Mathematics 308 — eighth homework

This is due next Monday, November 28.

1. A cube of side 1 is placed with centre at $(-1, -1, -2)$ with edges parallel to coordinates axes. The eye is located at $(0, 0, 5)$. Find exact expressions for the projections of its vertices onto the view plane.

2. An regular octahedron has 8 equilateral triangular faces. If its radius (distance from centre to vertex) is 1, what is the length of the edges?

3. What is the cosine of the angle between two radii of a regular tetrahedron (exact expression)? The angle itself?

4. What are the normal functions for the faces of the tetrahedron from the last assignment (exact)?

5. (a) Find the matrix of rotation of $30°$ around the x-axis. (b) The inverse of a rotation matrix A is its transpose ^tA. What is the inverse of the 4×4 matrix

$$\begin{bmatrix} A & 0 \\ v & 1 \end{bmatrix}$$

where A is a rotation matrix, v a 3D row vector? (c) Find the inverse of the matrix in (b) if A is as in (a) and $v = (1, 1, 1)$.

6. (Program) Draw in PS an octahedron of radius 1, one vertex at $(0, 0, 1)$, centre at the origin, a second vertex on the positive x-axis. Assign its faces 4 different colours, and then show the octahedron rotating with shaded faces. Place the eye at $(0, 0, 5)$ and a light source in the direction $[0, 1, 1/2, 0]$.

7. (Program) Draw an cubical box of side 2, open at top, centred at the origin, edges parallel to axes. The open top is at $z = 1$. Outside red, inside white. Show it spinning so as to show eventually both the inside and outside, especially the inside bottom. Eye at $(0, 0, 5)$. (The difficulty is to get the inside hidden by the outside. There is exactly one idea needed.)