CS 557
Homework 10
Due Tuesday, 6 October 2009

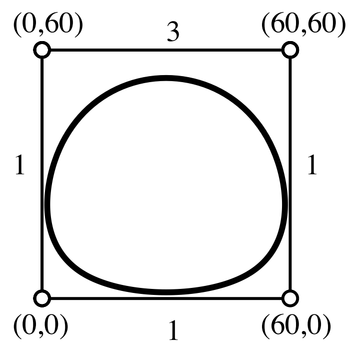

Figure 1: Cubic B-Spline Curve

1. For the curve in Figure 1, draw the hodograph. Show the control point coordinates and knot intervals.

2. A degree d B-spline curve with n control points can be expressed

$$\mathbf{P}(t) = \sum_{i=1}^{n} \mathbf{P_i} B_i^d(t).$$

   The knot vector for this curve contains $n + d - 1$ knots, denoted $[t_{1-d/2}, \ldots, t_{n+(d-1)/2}]$.

   Each B-spline basis function $B_i^d(t)$ can be expressed as an explicit B-spline curve whose x coordinates are the Greville abscissae (Section 6.9) and whose y coordinates are all zero except $y_i = 1$. Therefore, $B_i^d(t) = 0$ for $t \le t_{i-(d+1)/2}$ and $t \ge t_{i+(d+1)/2}$. Note that each basis function is a piecewise polynomial that has $d + 1$ non-zero segments.

   a. Given a knot vector $[t_0, \ldots, t_8] = [0, 0, 0, 1, 3, 5, 7, 7, 7]$ for a degree 3 B-spline curve, what are the control points for the B-spline basis function $B_4^3(t)$ expressed as an explicit B-spline curve?
   b. For $B_2^3(t)$?

3. Referring to the preceding problem, evaluate $B_4^3(3)$ and $B_2^3(3)$.