Tutorial 2: Transformations of 3D Worlds

Q1. The triangular facet of a solid object has vertices [10, 0, 10], [10, 10, 6], and [0, -10, 10]. It is to be viewed in perspective projection with the viewpoint at position [0, 0, -2] and the plane of projection with equation z=2. The screen window is set up using:

wxmin=0
wxmax=4
wymin=-1
wymax=1

Sketch what will be drawn on the screen.

What will be seen if orthographic projection is used instead of perspective?

Hint: start by moving scene to the standard configuration.

Q2. The transformation matrix:

$$T = \begin{pmatrix} Sx*Cos(\theta) & -Sx*Sin(\theta) & 0 \\ S_y*Sin(\theta) & S_y*Cos(\theta) & 0 \\ T_x & T_y & 1 \end{pmatrix}$$

performs a translation by T_x,T_y, a scaling by S_x,S_y and a rotation by θ.

a) In what order does it perform these?
b) What direction is the rotation angle θ measured in?
c) What is the inverse transformation?

Q3. If R is a rotation matrix, and S is a scaling matrix, show that in general R.S<>S.R. For what condition on S will they be equal.

Q4. A graphical animation scene requires an object to shrink. It's centre is located at the point (0,10,10), and the scene is being viewed in the normal perspective projection with the viewpoint at the origin.

a. Determine the transformation matrix that will shrink the object to 0.9 of its size, without changing its position.
b. Determine the transformation matrix that will make the object shrink and at the same time rotate clockwise about an axis through the centre parallel to the z axis by 10^o. Note that $Cos(10^o) = .98$ and $Sin(10^o) = .17$ Hint: remember that a positive rotation is clockwise about the axis of rotation when seen from the positive side of the axis.