

CPSC 314, Written Homework 2

Out: Wed 3 Feb 2010

Due: Fri 12 Feb 2010 5pm

Value: 4% of final grade

Total Points: 100

1. (6 pts) Give the camera/viewing transformation matrix for an eye position (0,1,6), a lookat point (1, 1, -1) and an up vector (0,-1,0).
2. (6 pts) Give the perspective projection matrix with a near plane of 4, far plane of 20, a horizontal field of view of 45° , and an aspect ratio of 4:3.
3. (6 pts) Give the NDC-to-display transformation matrix for a viewport 800 pixels wide and 500 pixels high, with the origin in the upper left of the display.
4. (10 pts) A tetrahedron has vertices (0, 0, 0, 1), (6, 0, 0, 1), (3, 0, -3, 1), and (3, 5, -1, 1) in world coordinates. Give its coordinates in the camera coordinate system, after the viewing transformation from problem 1 above has been applied to the points in world coordinates.
5. (10 pts) Then give the tetrahedron coordinates in the clipping coordinate system, after the perspective warp for the frustum specified in problem 2 has been applied to the tetrahedron points in camera coordinates (that is, the answer from problem 4).
6. (10 pts) Then give its coordinates in the normalized device coordinate system, after the perspective divide has been applied to the answer from problem 5.
7. (10 pts) Finally, give the point coordinates in the display coordinate system, after the viewport transformation of problem 3 has been applied to the answer from problem 6.
8. (30 pts) Derive the values $E = 2n / (r-1)$ and $A = (r+1)/(r-1)$ in the perspective to NDCS matrix, where $x' = Ex + Az$.
9. (12 pts) Suppose that you take a photograph with a digital camera that has a CCD imaging chip of size 4x3mm. Parallel light rays entering the camera lens will cross at a point X units behind it for a lens with focal length X. You are taking a picture of a small painting 50cm tall that you want to completely fill the vertical field of view. The lookat point is lined up with the eye point, so that the painting is perpendicular to your gaze vector. If you have a lens with focal length 20mm, how far back should you stand?