NETAJI SUBHAS UNIVERSITY OF TECHNOLOGY

Computer Graphics (COCSE64)
Practical File

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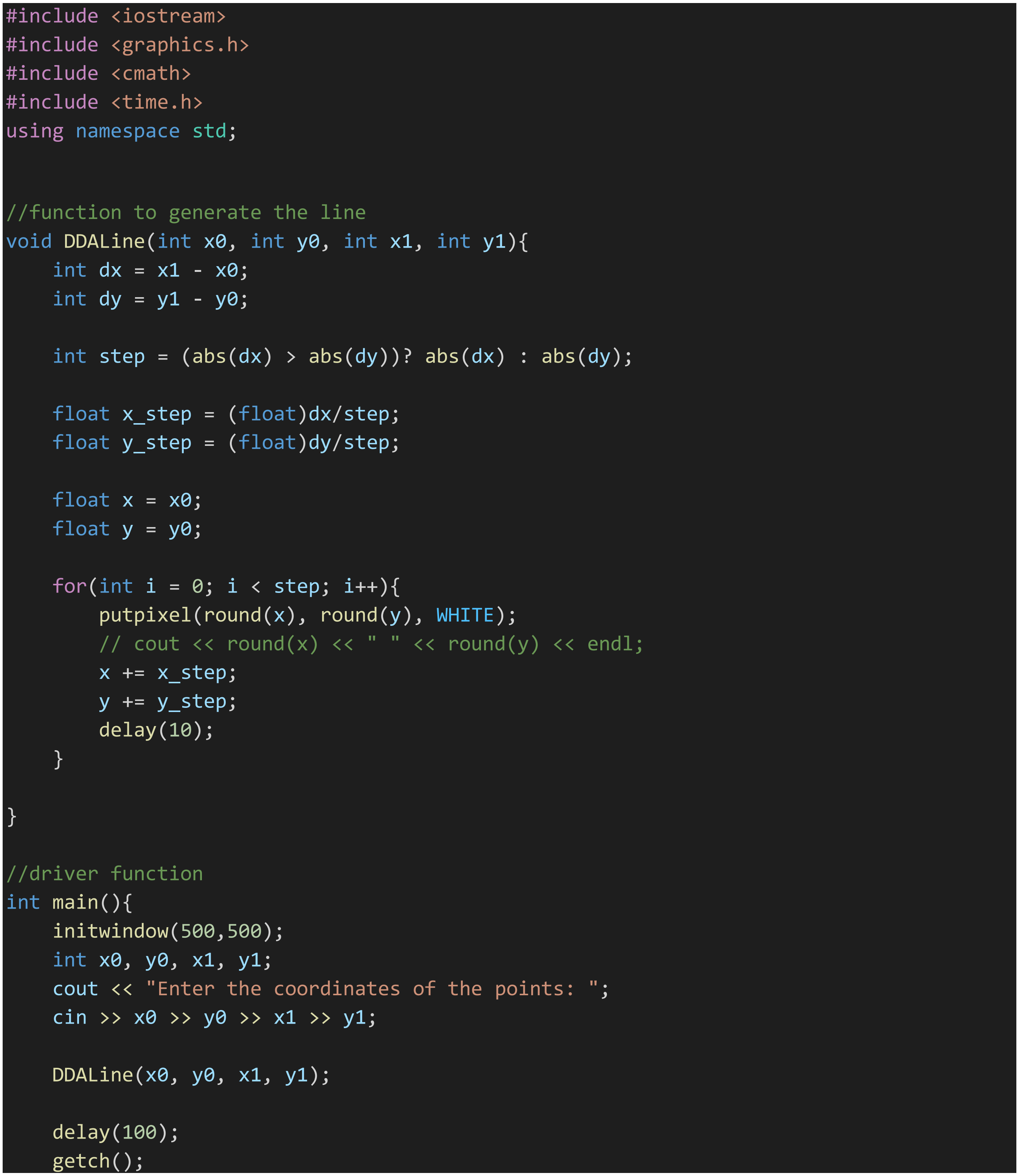
(2019UCO1518)

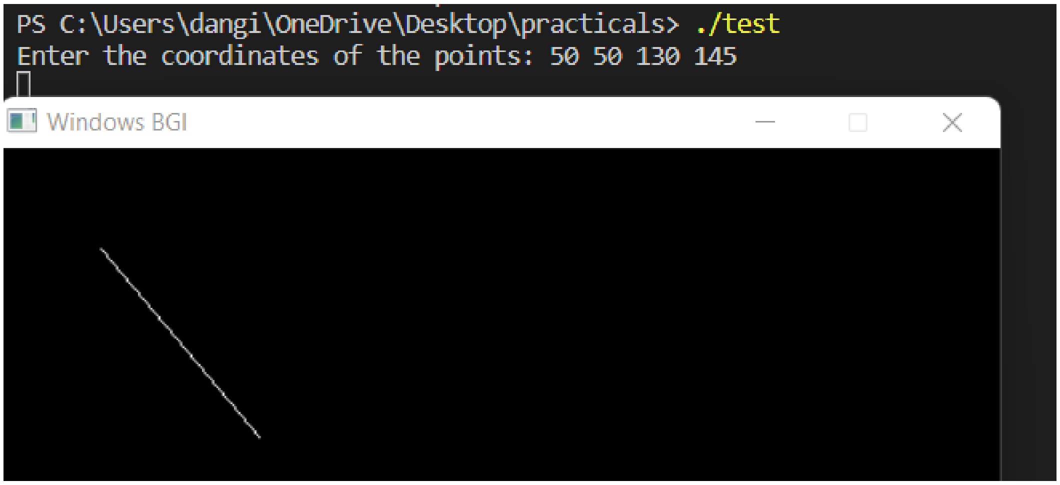
Exp no.	Experiment Name
1.	Generating line primitives using DDA
2.	Generating line primitives using Bresenham's Approach
3.	Generating circle using bresenham's approach
4.	Generating circle using mid point algorithm
5.	Generating ellipse using mid-point approach
6.	Generating hyperbola using mid point algorithm
7.	Implement line clipping approach using cohen sutherland
8.	Implement line clipping approach using liang barsky / cyrus beck
9.	Implement line clipping approach using mid-point subdivision

1 .Generating line primitives using DDA



```
#include <iostream>
#include <graphics.h>
#include <cmath>
#include <time.h>
using namespace std;


//function to generate the line
void DDALine(int x0, int y0, int x1, int y1){
    int dx = x1 - x0;
    int dy = y1 - y0;

    int step = (abs(dx) > abs(dy))? abs(dx) : abs(dy);

    float x_step = (float)dx/step;
    float y_step = (float)dy/step;

    float x = x0;
    float y = y0;

    for(int i = 0; i < step; i++){
        putpixel(round(x), round(y), WHITE);
        // cout << round(x) << " " << round(y) << endl;
        x += x_step;
        y += y_step;
        delay(10);
    }

}

//driver function
int main(){
    initwindow(500,500);
    int x0, y0, x1, y1;
    cout << "Enter the coordinates of the points: ";
    cin >> x0 >> y0 >> x1 >> y1;

    DDALine(x0, y0, x1, y1);

    delay(100);
    getch();
    delay(10000);
    closegraph();
    return 0;
}
```

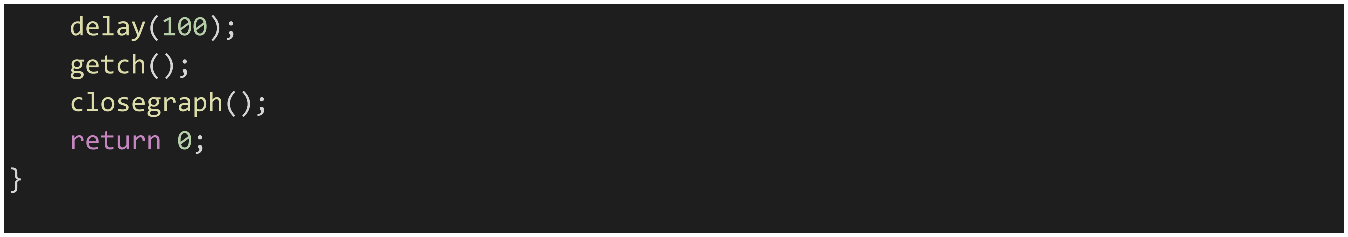
Output :



```
PS C:\Users\dangi\OneDrive\Desktop\practicals> ./test
Enter the coordinates of the points: 50 50 130 145
```

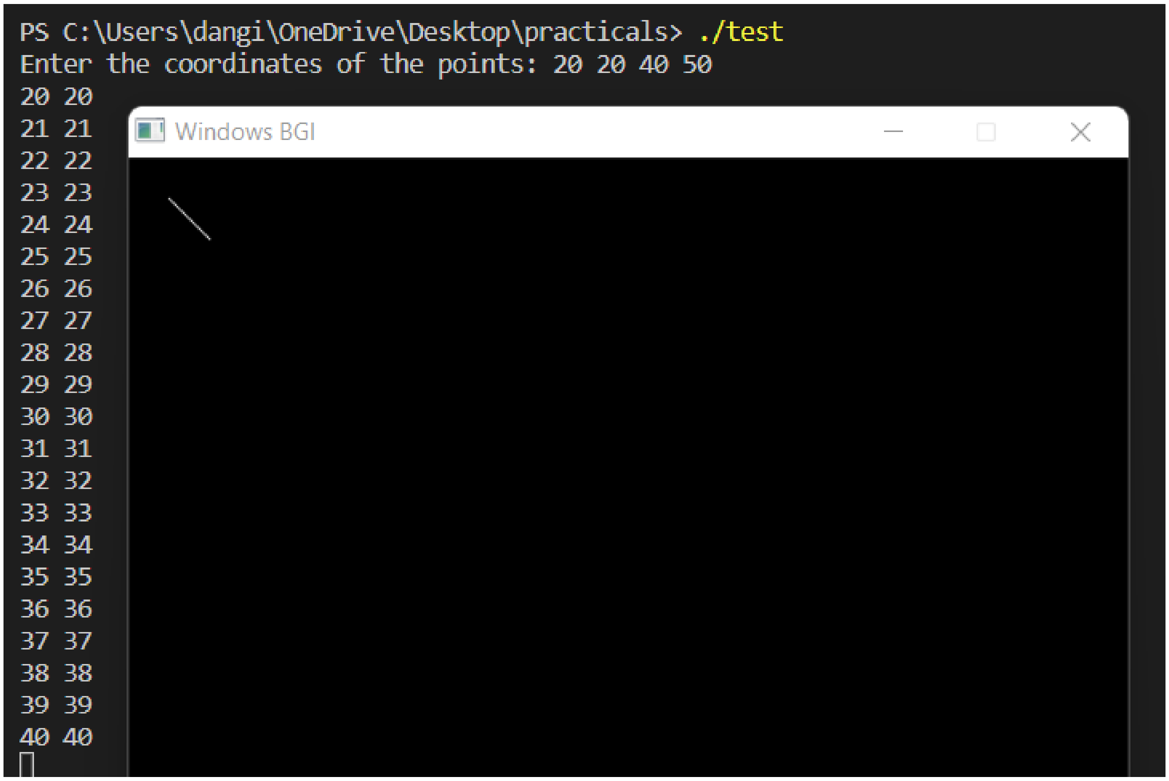
2 . Generating Line using Bresenham’s Approach

```
// LINE USING BRESENHAM

/* Assumptions :
1) Line is drawn from left to right.
2) x1 < x2 and y1 < y2
3) Slope of the line is between 0 and 1.
We draw a line from lower left to upper
right.
*/

#include <bits/stdc++.h>
#include <graphics.h>
using namespace std;

// function for line generation
void bresenham(int x1, int y1, int x2, int y2)
{
    int m_new = 2 * (y2 - y1);
    int slope_error_new = m_new - (x2 - x1);

    for (int x = x1, y = y1; x <= x2; x++)
    {
        putpixel(x, y, WHITE);
        cout << x << " " << y << endl;
        slope_error_new += m_new;
        if (slope_error_new >= 0)
        {
            y++;
            slope_error_new -= 2 * (x2 - x1);
        }
        delay(10);
    }
}

int main()
{
    initwindow(500, 500);
    int x1, y1, x2, y2;
    cout << "Enter the coordinates of the points: ";
    cin >> x1 >> y1 >> x2 >> y2;

    bresenham(x1, y1, x2, y2);
```



