CS 465 Homework 7

out: Friday 20 October 2006
due: Friday 27 October 2006

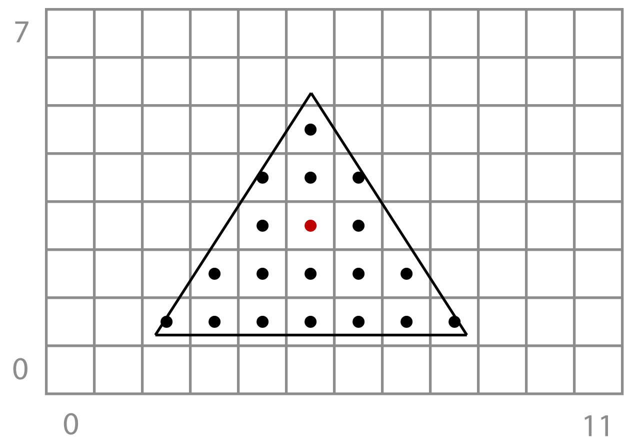
This homework is about the process of projecting and rasterizing a single triangle to produce a set of fragments. The eye space coordinates of the triangle's vertices are $(-3, -2.2, -8)$, $(4.4, -4.4, -16)$, and $(-1, 4.5, -20)$. In screen space, these vertices have coordinates $(1.75, 0.75)$, $(8.25, 0.75)$, and $(5, 5.75)$ for the particular camera in use.

Problem 1: Viewing

Suppose the viewport is 12 pixels across and 8 pixels high, and that the near and far planes are at $z = -5$ and $z = -40$ respectively. Use Shirley's convention of integer pixel centers (that is, the lower left pixel is at $(0, 0)$ and the boundaries of the image rectangle are on half-integers).

1. Give the viewport matrix that transforms canonical coordinates to screen coordinates. Let it preserve z, so that screen-space depth is simply equal to the canonical coordinate z'.
2. Using the eye-space and screen-space coordinates for the three triangle vertices, determine the values of l, r, b, and t as defined by Shirley. Now give the projection matrix for this camera.
3. Calculate the screen-space depth z' for each triangle vertex. *Hint: These values should be in the range* $[-1, 1]$.

Problem 2: Rasterization



The camera's image is shown in the illustration above. Assume that the rasterizer interpolates screen-space barycentric coordinates to determine which fragments to generate, and that it is supporting z-buffering. In addition, suppose that the triangle is to be texture-mapped, and that the vertices have texture coordinates $(u, v) = (0, 0)$, $(1, 0)$, and $(\frac{1}{2}, 1)$.

1. List all of the attributes that need to be interpolated by the rasterizer so that the triangle fragments can be generated correctly, with interpolated texture coordinates and z-buffer depth. Don't forget that texture coordinates need to be interpolated so that they end up varying linearly in eye space, not linearly in screen space.

2. What are the screen-space barycentric coordinates of the point $(5, 3)$, shown in red in the image above? *Hint: You should be able to do this without using any big equations!*

3. Compute all the attributes for the fragment at $(5, 3)$ (in their raw form as linearly interpolated by the rasterizer in screen space).

4. Compute the (u, v) coordinates for the fragment at $(5, 3)$.