COMPUTER GRAPHICS (16CS73)
LAB PROGRAMS(1-4)

Prepared by

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1. Write a program to generate a line using Bresenham's line drawing technique. Consider slopes greater than one and slopes less than one. User must able to draw as many lines and specify inputs through keyboard/mouse.

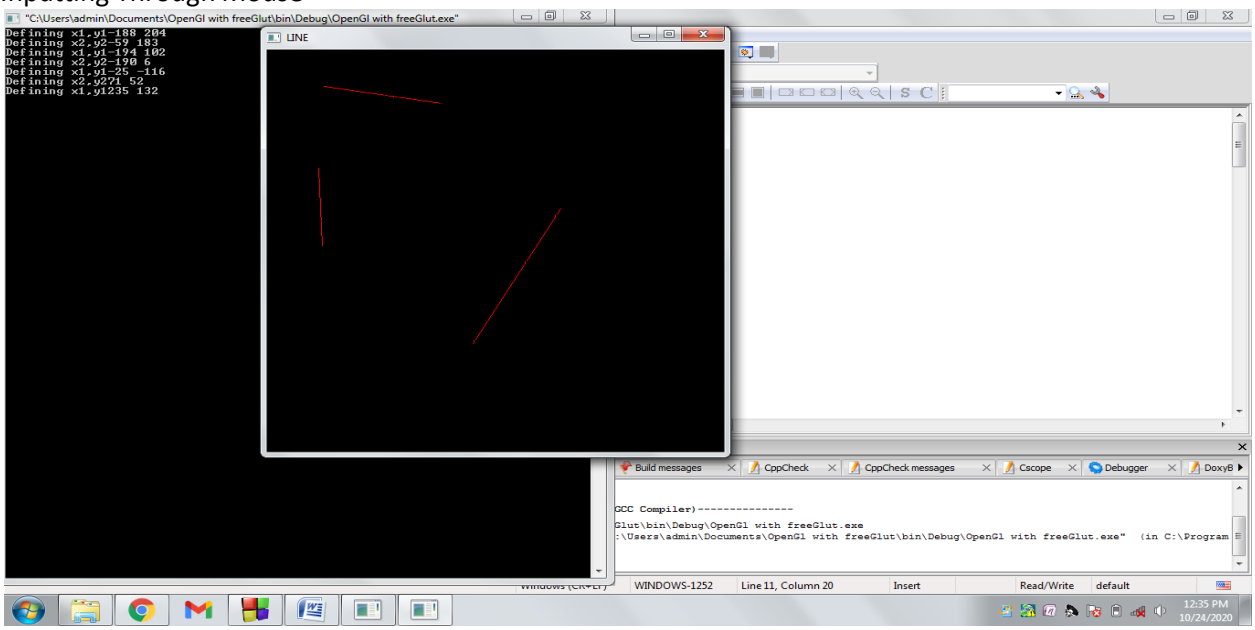
```
#include <iostream>
#include <GL/glut.h>
#include <time.h>
#include <stdio.h>
using namespace std;
int x1, x2, yc1, y2;
int flag = 0;
void draw_pixel(int x, int y)
{
	glColor3f(1, 0, 0);
	glBegin(GL_POINTS);
	glVertex2i(x, y);
	glEnd();
	glFlush();
}
void draw_line()
{
	int dx, dy, i, e;
	int incx, incy, inc1, inc2;
	int x, y;
	dx = x2 - x1;
	dy = y2 - yc1;
	if (dx < 0)dx = -dx;
	if (dy < 0)dy = -dy;
	incx = 1;
	if (x2 < x1)
		incx = -1;
	incy = 1;
	if (y2 < yc1)
		incy = -1;
	x = x1;
	y = yc1;
	if (dx > dy)
	{
		draw_pixel(x, y);
		e = 2 * dy - dx;
		inc1 = 2 * (dy - dx);
		inc2 = 2 * dy;
		for (i = 0; i < dx; i++)
		{
			if (e > 0)
			{
				y += incy;
				e += inc1;
			}
			else
				e += inc2;
```

```
                x += incx;
                draw_pixel(x, y);
            }
        }
        else
        {

            draw_pixel(x, y);
            e = 2 * dx - dy;
            inc1 = 2 * (dx - dy);
            inc2 = 2 * dx;
            for (i = 0; i < dy; i++)
            {
                if (e > 0)
                {
                    x += incx;
                    e += inc1;

                }
                else

                    e += inc2;
                y += incy;

                draw_pixel(x, y);
            }
        }
        glFlush();
}
void myinit()
{
        glClear(GL_COLOR_BUFFER_BIT);
        glClearColor(1, 1, 1, 1);
        gluOrtho2D(-250, 250, -250, 250);
}
void MyMouse(int button, int state, int x, int y)
{
        switch (button)
        {
        case GLUT_LEFT_BUTTON:
            if (state == GLUT_DOWN)
            {
                if (flag == 0)
                {
                    printf("Defining x1,y1");
                    x1 = x - 250;
                    yc1 = 250 - y;
                    flag++;
                    cout << x1 << " " << yc1 << " \n";
                }
                else
                {
```

