Question Set 9

CS 320

Chapter 11

1. Compute z_c and w_c.

$$\begin{bmatrix} x_n w_n \\ y_n w_n \\ z_n w_n \\ w_n \end{bmatrix} = \begin{bmatrix} x_c \\ y_c \\ z_c \\ w_c \end{bmatrix} = \begin{bmatrix} s_x & 0 & -c_x & 0 \\ 0 & s_y & -c_y & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & -1 & 0 \end{bmatrix} \begin{bmatrix} x_e \\ y_e \\ z_e \\ 1 \end{bmatrix}$$

2. Consider the two points $[0, 0, -1, 1]^t$ and $[0, 0, -2, 1]^t$. Each point is in eye coordinates. Compute z_n for each point. Should the graphics pipeline use $<$ or $>$ to determine which point is closer to the camera?

3. Are distances preserved by a projective transformation? Explain.

4. Show that the coordinates of the point at the left, bottom, far vertex of a frustum are $[\frac{fl}{n}, \frac{fb}{n}, f, 1]^t$. Then, "show" that

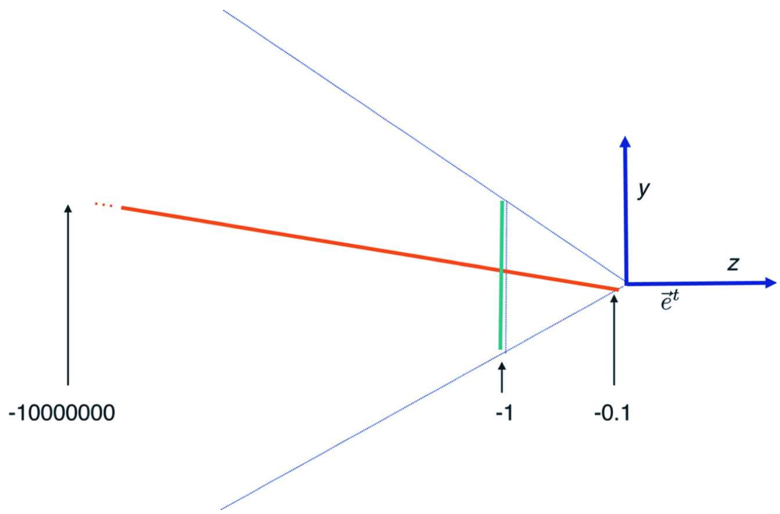
$$\begin{bmatrix} -\frac{2n}{r-l} & 0 & \frac{r+l}{r-l} & 0 \\ 0 & -\frac{2n}{t-b} & \frac{t+b}{t-b} & 0 \\ 0 & 0 & \frac{f+n}{f-n} & -\frac{2fn}{f-n} \\ 0 & 0 & -1 & 0 \end{bmatrix}$$

maps its frustum into the canonical cube by computing the normalized device coordinates of the eye coordinate points $[\frac{fl}{n}, \frac{fb}{n}, f, 1]^t$ and $[r, t, n, 1]^t$.

5. With depth buffering, does the order in which vertices are processed matter?

6. For a given piece of geometry, will every vertex processed have the same w_n value?

7. As seen in the following figure and explained in the textbook, the straightforward method of interpolating the z_e over the interior of two pieces of geometry with overlapping z_e values produces incorrect occlusion:



Suppose that we have two triangles such that the closest-in-z vertex of triangle is farther than the farthest-in-z vertex of the other triangle. If we linearly interpolate the z_e value over the interior of the triangles, would z-buffering produce an image with the correct occlusion?

8. Starting with the projection matrix P of problem 4, suppose we replace P with PQ where

$$Q = \begin{bmatrix} 3 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

What will be the effect in the resulting image?