SCHOOL OF COMPUTER SCIENCE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
DEHRADUN, UTTARAKHAND

COMPUTER GRAPHICS

LABORATORY FILE

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For

Vth Semester

Submitted To:
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LAB EXPERIMENT – 7

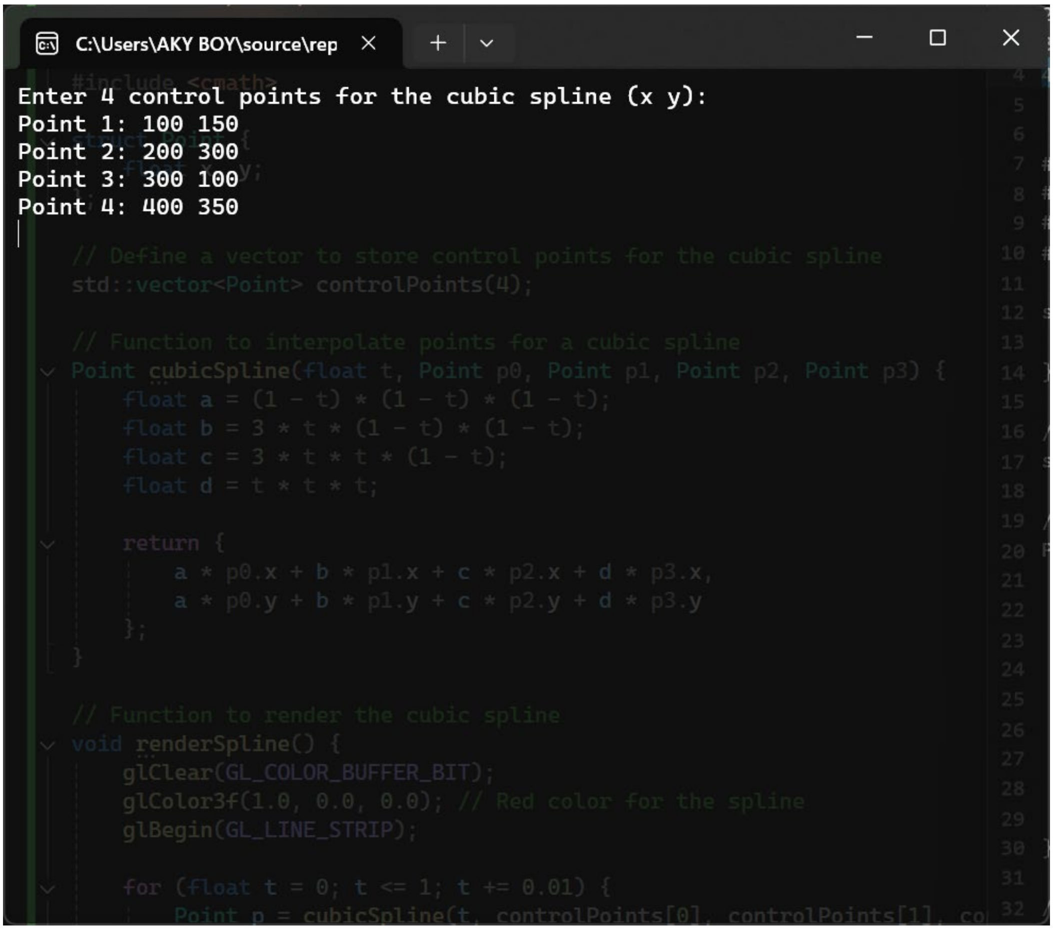
Drawing Bezier Curves

[Virtual GLUT based demonstration]