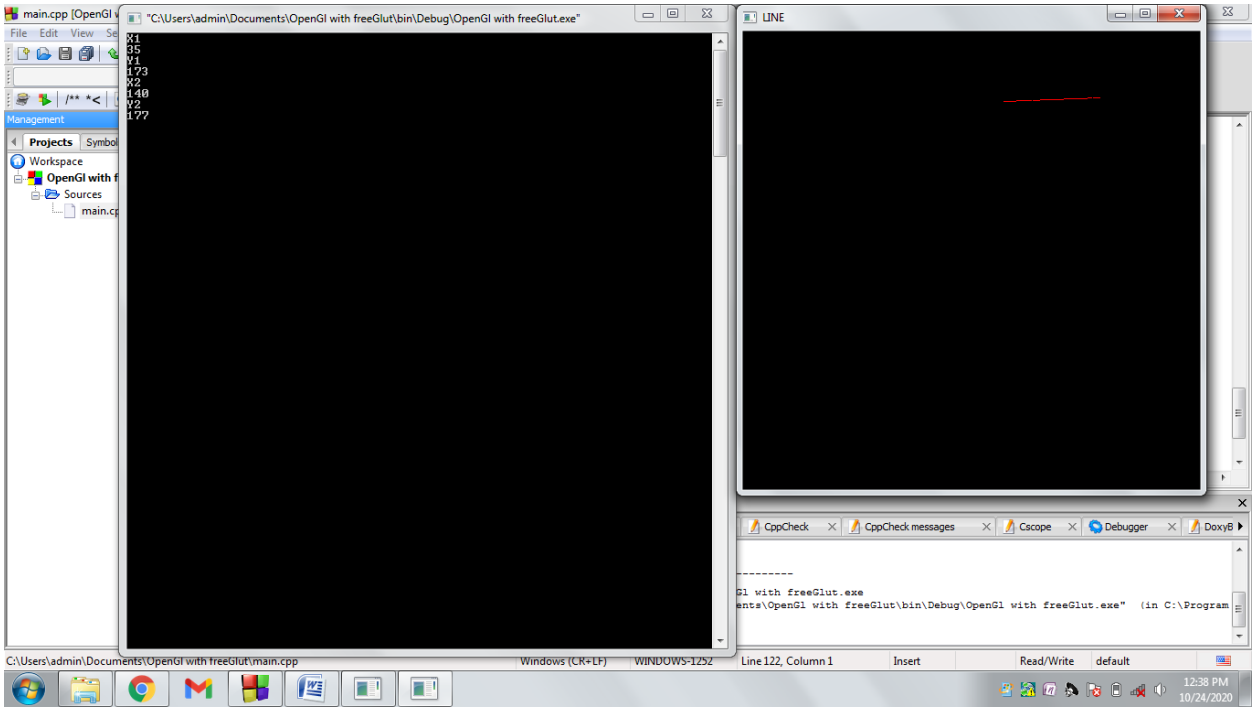
```
                                printf("Defining x2,y2");
                                x2 = x - 250;
                                y2 = 250 - y;
                                flag = 0;
                                cout << x2 << " " << y2 << " \n";
                                draw_line();

                        }

                }
                break;
        }
}
void display()
{}
int main(int ac, char* av[])
{
        /*
        //FOR KEYBOARD
        cout<<"X1\n";
        cin>>x1;
        cout<<"Y1\n";
        cin>>yc1;
        cout<<"X2\n";
        cin>>x2;
        cout<<"Y2\n";
        cin>>y2;
        //END KEYBOARD
        */
        glutInit(&ac, av);
        glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
        glutInitWindowSize(500, 500);
        glutInitWindowPosition(100, 200);
        glutCreateWindow("LINE");
        myinit();
        glutMouseFunc(MyMouse); //INCLUDE TO USE MOUSE, REMOVE WHILE USING KEYBOARD
        //draw_line(); //INCLUDE TO USE KEYBOARD, REMOVE WHILE USING MOUSE
        glutDisplayFunc(display);
        glutMainLoop();
}
```

OUTPUT :

1. Inputting Through Mouse



2. Inputting Through Keyboard



2. **Write a program to generate a circle and ellipse using Bresenham's circle drawing and ellipse drawing techniques. Use two windows to draw circle in one window and ellipse in the other window. User can specify inputs through keyboard/mouse.**

```
#include<gl/glut.h>
#include<stdio.h>
#include<math.h>
int xc, yc, r;
int rx, ry, xce, yce;
void draw_circle(int xc, int yc, int x, int y)
{
	glBegin(GL_POINTS);
	glVertex2i(xc + x, yc + y);
	glVertex2i(xc - x, yc + y);
	glVertex2i(xc + x, yc - y);
	glVertex2i(xc - x, yc - y);
	glVertex2i(xc + y, yc + x);
	glVertex2i(xc - y, yc + x);
	glVertex2i(xc + y, yc - x);
	glVertex2i(xc - y, yc - x);
	glEnd();
}
void circlebres()
{
	glClear(GL_COLOR_BUFFER_BIT);
	int x = 0, y = r;
	int d = 3 - 2 * r;
	while (x <= y)
	{
		draw_circle(xc, yc, x, y);
		x++;
		if (d < 0)
			d = d + 4 * x + 6;
		else
		{
			y--;
			d = d + 4 * (x - y) + 10;
		}
		draw_circle(xc, yc, x, y);
	}
	glFlush();
}
int p1_x, p2_x, p1_y, p2_y;
int point1_done = 0;
void myMouseFunccircle(int button, int state, int x, int y)
{
	if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1_done == 0)
	{
		p1_x = x - 250;
		p1_y = 250 - y;
		point1_done = 1;
```

```
	}
	else if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN)
	{
		p2_x = x - 250;
		p2_y = 250 - y;
		xc = p1_x;
		yc = p1_y;
		float exp = (p2_x - p1_x) * (p2_x - p1_x) + (p2_y - p1_y) * (p2_y - p1_y);
		r = (int)(sqrt(exp));
		circlebres();
		point1_done = 0;
	}
}


/////ELLIPSE//////////////
void draw_ellipse(int xce, int yce, int x, int y)
{
	glBegin(GL_POINTS);
	glVertex2i(x + xce, y + yce);
	glVertex2i(-x + xce, y + yce);
	glVertex2i(x + xce, -y + yce);
	glVertex2i(-x + xce, -y + yce);
	glEnd();
}
void midptellipse()
{
	glClear(GL_COLOR_BUFFER_BIT);
	float dx, dy, d1, d2, x, y;
	x = 0;
	y = ry;

	// Initial decision parameter of region 1
	d1 = (ry * ry) - (rx * rx * ry) +
		(0.25 * rx * rx);
	dx = 2 * ry * ry * x;
	dy = 2 * rx * rx * y;

	// For region 1
	while (dx < dy)
	{

		// Print points based on 4-way symmetry
		draw_ellipse(xce, yce, x, y);



		// Checking and updating value of
		// decision parameter based on algorithm
		if (d1 < 0)
		{
			x++;
```

