Programming Assignment #4
CS410 : Introduction to Computer Graphics
Fall 2015

Ray Tracing
Due Tuesday, Dec. 8th.

Motivation

In the third assignment, you created an image from all the one-hop interactions between light sources, polygons, and the camera. In this assignment, you will finish your ray tracer by (1) adding indirect specular reflections (a.k.a. inter-reflections), (2) adding translucency, and (3) implementing anti-aliasing. Also, this time you should expect your program to be evaluated on multiple objects at the same time, to set up opportunities for interesting inter-reflections.

Task

The arguments to your program (both input and output) are the same as in PA3. The major difference is in the quality of the output image. There is, however, one difference in the material property file. Every material in PA3 had 5 properties: the 3 diagonal elements of the diffuse reflection matrix, the specular reflection constant, and the shininess coefficient. Now there is a 6th property: percent translucency (k_t). When this number of is 0.0, the material is opaque. This is the norm. When the percent translucency is 1.0, the material is completely clear, like a window. When the translucency is between 0.0 and 1.0, it determines the percent of light that passes through the surface.

Algorithmically, one difference between PA3 and PA4 is that in PA4, in addition to the reflectance terms computed in PA3, you also through two recursive rays, one in the direction of reflection, the other in the direction of refraction. You compute the light coming in along these rays, multiply it by k_s or k_t, and add it to the reflection. The recursion ends when a ray does not intersect and polygon, or when the product of the k_s/k_t terms the returned value will be multiplied by is less than 1/512.

But what is the direction of refraction, you might rightly ask. Since our models are made up of polygons, it is in the direction opposite V. How much is it offset, you might ask. None, since we will assume infinitely thin polygons.

The other algorithmic difference between PA3 and PA4 is anti-aliasing. Instead of throwing one ray through the center of every pixel, you will throw five rays randomly distributed over the square from (u – 0.5, v – 0.5) to (u + 0.5, v + 0.5). Use a different random distribution for every pixel. Store as the pixel's final value the average of the five returned reflectance values.

Submission/Grading

Make a tar file that includes your source files, a makefile if appropriate, and a README.txt file that explicitly tells us (1) how to compile your program and (2) how to execute it. Submit this tar file via the Checkin script on the class web site. The GTA will unpack your tar file, compile your program, and then test it.. Note that your tar file should not contain executable or compiled files, just source files.

Reminder

There is no "late period". The program is due when it is due. All work you submit must be your own. You may not copy code from colleagues or the web or anywhere else. Cheating will not be tolerated, and will be handled in accordance with university and department policy.