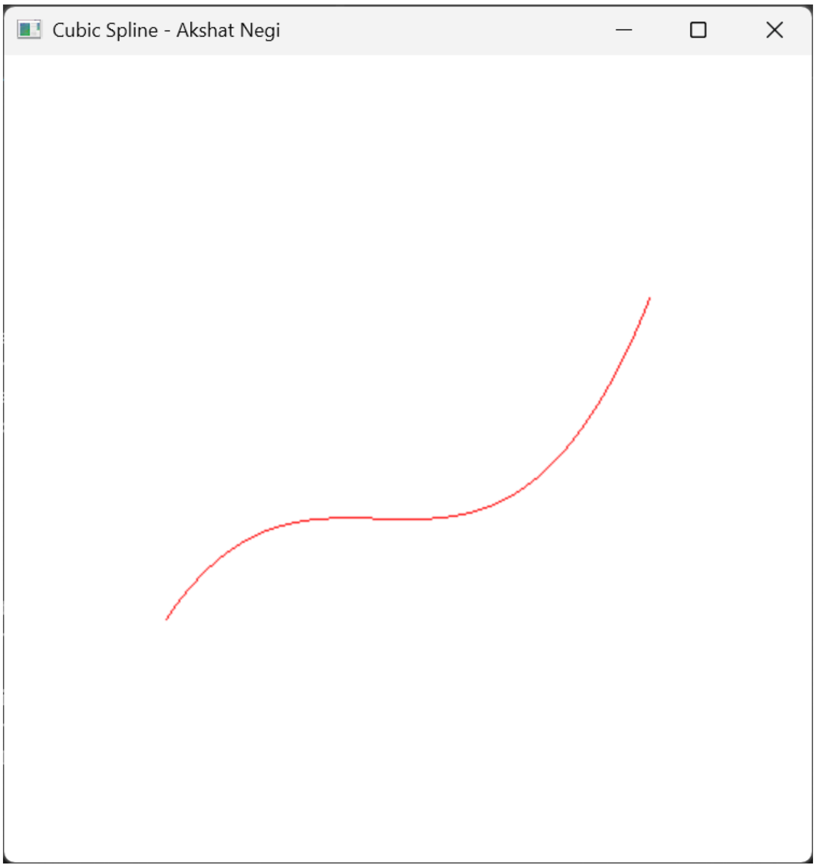
a. Write a program to draw a cubic spline.

```
#include <GL/freeglut.h>
#include <vector>
#include <iostream>
#include <cmath>

struct Point {
    float x, y;
};

// Define a vector to store control points for the cubic spline
std::vector<Point> controlPoints(4);

// Function to interpolate points for a cubic spline
Point cubicSpline(float t, Point p0, Point p1, Point p2, Point p3) {
    float a = (1 - t) * (1 - t) * (1 - t);
    float b = 3 * t * (1 - t) * (1 - t);
    float c = 3 * t * t * (1 - t);
    float d = t * t * t;

    return {
        a * p0.x + b * p1.x + c * p2.x + d * p3.x,
        a * p0.y + b * p1.y + c * p2.y + d * p3.y
    };
}

// Function to render the cubic spline
void renderSpline() {
    glClear(GL_COLOR_BUFFER_BIT);
    glColor3f(1.0, 0.0, 0.0); // Red color for the spline
    glBegin(GL_LINE_STRIP);

    for (float t = 0; t <= 1; t += 0.01) {
        Point p = cubicSpline(t, controlPoints[0], controlPoints[1], controlPoints[2],
controlPoints[3]);
        glVertex2f(p.x, p.y);
    }

    glEnd();
    glFlush();
}

void init() {
    glClearColor(1.0, 1.0, 1.0, 1.0);
    glOrtho(0.0, 500.0, 0.0, 500.0, -1.0, 1.0);
}

int main(int argc, char** argv) {
    std::cout << "Enter 4 control points for the cubic spline (x y):\n";
    for (int i = 0; i < 4; ++i) {
        std::cout << "Point " << i + 1 << ": ";
        std::cin >> controlPoints[i].x >> controlPoints[i].y;
    }
    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize(500, 500);
    glutCreateWindow("Cubic Spline - Akshat Negi");
    init();
    glutDisplayFunc(renderSpline);
    glutMainLoop();
    return 0;
}
```

```
4 control points for the cubic spline (x y):

100 150

200 300

300 100

400 350
```



```
Enter 4 control points for the cubic spline (x y):
Point 1: 100 150
Point 2: 200 300
Point 3: 300 100
Point 4: 400 350
```