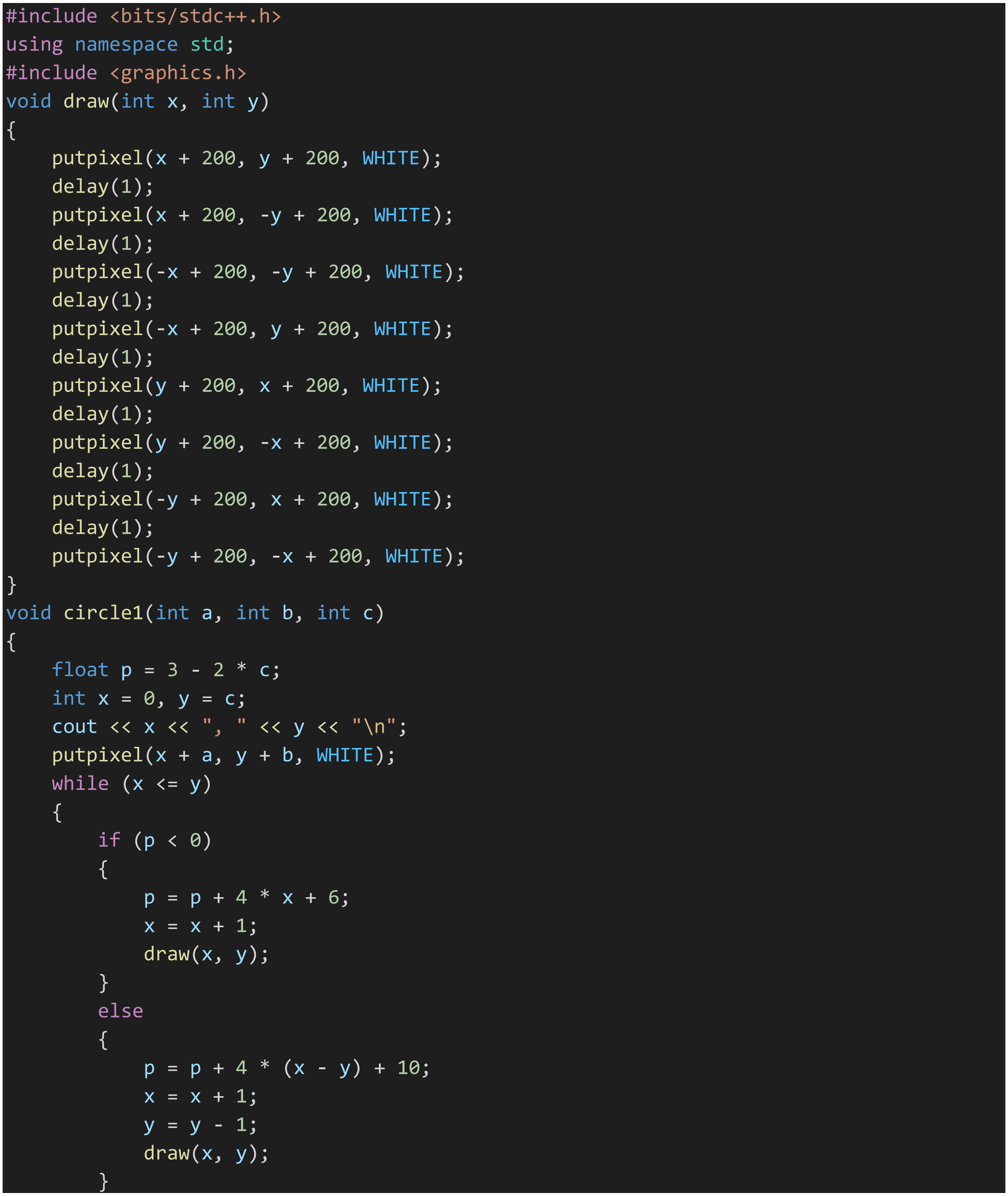
```
    delay(100);
    getch();
    closegraph();
    return 0;
}
```

Output :

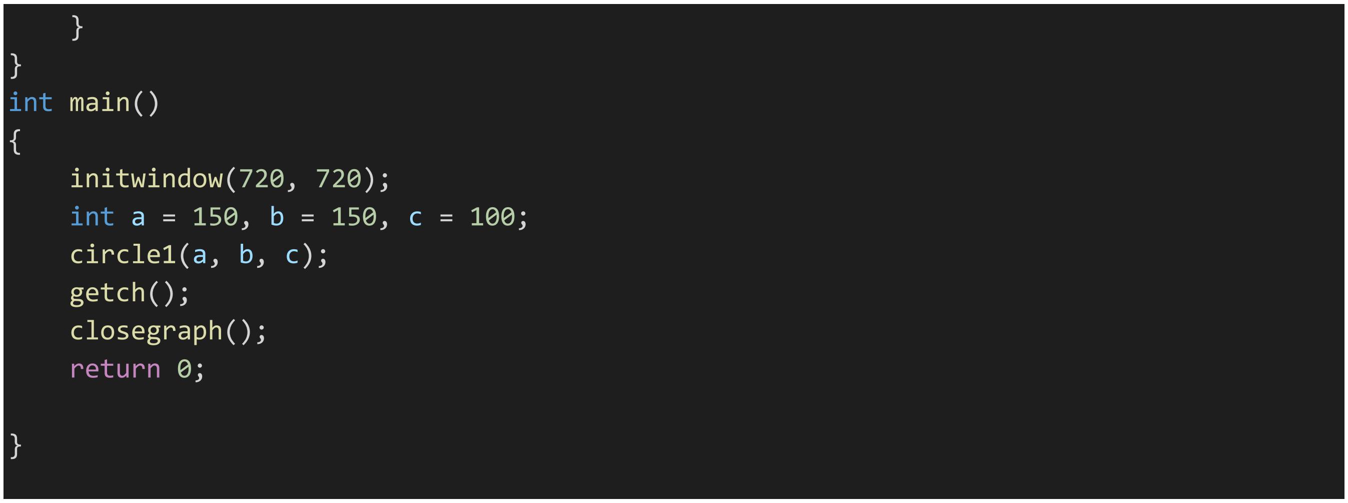


```
PS C:\Users\dangi\OneDrive\Desktop\practicals> ./test
Enter the coordinates of the points: 20 20 40 50
20 20
21 21
22 22
23 23
24 24
25 25
26 26
27 27
28 28
29 29
30 30
31 31
32 32
33 33
34 34
35 35
36 36
37 37
38 38
39 39
40 40
```

3. Generating circle using bresenham’s approach

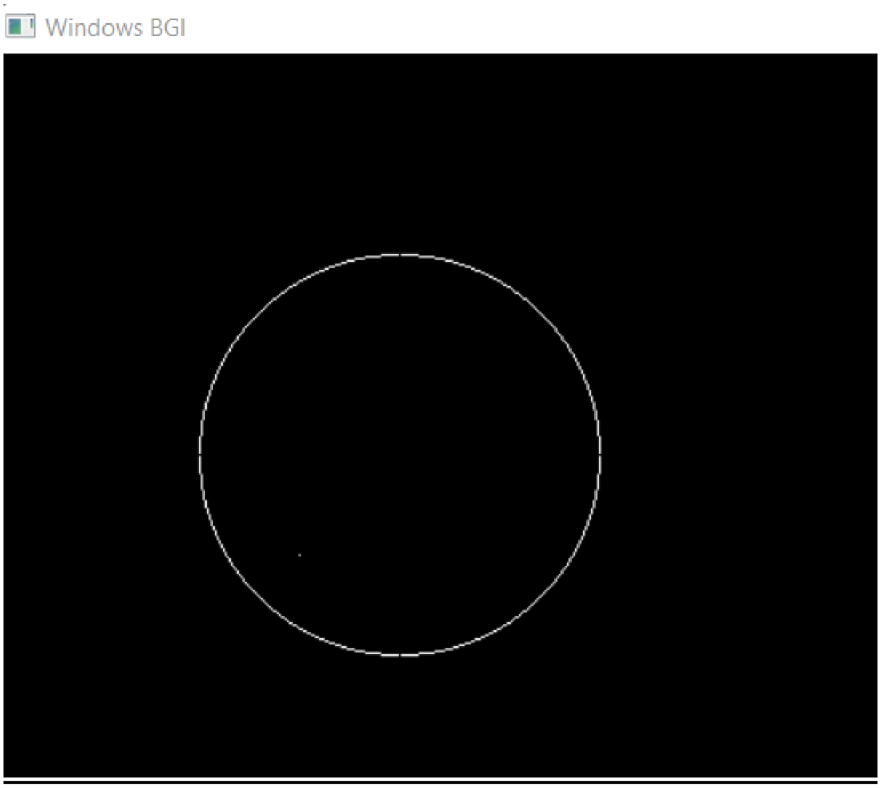


```
#include <bits/stdc++.h>
using namespace std;
#include <graphics.h>
void draw(int x, int y)
{
    putpixel(x + 200, y + 200, WHITE);
    delay(1);
    putpixel(x + 200, -y + 200, WHITE);
    delay(1);
    putpixel(-x + 200, -y + 200, WHITE);
    delay(1);
    putpixel(-x + 200, y + 200, WHITE);
    delay(1);
    putpixel(y + 200, x + 200, WHITE);
    delay(1);
    putpixel(y + 200, -x + 200, WHITE);
    delay(1);
    putpixel(-y + 200, x + 200, WHITE);
    delay(1);
    putpixel(-y + 200, -x + 200, WHITE);
}
void circle1(int a, int b, int c)
{
    float p = 3 - 2 * c;
    int x = 0, y = c;
    cout << x << ", " << y << "\n";
    putpixel(x + a, y + b, WHITE);
    while (x <= y)
    {
        if (p < 0)
        {
            p = p + 4 * x + 6;
            x = x + 1;
            draw(x, y);
        }
        else
        {
            p = p + 4 * (x - y) + 10;
            x = x + 1;
            y = y - 1;
            draw(x, y);
        }
```

