Homework 2

15-462: Computer Graphics

February 26, 2009

1. For a diffuse surface, is it better to compute shading at the vertex or fragment level, why? What about for a specular surface with a sharp specular highlight?

2. Suppose you wanted to build a spline curve out of polynomial segments. Your requirement is that each curve pass through its control end points and have pre-specified derivatives at those endpoints. What degree polynomial is required for your spline segments? (Hint: These are nothing but Hermite Splines.) Assuming adjacent splines agree in position and derivative, what degree of continuity will the whole curve have? Now suppose the curve must also respect pre-specified *second* derivatives at it's endpoints, and that these second derivatives will also agree across adjacent splines? What degree polynomial must the spline segments be? What degree of continuity will the whole curve have?

3. What is the signed distance function for a 2D triangle with vertices $(0, 0)$, $(0, 1)$, and $(1, 0)$?

4. Given two 3D shapes, A and B, described by implicit functions f_A and f_B (respecting the inside/outside convention), give an implicit function for their union $A \cup B$, another for their intersection $A \cap B$, one for the complement of $\bar{A}$, and one for the set difference $A - B$.

5. Intersect the ray starting at (x_p, y_p, z_p) going in direction (x_d, y_d, z_d) with the quadratic surface $z = x^2 + y^2$. Note that the solution will be of the form:

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

and it is sufficient to give expressions for a, b, and c.