CSCI 550 (Fall 2009)

Assignment #2

Handout: Tuesday, Oct. 6, 2009
Due: 3:00pm, Tuesday, Oct. 27, 2009

All assignments will be submitted through oncourse.
The non-programming part can be in any format such as Microsoft Word, PDF, plain text or scanned hand-writing.
The programming part should include: (1) all source code files; (2) the executable file (.exe); and (3) a README file containing necessary instructions, known bugs, and any other notes you would like me to read.

Part 1: non-programming problems (*100 pts*)

1. The projection of a point $P = (x, y, z)$ to a plane in 3D space is a point on the plane that is closest to P. If the plane is defined by a point $P_0 = (x_0, y_0, z_0)$ and a normal vector $\mathbf{n} = (x_1, y_1, z_1)$, compute the projection of P on this plane.

2. Given four 3D points P_0, P_1, P_2, P_3, design a robust procedure to determine whether the four points are on the same plane.

3. Prove that two 3D scaling transformations are commutative. What about two rotations? Why?

4. (a) Write a 2D rotation matrix that rotates by 90 degree counter-clockwise.
   (b) Write the above matrix as a product of 3 shearing matrices.

5. Derive (describe your derivation process) the transformation matrix for a reflection transformation about a plane with equation $x + y + z = 1$.

Part 2: Programming problems (*100 pts*)

This project is based on your 2D polyline drawing program from your first assignment. For each polyline you created on the X-Y plane, you need to build a 3D surface object by rotating the polygon about the Y-axis, and then view it as a wireframe polygon mesh.

Your program ought to be able to go back and force between the 2D and 3D spaces so that the 2D polygon may be edited to generate a modified 3D object. Only wireframe rendering is required, and no lighting and shading is necessary. The depth buffer should be used to enable hidden surface removal. In the 3D state, the wrireframe surface should be rotated continuously about all three axes to show all sides of the surface object.