mouse);
    glEnable(GL_DEPTH_TEST); /* Enable hidden--surface--removal */
    glutMainLoop();
}
```

**OUTPUT** :

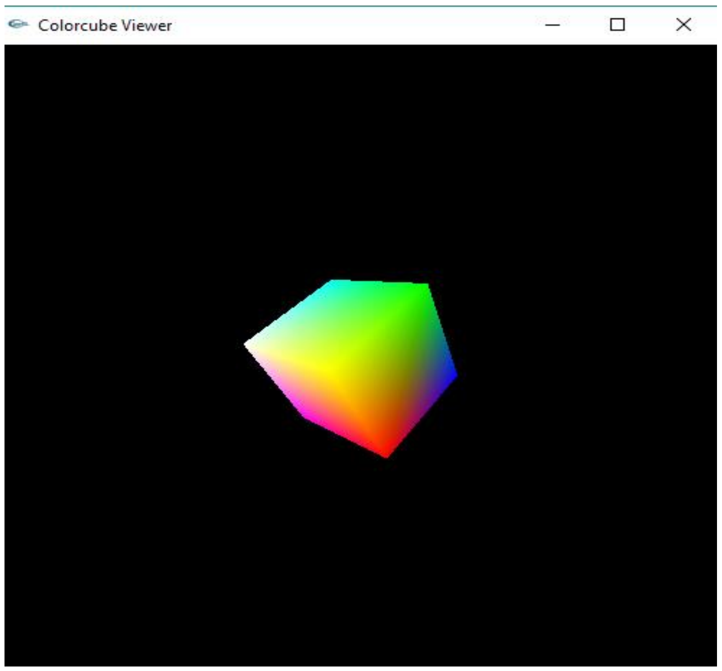


**4. Program to draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing.**

```
#include <stdlib.h>
#include <GL/glut.h>

GLfloat vertices[][3] = {{-1,-1,-1},{1,-1,-1},{1,1,-1},{-1,1,-1},
                         {-1,-1,1},{1,-1,1}, {1,1,1},{-1,1,1}};
GLfloat colors[][3] = {{1,0,0},{1,1,0},{0,1,0},{0,0,1},
                       {1,0,1},{1,1,1},{0,1,1},{0.5,0.5,0.5}};


void polygon(int a, int b, int c , int d)
{
      glBegin(GL_POLYGON);
            glColor3fv(colors[a]);
            glVertex3fv(vertices[a]);
            glColor3fv(colors[b]);
            glVertex3fv(vertices[b]);
            glColor3fv(colors[c]);
            glVertex3fv(vertices[c]);
            glColor3fv(colors[d]);
            glVertex3fv(vertices[d]);
      glEnd();
}

void colorcube(void)
{
      polygon(0,3,2,1);
      polygon(0,4,7,3);
      polygon(5,4,0,1);
      polygon(2,3,7,6);
      polygon(1,2,6,5);
      polygon(4,5,6,7);
}

GLfloat theta[] = {0.0,0.0,0.0};
GLint axis = 2;
GLdouble viewer[]= {0.0, 0.0, 5.0}; /* initial viewer location */

void display(void)
{
      glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
      glLoadIdentity();
      gluLookAt(viewer[0],viewer[1],viewer[2], 0.0, 0.0, 0.0, 0.0, 1.0, 0.0);
      glRotatef(theta[0], 1.0, 0.0, 0.0);
      glRotatef(theta[1], 0.0, 1.0, 0.0);
      glRotatef(theta[2], 0.0, 0.0, 1.0);
      colorcube();
       glFlush();
      glutSwapBuffers();
}
```

```
void mouse(int btn, int state, int x, int y)
{
      if(btn==GLUT_LEFT_BUTTON && state == GLUT_DOWN) axis = 0;
      if(btn==GLUT_MIDDLE_BUTTON && state == GLUT_DOWN) axis = 1;
      if(btn==GLUT_RIGHT_BUTTON && state == GLUT_DOWN) axis = 2;
      theta[axis] += 2.0;
      if( theta[axis] > 360.0 ) theta[axis] -= 360.0;
      display();
}

void keys(unsigned char key, int x, int y)
{
      if(key == 'x') viewer[0]-= 1.0;
      if(key == 'X') viewer[0]+= 1.0;
      if(key == 'y') viewer[1]-= 1.0;
      if(key == 'Y') viewer[1]+= 1.0;
      if(key == 'z') viewer[2]-= 1.0;
      if(key == 'Z') viewer[2]+= 1.0;
      display();
}