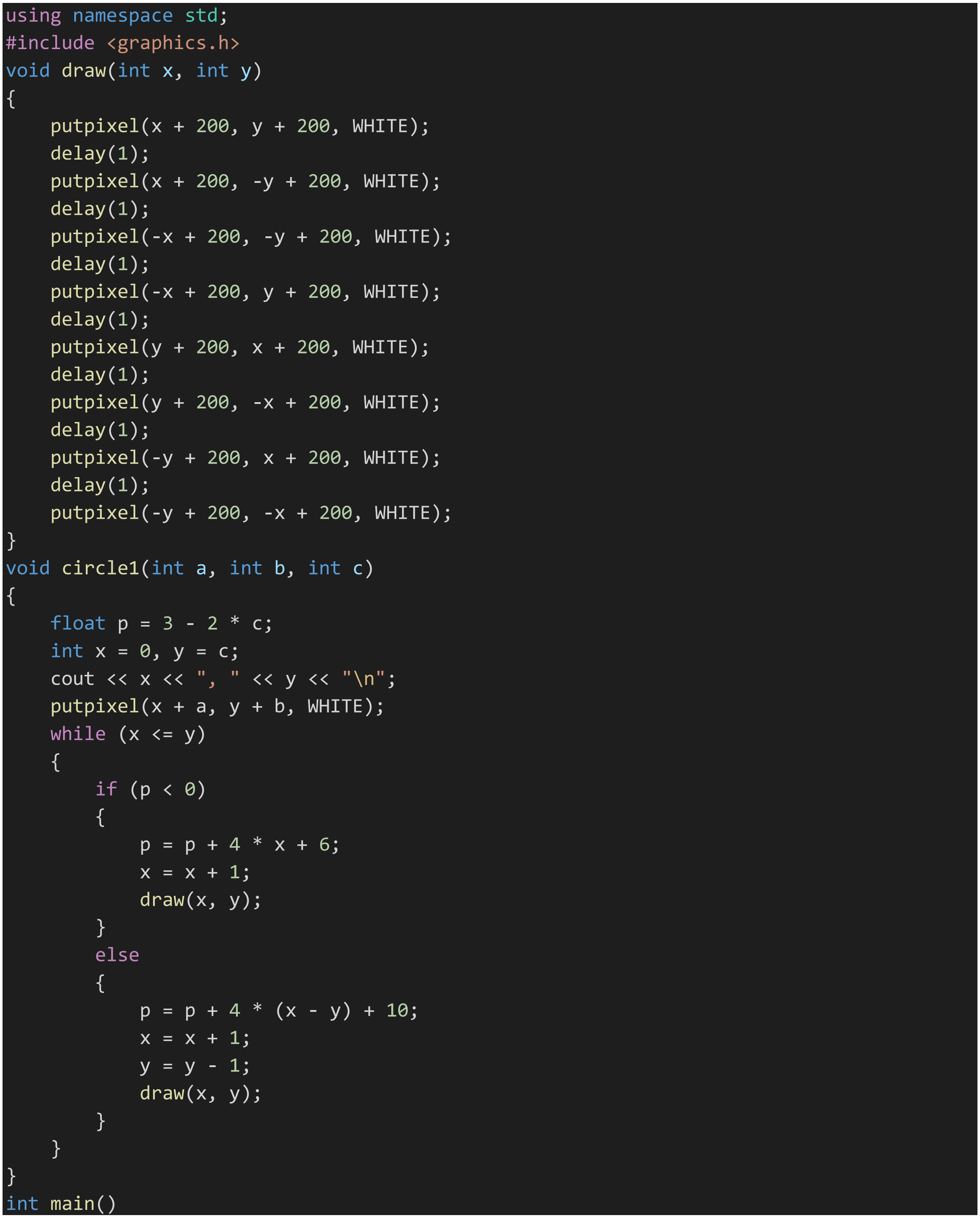


```
    }
}
int main()
{
    initwindow(720, 720);
    int a = 150, b = 150, c = 100;
    circle1(a, b, c);
    getch();
    closegraph();
    return 0;

}
```

Output :



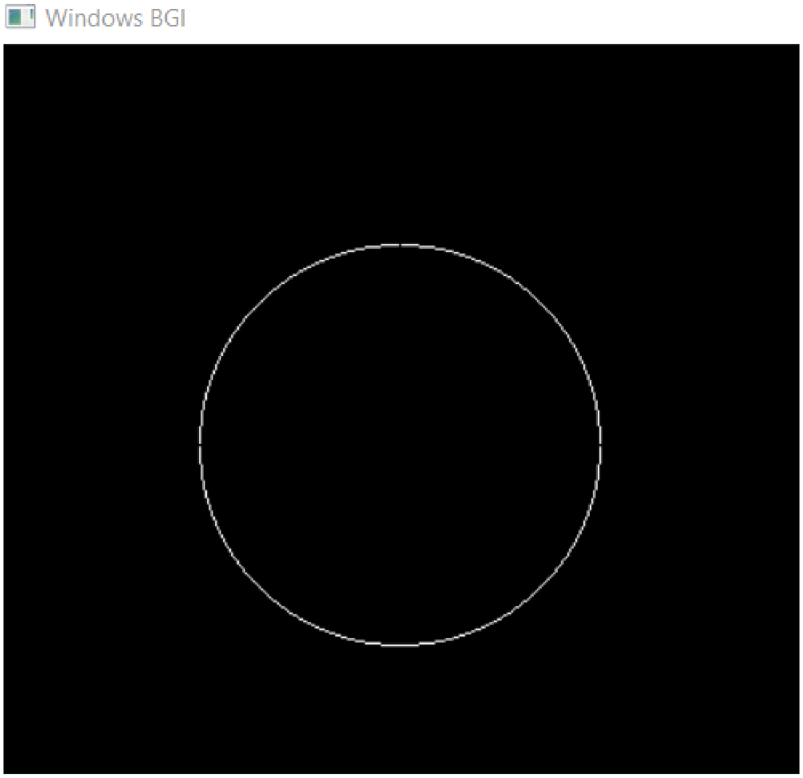
4. Generating circle using Mid point approach



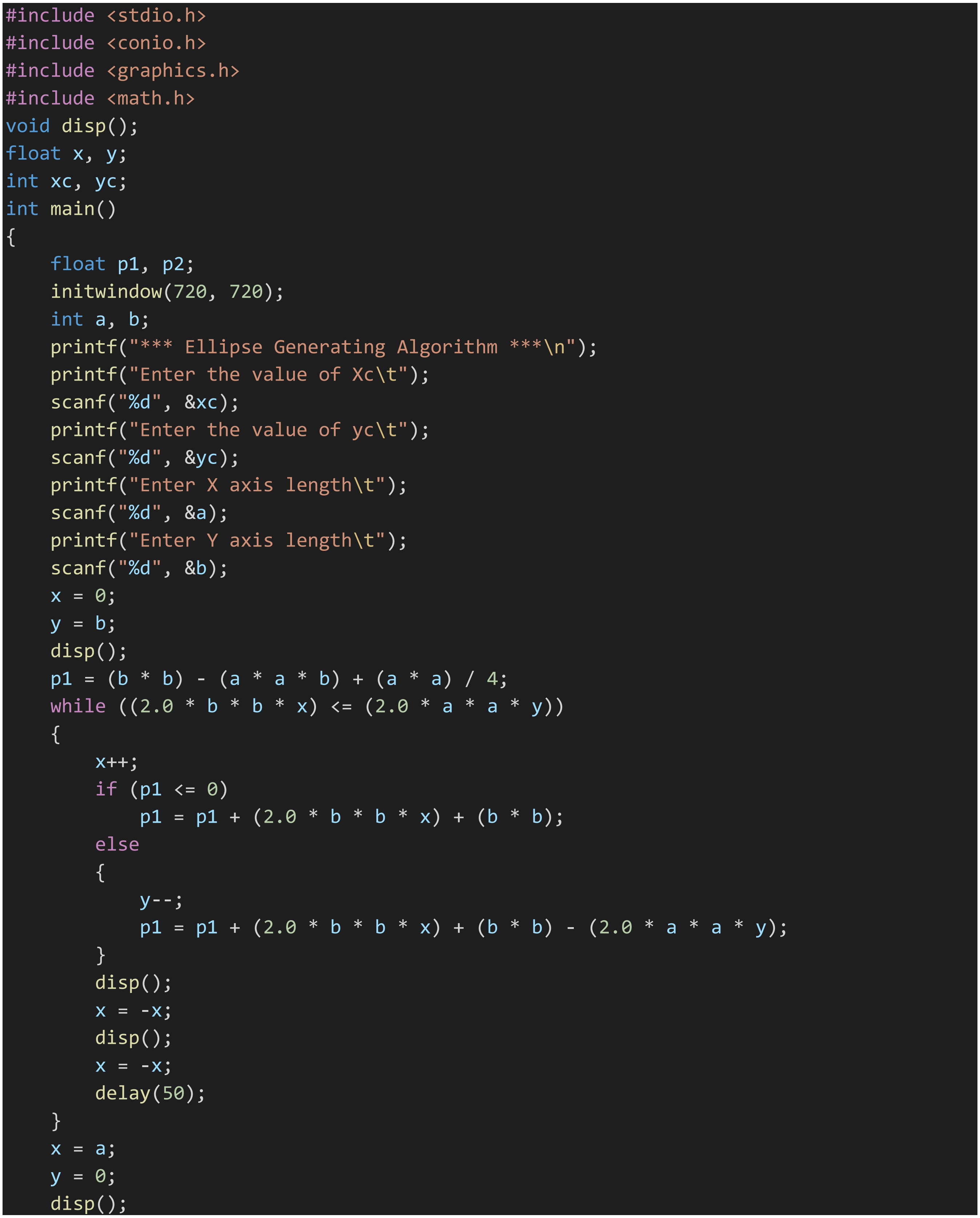
```
using namespace std;
#include <graphics.h>
void draw(int x, int y)
{
    putpixel(x + 200, y + 200, WHITE);
    delay(1);
    putpixel(x + 200, -y + 200, WHITE);
    delay(1);
    putpixel(-x + 200, -y + 200, WHITE);
    delay(1);
    putpixel(-x + 200, y + 200, WHITE);
    delay(1);
    putpixel(y + 200, x + 200, WHITE);
    delay(1);
    putpixel(y + 200, -x + 200, WHITE);
    delay(1);
    putpixel(-y + 200, x + 200, WHITE);
    delay(1);
    putpixel(-y + 200, -x + 200, WHITE);
}
void circle1(int a, int b, int c)
{
    float p = 3 - 2 * c;
    int x = 0, y = c;
    cout << x << ", " << y << "\n";
    putpixel(x + a, y + b, WHITE);
    while (x <= y)
    {
        if (p < 0)
        {
            p = p + 4 * x + 6;
            x = x + 1;
            draw(x, y);
        }
        else
        {
            p = p + 4 * (x - y) + 10;
            x = x + 1;
            y = y - 1;
            draw(x, y);
        }
    }
}
int main()
```

```
{
    initwindow(720, 720);
    int a = 150, b = 150, c = 100;
    circle1(a, b, c);
    getch();
    closegraph();
    return 0;

}
```