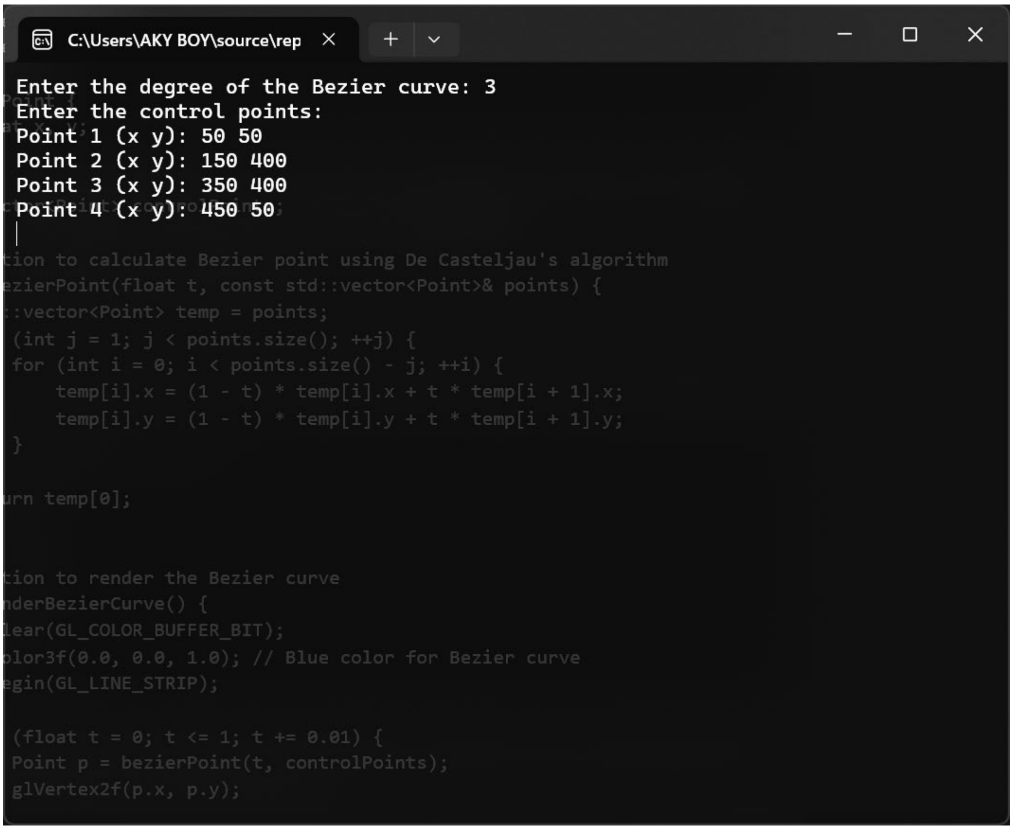
b. WAP to draw a Bezier curve.