void myReshape(int w, int h)
{
      glViewport(0, 0, w, h);
      glMatrixMode(GL_PROJECTION);
      glLoadIdentity();
      if(w<=h)
            glFrustum(-2.0, 2.0, -2.0 * (GLfloat) h/ (GLfloat) w, 2.0* (GLfloat) h /
            (GLfloat) w,2.0, 20.0);
      else
            glFrustum(-2.0, 2.0, -2.0 * (GLfloat) w/ (GLfloat) h, 2.0* (GLfloat) w /
            (GLfloat) h, 2.0, 20.0);
      glMatrixMode(GL_MODELVIEW);
}

void  main(int argc, char **argv)
{
      glutInit(&argc, argv);
      glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH);
      glutInitWindowSize(500, 500);
      glutCreateWindow("Colorcube Viewer");
      glutReshapeFunc(myReshape);
      glutDisplayFunc(display);
      glutMouseFunc(mouse);
      glutKeyboardFunc(keys);
      glEnable(GL_DEPTH_TEST);
      glutMainLoop();
}
```

**OUTPUT** :



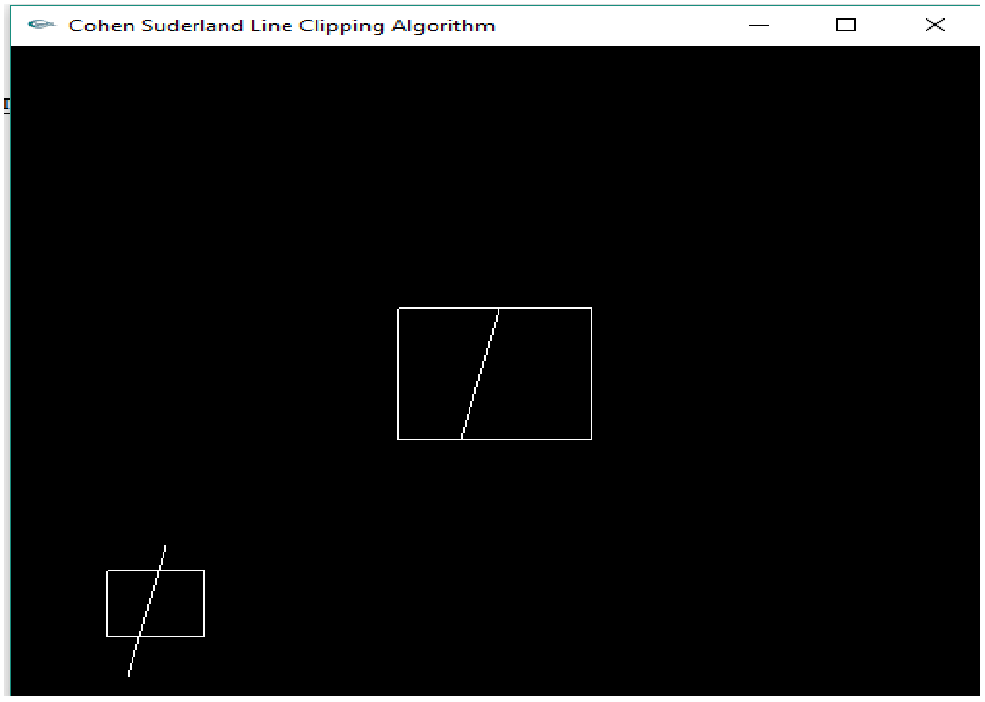
**5. Program to clip a lines using Cohen-Sutherland line-clipping algorithm.**

```
#include <stdio.h>
#include <GL\glut.h>

double xmin=50,ymin=50, xmax=100,ymax=100;
double xvmin=200,yvmin=200,xvmax=300,yvmax=300;
const int RIGHT = 8;
const int LEFT = 2;
const int TOP = 4;
const int BOTTOM = 1;

int ComputeOutCode (double x, double y)
{
      int code = 0;
      if (y > ymax)               //above the clip window
            code |= TOP;
      else if (y < ymin)          //below the clip window
            code |= BOTTOM;
      if (x > xmax)               //to the right of clip window
            code |= RIGHT;
      else if (x < xmin)          //to the left of clip window
            code |= LEFT;
      return code;
}
void CohenSutherland(double x0, double y0,double x1, double y1)
{
      int outcode0, outcode1, outcodeOut;
      bool accept = false, done = false;
      outcode0 = ComputeOutCode (x0, y0);
      outcode1 = ComputeOutCode (x1, y1);
      do{
            if (!(outcode0 | outcode1))
            {
                  accept = true;
                  done = true;
            }
            else if (outcode0 & outcode1)
                  done = true;
            else  {
                  double x, y;
                  outcodeOut = outcode0? outcode0: outcode1;
                  if (outcodeOut & TOP)
                  {
                        x = x0 + (x1 - x0) * (ymax - y0)/(y1 - y0);
                        y = ymax;
                  }
                  else if (outcodeOut & BOTTOM)
                  {
                        x = x0 + (x1 - x0) * (ymin - y0)/(y1 - y0);
                        y = ymin;
                  }
                  else if (outcodeOut & RIGHT)
                  {
                        y = y0 + (y1 - y0) * (xmax - x0)/(x1 - x0);
                        x = xmax;
                  }
```