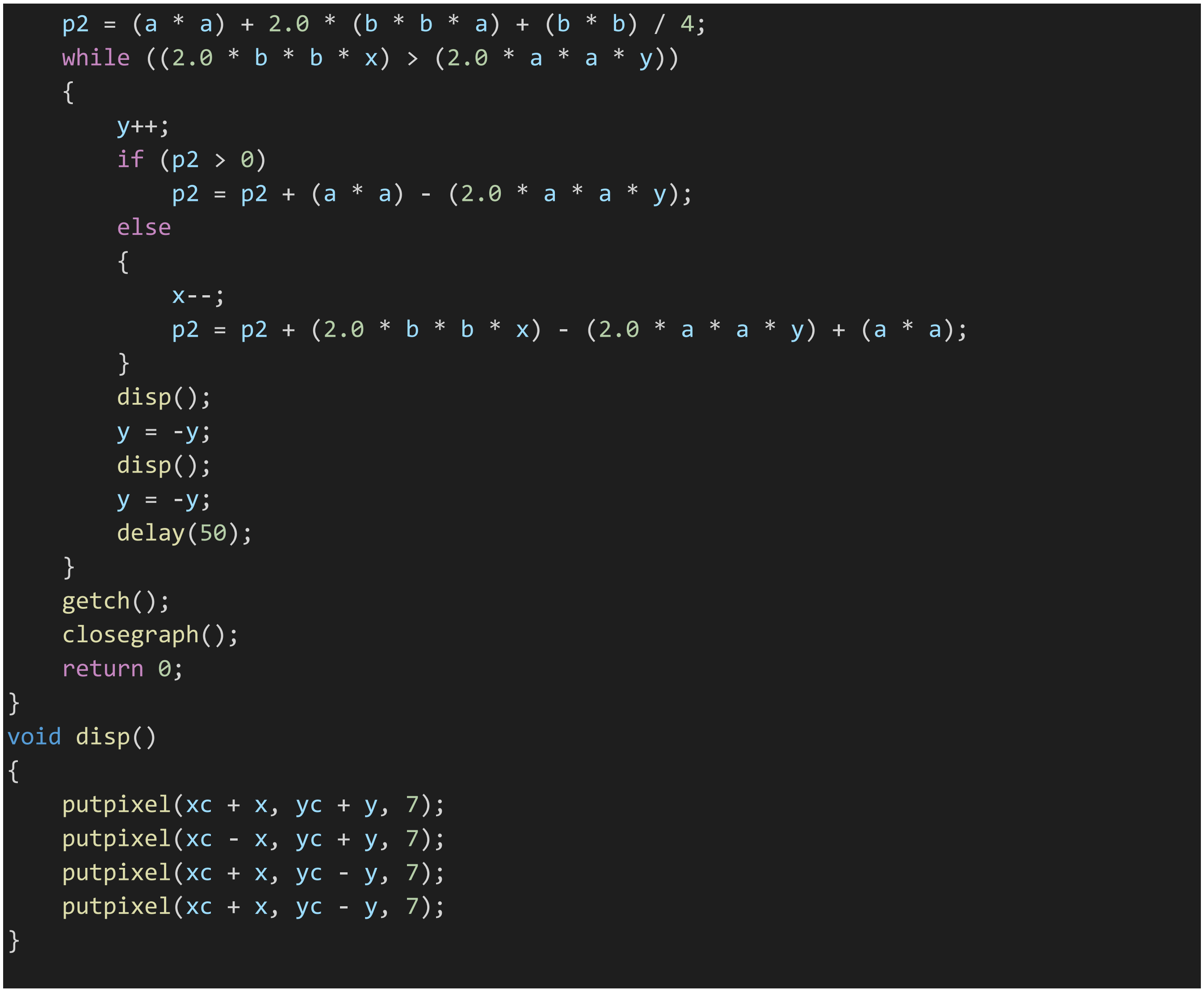
Output :



5. Generating ellipse using mid point algorithm

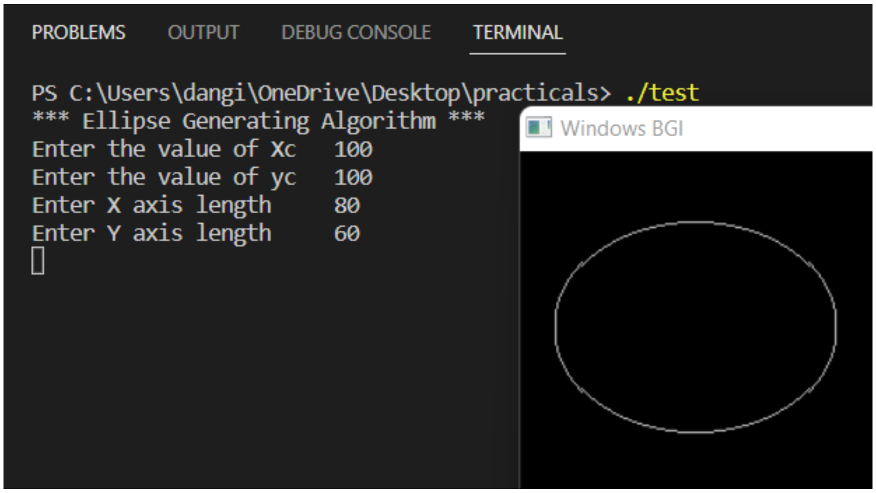


```c
#include <stdio.h>
#include <conio.h>
#include <graphics.h>
#include <math.h>
void disp();
float x, y;
int xc, yc;
int main()
{
    float p1, p2;
    initwindow(720, 720);
    int a, b;
    printf("*** Ellipse Generating Algorithm ***\n");
    printf("Enter the value of Xc\t");
    scanf("%d", &xc);
    printf("Enter the value of yc\t");
    scanf("%d", &yc);
    printf("Enter X axis length\t");
    scanf("%d", &a);
    printf("Enter Y axis length\t");
    scanf("%d", &b);
    x = 0;
    y = b;
    disp();
    p1 = (b * b) - (a * a * b) + (a * a) / 4;
    while ((2.0 * b * b * x) <= (2.0 * a * a * y))
    {
        x++;
        if (p1 <= 0)
            p1 = p1 + (2.0 * b * b * x) + (b * b);
        else
        {
            y--;
            p1 = p1 + (2.0 * b * b * x) + (b * b) - (2.0 * a * a * y);
        }
        disp();
        x = -x;
        disp();
        x = -x;
        delay(50);
    }
    x = a;
    y = 0;
    disp();
```



```
    p2 = (a * a) + 2.0 * (b * b * a) + (b * b) / 4;
    while ((2.0 * b * b * x) > (2.0 * a * a * y))
    {
        y++;
        if (p2 > 0)
            p2 = p2 + (a * a) - (2.0 * a * a * y);
        else
        {
            x--;
            p2 = p2 + (2.0 * b * b * x) - (2.0 * a * a * y) + (a * a);
        }
        disp();
        y = -y;
        disp();
        y = -y;
        delay(50);
    }
    getch();
    closegraph();
    return 0;
}
void disp()
{
    putpixel(xc + x, yc + y, 7);
    putpixel(xc - x, yc + y, 7);
    putpixel(xc + x, yc - y, 7);
    putpixel(xc + x, yc - y, 7);
}
```

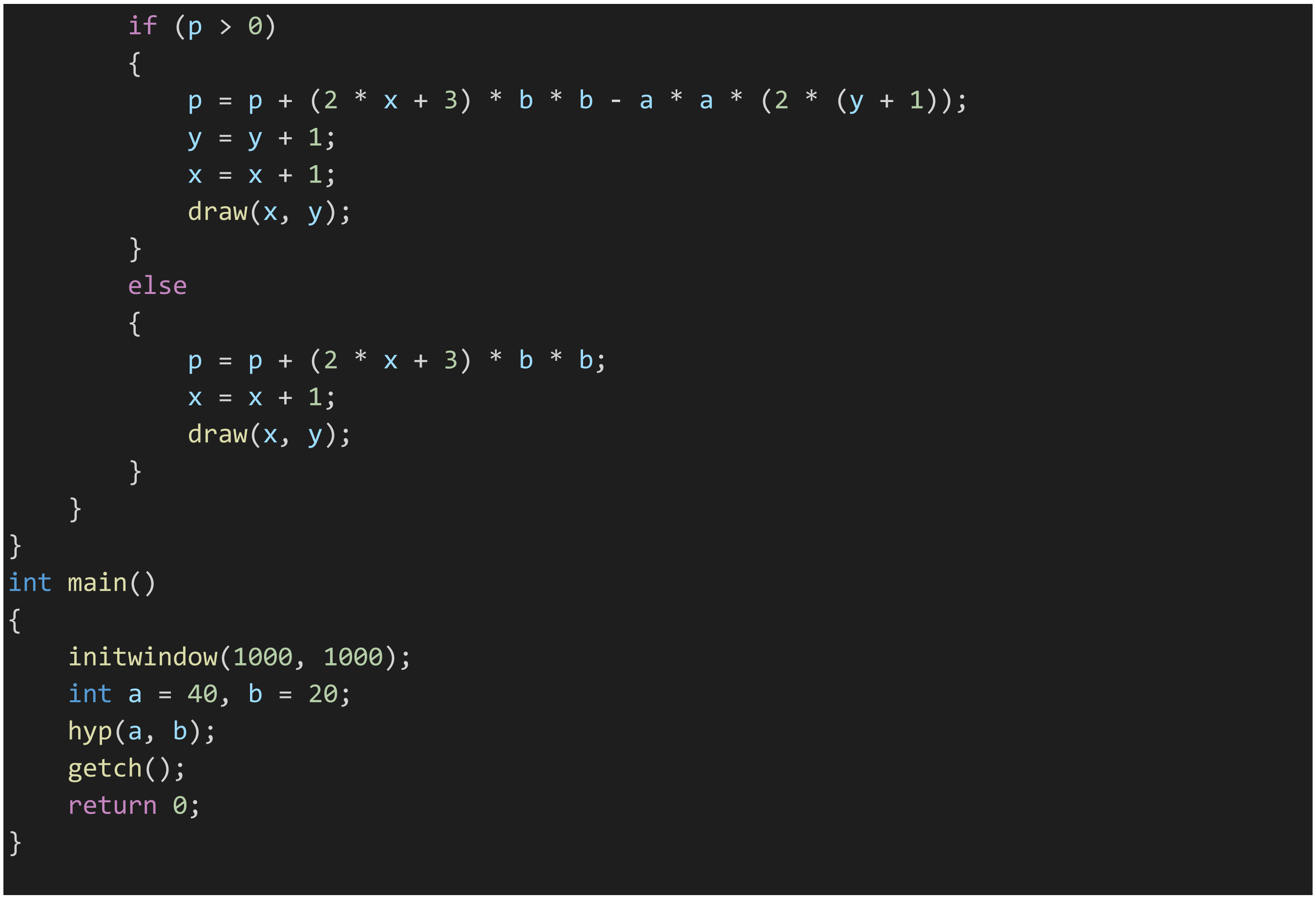
Output :



```
PS C:\Users\dangi\OneDrive\Desktop\practicals> ./test
*** Ellipse Generating Algorithm ***
Enter the value of Xc   100
Enter the value of yc   100
Enter X axis length     80
Enter Y axis length     60
```

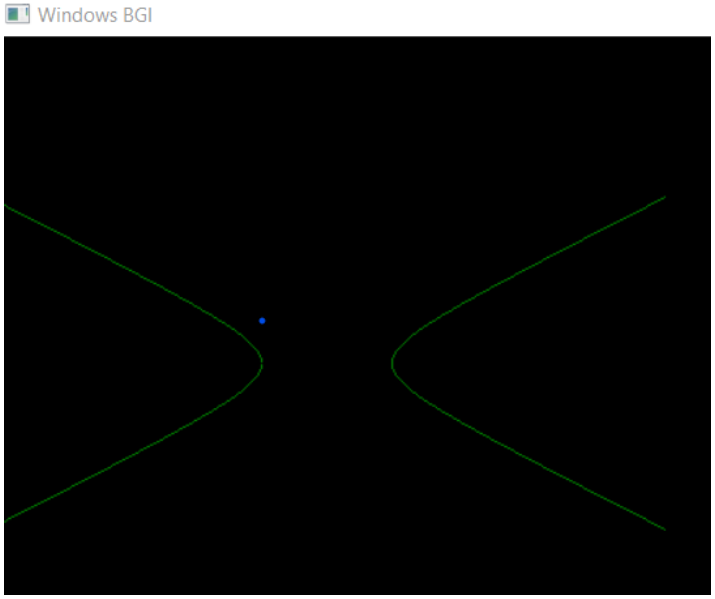
6. Generating hyperbola using Mid point algorithm

```
#include <bits/stdc++.h>
using namespace std;
#include <graphics.h>
// // Driver program
void draw(int x, int y)
{
    putpixel(x + 200, y + 200, GREEN);
    delay(1);
    putpixel(x + 200, -y + 200, GREEN);
    delay(1);
    putpixel(-x + 200, -y + 200, GREEN);
    delay(1);
    putpixel(-x + 200, y + 200, GREEN);
    delay(1);
}
void hyp(int a, int b)
{
    double p = (float)(1 / 4 + a) * (b * b) - (float)1 * (a * a);
    cout << p << "\n";
    int x = a, y = 0;
    putpixel(x + 200, y + 200, GREEN);
    while (y < (b * b) / (sqrt(a * a - b * b)))
    {
        if (p > 0)
        {
            p = p - (2 * y + 3) * (a * a);
            y = y + 1;
            draw(x, y);
        }
        else
        {
            p = p + (2 * (x + 1) * (b * b)) - (2 * y + 3) * (a * a);
            y = y + 1;
            x = x + 1;
            draw(x, y);
        }
        cout << p << "\n";
    }
    p = (x + 1) * (x + 1) * b * b - (y + 1 / 2) * (y + 1 / 2) * a * a - a * a * b * b;
    while (y < 300)
    {
        cout << "aa";
```



