

**Course:** “Computer Graphics,” ECS 175, Fall Quarter 2019

**Instructor:** Bernd Hamann

**Project 4:** “A SIMPLE BÉZIER AND B-SPLINE CURVE EDITOR”

**Date due:** Wednesday, November 27, 2019

**Remark:** You must NOT use OpenGL’s routines for generating Bézier or B-spline curves! You can use OpenGL for rendering but not for evaluating these curves.

The fourth project requires the implementation of a 2D **Bézier** and **B-spline curve editor**. A 2D Bézier curve is defined as

$$\mathbf{c}(t) = (x(t), y(t))^T = \sum_{i=0}^n \mathbf{b}_i B_i^n(t) = \sum_{i=0}^n (x_i, y_i)^T \binom{n}{i} (1-t)^{n-i} t^i, \quad t \in [0, 1].$$

For the evaluation of a Bézier curve, use the **de Casteljau algorithm** to compute points on the curve. A single 2D parametric B-spline curve is defined as

$$\mathbf{c}(t) = (x(t), y(t))^T = \sum_{i=0}^n \mathbf{d}_i N_i^k(t) = \sum_{i=0}^n (x_i, y_i)^T N_i^k(t), \quad t \in [\tau_{k-1}, \tau_{n+1}].$$

Remember that you do not need to evaluate the normalized B-spline basis functions  $N_i^k(t)$ . For the evaluation of a B-spline curve, use the **de Boor algorithm** to generate points on the curve.

insert between a & b

When dealing with a **Bézier curve**, the user must be able to **add, insert, delete, and modify** the **Bézier points**  $\mathbf{b}_i$ . The same applies to a **B-spline curve**: The user must be able to **add, insert, delete, and modify** the **de Boor points**  $\mathbf{d}_i$ . In addition to this, the user must be able to **change the order**  $k$  of a B-spline curve and **modify** the values of the **knots**  $\tau_0, \dots, \tau_{n+k}$ . Initially, you can define the order to be  $k = 2$  and the knots to be  $\tau_i = i$ ,  $i = 0, \dots, n + k$ .

The user must be able to **specify** the **number of points** used for rendering a Bézier or B-spline curve by a sequence of line segments (“display resolution”).

The user should be able to **change all parameters easily** by providing a screen area used for displaying and specifying the coordinates of control points (Bézier and de Boor points), the order and the knots of a B-spline curve, and the display resolution. The specification of control points should be made as easy as possible. Either the user **types in the control information directly**, or – when modifying control points – uses a “rubber band” technique to interactively move control points.

The curve editor must provide a facility to **store** the **parameters** defining a Bézier or B-spline curve. The system must be capable of **reading** and **writing control information** for Bézier and B-spline curves.

It must be possible to manipulate, create, and display a scene containing **multiple Bézier** and **multiple B-spline curves**. **Make it possible to select a certain curve and to operate just on the selected one!**

Besides having to hand in a program listing, please prepare a “manual sheet” explaining how to use your program.

The overall grade (on a scale from 0 to 100) will depend on i) **completeness** (40%), ii) **correctness** (40%), iii) **interface quality** (15%), and iv) the **manual sheet** (5%). No project will be accepted when it is more than seven (7) days late; for each day, one (1) point will be deduced.

**DO NOT REMOVE YOUR PROGRAM! YOU WILL BE ABLE TO USE IT IN THE NEXT ASSIGNMENT(S).**

**H A V E      F U N      ! ! !**