CS 4620 Written Assignment 7: Ray 2

Out: Saturday 21th November 2015

Due: Thursday 3rd December 2015

This written part should be done alone, not in pairs.

1. Short-answer Questions:

a) Jimmy just purchased his new winter outfit from hat to shoes. Now he wants to take a look at his new look in the mirror. Jimmy is **6-foot** tall. What is the **minimum dimension** (assuming square mirror) of the mirror that he has to buy for him to see his entire body, if he is standing **10 feet** away from the mirror? How about if he is standing **30 feet** away from the mirror?

b) (2-D) A laser beam is shone at a flat glass block of infinite area at an incident angle of **45 degrees** (measured between the incident ray and the normal of the surface). The laser is positioned **at (0, 0),** and the surfaces of the glass block are positioned between **x = 1 and x = 1+T**. What is the length of the area that can be swept by the laser beam if T is varied from **0 to 5**. (See Figure 1.)

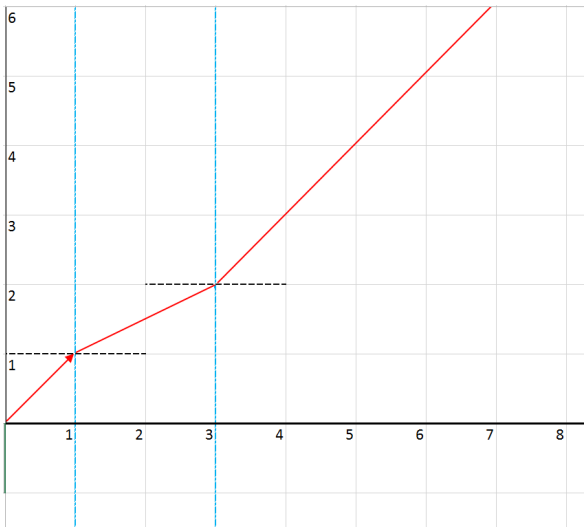

Figure 1

2. Suppose we are rendering an image for the IKEA catalog, showing a **cylindrical** coffee mug available in stainless-steel material. The mug will be illuminated by an ambient light, as well as a window. The camera is positioned at **(0, 0, 20),** viewing in direction **(0, 0, -1)** with up direction **(0, 1, 0).** The mug is centered at the origin of the coordinate system, with **height 10** and **radius 5.** The mug's axis is aligned with the y-axis. And the whole mug can be captured in the image.

For a nice product photo we'd like to see the window reflected on the side of the mug. Where can the window be placed (assume for now that the window is a point) in the environment map where it will be reflected on the side of the cylindrical mug? What if the camera is positioned at **(0, 0, 100)?** Your answer should be a sketch in (ϕ, θ) space showing the region that is reflected in the mug. Compute the (ϕ, θ) coordinates of the corners of the region and of the highest and lowest ϕ and θ. As a simpler example of such problem, consider a camera positioned at **(0, 0, 1),** and looking at a mirror-like square in the x-y plane. The vertices of the square are at **(1, 1, 0), (-1, 1, 0), (-1, -1, 0) and (1, -1, 0).**

In Figure 3 the red arrows are the critical rays you need to consider to find the critical points on the border of the reflected region. The reflected region for this simple case is shown in Figure 4.

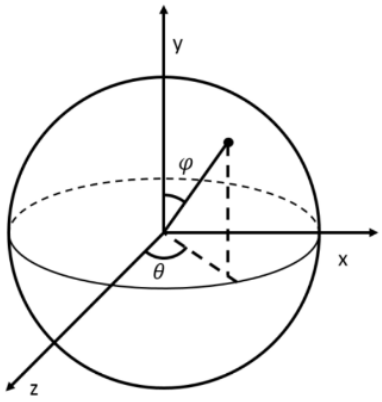

Figure 2: Spherical Coordinate system

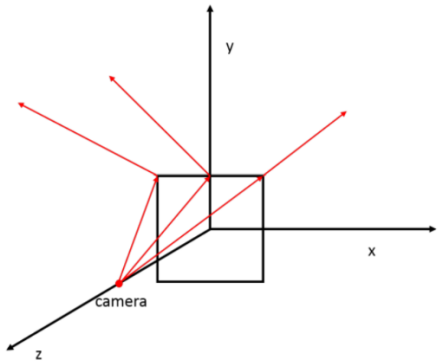

Figure 3: Simple Reflection Example

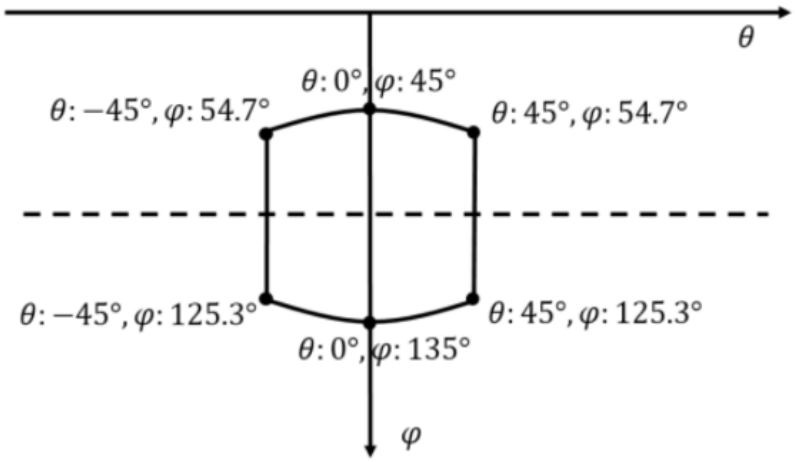

Figure 4: range of ϕ and θ

3. Consider the same setup as in question 2, except this time replace the mug with a disco ball made of stainless steel. Treat the disco ball as a perfect, smooth, reflective sphere. The radius of the disco ball is 1. The blinking disco light is positioned at (2, 0, 0), and shone towards the center of the disco ball. Again, sketch the region that will be illuminated by the disco light in (ϕ, θ) space. What if the disco light is positioned at (+∞, 0, 0) (assume no attenuation)?