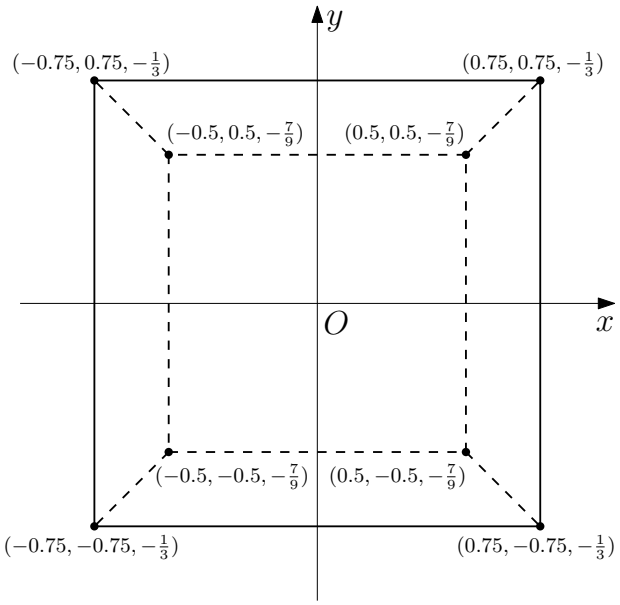
CS4620 Fall 2011
HW2 - 3D Transforms and Graphics Pipeline

Due: Oct 3 2011

1 3D Projection

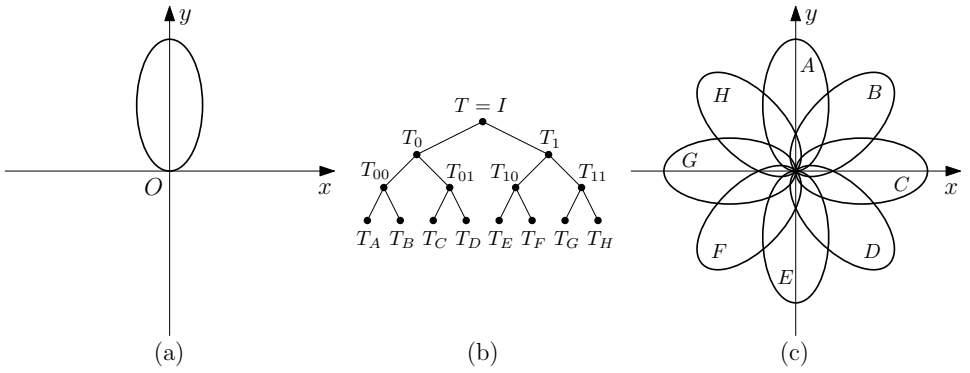
Compute the 4×4 3D matrix M that projects an axis-aligned unit cube centered at $(2.5, 0, 0)$ in world space into the following figure in the clip space (i.e. given a point x in homogeneous coordinates, $y = Mx$ equals the coordinates of that point in the clip space). Assume that the camera is at the origin in world space with up-direction $(0, 0, 1)$. (Hint: $M = M_{\text{orth}} P M_{\text{cam}}$.)



2 Hierarchical Transformation

Let A, B, C, D, E, F, G, H be overlapping 2D ellipses as shown in (a). Compute the 3×3 2D matrices in the scene graph shown in (b), such that after performing the corresponding transformations, the scene becomes (c). In addition, your solution should satisfy the following constraints:

$$
\begin{aligned}
T_A = T_C = T_E = T_G; \\
T_B = T_D = T_F = T_H; \\
T_{00} = T_{10}; \\
T_{01} = T_{11}.
\end{aligned}
$$



3 Rasterization

Given a 2D triangle with vertices $A = (0, 0)$, $B = (50, 50)$, and $C = (-50, 75)$. How many integer points (i.e., points with integer coordinates) lie within or on the boundary of ABC?

4 Shadows

Assume the ground is the XOY plane (in 3D). Place an axis-aligned unit cube on the ground centered at $(0, 0, 0.5)$. Assume the cube is lit by two directional light sources along directions $(0, -1, -1)$ and $(1, 1, -1)$. Compute the total area on the ground that is in shadow (i.e., NOT lit by both directional sources).