Fall 2009

22C:151 Introduction to Computer Graphics

Assignment 4

Due: On paper at the beginning of class on Tuesday September 29th

Goal: Get a feel for matrices and how they are used and applied in OpenGL.

Problem 1 (10 points): Write down the following matrices in two ways: (1) the standard 4×4 matrix notation and (2) as the one dimensional 16-entry array used in OpenGL.

- A matrix for translation by -2 in x, 3 in y, and -7 in z.
- A matrix for scaling by a factor of 6 in x, -1.5 in y, and 4 in z.
- A matrix for rotation of 90° around the x-axis
- A matrix for rotation of 30° around the axis $\vec{r} = (1, 1, 1)$
- A projection matrix (i.e., to set up a camera's perspective) for a viewing frustum with a field of view of 90°, an aspect ratio of $\frac{4}{3}$, a near plane at distance 1, and a far plane at distance 100.

Problem 2 (10 points): For each of the following cases, draw (on paper) 3 images. One of the initial geometry, one after the first transformation has been applied, and one after both transformations have been applied. *(If you draw neatly and clearly label, you may combine the three images for each case into one graph.)*

- Triangle with vertices at (1,1), (3,1), and (2,4)
  1. Translate in x by -1 units and in y by 2 unit.
  2. Scale in x by a factor of 3 and scale in y by a factor of 2.
- Traiangle with vertices at (1,1), (3,1), and (2,4)
  1. Scale in x by a factor of 3 and scale in y by a factor of 2.
  2. Translate in x by -1 units and in y by 2 unit.
- Quadrilateral with vertices at (1,1), (-1,1), (-1,-1), and (1,-1)
  1. Rotate around z-axis by 45°.
  2. Scale by $\sqrt{2}$ in both x and y.
- Quadrilateral with vertices at (1,1), (-1,1), (-1,-1), and (1,-1)
  1. Scale by $\sqrt{2}$ in both x and y.
  2. Rotate around z-axis by 45°.
- Quadrilateral with vertices at (1,1), (-1,1), (-1,-1), and (1,-1)
  1. Rotate around z-axis by 45°.
  2. Translate by 2 in both x and y.
- Quadrilateral with vertices at (1,1), (-1,1), (-1,-1), and (1,-1)
  1. Translate by 2 in both x and y.
  2. Rotate around the z-axis (pointing out of the paper) by 45°.

NOTE: Do *not* post your answers on your web page (for obvious reasons).