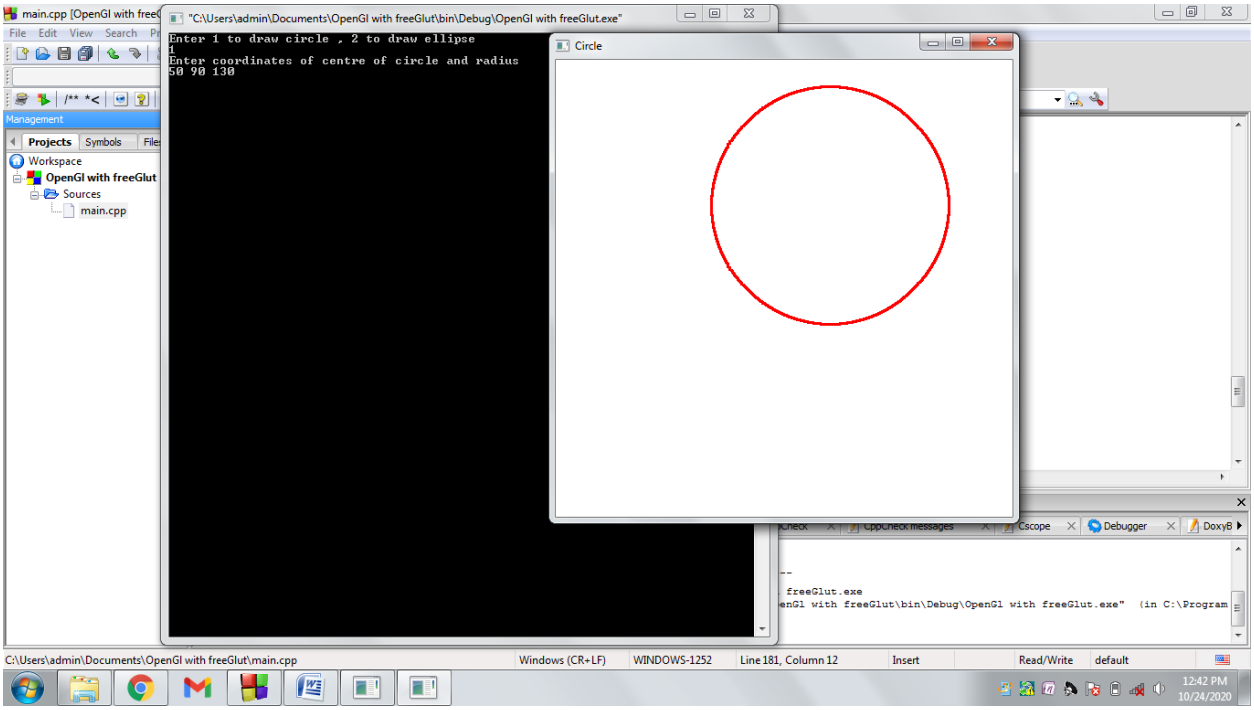
```
                dx = dx + (2 * ry * ry);
                d1 = d1 + dx + (ry * ry);
            }
            else
            {
                x++;
                y--;
                dx = dx + (2 * ry * ry);
                dy = dy - (2 * rx * rx);
                d1 = d1 + dx - dy + (ry * ry);
            }
        }

        // Decision parameter of region 2
        d2 = ((ry * ry) * ((x + 0.5) * (x + 0.5))) +
            ((rx * rx) * ((y - 1) * (y - 1))) -
            (rx * rx * ry * ry);

        // Plotting points of region 2
        while (y >= 0)
        {

            // Print points based on 4-way symmetry
            draw_ellipse(xce, yce, x, y);

            // Checking and updating parameter
            // value based on algorithm
            if (d2 > 0)
            {
                y--;
                dy = dy - (2 * rx * rx);
                d2 = d2 + (rx * rx) - dy;
            }
            else
            {
                y--;
                x++;
                dx = dx + (2 * ry * ry);
                dy = dy - (2 * rx * rx);
                d2 = d2 + dx - dy + (rx * rx);
            }
        }
        glFlush();
}
int p1e_x, p2e_x, p1e_y, p2e_y, p3e_x, p3e_y;
int point1e_done = 0;
void myMouseFunc(int button, int state, int x, int y)
{
        if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1e_done == 0)
        {
            p1e_x = x - 250;
            p1e_y = 250 - y;
```

```
			xce = p1e_x;
			yce = p1e_y;
			point1e_done = 1;
		}
		else if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1e_done == 1)
		{
			p2e_x = x - 250;
			p2e_y = 250 - y;
			float exp = (p2e_x - p1e_x) * (p2e_x - p1e_x) + (p2e_y - p1e_y) * (p2e_y - p1e_y);
			rx = (int)(sqrt(exp));
			//midptellipse();
			point1e_done = 2;
		}
		else if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN && point1e_done == 2)
		{
			p3e_x = x - 250;
			p3e_y = 250 - y;
			float exp = (p3e_x - p1e_x) * (p3e_x - p1e_x) + (p3e_y - p1e_y) * (p3e_y - p1e_y);
			ry = (int)(sqrt(exp));
			midptellipse();
			point1e_done = 0;
		}
}
void myDrawing()
{ }
void myDrawingc()
{ }

void minit()
{
		glClearColor(1, 1, 1, 1);
		glColor3f(1.0, 0.0, 0.0);
		glPointSize(3.0);
		gluOrtho2D(-250, 250, -250, 250);
}

int main(int argc, char* argv[])
{

		glutInit(&argc, argv);
		glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
		glutInitWindowSize(500, 500);
		glutInitWindowPosition(0, 0);
		/*
		//FOR MOUSE
		int id1 = glutCreateWindow("Circle");
		glutSetWindow(id1);
		glutMouseFunc(myMouseFunccircle);
		glutDisplayFunc(myDrawingc);
		minit();
		glutInitWindowSize(500, 500);
		glutInitWindowPosition(600, 100);
```