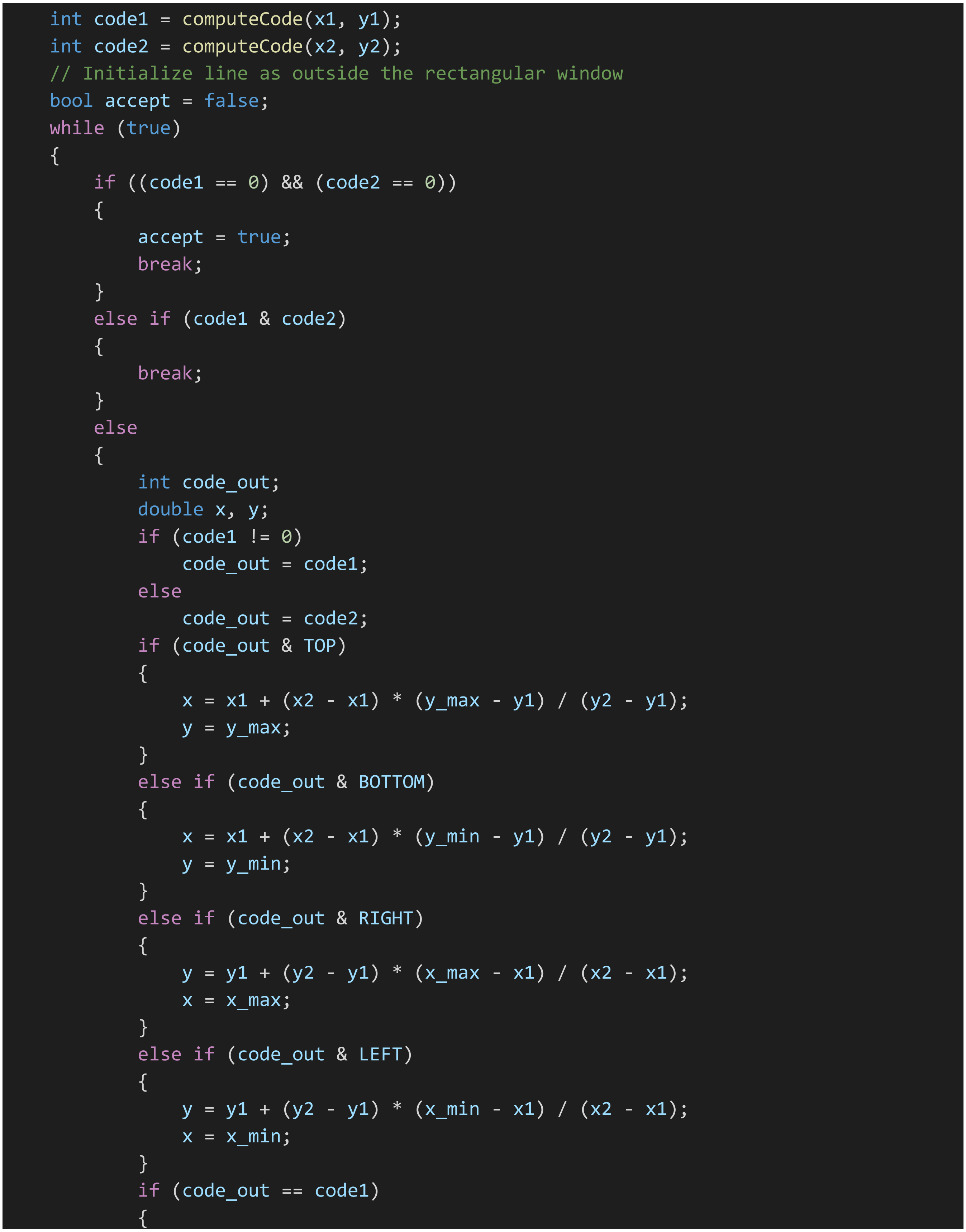
```
        if (p > 0)
        {
            p = p + (2 * x + 3) * b * b - a * a * (2 * (y + 1));
            y = y + 1;
            x = x + 1;
            draw(x, y);
        }
        else
        {
            p = p + (2 * x + 3) * b * b;
            x = x + 1;
            draw(x, y);
        }
    }
}
int main()
{
    initwindow(1000, 1000);
    int a = 40, b = 20;
    hyp(a, b);
    getch();
    return 0;
}
```

Output :

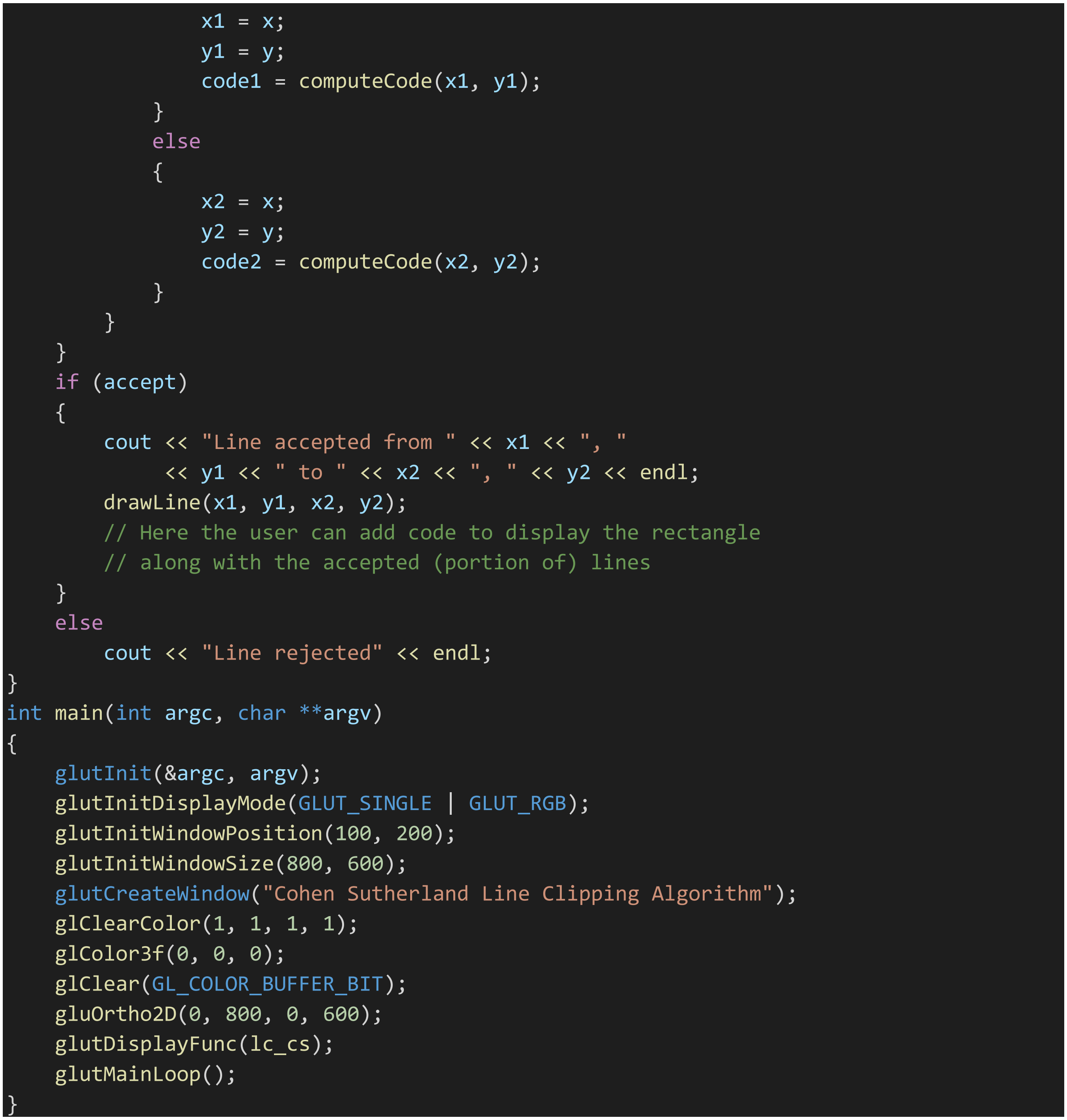


7. Implement Line Clipping approach using Cohen Sutherland

```
#include <iostream>
#include <GL/glut.h>
using namespace std;
// Defining region codes
const int INSIDE = 0; // 0000
const int LEFT = 1;   // 0001
const int RIGHT = 2;  // 0010
const int BOTTOM = 4; // 0100
const int TOP = 8;    // 1000
const int x_max = 700;
const int y_max = 500;
const int x_min = 100;
const int y_min = 100;
void drawLine(int x1, int y1, int x2, int y2)
{
    glBegin(GL_LINES);
    glVertex2i(x1, y1);
    glVertex2i(x2, y2);
    glEnd();
    glFlush();
}
int computeCode(double x, double y)
{ // initialized as being inside
    int code = INSIDE;
    if (x < x_min) // to the left of rectangle
        code |= LEFT;
    else if (x > x_max) // to the right of rectangle
        code |= RIGHT;
    if (y < y_min) // below the rectangle
        code |= BOTTOM;
    else if (y > y_max) // above the rectangle
        code |= TOP;
    return code;
}
void lc_cs()
{
    int x1, y1, x2, y2;
    cout << "Enter the first point: ";
    cin >> x1 >> y1;
    cout << "Enter the second point: ";
    cin >> x2 >> y2;
    // Compute region codes for P1, P2
```