```
                        else
                        {
                                y = y0 + (y1 - y0) * (xmin - x0)/(x1 - x0);
                                x = xmin;
                        }

                if (outcodeOut == outcode0)
                        {
                                x0 = x;
                                y0 = y;
                                outcode0 = ComputeOutCode (x0, y0);
                        }
                        else
                        {
                                x1 = x;
                                y1 = y;
                                outcode1 = ComputeOutCode (x1, y1);
                        }
                }
        }while (!done);

        if (accept)
        {
                double sx=(xvmax-xvmin)/(xmax-xmin);
                double sy=(yvmax-yvmin)/(ymax-ymin);
                double vx0=xvmin+(x0-xmin)*sx;
                double vy0=yvmin+(y0-ymin)*sy;
                double vx1=xvmin+(x1-xmin)*sx;
                double vy1=yvmin+(y1-ymin)*sy;

                glColor3f(1.0, 1.0, 1.0);
                glBegin(GL_LINE_LOOP);
                        glVertex2f(xvmin, yvmin);
                        glVertex2f(xvmax, yvmin);
                        glVertex2f(xvmax, yvmax);
                        glVertex2f(xvmin, yvmax);
                glEnd();

                glColor3f(1.0,1.0,1.0);
                glBegin(GL_LINES);
                        glVertex2d (vx0, vy0);
                        glVertex2d (vx1, vy1);
                glEnd();
        }
}

void display()
{
        double x0=60,y0=20,x1=80,y1=120;
        glClear(GL_COLOR_BUFFER_BIT);
        glColor3f(1.0,1.0,1.0);
        glBegin(GL_LINES);
          glVertex2d (x0, y0);
          glVertex2d (x1, y1);
        glEnd();
        glColor3f(1.0, 1.0, 1.0);
```

```
      glBegin(GL_LINE_LOOP);
            glVertex2f(xmin, ymin);
            glVertex2f(xmax, ymin);
            glVertex2f(xmax, ymax);
            glVertex2f(xmin, ymax);
      glEnd();
      CohenSutherland(x0,y0,x1,y1);
      glFlush();
}

void myinit()
{
      glClearColor(0.0,0.0,0.0,1.0);
      glMatrixMode(GL_PROJECTION);
      glLoadIdentity();
      gluOrtho2D(0.0,500.0,0.0,500.0);
      glMatrixMode(GL_MODELVIEW);

}
void main(int argc, char **argv)
{
      glutInit(&argc,argv);
      glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB);
      glutInitWindowSize(500,500);
      glutInitWindowPosition(0,0);
      glutCreateWindow("Cohen Suderland Line Clipping Algorithm");
      myinit();
      glutDisplayFunc(display);
      glutMainLoop();
}
```

**OUTPUT** :

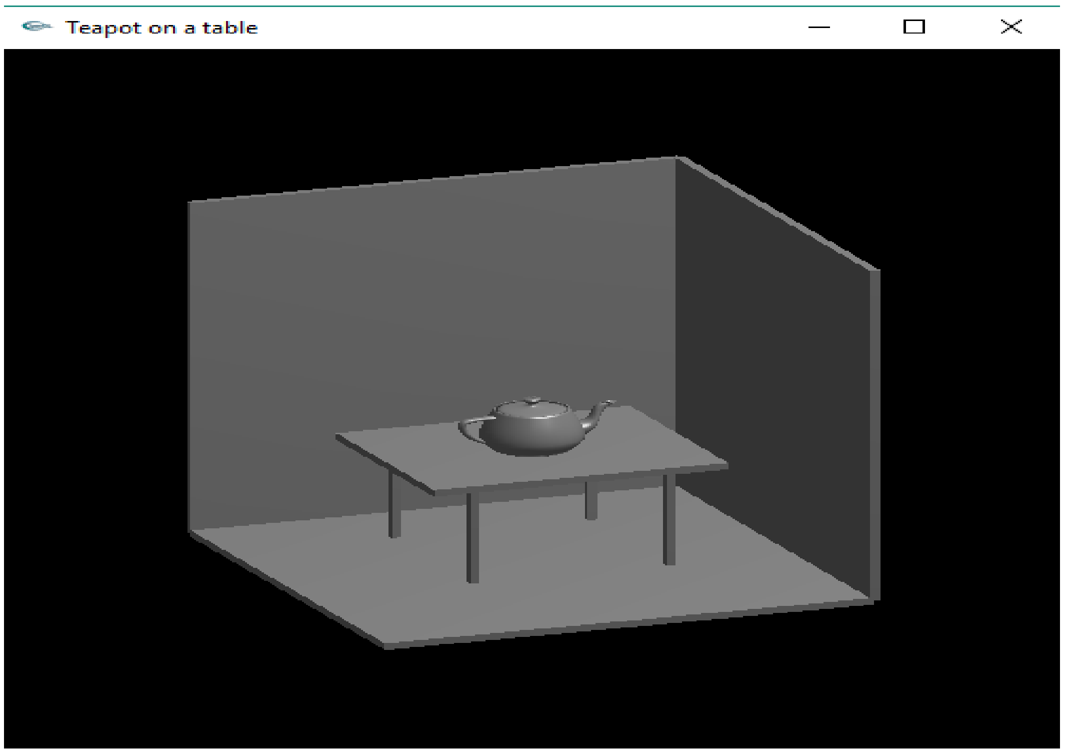


**6. Program to draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the properties of the surfaces of the solid object used in the scene.**