# Take necessary values as input from the user like degree of the Bezier curve.

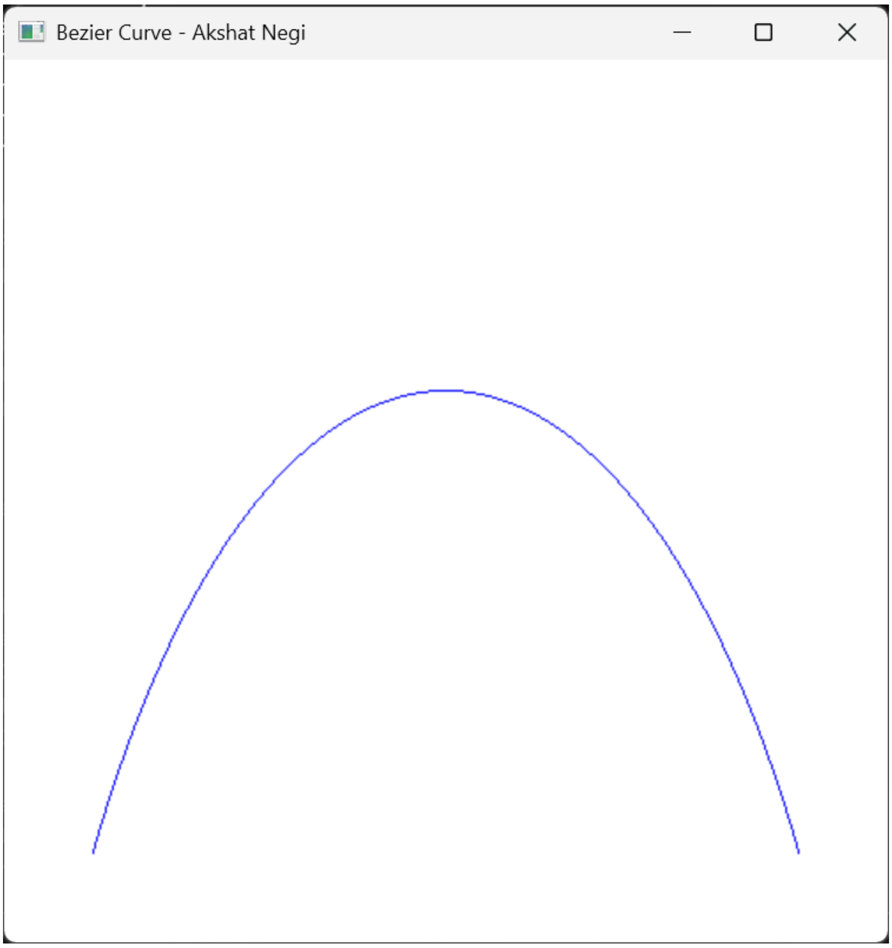
```
#include <GL/freeglut.h>
#include <iostream>
#include <vector>

struct Point {
    float x, y;
};

std::vector<Point> controlPoints;

// Function to calculate Bezier point using De Casteljau's algorithm
Point bezierPoint(float t, const std::vector<Point>& points) {
    std::vector<Point> temp = points;
    for (int j = 1; j < points.size(); ++j) {
        for (int i = 0; i < points.size() - j; ++i) {
            temp[i].x = (1 - t) * temp[i].x + t * temp[i + 1].x;
            temp[i].y = (1 - t) * temp[i].y + t * temp[i + 1].y;
        }
    }
    return temp[0];
}

// Function to render the Bezier curve
void renderBezierCurve() {
    glClear(GL_COLOR_BUFFER_BIT);
    glColor3f(0.0, 0.0, 1.0); // Blue color for Bezier curve
    glBegin(GL_LINE_STRIP);

    for (float t = 0; t <= 1; t += 0.01) {
        Point p = bezierPoint(t, controlPoints);
        glVertex2f(p.x, p.y);
    }

    glEnd();
    glFlush();
}

void init() {
    glClearColor(1.0, 1.0, 1.0, 1.0);
    glOrtho(0.0, 500.0, 0.0, 500.0, -1.0, 1.0);
}

int main(int argc, char** argv) {
    int degree;
    std::cout << "Enter the degree of the Bezier curve: ";
    std::cin >> degree;
    controlPoints.resize(degree + 1);

    std::cout << "Enter the control points:\n";
    for (int i = 0; i <= degree; i++) {
        std::cout << "Point " << i + 1 << " (x y): ";
        std::cin >> controlPoints[i].x >> controlPoints[i].y;
    }

    glutInit(&argc, argv);
    glutInitDisplayMode(GLUT_SINGLE | GLUT_RGB);
    glutInitWindowSize(500, 500);
    glutCreateWindow("Bezier Curve - Akshat Negi");
    init();
    glutDisplayFunc(renderBezierCurve);
    glutMainLoop();
    return 0;
}
```

SAMPLE INPUTS

```
Enter the degree of the Bezier curve: 2

Enter the control points:

Point 1 (x y): 100 100

Point 2 (x y): 250 400

Point 3 (x y): 400 100


Enter the degree of the Bezier curve: 3

Enter the control points:

Point 1 (x y): 50 50

Point 2 (x y): 150 400

Point 3 (x y): 350 400

Point 4 (x y): 450 50


Enter the degree of the Bezier curve: 4

Enter the control points:

Point 1 (x y): 50 50
Point 2 (x y): 100 400

Point 3 (x y): 250 300

Point 4 (x y): 400 400

Point 5 (x y): 450 50
```



```
Enter the degree of the Bezier curve: 3
Enter the control points:
Point 1 (x y): 50 50
Point 2 (x y): 150 400
Point 3 (x y): 350 400
Point 4 (x y): 450 50
```



Bezier Curve - Akshat Negi