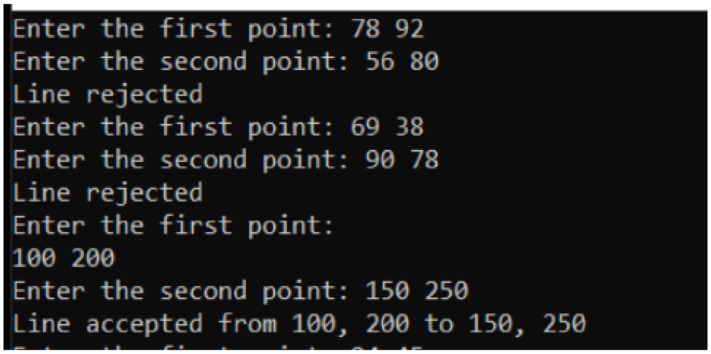


```
    int code1 = computeCode(x1, y1);
    int code2 = computeCode(x2, y2);
    // Initialize line as outside the rectangular window
    bool accept = false;
    while (true)
    {
        if ((code1 == 0) && (code2 == 0))
        {
            accept = true;
            break;
        }
        else if (code1 & code2)
        {
            break;
        }
        else
        {
            int code_out;
            double x, y;
            if (code1 != 0)
                code_out = code1;
            else
                code_out = code2;
            if (code_out & TOP)
            {
                x = x1 + (x2 - x1) * (y_max - y1) / (y2 - y1);
                y = y_max;
            }
            else if (code_out & BOTTOM)
            {
                x = x1 + (x2 - x1) * (y_min - y1) / (y2 - y1);
                y = y_min;
            }
            else if (code_out & RIGHT)
            {
                y = y1 + (y2 - y1) * (x_max - x1) / (x2 - x1);
                x = x_max;
            }
            else if (code_out & LEFT)
            {
                y = y1 + (y2 - y1) * (x_min - x1) / (x2 - x1);
                x = x_min;
            }
            if (code_out == code1)
            {
```



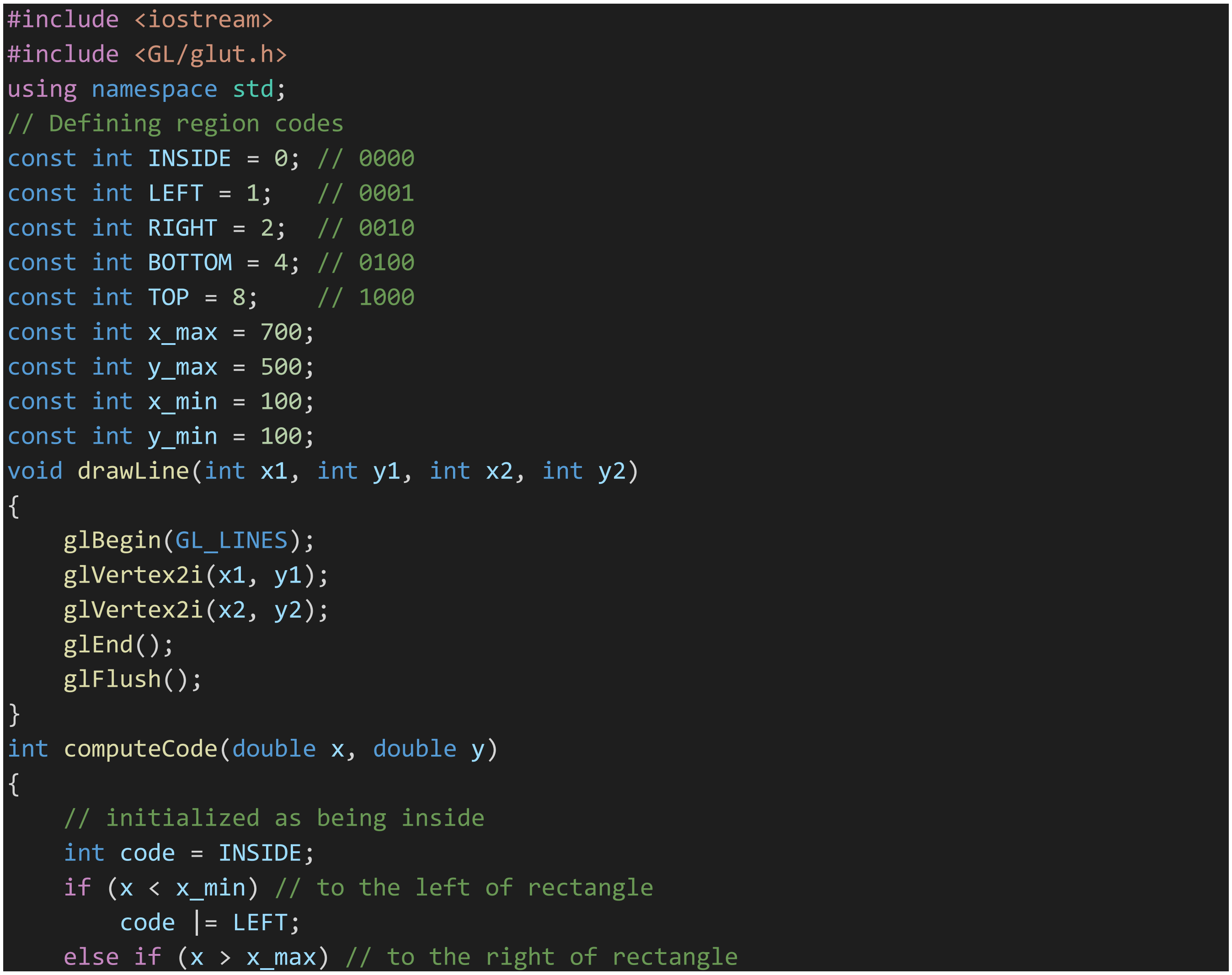
```
                x1 = x;
                y1 = y;
                code1 = computeCode(x1, y1);
            }
            else
            {
                x2 = x;
                y2 = y;
                code2 = computeCode(x2, y2);
            }
        }
    }
    if (accept)
    {
        cout << "Line accepted from " << x1 << ", "
             << y1 << " to " << x2 << ", " << y2 << endl;
        drawLine(x1, y1, x2, y2);
        // Here the user can add code to display the rectangle
        // along with the accepted (portion of) lines
    }
    else
        cout << "Line rejected" << endl;
}
int main(int argc, char **argv)
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowPosition(100, 200);
    glutInitWindowSize(800, 600);
    glutCreateWindow("Cohen Sutherland Line Clipping Algorithm");
    glClearColor(1, 1, 1, 1);
    glColor3f(0, 0, 0);
    glClear(GL_COLOR_BUFFER_BIT);
    gluOrtho2D(0, 800, 0, 600);
    glutDisplayFunc(lc_cs);
    glutMainLoop();
}
```

Output :

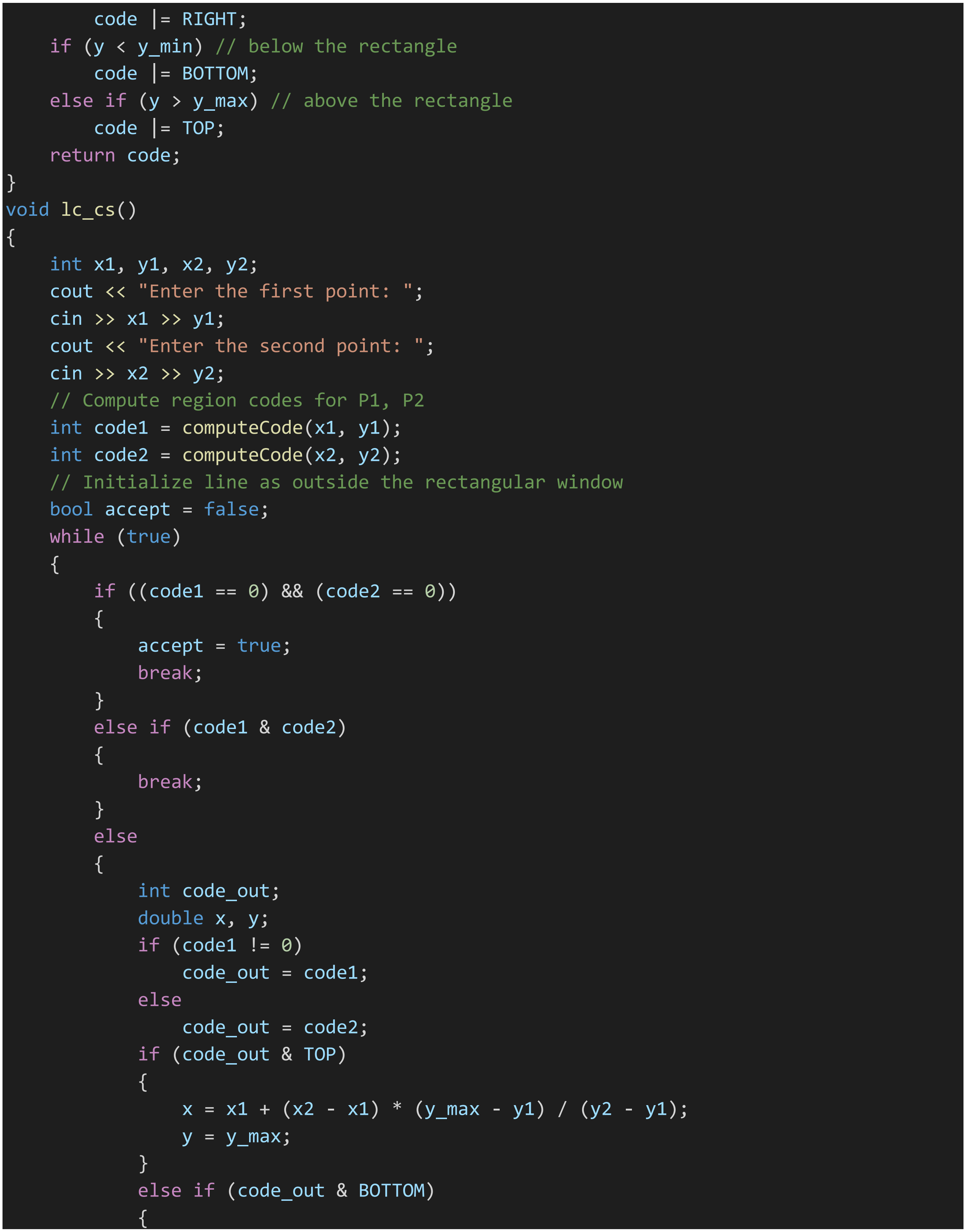


```
Enter the first point: 78 92
Enter the second point: 56 80
Line rejected
Enter the first point: 69 38
Enter the second point: 90 78
Line rejected
Enter the first point:
100 200
Enter the second point: 150 250
Line accepted from 100, 200 to 150, 250
```

