Programming #4: Part II (4190.410)
Due: November 27, 2013

A bicubic Bézier surface $S(u, v) = \sum_{k=0}^{3} \sum_{l=0}^{3} b_{kl} B^3_k(u) B^3_l(v)$, $0 \leq u, v \leq 1$, can be approximated by a dense mesh sampled at the uniform parameters: $u_i = i/511, v_j = j/511$, for $i, j = 0, \cdots, 511$. Implement a spherical environmental mapping to the Bézier surface $S(u, v)$. The partial derivatives of the Bézier surface $S(u, v)$ can be computed as follows:

$$S_u(u, v) = \sum_{k=0}^{2} \sum_{l=0}^{3} 3(b_{k+1,l} - b_{k,l}) B^2_k(u) B^3_l(v),$$

$$S_v(u, v) = \sum_{k=0}^{3} \sum_{l=0}^{2} 3(b_{k,l+1} - b_{k,l}) B^3_k(u) B^2_l(v).$$

The unit normal $N(u, v)$ can be computed using the two partial derivatives:

$$N(u, v) = \frac{S_u(u, v) \times S_v(u, v)}{\|S_u(u, v) \times S_v(u, v)\|}.$$

Design an interactive system that can control the shape of $S(u, v)$ by dragging its control points projected onto the $xy$, $yz$, and $zx$-planes. The connected network of 16 control points can be displayed as a wireframe of 24 edges, each connecting two adjacent control points.