CS 465 Homework 2

out: Friday 3 September 2004
due: Friday 10 September 2004

Problem 2: Ray intersection

1. Give the t values of the intersection(s) of the following rays with (i) a sphere of radius 1.25 centered at $(1, 1, 1)$ and (ii) the triangle with vertices $(1, 0, 0)$, $(0, 1, 0)$, and $(0, 0, 1)$. Also compute the intersection points. In a ray tracer, which surface would be hit by each ray?

   (a) $((0, 0, 0), (1, 1, 1))$

   (b) $((0, 0.001, 0.001), (1, 0, 0))$

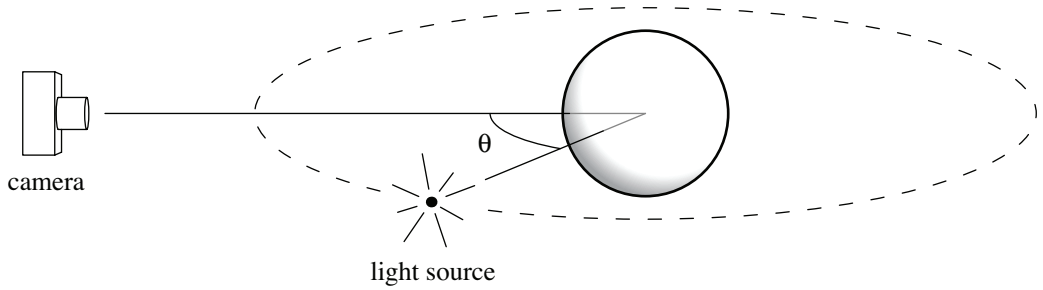
   (c) $((0.001, 0, 0), (0, 1, 1))$

   Here $(\mathbf{p}, \mathbf{d})$ refers to a ray based at $\mathbf{p}$ aimed in direction $\mathbf{d}$.

2. If you accidentally reverse one of the three edge tests in the triangle intersection, what shape will you end up with instead of a triangle?

Problem 3: Shading

A sphere of radius 1 is illuminated by a light source 3 units away and viewed by a camera 5 units away (both distances measured from the center of the sphere). The camera, the source, and the center of the sphere lie in a horizontal plane. The angle between the directions to the camera and light source is θ:



Suppose we render an image using this camera. The sphere will appear as a circle in the image. Consider the color in the image at the center of the image of the sphere and at the right edge of the image of the sphere.

1. For what range of values of θ is the Lambertian shading on the sphere non-zero at the right edge? At the center? For what values of theta is it maximized in each of those two places?

2. Answer the same questions for the specular component of the Phong model, with exponent $n = 40$.

Define θ as the counterclockwise angle from the camera to the light—that is, $\theta < 0$ when the source is on the left of the camera, $\theta > 0$ when then source is on the right of the camera, $\theta = 0$ when the source is right in front of the camera, and $\theta = \pm 180^\circ$ when they are opposite one another.

Feel free to round your answers to the nearest degree.