

EXERCISES FOR INF3320

LINEAR, AFFINE, AND PROJECTIVE TRANSFORMS (PART II)

20/09/2010

1. Assume the camera is in its usual position, centered around the origin, looking down negative z and 'up'-direction is positive y .
 - (a) Find a sequence of transformations such that the camera is centered onto $[3, 2, 0]$ and looking along $[1, 1, 0]$, and the 'up'-direction is positive z .
 - (b) Formulate the solution of (a) as an sequence of OpenGL, as well as a sequence of GLM matrix operations.
2. Formulate a sequence of OpenGL calls that sets the `MODELVIEW` matrix to represent a rotation of θ around the axis given by the two points $[1, 1, 4]$ and $[3, 4, 7]$. Also formulate a sequence of GLM matrix operations that achieves the same result.
3. Write down the three 4×4 matrices that performs:
 - (a) A translation in \mathbb{R}^3 along an arbitrary vector.
 - (b) A rotation in \mathbb{R}^3 about the z axis.
 - (c) An uniform scaling in \mathbb{R}^3 .
4. Prove that the following sequences of transformations commutes:
 - (a) A rotation and an uniform scaling.
 - (b) Two rotations about the z -axis.
 - (c) Two translations.

5. Given a bounding box defined by

$$\mathbb{B} = \{[x, y, z] : -1 \leq x \leq 1, -1 \leq y \leq 1, -3 \leq z \leq -1\}.$$

The `MODELVIEW` and `PROJECTION` matrices are identity matrices.

Formulate a sequence of calls to `glFrustum` and other transformation functions s.t. the complete bounding box is inside the frustum. Also formulate a sequence of GLM matrix operations that achieves the same result.

6. Then, assume the bounding box are given by

$$\mathbb{B} = \{[x, y, z] : -1 \leq x \leq 1, -1 \leq y \leq 1, -1 \leq z \leq 1\}$$

The `MODELVIEW` and `PROJECTION` matrices are identity matrices.

What is the simplest sequence of OpenGL calls s.t. the complete bounding box is inside the frustum? What is the sequence of GLM matrix operations that achieves the same result?