```
#include<GL/glut.h>

void teapot(GLfloat x,GLfloat y,GLfloat z)
{
	glPushMatrix();
	glTranslatef(x,y,z);
	glutSolidTeapot(0.1);
	glPopMatrix();
}

void tableTop(GLfloat x,GLfloat y,GLfloat z)
{
	glPushMatrix();
	glTranslatef(x,y,z);
	glScalef(0.6,0.02,0.5);
	glutSolidCube(1.0);
	glPopMatrix();
}

void tableLeg(GLfloat x,GLfloat y,GLfloat z)
{
	glPushMatrix();
	glTranslatef(x,y,z);
	glScalef(0.02,0.3,0.02);
	glutSolidCube(1.0);
	glPopMatrix();
}

void wall(GLfloat x,GLfloat y,GLfloat z)
{
	glPushMatrix();
	glTranslatef(x,y,z);
	glScalef(1.0,1.0,0.02);
	glutSolidCube(1.0);
	glPopMatrix();
}

void light()
{
	GLfloat mat_ambient[]={1.0,1.0,1.0,1.0};
	GLfloat mat_diffuse[]={0.5,0.5,0.5,1.0};
	GLfloat mat_specular[]={1.0,1.0,1.0,1.0};
	GLfloat mat_shininess[]={50.0f};
	glMaterialfv(GL_FRONT,GL_AMBIENT,mat_ambient);
	glMaterialfv(GL_FRONT,GL_DIFFUSE,mat_diffuse);
	glMaterialfv(GL_FRONT,GL_SPECULAR,mat_specular);
	glMaterialfv(GL_FRONT,GL_SHININESS,mat_shininess);
	GLfloat light_position[]={2.0,6.0,3.0,1.0};
	GLfloat lightIntensity[]={0.7,0.7,0.7,1.0};
	glLightfv(GL_LIGHT0,GL_POSITION,light_position);
	glLightfv(GL_LIGHT0,GL_DIFFUSE,lightIntensity);
}
```

```
void display()
{
      GLfloat teapotP=-0.07,tabletopP=-0.15,tablelegP=0.2,wallP=0.5;
      glClear(GL_COLOR_BUFFER_BIT|GL_DEPTH_BUFFER_BIT);
      glLoadIdentity();
      gluLookAt(-2.0,2.0,5.0,0.0,0.0,0.0,0.0,1.0,0.0);

      light();                            //Adding light source to your project

      teapot(0.0,teapotP,0.0);                                //Create teapot

      tableTop(0.0,tabletopP,0.0);                      //Create table’s top
      tableLeg(tablelegP,-0.3,tablelegP);               //Create 1st leg
      tableLeg(-tablelegP,-0.3,tablelegP);              //Create 2nd leg
      tableLeg(-tablelegP,-0.3,-tablelegP);             //Create 3rd leg
      tableLeg(tablelegP,-0.3,-tablelegP);              //Create 4th leg

      wall(0.0,0.0,-wallP);                             //Create 1st wall
      glRotatef(90.0,1.0,0.0,0.0);
      wall(0.0,0.0,wallP);                              //Create 2nd wall
      glRotatef(90.0,0.0,1.0,0.0);
      wall(0.0,0.0,wallP);                              //Create 3rd wall
      glFlush();
}

void myinit()
{
      glClearColor(0.0,0.0,0.0,1.0);
      glMatrixMode(GL_PROJECTION);
      glLoadIdentity();
      glOrtho(-1.0,1.0,-1.0,1.0,-1.0,10.0);
      glMatrixMode(GL_MODELVIEW);
}

