

# Homework 1

15-462

Fall 2013

Due September 26th, in class

1. Let a triangle be defined by its points  $(2, 6, 9)$ ,  $(6, 1, 5)$  and  $(-2, -1, 1)$ . The color at each point respectively is  $(255, 0, 0)$ ,  $(200, 100, 0)$  and  $(0, 255, 100)$ .

(a) Calculate the normal of the triangle. [5 points]

(b) Show that the point  $(2, 2, 5)$  is within the triangle. [5 points]

(c) Calculate color of the point  $(2, 2, 5)$ . [5 points]

2. Suppose there is an object located at the origin. You have a camera located at  $(-1, 1, 0)$ , with an up vector of  $(1, 1, 0)$ , and use it to point at the object. Derive the transformation matrix to transform a point in world coordinate to the camera coordinate specified above. [10 points]

3. Find the implicit equation for a cylinder with a height of  $h$  and a radius of  $r$ . [10 points]

4. Give the parameterization for the plane that contains  $\langle 5, 2, 3 \rangle$ ,  $\langle 3, 0, 4 \rangle$ , and  $\langle 2, 0, 1 \rangle$ . [10 points]

5. Please describe the parameterization for a cylinder of radius  $r$  and central axis  $a(t) = \langle 0, 0, 3 \rangle + \langle 0, 1, 0 \rangle t$ . [10 points]

6. Let there be viewing area with a viewing line ranging from  $(0.0, -1.0)$  to  $(0.0, 1.0)$  and a far-clipping line ranging from  $(4.0, -5.0)$  to  $(4.0, 5.0)$ .

(a) Find the viewing point. [5 points]

(b) Project the 2D points  $(2.5, 3.0)$  and  $(1.0, 3.0)$  onto the line:  $x = 1$ . Use perspective projection. [5 points]

(c) Which points fall on the viewing line  $((0.0, -1.0)$  to  $(0.0, 1.0))$ ? [5 points]

7.

$$f(t) = 4(1-t)^2 p_0 + 3t(1-t)p_1 + 2t^2 p_2$$

(a) What is the basis matrix? [10 points]

(b) Which control points are interpolated and which points are not? If the points are interpolated, prove that they are. [10 points]