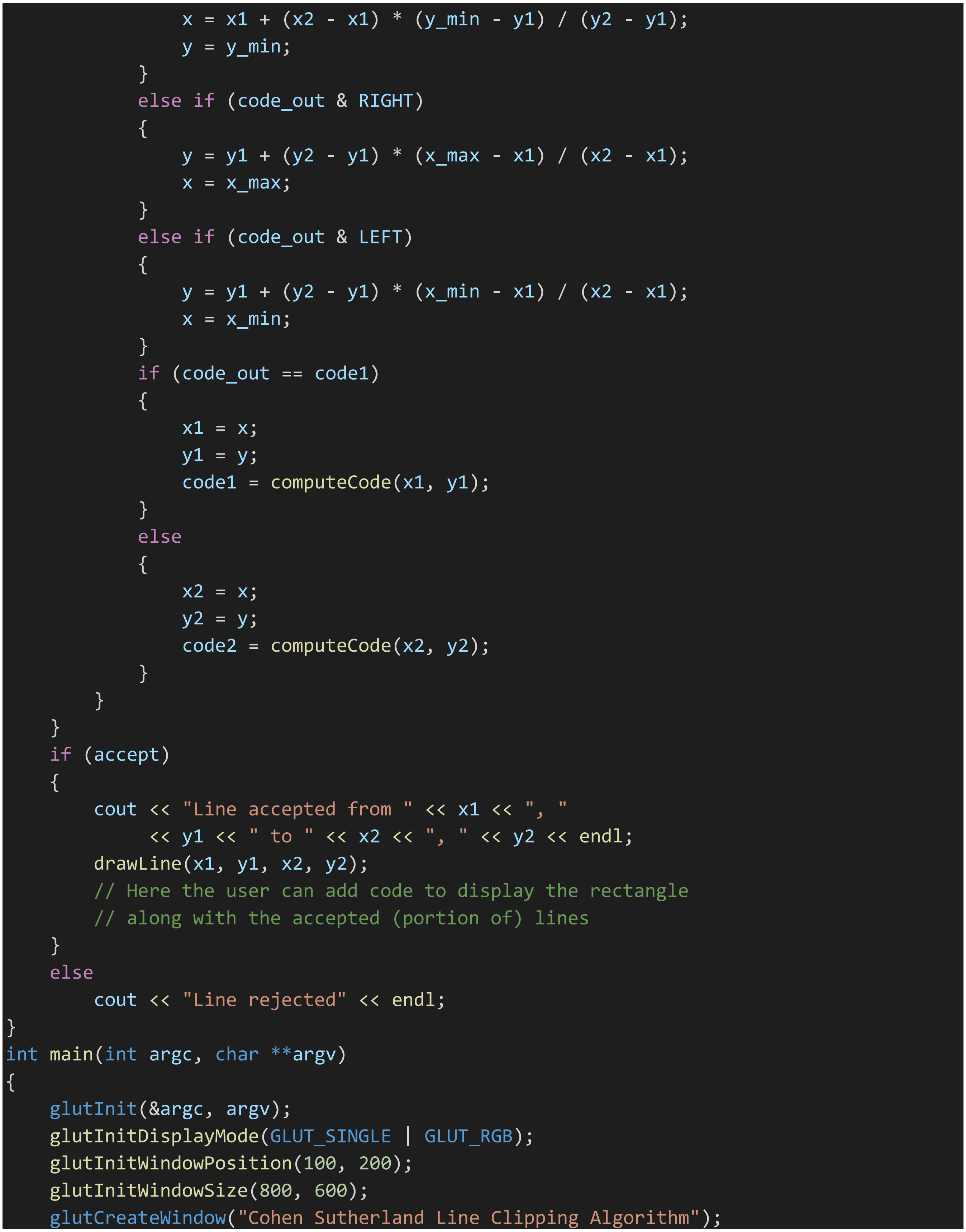
8. Implement Line Clipping approach using Liang Barsky / Cyrus Beck



```cpp
#include <iostream>
#include <GL/glut.h>
using namespace std;
// Defining region codes
const int INSIDE = 0; // 0000
const int LEFT = 1;    // 0001
const int RIGHT = 2;   // 0010
const int BOTTOM = 4; // 0100
const int TOP = 8;     // 1000
const int x_max = 700;
const int y_max = 500;
const int x_min = 100;
const int y_min = 100;
void drawLine(int x1, int y1, int x2, int y2)
{
    glBegin(GL_LINES);
    glVertex2i(x1, y1);
    glVertex2i(x2, y2);
    glEnd();
    glFlush();
}
int computeCode(double x, double y)
{
    // initialized as being inside
    int code = INSIDE;
    if (x < x_min) // to the left of rectangle
        code |= LEFT;
    else if (x > x_max) // to the right of rectangle
```

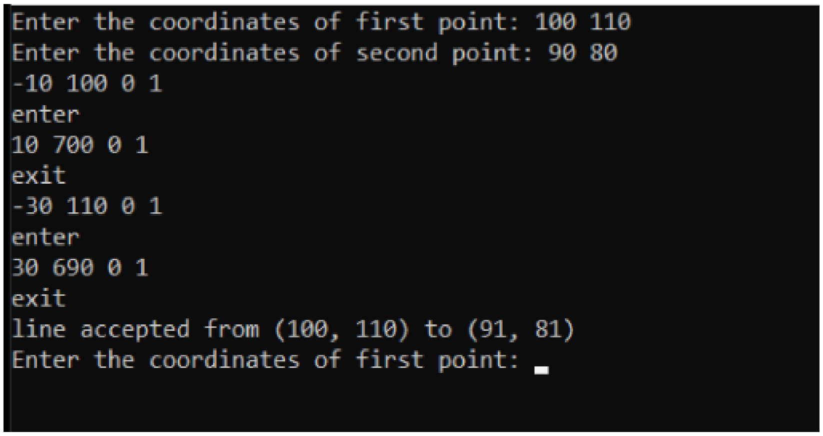


```
        code |= RIGHT;
    if (y < y_min) // below the rectangle
        code |= BOTTOM;
    else if (y > y_max) // above the rectangle
        code |= TOP;
    return code;
}
void lc_cs()
{
    int x1, y1, x2, y2;
    cout << "Enter the first point: ";
    cin >> x1 >> y1;
    cout << "Enter the second point: ";
    cin >> x2 >> y2;
    // Compute region codes for P1, P2
    int code1 = computeCode(x1, y1);
    int code2 = computeCode(x2, y2);
    // Initialize line as outside the rectangular window
    bool accept = false;
    while (true)
    {
        if ((code1 == 0) && (code2 == 0))
        {
            accept = true;
            break;
        }
        else if (code1 & code2)
        {
            break;
        }
        else
        {
            int code_out;
            double x, y;
            if (code1 != 0)
                code_out = code1;
            else
                code_out = code2;
            if (code_out & TOP)
            {
                x = x1 + (x2 - x1) * (y_max - y1) / (y2 - y1);
                y = y_max;
            }
            else if (code_out & BOTTOM)
            {
```



```
                x = x1 + (x2 - x1) * (y_min - y1) / (y2 - y1);
                y = y_min;
            }
            else if (code_out & RIGHT)
            {
                y = y1 + (y2 - y1) * (x_max - x1) / (x2 - x1);
                x = x_max;
            }
            else if (code_out & LEFT)
            {
                y = y1 + (y2 - y1) * (x_min - x1) / (x2 - x1);
                x = x_min;
            }
            if (code_out == code1)
            {
                x1 = x;
                y1 = y;
                code1 = computeCode(x1, y1);
            }
            else
            {
                x2 = x;
                y2 = y;
                code2 = computeCode(x2, y2);
            }
        }
    }
    if (accept)
    {
        cout << "Line accepted from " << x1 << ", "
             << y1 << " to " << x2 << ", " << y2 << endl;
        drawLine(x1, y1, x2, y2);
        // Here the user can add code to display the rectangle
        // along with the accepted (portion of) lines
    }
    else
        cout << "Line rejected" << endl;
}
int main(int argc, char **argv)
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowPosition(100, 200);
    glutInitWindowSize(800, 600);
    glutCreateWindow("Cohen Sutherland Line Clipping Algorithm");
    glClearColor(1, 1, 1, 1);
    glColor3f(0, 0, 0);
    glClear(GL_COLOR_BUFFER_BIT);
    gluOrtho2D(0, 800, 0, 600);
    glutDisplayFunc(lc_cs);
    glutMainLoop();
}
```

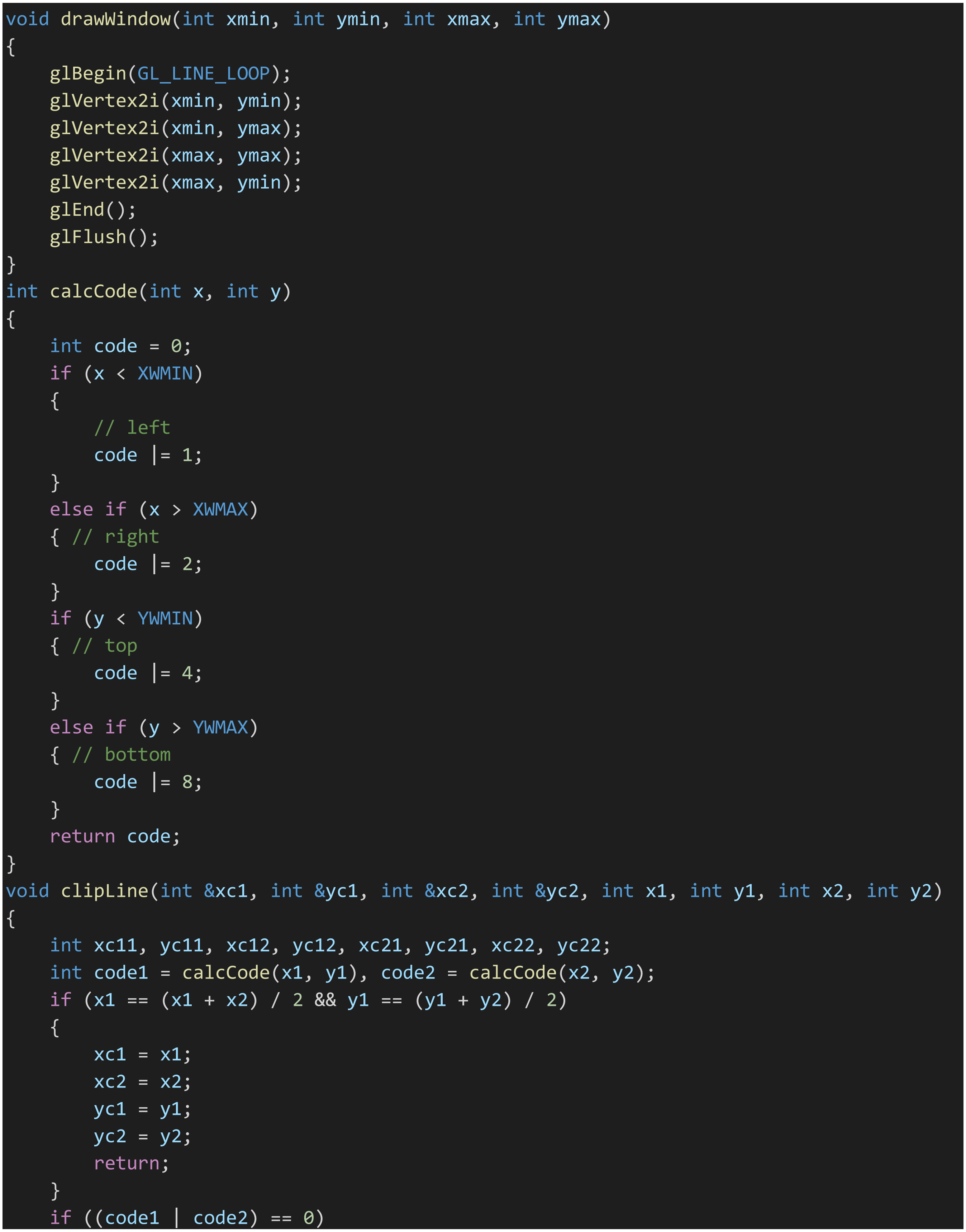
Output :



