CPSC 314
Assignment 3

Due Wednesday April 5, 2006, 11:59pm

Answer the questions in the spaces provided on the question sheets. If you run out of space for an answer, use separate pages and staple them to your assignment.

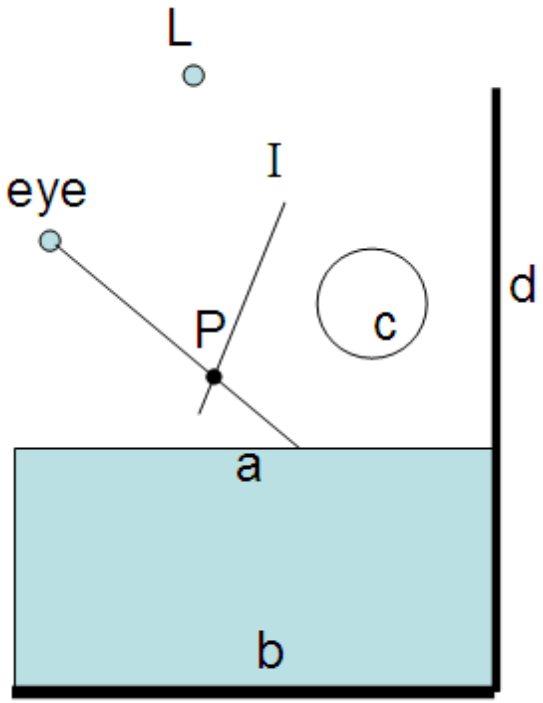
Name: _____

Student Number: _____

Question 1	/ 8
Question 2	/ 4
Question 3	/ 30
TOTAL	/ 42

1. Ray tracing

   (a) (4 points) Sketch the paths of the reflected and transmitted rays that result for the ray cast through the pixel P. Also draw a "ray tree" diagram. Label the relevant points and the rays in the scene and in your ray tree diagram. Label your shadow rays, and annotate the blocked shadow rays with an 'x' in your ray tree diagram. Only illustrate the ray tree to a maximum depth of 3. Assume that a represents a water surface, b and d are diffuse surfaces, and c is a shiny, opaque (solid) sphere.



   (b) (4 points) A ray $R(t)$ begins at a point C and is traveling in a direction V. There is a cylinder in the scene of radius r with its base centered at the origin and with a height $z = h$. Determine how to compute whether the ray intersects the cylinder, and, if so, at what point the ray first encounters the cylinder.

2. (4 points) Parametric Curves

   Determine the basis matrix for a parametric cubic curve defined by $P_0 = P(0)$, $T_0 = P'(0)$, $A_0 = P''(0)$, $P_1 = P(1)$. Do not bother with numerically inverting any matrices.

3. (30 points) Graphics Demo

   Implement a scene, animation, game, or tutorial of your choice in OpenGL. It is recommended that you work in groups of two, in which case you need only hand in one demo. A list of ideas is suggested below. Your final mark will be based in part on a short demo given to a TA or the instructor. You can use any of the OpenGL demo programs provided during this course as a starting point if you like, although you should document this in your README file.

   If you need help regarding how to implement any particular features, do not hesistate to ask the instructor or the TAs. Be sure to develop your project in testable stages. The best demos will be glorified forever in the 314 Hall of Fame!

   Driving Game

   Create a world with roads, or perhaps rough terrain without roads. Implement a mouse or keyboard interface for steering your virtual car around in this world. Ideas for optional features could include collision detection, night-driving mode, having the car leave tracks on the pavement or sand, providing control over the camera point-of-view (first person, third person, etc.), adding other autonomous cars in the world, etc. Be creative and add your own featuers.

   Tutorial

   Implement a tutorial for part of the course that you think would benefit from a demonstration or tutorial. One idea is to generate a graphics 3D visualization of the various rays that are produced during ray tracing a simple scene. Another is to produced a graphical demonstration of Bezier curves or Bezier surface patches. You might animate the control points in a procedural fashion and show the resulting animated shape of the curve or surface. One last idea is to graphically illustrate, in 3D, the various vectors involved in performing local lighting computations. As the user moves the mouse, the vectors N, R, L, V are all drawn for the given surface point.

   Ray Tracer

   Build a simple ray tracer. Begin with simple scenes. A single reflective sphere that sits on a checkerboard terrain is a good test case. Work towards more complex scenes as time allows.

   Fractal Terrain

   Interesting mountain-like terrains are easily generated using a recursive procedure and random numbers. Talk to the instructor or your TAs if you're interested in this.

   Surfaces of Revolution or Swept Surfaces

   An object like a wine glass is a surface of revolution. Build an application which lets you draw a curve using the mouse, and then this curve is turned into a 3D object by rotating it around a given axis, or by sweeping some other fixed cross-sectional shape along the curve.

   Particle System

Use simple physics (F=ma) to implement a fireworks simulation.

Another demo of your choosing

Create an OpenGL scene or animation that illustrates something that you have a personal interest in. Add something interesting to one of the previous assignments.

Research Report

Investigate some area of interest to you in further depth. How is computer graphics used to support medical imaging? How were the special effects for a given film done ? What are the social implications of being able to easily create videos of 3D scenes that are indistinguishable from reality ? Should the goal of computer graphics be to continually achieve better realism, or should it be to achieve new visual styles that would be impossible with conventional film ? How has computer graphics influenced the design of objects around us ? Etc.

Hand-in Instructions

You do not have to hand in any printed code. You need only do one submission for a group of two. Create a README file that includes the names and login ID of the group members of your project, and any information you would like to pass on the marker.

Create a folder called 'assn3' under your cs414 directory and put all the source files, your makefile, and your README file there. Also include any images that are used as texture maps. Do not use further sub-directories.

The assignment should be handed in with the exact command:

```
handin cs314 assn3
```