

CS 355 Homework #3:

3D Graphics Pipeline

Due: November 6, 2013

1. A user specifies that the camera's position ("look from point") is $(10, 0, 0)$, and the camera's direction ("look at point") is towards the point $(0, 0, 10)$. They also specify an "up" vector of $(0, 1, 0)$. (Hint: this is already orthogonal to the viewing direction.)
 - What is the 4×4 rotation matrix you would use for the world-to-camera transformation?
 - What 4×4 translation matrix would you use?
 - What is the combined world-to-camera matrix in terms of the previous two matrices?
 - Where is the world-space point $\mathbf{p}_w = (0, 10, 50)$ in camera coordinates?
2. A virtual camera has the following parameters:
 - horizontal field of view of 60 degrees (full angle from side to side)
 - aspect ratio of 16:9 (horizontal to vertical)
 - near plane $n = 1$
 - far plane $f = 1000$For this camera,
 - What is the clip matrix for this camera?
 - What are the clip-space coordinates of the camera-space point $\mathbf{p}_c = (10, 10, 20)$?
 - Is this point within the viewing frustum?
 - What are the canonical view coordinates of this point?
3. The virtual camera in the previous question is used to render an HD scene at 1920×1080 .
 - What is the viewport matrix that maps the canonical view to this screen, assuming the origin of the screen's coordinate system is in the upper left corner? (Hint: start by scaling the screen to the desired size, then translating to move the origin from the center to the corner—you already know how to write that as a single matrix.)
 - What are the onscreen coordinates of the point $(10, 10, 20)$ from the previous problem? (Start with the projected canonical view coordinate that you already calculated.)

4. A triangle has vertices at $(3, 4, 1)$, $(4, 2, 3)$, and $(5, 6, 1)$ given in counterclockwise order in world space.
- what is the normal to this triangle?
 - if the camera's optical axis points in the same direction as the vector $(1, 1, 1)$, is this triangle front-facing or back-facing?