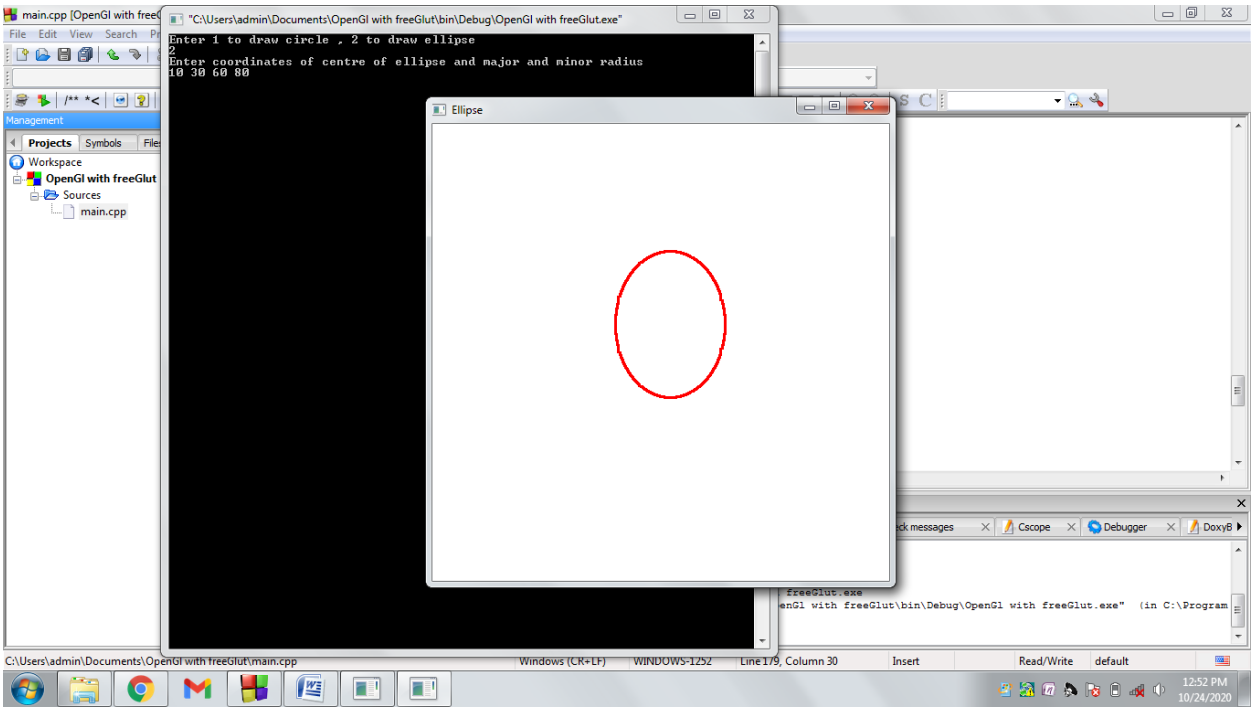
```
int id2 = glutCreateWindow("Ellipse");
glutSetWindow(id2);
glutMouseFunc(myMouseFunc);
glutDisplayFunc(myDrawing);
//END MOUSE
*/
//FOR KEYBOARD
printf("Enter 1 to draw circle , 2 to draw ellipse\n");
int ch;
scanf("%d",&ch);
switch(ch){
case 1:
printf("Enter coordinates of centre of circle and radius\n");
scanf("%d%d%d",&xc,&yc,&r);
glutCreateWindow("Circle");
glutDisplayFunc(circlebres);
break;
case 2:
printf("Enter coordinates of centre of ellipse and major and minor radius\n");
scanf("%d%d%d%d",&xce,&yce,&rx,&ry);
glutCreateWindow("Ellipse");
glutDisplayFunc(midptellipse);
break;
}
//END KEYBOARD
minit();
glutMainLoop();
}
```

OUTPUT :

