Tut 4

Qn 1

Assume that the camera C1 is positioned at (30, 30, 30), pointing in the direction $(\cos 30^o, \sin 30^o, 0)$ and the upward direction is (0, 1, 0). Calculate the 4 x 4 transformation matrix $\mathbf{M}_{VC \leftarrow WC}$.

Qn 2

Two cameras are needed in 3D movies production and virtual reality applications.

Assume that the first camera is C1 above. A second camera C2 is positioned at (X_{VC}, Y_{VC}, Z_{VC}) = (2, 0, 0) in C1's coordinate system. All other parameters of the two cameras remain the same. Calculate the 4 x 4 transformation matrix $\mathbf{M}_{VC \leftarrow WC}$ for the second camera.

Qn 3

Let the X-Y plane be the view plane. The projection is parallel with projection vector $(\frac{\sqrt{3}}{2}, 0.5, -2)$. Identify the type of projection and give the 4×4 homogeneous projective transformation matrix.

Qn 4

a) A scene is projected using the orthographic projection for which the view plane is Z = -100.

   Write the 4 x 4 homogeneous coordinate transform.

   Give the OpenGL command that implements this transform. To specify the parameters of this command, assume the display window is centered at (200, 200) and the window is a square of size 200 x 200. Assume the near and far clipping planes are Z = -100 and Z = -1000 respectively.

b) A scene is projected such that all the projection vectors are parallel, with the direction of projection v = (-1, 1, $\sqrt{2}$) and Z = 1 is the view plane.

   Name the type of projection.
   Derive the 4 x 4 homogeneous coordinate transform.

[Hint: One method is to use $\mathbf{p} = \mathbf{P} + t\mathbf{v}$, where $\mathbf{p}$ is the projected point, $\mathbf{P}$ is the 3D point, and t is an unknown scalar, to derive the transform.]

c) A camera is set in this way:

The camera is positioned at (200, 200, 200) in world coordinates
The Y axis of the world coordinate system is the view up vector for the camera
The camera is pointing towards the origin, which is the center of the scene.

Derive the 4 x 4 homogenous coordinate transform $\mathbf{M}$ that transforms a point from world coordinates to camera (or viewer) coordinates.

Give the OpenGL command that implements the transform.

d) If the camera above is rotated about its (local) Z axis by 30^o, find the new transform $\mathbf{M}$ by reasoning using change of coordinate systems.

OpenGL Mini-project Progress

You can now understand fully the relevant commands about camera and projection in OpenGL Ex 1 and 2. Try changing the parameters. What do you observe? Play with the relevant programs in TUTORS (bundled with OpenGL Ex 1 files).

Usually the mini-project uses perspective projection for realism. You may experiment with changing the projection matrix to Cavalier and Cabinet projection followed by orthographic projection *glOrtho*. Use the cube. Measure the projected cube with a ruler. Is the result what you expect?