void main(int argc,char **argv)
{
      glutInit(&argc,argv);
      glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB|GLUT_DEPTH);
      glutInitWindowSize(500,500);
      glutInitWindowPosition(0,0);
      glutCreateWindow("Teapot on a table");
      myinit();
      glutDisplayFunc(display);
      glEnable(GL_LIGHTING);
      glEnable(GL_LIGHT0);
      glShadeModel(GL_SMOOTH);
      glEnable(GL_NORMALIZE);
      glEnable(GL_DEPTH_TEST);
      glutMainLoop();
}
```

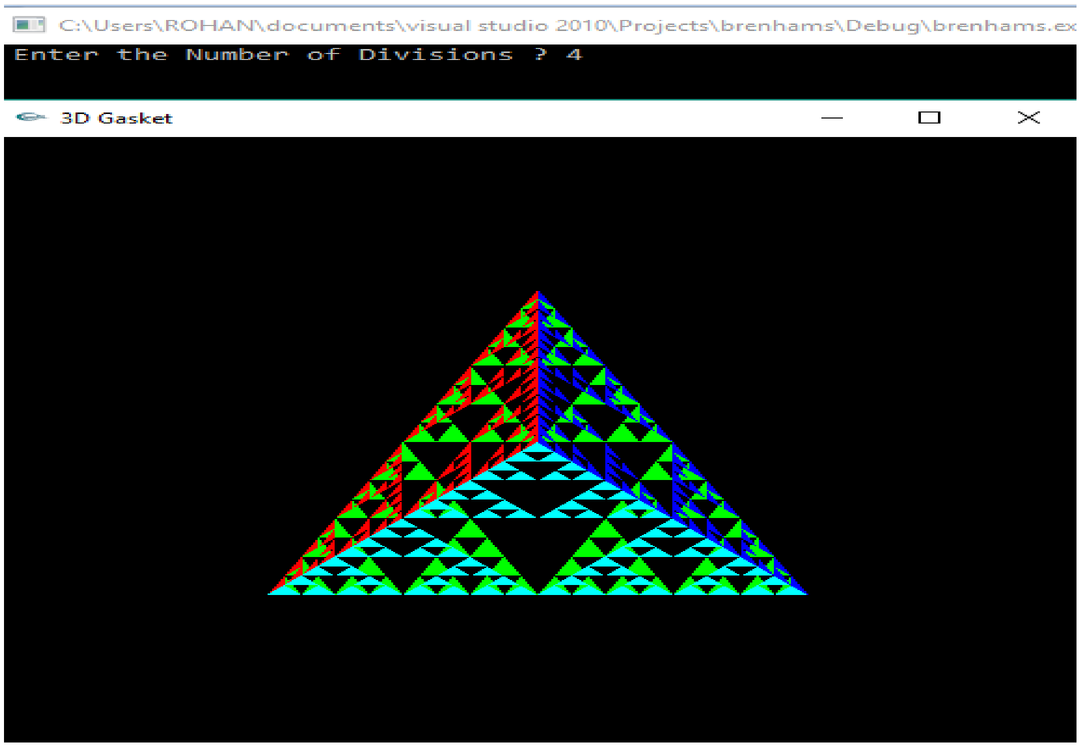
**OUTPUT** :



**7. Program to recursively subdivide a tetrahedron to from 3D Sierpinski gasket. The number of recursive steps is to be specified by the user**

```
#include <stdlib.h>
#include <stdio.h>
#include <GL/glut.h>

typedef float point[3];

point v[]={{0.0, 0.0, 0.0}, {0.0, 1.0, -1.0},{-1.0, -1.0, -1.0},
                    {1.0, -1.0, -1.0}};
int n;

void triangle( point a, point b, point c)
{
    glBegin(GL_POLYGON);
      glVertex3fv(a);
       glVertex3fv(b);
       glVertex3fv(c);
    glEnd();
}

void divide_triangle(point a, point b, point c, int m)
{
    point v1, v2, v3;
    int j;
    if(m>0)
    {
        for(j=0; j<3; j++) v1[j]=(a[j]+b[j])/2;
        for(j=0; j<3; j++) v2[j]=(a[j]+c[j])/2;
        for(j=0; j<3; j++) v3[j]=(b[j]+c[j])/2;
        divide_triangle(a, v1, v2, m-1);
        divide_triangle(c, v2, v3, m-1);
        divide_triangle(b, v3, v1, m-1);
    }
    else(triangle(a,b,c)); /* draw triangle at end of recursion */
}


void tetrahedron( int m)
{
      glColor3f(1.0,0.0,0.0);
    divide_triangle(v[0], v[1], v[2], m);
      glColor3f(0.0,1.0,0.0);
    divide_triangle(v[3], v[2], v[1], m);
      glColor3f(0.0,0.0,1.0);
    divide_triangle(v[0], v[3], v[1], m);
      glColor3f(0.0,0.0,0.0);
    divide_triangle(v[0], v[2], v[3], m);
}
void display(void)
{
      glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
      glLoadIdentity();
      tetrahedron(n);
      glFlush();
}