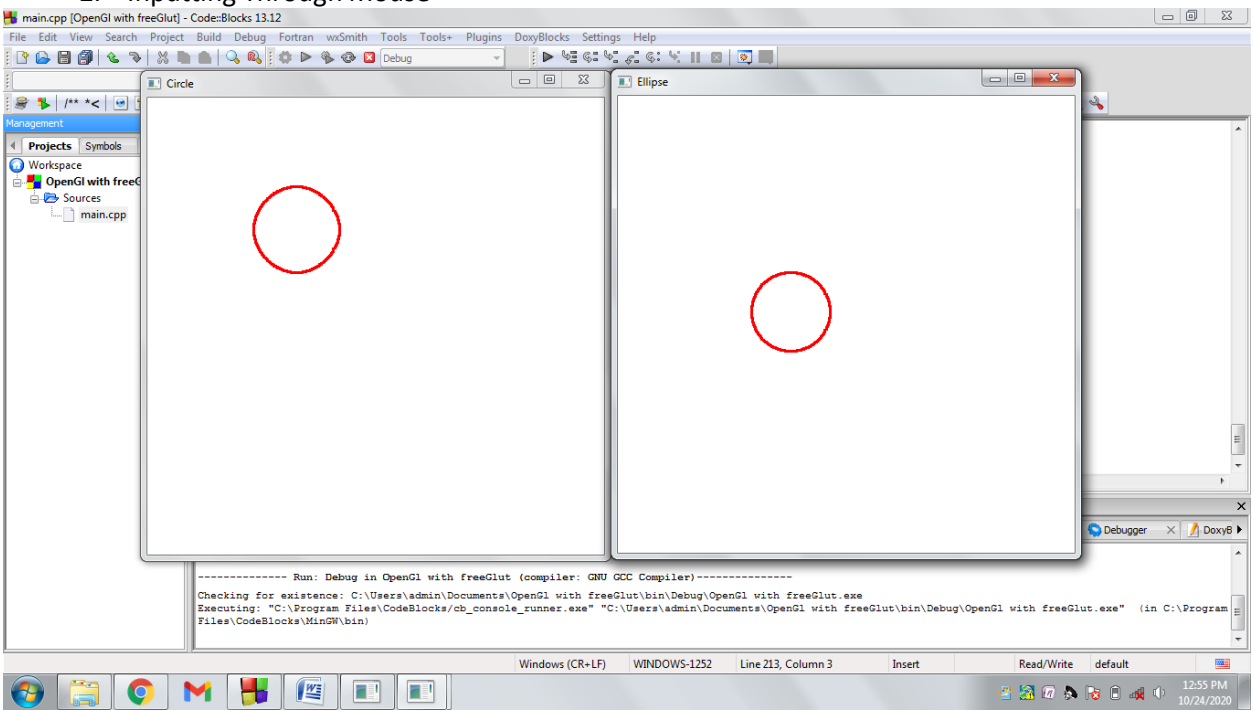
1. a) Inputting Through Key board



b) Inputting Through keyboard



2. Inputting Through Mouse

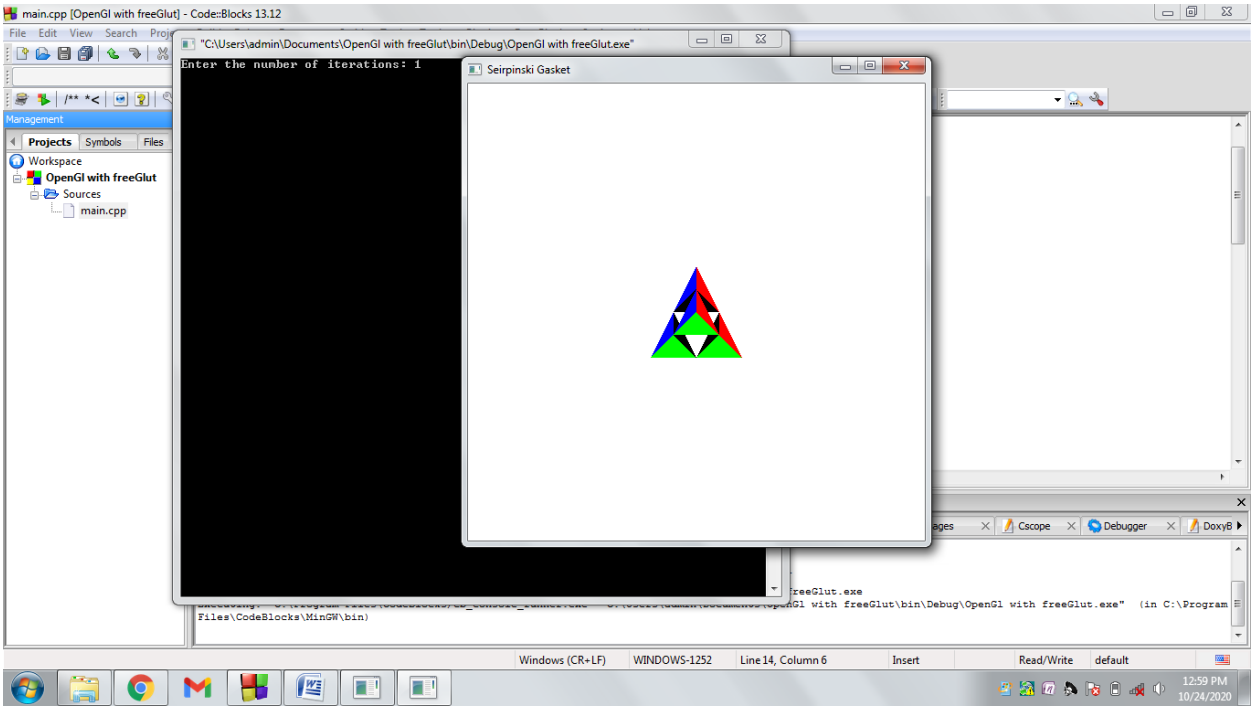


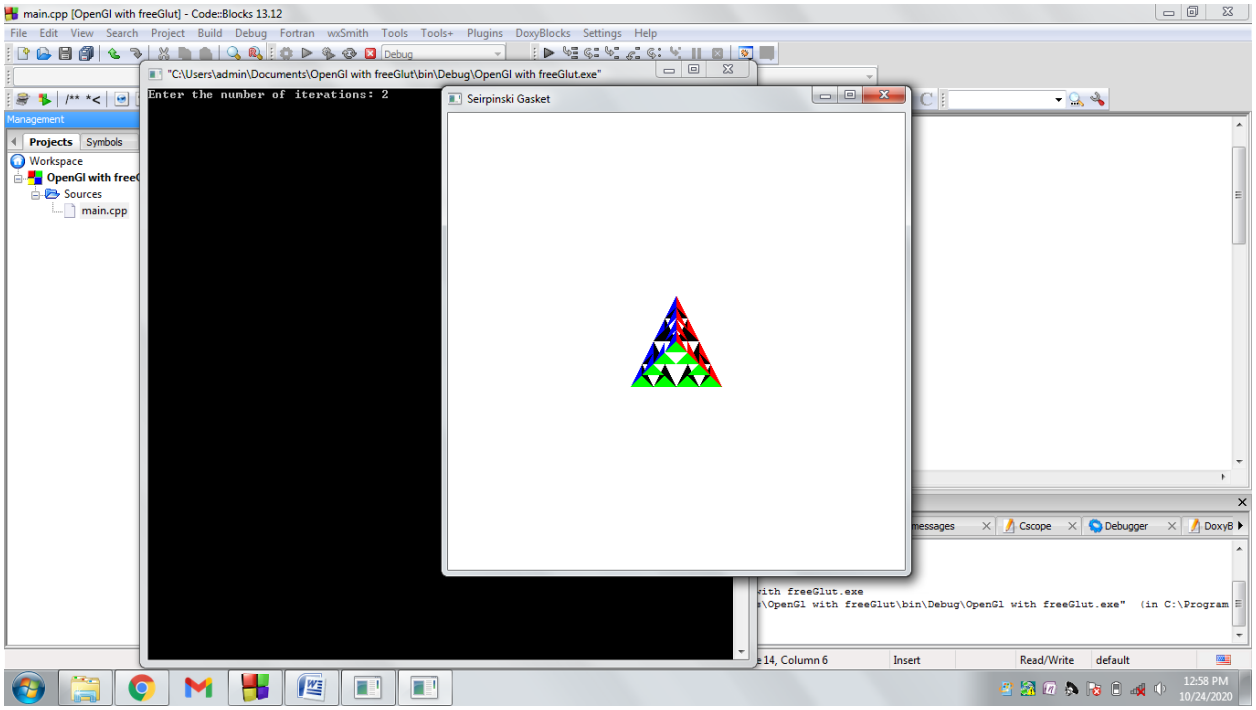
3. Write a program to recursively subdivides a tetrahedron to form 3D Sierpinski gasket. The number of recursive steps is to be specified at execution time.

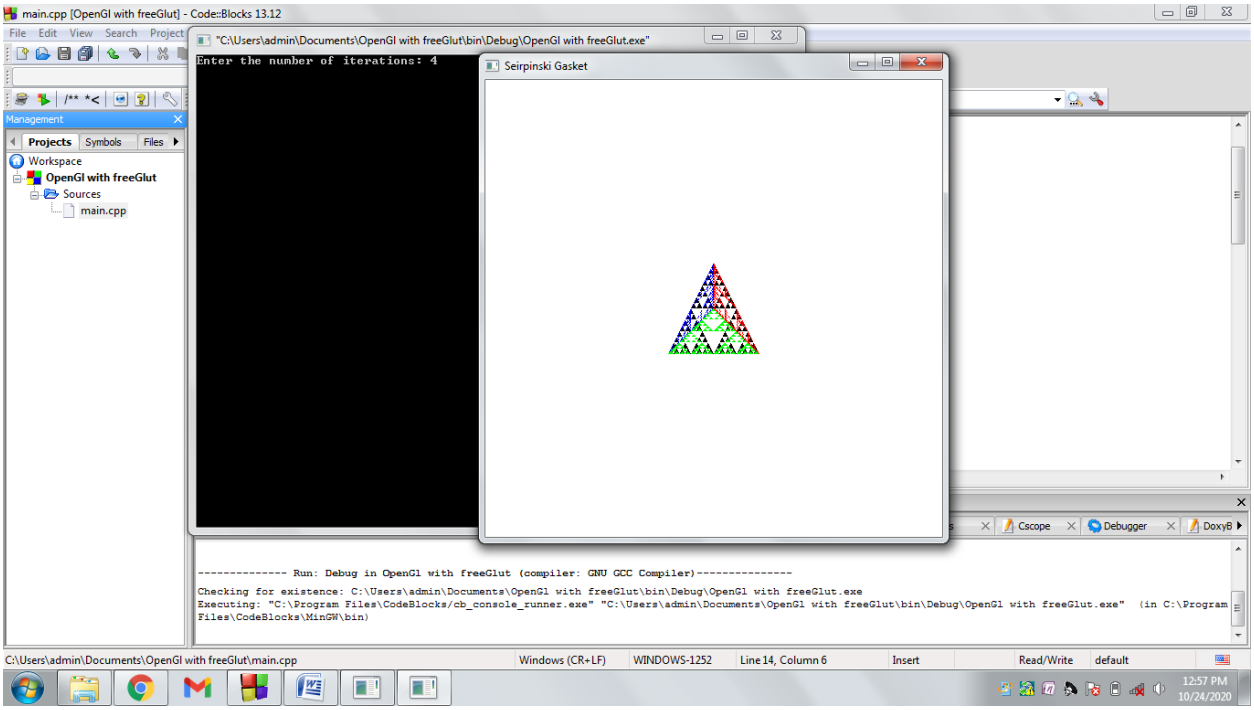
```
#include<gl/glut.h>
#include<stdio.h>
int m;
typedef float point[3];
point tetra[4] = { {0,100,-100},{0,0,100},{100,-100,-100},{-100,-100,-100} };
void tetrahedron(void);
void myinit(void);
void divide_triangle(point a, point b, point c, int m);
void draw_triangle(point p1, point p2, point p3);
int main(int argv, char** argc)
{
	//int m;
	printf("Enter the number of iterations: ");
	scanf("%d", &m);
	glutInit(&argv, argc);
	glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB | GLUT_DEPTH);
	glutInitWindowPosition(100, 200);
	glutInitWindowSize(500, 500);
	glutCreateWindow("Seirpinski Gasket");
