This homework WILL NOT BE GRADED. It is intended to help you prepare for the final exam. These questions were taken from last semester’s final.

Question 1:

You wish to find the parameter values for any intersection points between a ray, \( x = x_0 + td \) with \( x_0 = (x_0, y_0, z_0) \) and \( d = (d_x, d_y, d_z) \), and an cylinder of height 1 centered at the origin and aligned with the z-axis.

a. Assume for the moment that the cylinder has infinite height (that is, it goes all the way to positive and negative infinite z.) The implicit equation for this tube is \( x^2 + y^2 - 1 = 0 \). What equation do you need to solve to find the parametric values of the intersection points(s)?

b. How would you determine if the ray hit the original unit-height cylinder?

c. How would you determine if the ray passed through one (or both) of the endcaps of the cylinder?

Question 2:

Consider the area light source, light blocker and surface shown below. For ray-tracing, the area light source is approximated as three point sources distributed as shown.

a. Which point, A, B, C or D, will be the brightest?

b. Which point will be the darkest?

c. What is the relationship between the brightness at point B and the brightness at point C?
Question 3:

Recall the notation used in class for light paths. For example, the OpenGL model for diffuse illumination captures \( LDE \) paths.

a. What class of paths is captured by basic ray-tracing?

b. What class of paths is captured by a radiosity algorithm?

c. Sketch a situation in which radiosity and basic ray-tracing will give significantly different answers. Your diagram must contain a path that is captured by basic ray-tracing but not radiosity, and one that is captured by radiosity but not basic ray-tracing. Label these paths. Also indicate:

- the location of the light source
- the location of the viewer
- whether or not each surface is diffuse or specular (mirror-like)