Course: “Computer Graphics,” ECS 175, Fall Quarter 2015
Instructor: Bernd Hamann

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

Date due: Monday, November 23, 2015

Remark: You must NOT use GL’s routines for generating Bézier or B-spline curves! You can use GL 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

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

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

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

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.

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** $\tau_0, \ldots, \tau_{n+k}$. Initially, you can define the order to be $k = 2$ and the knots to be $\tau_i = i$, $i = 0, ..., n+k$.

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).

HAVE FUN !!!