Faculty of Science

Course:	CSCI 4110U: Advanced Computer Graphics
Lab Assignment:	3
Topic:	Parametrics – Bézier Curves

Overview

In this lab, you will create the geometry for a 3D cubic Bézier curve. The code to generate a strip of lines (based on hard-coded points), and draw those lines, is provided. You are expected to make modifications to this program to make it draw a cubic Bézier curve.

Instructions

First, you should download the base project from the repository is given, below:

- https://github.com/randyfortier/CSCI4110U_Labs

The parametric equations for a 3D cubic Bézier curve are below:

$$x = (1-t)^3 \cdot p0.x + (1-t)^2 \cdot 3t \cdot p1.x + (1-t) \cdot 3t^2 \cdot p2.x + t^3 \cdot p3.x$$

$$y = (1-t)^3 \cdot p0.y + (1-t)^2 \cdot 3t \cdot p1.y + (1-t) \cdot 3t^2 \cdot p2.y + t^3 \cdot p3.y$$

$$z = (1-t)^3 \cdot p0.z + (1-t)^2 \cdot 3t \cdot p1.z + (1-t) \cdot 3t^2 \cdot p2.z + t^3 \cdot p3.z$$

The parameter for these equations, `t`, will range from `0.0` to `1.0`. The smaller the step size, the more points generated and the smoother the curve. In the example where the screenshot is taken, 21 points are used. In these equations `p0`, `p1`, `p2`, and `p3` are the four control points. For the purposes of the screenshot, the following control points were used:

```
glm::vec3 controlPoint1(-2.00f, -1.50f,  2.00f);
glm::vec3 controlPoint2( 2.50f,  2.50f, -0.50f);
glm::vec3 controlPoint3(-1.00f,  1.00f, -2.50f);
glm::vec3 controlPoint4( 2.00f, -2.50f, -0.50f);
```

The result of this process should look similar to Figure 1.

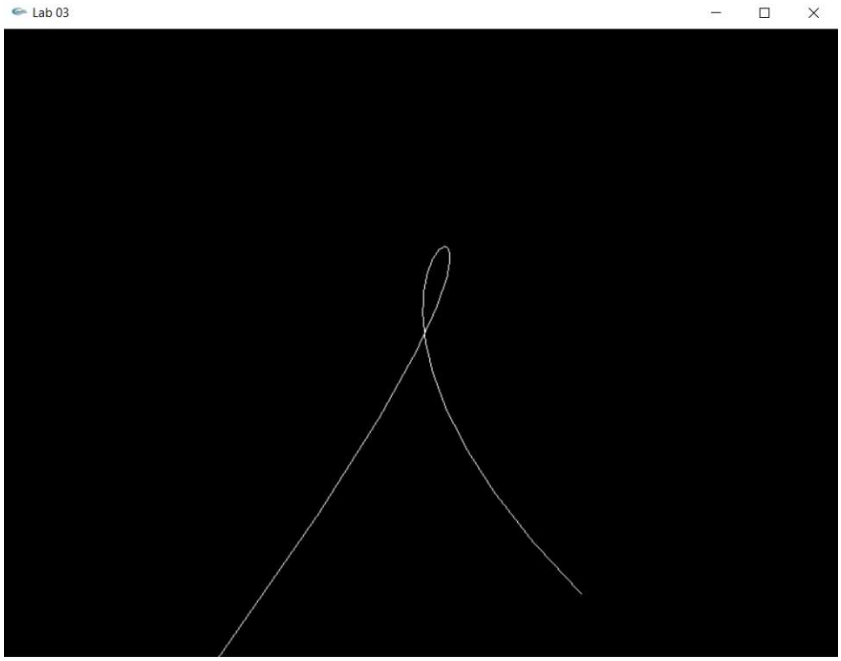

Figure 1 – the output of the modified program

Need an Extra Challenge?

If you feel like this is too easy for you (e.g. you have some background with OpenGL), you are welcome to try one of these variations (presented in order of difficulty):

1. Extrude a triangle along a Bézier curve, keeping orientation of the triangle the same throughout
2. Extrude a circle along a Bézier curve (similar to Lab 02), keeping orientation of the circle the same throughout
3. Extrude a triangle along a Bézier curve, orienting the triangle to be perpendicular to the curve
4. Extrude a circle along a Bézier curve (similar to Lab 02), orienting the circle to be perpendicular to the curve

Lab Report

To demonstrate to the lab instructor your completion of this laboratory assignment, merely show them the modified OpenGL program.