CS 4620 Homework 8: Spline Evaluation and Subdivision

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Problem 1: De Casteljau's Algorithm *(based on Buss, Exercise VII.11)*

(a) Derive an extension of the de Casteljau algorithm for degree three curves that applies to Bézier patches of degree three, i.e., describe an algorithm to evaluate the surface at an arbitrary $(u, v) \in [0, 1] \times [0, 1]$ parameter value.

(b) Verify your method on the scalar-valued function example where all $p_{ij} = 0$, $i = 0...3$, $j = 0...3$ except for $p_{00} = 1$, i.e., $p_{ij} = \delta_{i0}\delta_{j0}$. What should $p(u, v)$ be in this case? Verify that your method reproduces this case correctly at $(u, v) = (0.2, 0.2)$.

Problem 2: Recursive Subdivision *(based on Buss, Exercise VII.12)*

(a) Derive a recursive subdivision method for degree three Bézier patches based on recursive subdivision for Bézier curves. At each step, your method should either subdivide in the u direction or in the v direction and split a patch into two patches, i.e., it should not subdivide in both directions at once. *(Hint: Recall the connection between de Casteljau's method and recursive subdivision.)*

(b) Using the 4-by-4 grid of $p_{ij} = \delta_{i0}\delta_{j0}$ values from Problem 1(b), apply your method to compute the 7-by-7 grid of control values.