15-462 Computer Graphics
Programming assignment 2

Problem 3b (velvet)

The reason why velvet is hard to approximate is because its surface consists of many tiny fibers. These fibers are oriented in a random way, and often touch each other. When light strikes the surface of the velvet, it bounces in a random way on the fibers. The Phong lighting model doesn't take this complex geometry into account. To accurately model the surface of velvet, we would need to know the precise 3D shape and orientation of the fibers and, say, use ray-tracing to determine how light is reflected off the surface.

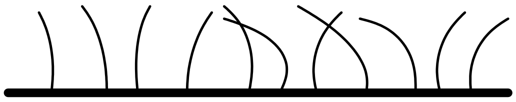

Figure 1: Surface of velvet

Problem 4 (Clipping)

The 6-polygon P lies in some plane, positioned somewhere in 3D space (call this plane Ω). Clipping the 6-polygon against the viewing volume can be decomposed into the following two steps:

1. First, determine the intersection of Ω with the viewing volume. Call it R.
2. Now perform a 2D clip of 6-polygon P against R (all in the plane Ω). The resulting object (call it S) is precisely the object that we would obtain by clipping P against the viewing volume.

So, how many vertices can S have? First, note that R can be a triangle, a quadrilateral or even a hexagon, as can be seen on Figure 2.

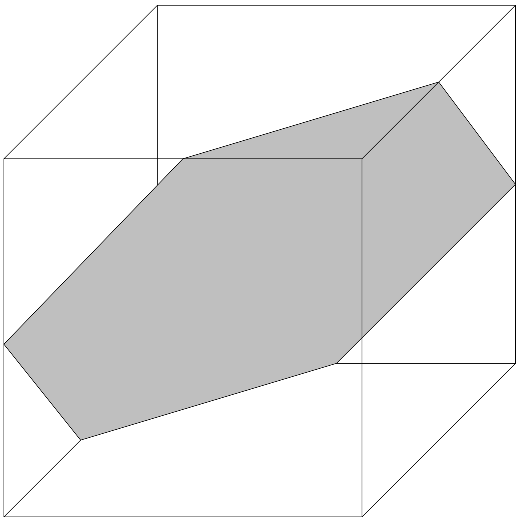

Figure 2: A plane can intersect a cube in a hexagon. Hexagon R is shown shaded.

The maximum number of vertices in the convex/concave case are obtained when R is a hexagon and P is positioned in the way suggested by Figures 3 and 4.

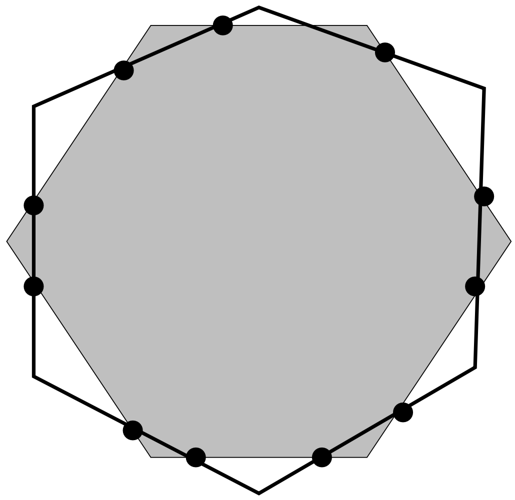

Figure 3: Convex case: maximum number (12) of vertices in S. Hexagon R is shown shaded. Only the outline of polygon P is shown.

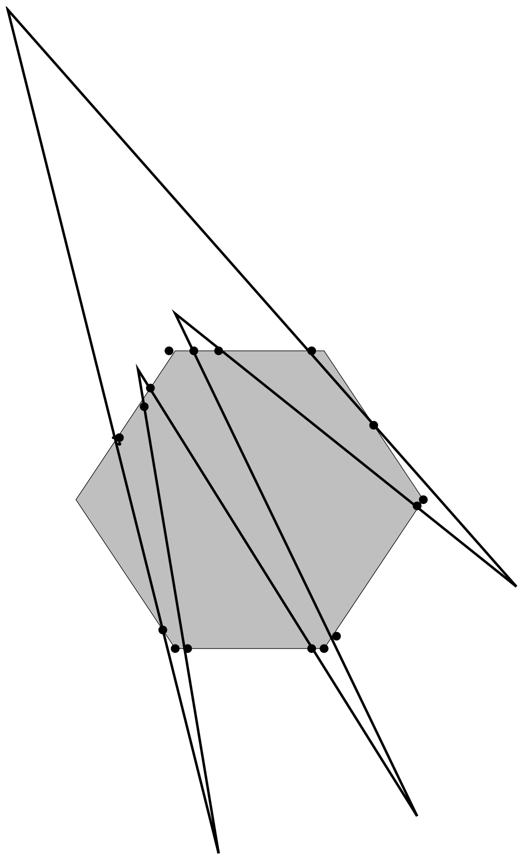

Figure 4: Concave case: maximum number (16) of vertices in S. Hexagon R is shown shaded. Only the outline of polygon P is shown.