# Programming #2: Part IV (4190.562)

## Due: May 30, 2016

A bicubic Bézier surface

$$S(u,v) = \sum_{i=0}^{3}\sum_{j=0}^{3} \mathbf{b}_{ij} B_i^3(u) B_j^3(v) = \sum_{i=0}^{3}\sum_{j=0}^{3} (x_{ij}, y_{ij}, z_{ij}) B_i^3(u) B_j^3(v),$$

for $0 \leq u, v \leq 1$, can be used for the deformation of a 3D shape given as a point cloud: $\{\mathbf{p}_k \mid k = 1, \cdots, N\}$.

**Part I:** For each point $\mathbf{p}_k$, compute the closest point $S(u_k, v_k)$ and bind $\mathbf{p}_k$ to the local frame at $S(u_k, v_k)$ (determined by the tangent and normal directions). When we edit the bicubic Bézier surface $S(u, v)$, each point $\mathbf{p}_k$ should move to the corresponding position in the new local frame at $S(u_k, v_k)$ under the shape deformation of $S(u, v)$.

**Part II:** Construct the BVHs for two 3D shapes (under deformation) using the PQP library, and compute the intersection of two shapes.

**Part III:** Compute the self-intersections of the 3D shapes (under deformation).

**Part IV:** Implement an environmental mapping to the 3D shapes (under deformation).