	glutDisplayFunc(tetrahedron);
	glEnable(GL_DEPTH_TEST);
	myinit();
	glutMainLoop();
}
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
		draw_triangle(a, b, c);
}
void myinit()
{
	glClearColor(1, 1, 1, 1);

	//glFlush();
```

```
        glOrtho(-500.0, 500.0, -500.0, 500.0, -500.0,500.0);
        //gluOrtho(-500.0,500.0,-500.0,500.0,-500.0,500.0);
}
void tetrahedron(void)
{
        //myinit();
        glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
        glColor3f(1.0, 0.0, 0.0);
        divide_triangle(tetra[0], tetra[1], tetra[2], m);
        glColor3f(0.0, 1.0, 0.0);
        divide_triangle(tetra[3], tetra[2], tetra[1], m);
        glColor3f(0.0, 0.0, 1.0);
        divide_triangle(tetra[0], tetra[3], tetra[1], m);
        glColor3f(0.0, 0.0, 0.0);
        divide_triangle(tetra[0], tetra[2], tetra[3], m);
        glFlush();
}
void draw_triangle(point p1, point p2, point p3)
{
        glBegin(GL_TRIANGLES);
        glVertex3fv(p1);
        glVertex3fv(p2);
        glVertex3fv(p3);
        glEnd();
}
```