void myReshape(int w, int h)
{
    glViewport(0, 0, w, h);
    glMatrixMode(GL_PROJECTION);
    glLoadIdentity();
    if (w <= h)
        glOrtho(-2.0, 2.0, -2.0 * (GLfloat) h / (GLfloat) w,
            2.0 * (GLfloat) h / (GLfloat) w, -10.0, 10.0);
    else
        glOrtho(-2.0 * (GLfloat) w / (GLfloat) h,
            2.0 * (GLfloat) w / (GLfloat) h, -2.0, 2.0, -10.0, 10.0);
    glMatrixMode(GL_MODELVIEW);
}

void main(int argc, char **argv)
{
      printf(" Enter the Number of Divisions ? ");
      scanf("%d",&n);
      glutInit(&argc, argv);
      glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB | GLUT_DEPTH);
      glutInitWindowSize(500, 500);
      glutCreateWindow("3D Gasket");
      glutReshapeFunc(myReshape);
      glutDisplayFunc(display);
      glEnable(GL_DEPTH_TEST);
      glClearColor (1.0, 1.0, 1.0, 1.0);
      glutMainLoop();
}
```

**OUTPUT** :


C:\Users\ROHAN\documents\visual studio 2010\Projects\brenhams\Debug\brenhams.ex
3D Gasket

```
Enter the Number of Divisions ? 4
```

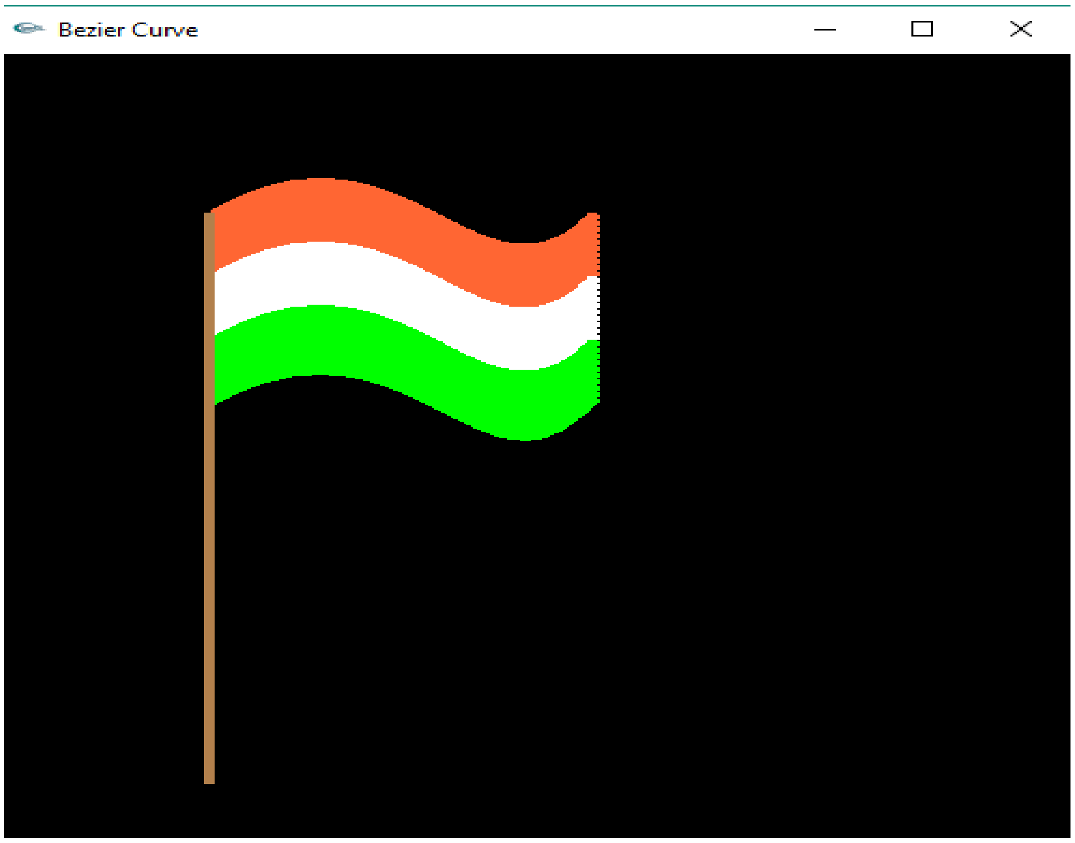
**8. Develop a menu driven program to animate a flag using Bezier curve algorithm.**

