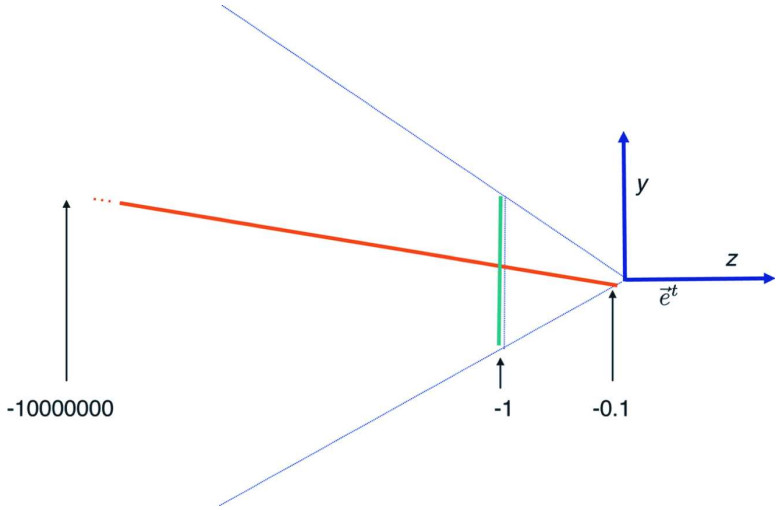
Question Set 9-10

CS 320

Chapter 11

1. With depth buffering, does the order in which vertices are processed matter?
2. For a given piece of geometry, will every vertex processed have the same w_n value?
3. 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 one 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?

4. Starting with this projection matrix P:

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

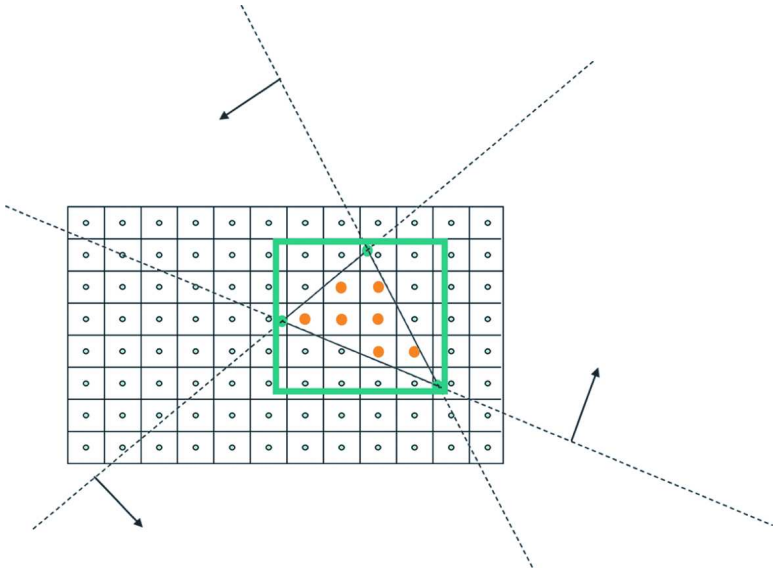
suppose we replace P with PQ where

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

What will be the effect in the resulting image?

Chapters 12 and 13

1. Give two reasons for performing clipping.
2. Why do we take the intermediate step of computing and clipping against clip coordinates, rather than immediately computing normalized device coordinates and clipping against them?
3. What are the comparisons used in performing clipping?
4. What is backface culling?
5. Conceptually and computationally, how do we determine if a triangle's front face is visible to the camera?
6. What is the purpose of the viewport matrix?
7. Starting from three vertices in window coordinates, explain how to rasterize a triangle.



8. How can one use this equation:

$$\begin{bmatrix} a & b & c \end{bmatrix} = \begin{bmatrix} v_1 & v_2 & v_3 \end{bmatrix} M^{-1}$$

derived from

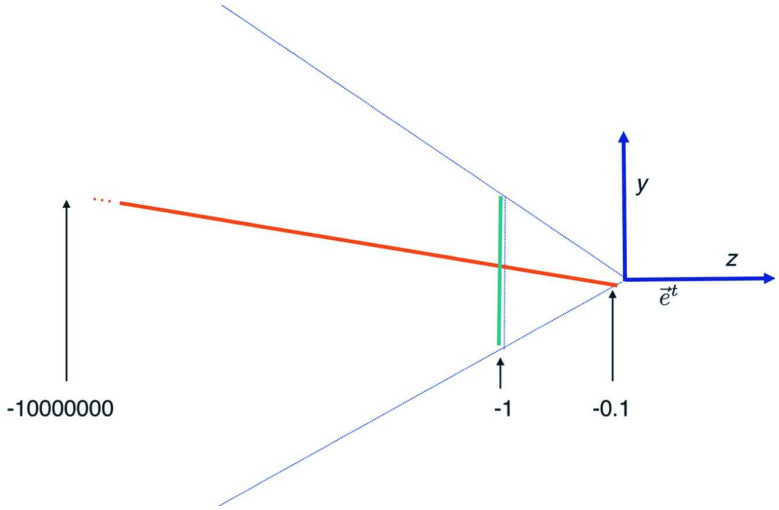
$$\begin{bmatrix} v_1 & v_2 & v_3 \end{bmatrix} = \begin{bmatrix} a & b & c \end{bmatrix} \begin{bmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ 1 & 1 & 1 \end{bmatrix}$$

to determine the coefficients of an edge function

$$\text{edge} = ax_w + by_w + c$$

for use in rasterization?

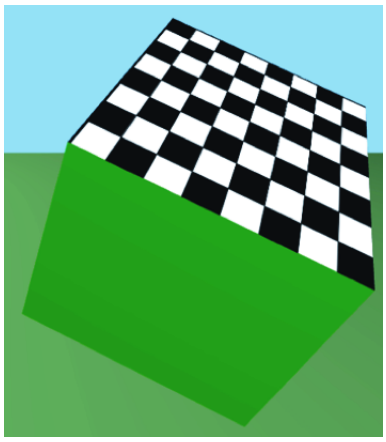
9. Recall this figure



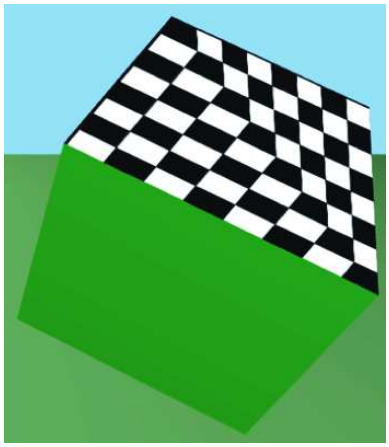
which demonstrated that using z_e for depth buffering gives incorrect results. Instead, z_w (which is z_n mapped onto $[0, 1]$) is used. Explain why z_w gives the correct result.

(There's one more problem — turn the page.)

10. The textured face of this cube consists of two texture-mapped triangles, with appropriate texture coordinates assigned to each of the three vertices of each triangle.



In the following figure, linear interpolation of the texture coordinates produces an incorrect image. Would this interpolation have been performed in object space, eye space, clip space, normalized device space, or window space? (Name all spaces in which this result could have occurred.) Explain why this happened.



How does rational linear interpolation correct this?