OUTPUT :




main.cpp [OpenGl with freeGlut] - Code::Blocks 13.12
"C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe"
Enter the number of iterations: 2
Seirpinski Gasket

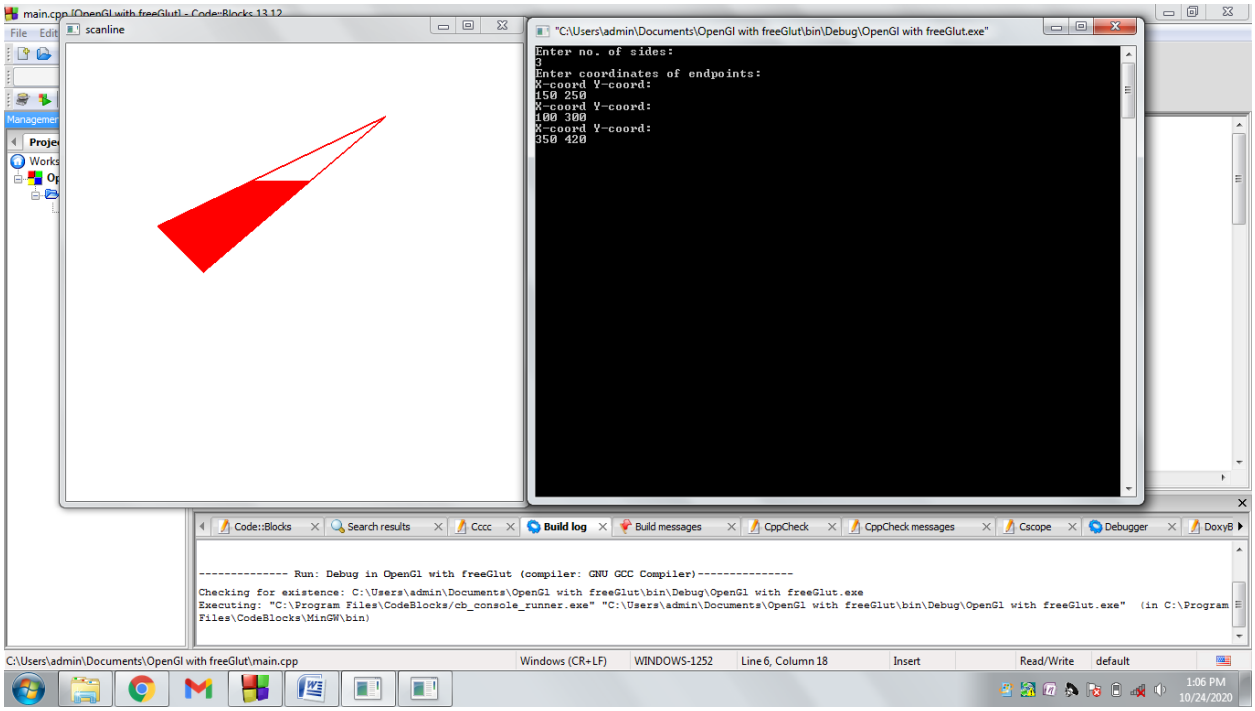

main.cpp [OpenGl with freeGlut] - Code::Blocks 13.12
"C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe"
Enter the number of iterations: 4
Seirpinski Gasket
OpenGl with freeGlut
main.cpp

