

# Introduction to Computer Graphics

CS 445/645

Spring 2004

Professor David Brogan

## Homework 1

Due: March 4<sup>th</sup> at end of class

Collaboration policy: You must work on this alone. You may ask the TA and the professor for help. You may use outside resources like the textbook and the web.

1. We have emphasized the importance of understanding how the order of transformations influences the way a model is moved in the world. Consider the following three transformations:

```
glRotatef (30.0, 0.0, 1.0, 0.0);  
glRotatef (45.0, 0.0, 0.0, 1.0);  
glTranslatef (0.0, 0.0, -0.5);
```

There are six possible orderings of the above commands. Discuss the position of the teapot in the scene if `glutSolidTeapot()` were executed as a final command in each of the six cases. Pictures indicating the rotated axes will help. It would also be useful to write a simple OpenGL program to see the exact results.

2. In class, we walked through the process of transforming world coordinates to camera coordinates, where the camera was defined by: eye point, look-at point, and y-up. The camera implicitly looked down the negative z-axis. Computer graphics researchers like this camera because they consider the screen as being the x/y plane and z comes out from the screen. Roboticians also use a right-hand coordinate system, but they prefer to think of the world with z being up and the ground is the x/y plane. In this representation, it is natural to consider the camera looking down the positive y-axis with a z-up being defined. Create a transformation matrix,  $V$ , that transforms from world coordinates to a robotician's camera coordinates.
3. How do you determine if two vectors are parallel?
4. How would you compute the intersection between a line and a sphere?