```
#include<GL/glut.h>
#include<stdio.h>
#include<math.h>
#define PI 3.1416
typedef struct point
{
            GLfloat x, y, z;
};
void bino(int n, int *C)
{
      int k, j;
      for(k=0;k<=n;k++)
            {
                        C[k]=1;
                        for(j=n;j>=k+1; j--)
                        C[k]*=j;
                        for(j=n-k;j>=2;j--)
                        C[k]/=j;
            }
}
void computeBezPt(float u, point *pt1, int cPt, point *pt2, int *C)
{
            int k, n=cPt-1;
            float bFcn;
            pt1 ->x =pt1 ->y = pt1->z=0.0;
            for(k=0; k< cPt; k++)
            {
                        bFcn = C[k] * pow(u, k) * pow( 1-u, n-k);
                        pt1 ->x += pt2[k].x * bFcn;
                        pt1 ->y += pt2[k].y * bFcn;
                        pt1 ->z += pt2[k].z * bFcn;
            }
}
void bezier(point *pt1, int cPt, int bPt)
{
            point bcPt;
            float u;
            int *C, k;
            C= new int[cPt];
            bino(cPt-1, C);
            glBegin(GL_LINE_STRIP);
            for(k=0; k<=bPt; k++)
            {
                        u=float(k)/float(bPt);
                        computeBezPt(u, &bcPt, cPt, pt1, C);
                        glVertex2f(bcPt.x, bcPt.y);
            }
            glEnd();
            delete[]C;
}
```

```
float theta = 0;
void display()
{
            glClear(GL_COLOR_BUFFER_BIT);
            int nCtrlPts = 4, nBCPts =20;
            point ctrlPts[4] = {{100, 400, 0},  {150, 450, 0},  {250, 350, 0},
                                    {300, 400, 0}};
            ctrlPts[1].x +=50*sin(theta * PI/180.0);
            ctrlPts[1].y +=25*sin(theta * PI/180.0);
            ctrlPts[2].x -= 50*sin((theta+30)  * PI/180.0);
            ctrlPts[2].y -= 50*sin((theta+30)  * PI/180.0);
            ctrlPts[3].x -= 25*sin((theta)  * PI/180.0);
            ctrlPts[3].y += sin((theta-30)  * PI/180.0);
            theta+=0.2;
            glClear(GL_COLOR_BUFFER_BIT);
            glColor3f(1.0, 1.0, 1.0);
            glPointSize(5);
            glPushMatrix();
            glLineWidth(5);
            glColor3f(1, 0.4, 0.2);  //Indian flag: Orange color code
            for(int i=0;i<50;i++)
            {
                        glTranslatef(0, -0.8, 0);
                        bezier(ctrlPts, nCtrlPts, nBCPts);
            }
            glColor3f(1, 1, 1);     //Indian flag: white color code
            for(int i=0;i<50;i++)
            {
                        glTranslatef(0, -0.8, 0);
                        bezier(ctrlPts, nCtrlPts, nBCPts);
            }
            glColor3f(0, 1, 0);     //Indian flag: green color code
            for(int i=0;i<50;i++)
            {
                        glTranslatef(0, -0.8, 0);
                        bezier(ctrlPts, nCtrlPts, nBCPts);
            }
            glPopMatrix();
            glColor3f(0.7, 0.5,0.3);
            glLineWidth(5);
            glBegin(GL_LINES);
                        glVertex2f(100,400);
                        glVertex2f(100,40);
            glEnd();

            glutPostRedisplay();
            glutSwapBuffers();
}
void init()
{
            glMatrixMode(GL_PROJECTION);
            glLoadIdentity();
            gluOrtho2D(0,500,0,500);
}
```

```
void main(int argc, char **argv)
{
            glutInit(&argc, argv);
            glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB);
            glutInitWindowPosition(0, 0);
            glutInitWindowSize(500,500);
            glutCreateWindow("Bezier Curve");
            init();
            glutDisplayFunc(display);
            glutMainLoop();
}
```

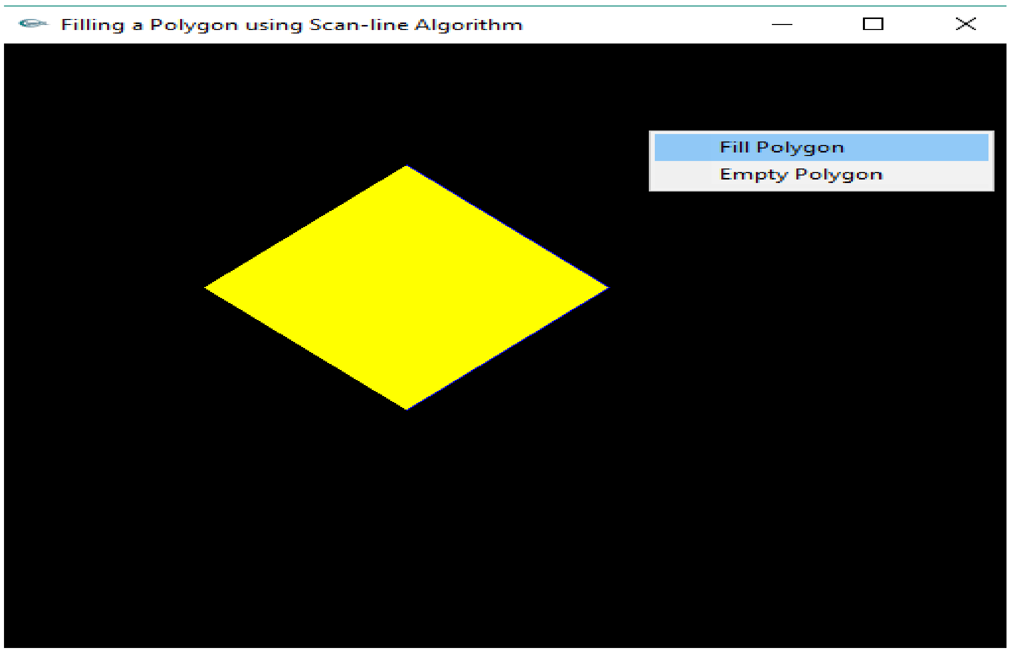
**OUTPUT** :



**9. Develop a menu driven program to fill any given polygon using scan-line area filling algorithm.**