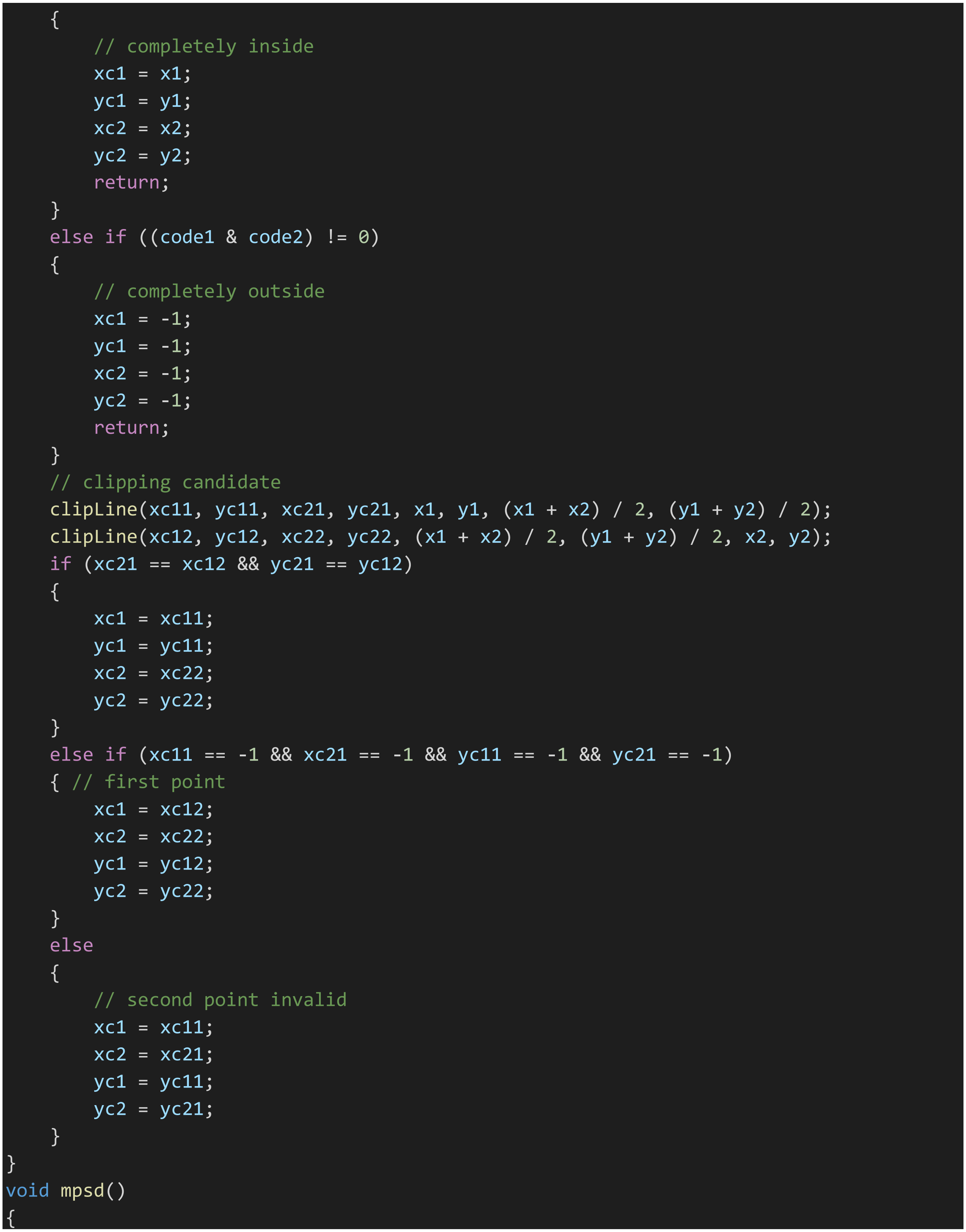
```
Enter the coordinates of first point: 100 110
Enter the coordinates of second point: 90 80
-10 100 0 1
enter
10 700 0 1
exit
-30 110 0 1
enter
30 690 0 1
exit
line accepted from (100, 110) to (91, 81)
Enter the coordinates of first point:
```

9. Implement Line Clipping approach using Mid-Point Subdivision

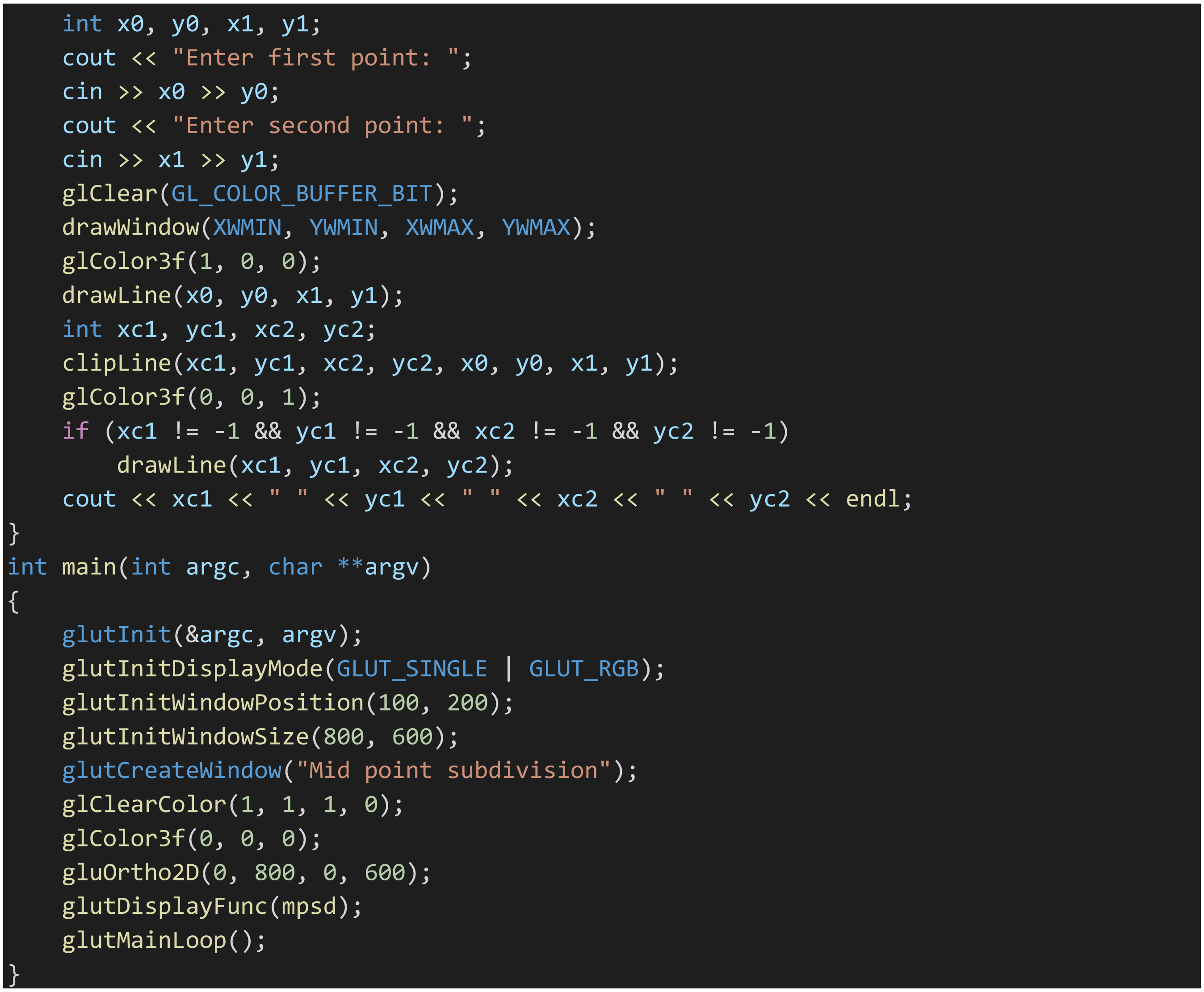
```
#include <iostream>
#include <GL/glut.h>
using namespace std;
#define XWMIN 100
#define XWMAX 400
#define YWMIN 100
#define YWMAX 400
void drawLine(int x1, int y1, int x2, int y2)
{
    glBegin(GL_LINES);
    glVertex2i(x1, y1);
    glVertex2i(x2, y2);
    glEnd();
    glFlush();
}
```



```
void drawWindow(int xmin, int ymin, int xmax, int ymax)
{
    glBegin(GL_LINE_LOOP);
    glVertex2i(xmin, ymin);
    glVertex2i(xmin, ymax);
    glVertex2i(xmax, ymax);
    glVertex2i(xmax, ymin);
    glEnd();
    glFlush();
}
int calcCode(int x, int y)
{
    int code = 0;
    if (x < XWMIN)
    {
        // left
        code |= 1;
    }
    else if (x > XWMAX)
    { // right
        code |= 2;
    }
    if (y < YWMIN)
    { // top
        code |= 4;
    }
    else if (y > YWMAX)
    { // bottom
        code |= 8;
    }
    return code;
}
void clipLine(int &xc1, int &yc1, int &xc2, int &yc2, int x1, int y1, int x2, int y2)
{
    int xc11, yc11, xc12, yc12, xc21, yc21, xc22, yc22;
    int code1 = calcCode(x1, y1), code2 = calcCode(x2, y2);
    if (x1 == (x1 + x2) / 2 && y1 == (y1 + y2) / 2)
    {
        xc1 = x1;
        xc2 = x2;
        yc1 = y1;
        yc2 = y2;
        return;
    }
    if ((code1 | code2) == 0)
```

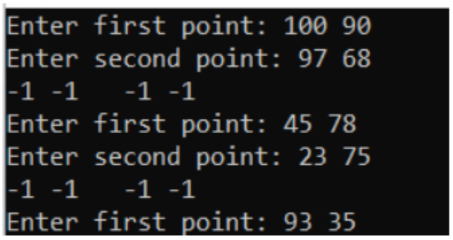


```
    {
        // completely inside
        xc1 = x1;
        yc1 = y1;
        xc2 = x2;
        yc2 = y2;
        return;
    }
    else if ((code1 & code2) != 0)
    {
        // completely outside
        xc1 = -1;
        yc1 = -1;
        xc2 = -1;
        yc2 = -1;
        return;
    }
    // clipping candidate
    clipLine(xc11, yc11, xc21, yc21, x1, y1, (x1 + x2) / 2, (y1 + y2) / 2);
    clipLine(xc12, yc12, xc22, yc22, (x1 + x2) / 2, (y1 + y2) / 2, x2, y2);
    if (xc21 == xc12 && yc21 == yc12)
    {
        xc1 = xc11;
        yc1 = yc11;
        xc2 = xc22;
        yc2 = yc22;
    }
    else if (xc11 == -1 && xc21 == -1 && yc11 == -1 && yc21 == -1)
    { // first point
        xc1 = xc12;
        xc2 = xc22;
        yc1 = yc12;
        yc2 = yc22;
    }
    else
    {
        // second point invalid
        xc1 = xc11;
        xc2 = xc21;
        yc1 = yc11;
        yc2 = yc21;
    }
}
void mpsd()
{
```



```
    int x0, y0, x1, y1;
    cout << "Enter first point: ";
    cin >> x0 >> y0;
    cout << "Enter second point: ";
    cin >> x1 >> y1;
    glClear(GL_COLOR_BUFFER_BIT);
    drawWindow(XWMIN, YWMIN, XWMAX, YWMAX);
    glColor3f(1, 0, 0);
    drawLine(x0, y0, x1, y1);
    int xc1, yc1, xc2, yc2;
    clipLine(xc1, yc1, xc2, yc2, x0, y0, x1, y1);
    glColor3f(0, 0, 1);
    if (xc1 != -1 && yc1 != -1 && xc2 != -1 && yc2 != -1)
        drawLine(xc1, yc1, xc2, yc2);
    cout << xc1 << " " << yc1 << " " << xc2 << " " << yc2 << endl;
}
int main(int argc, char **argv)
{
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowPosition(100, 200);
    glutInitWindowSize(800, 600);
    glutCreateWindow("Mid point subdivision");
    glClearColor(1, 1, 1, 0);
    glColor3f(0, 0, 0);
    gluOrtho2D(0, 800, 0, 600);
    glutDisplayFunc(mpsd);
    glutMainLoop();
}
```

Output :



```
Enter first point: 100 90
Enter second point: 97 68
-1 -1   -1 -1
Enter first point: 45 78
Enter second point: 23 75
-1 -1   -1 -1
Enter first point: 93 35
```