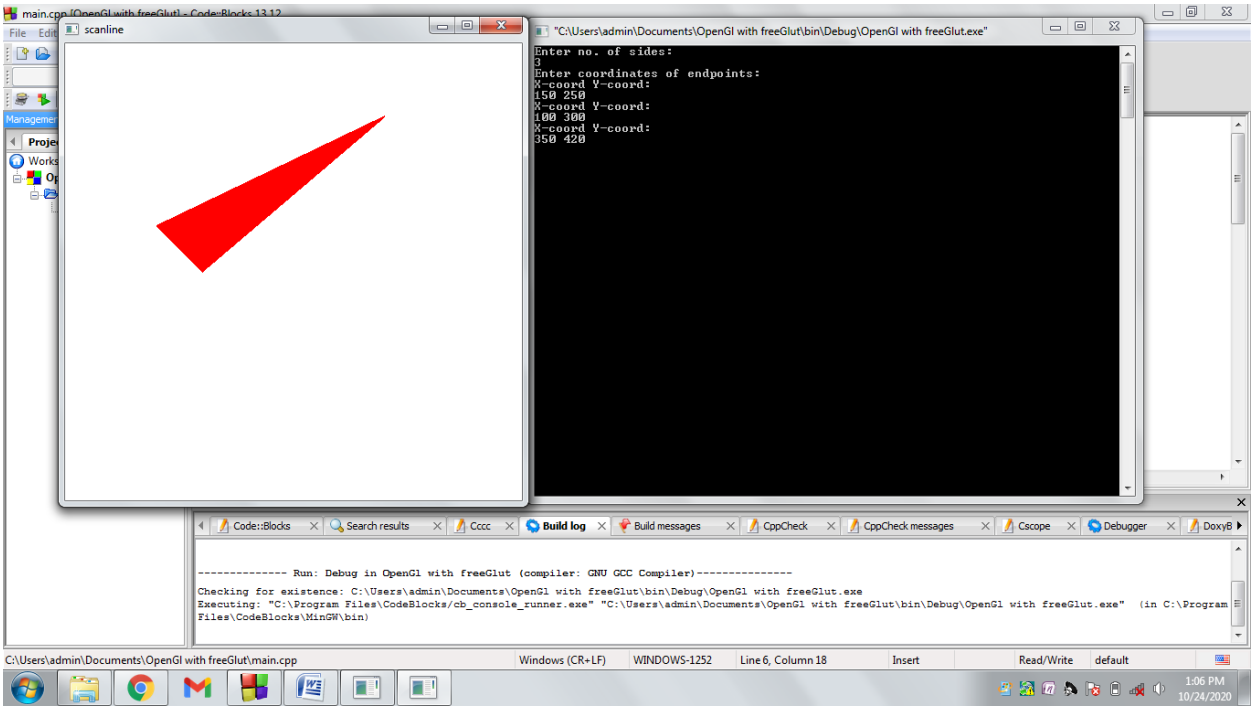
4. Write a program to fill any given polygon using scan-line area filling algorithm.

```
#include<stdlib.h>
#include<gl/glut.h>
#include<algorithm>
#include<iostream>
#include<windows.h>
#include<stdio.h>
using namespace std;
float x[100], y[100]; //= { 0,0,20,100,100 }, y[] = { 0,100,50,100,0 };
int n, m;
int wx = 500, wy = 500;
static float intx[10] = { 0 };

void draw_line(float x1, float y1, float x2, float y2) {
	Sleep(100);
	glColor3f(1, 0, 0);
	glBegin(GL_LINES);
	glVertex2f(x1, y1);
	glVertex2f(x2, y2);
	glEnd();
	glFlush();

}

void edgeDetect(float x1, float y1, float x2, float y2, int scanline) {

	float temp;
	if (y2 < y1) {

		temp = x1; x1 = x2; x2 = temp;
		temp = y1; y1 = y2; y2 = temp;
	}

	if (scanline > y1 && scanline < y2)
		intx[m++] = x1 + (scanline - y1) * (x2 - x1) / (y2 - y1);
}

void scanfill(float x[], float y[]) {
	for (int s1 = 0; s1 <= wy; s1++) {
		m = 0;
		for (int i = 0; i < n; i++) {

			edgeDetect(x[i], y[i], x[(i + 1) % n], y[(i + 1) % n], s1);
		}
		sort(intx, (intx + m));
		if (m >= 2)
			for (int i = 0; i < m; i = i + 2)
				draw_line(intx[i], s1, intx[i + 1], s1);

	}
```

```
}

void display_filled_polygon() {

	glClear(GL_COLOR_BUFFER_BIT);
	glLineWidth(2);
	glBegin(GL_LINE_LOOP);
	for (int i = 0; i < n; i++)
		glVertex2f(x[i], y[i]);
	glEnd();
	scanfill(x, y);
	//glFlush();
}
void myInit() {

	glClearColor(1, 1, 1, 1);
	glColor3f(0, 0, 1);
	glPointSize(1);

	gluOrtho2D(0, wx, 0, wy);

}
void main(int ac, char* av[]) {
	glutInit(&ac, av);
	printf("Enter no. of sides: \n");
	scanf("%d", &n);
	printf("Enter coordinates of endpoints: \n");
	for (int i = 0; i < n; i++)
	{
		printf("X-coord Y-coord: \n");
		scanf("%f %f", &x[i], &y[i]);
	}
	glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
	glutInitWindowSize(500, 500);
	glutInitWindowPosition(0, 0);
	glutCreateWindow("scanline");
	glutDisplayFunc(display_filled_polygon);
	myInit();
	glutMainLoop();

}
```

OUTPUT :


scanline
"C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe"
Enter no. of sides:
3
Enter coordinates of endpoints:
X-coord Y-coord:
150 250
X-coord Y-coord:
100 300
X-coord Y-coord:
350 420
Code::Blocks
Search results
Cccc
Build log
Build messages
CppCheck
CppCheck messages
Cscope
Debugger
DoxyB
---------- Run: Debug in OpenGl with freeGlut (compiler: GNU GCC Compiler)----------
Checking for existence: C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe
Executing: "C:\Program Files\CodeBlocks/cb_console_runner.exe" "C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe" (in C:\Program Files\CodeBlocks\MinGW\bin)
C:\Users\admin\Documents\OpenGl with freeGlut\main.cpp
Windows (CR+LF)
WINDOWS-1252
Line 6, Column 18
Insert
Read/Write
default
1:06 PM
10/24/2020


scanline
"C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe"
Enter no. of sides:
3
Enter coordinates of endpoints:
X-coord Y-coord:
150 250
X-coord Y-coord:
100 300
X-coord Y-coord:
350 420
Code::Blocks
Search results
Cccc
Build log
Build messages
CppCheck
CppCheck messages
Cscope
Debugger
DoxyB
---------- Run: Debug in OpenGl with freeGlut (compiler: GNU GCC Compiler)----------
Checking for existence: C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe
Executing: "C:\Program Files\CodeBlocks/cb_console_runner.exe" "C:\Users\admin\Documents\OpenGl with freeGlut\bin\Debug\OpenGl with freeGlut.exe" (in C:\Program Files\CodeBlocks\MinGW\bin)
C:\Users\admin\Documents\OpenGl with freeGlut\main.cpp
Windows (CR+LF)
WINDOWS-1252
Line 6, Column 18
Insert
Read/Write
default
1:06 PM
10/24/2020