```
#include <stdlib.h>
#include <stdio.h>
#include <glut.h>
float x1,x2,x3,x4,y1,y2,y3,y4;
int fillFlag=0;
void edgedetect(float x1,float y1,float x2,float y2,int *le,int *re)
{
float mx,x,temp;
int i;
      if((y2-y1)<0){
            temp=y1;y1=y2;y2=temp;
            temp=x1;x1=x2;x2=temp;
      }
      if((y2-y1)!=0)
            mx=(x2-x1)/(y2-y1);
      else
            mx=x2-x1;
      x=x1;
      for(i=y1;i<=y2;i++)
      {
            if(x<(float)le[i])
                  le[i]=(int)x;
            if(x>(float)re[i])
                  re[i]=(int)x;
            x+=mx;
      }
}
void draw_pixel(int x,int y)
{
      glColor3f(1.0,1.0,0.0);
      glBegin(GL_POINTS);
      glVertex2i(x,y);
      glEnd();
}
void scanfill(float x1,float y1,float x2,float y2,float x3,float y3,float x4,float y4)
{
      int le[500],re[500];
      int i,y;
      for(i=0;i<500;i++)
      {
            le[i]=500;
            re[i]=0;
      }
      edgedetect(x1,y1,x2,y2,le,re);
      edgedetect(x2,y2,x3,y3,le,re);
      edgedetect(x3,y3,x4,y4,le,re);
      edgedetect(x4,y4,x1,y1,le,re);
      for(y=0;y<500;y++)
      {

                  for(i=(int)le[y];i<(int)re[y];i++)
                        draw_pixel(i,y);
      }
}
void display()
{
x1=200.0;y1=200.0;x2=100.0;y2=300.0;x3=200.0;y3=400.0;x4=300.0;y4=300.0;
glClear(GL_COLOR_BUFFER_BIT);
glColor3f(0.0, 0.0, 1.0);
glBegin(GL_LINE_LOOP);
            glVertex2f(x1,y1);
            glVertex2f(x2,y2);
            glVertex2f(x3,y3);
            glVertex2f(x4,y4);
      glEnd();
      if(fillFlag==1)
      scanfill(x1,y1,x2,y2,x3,y3,x4,y4);
glFlush();
}

void init()
{
      glClearColor(0.0,0.0,0.0,1.0);
      glColor3f(1.0,0.0,0.0);
      glPointSize(1.0);
      glMatrixMode(GL_PROJECTION);
      glLoadIdentity();
      gluOrtho2D(0.0,499.0,0.0,499.0);
}
void fillMenu(int option)
{
      if(option==1)
            fillFlag=1;
      if(option==2)
            fillFlag=2;
      display();
}
void main(int argc, char* argv[])
{
      glutInit(&argc,argv);
      glutInitDisplayMode(GLUT_SINGLE|GLUT_RGB);
      glutInitWindowSize(500,500);
      glutInitWindowPosition(0,0);
      glutCreateWindow("Filling a Polygon using Scan-line Algorithm");
      init();
      glutDisplayFunc(display);
      glutCreateMenu(fillMenu);
      glutAddMenuEntry("Fill Polygon",1);
      glutAddMenuEntry("Empty Polygon",2);
      glutAttachMenu(GLUT_RIGHT_BUTTON);
      glutMainLoop();
}
```

**OUTPUT** :



**WEB LINK** :

https://drive.google.com/open?id=1nS2plGPXyv4n3I0bBYnWSMBae3gTzl6J

**You can visit above link to get the following**

1. **Softcopy of CG LAB(15CSL68) Manual.**
2. **Output daigrams of each experiments.**