CS 314: Quiz 1

September 18, 2008

1. If the three barycentric coordinates (α, β, γ) of a point with respect to a triangle are all positive, the point is inside the triangle. What does it mean if all three are negative?

It means you have a bug in your code: the barycentric coordinates always sum to one, $\alpha + \beta + \gamma = 1$, so there is no way for them to all be negative. Of course, the edge functions from which we built the barycentric coordinates could all be negative, which would mean the point is inside (and the triangle is oriented clockwise).

2. Suppose the camera is at position $(5, 3, 10)$ in world space coordinates, is level with the ground (i.e. horizontal) but pointing $45° = \frac{\pi}{4}$ off the x-axis away from the z-axis. Write down the model-view transformation as a sequence of primitive transformations (e.g. translation, rotation around a specified axis, . . .).

Obviously we'll need a translation and a rotation to handle this. The translation should go first, to transform the point $(5, 3, 10)$ in world space located at the camera to the origin $(0, 0, 0)$ in camera space: we need a `translate(-5,-3,-10)`. Once there, we can deal with rotation; since the camera is level with the ground, it should be a rotation in the xz-plane, i.e. around the y-axis. Remember that in camera space, the camera faces its negative z-axis; from the description in the question we know the camera is pointed straight at points like $(5 + 1, 3, 10 - 1) = (6, 3, 9)$ in world space, and so we need to make sure they transform to the negative z-axis in camera space coordinates. It's not too hard to see the correct rotation around the y-axis is by $+45°$.

Putting this together, the model-view transformation could be symbolically written as the matrix product:

$$M = \mathrm{rotate-y}(45°)\ \mathrm{translate}(-5, -3, -10)$$