Coms 331 **Clipping - Part 1** **Fall 2007**

Homework 30

1. Starting with the formula

$$R.y = P.y + \frac{(x_{min} - P.x)(Q.y - P.y)}{Q.x - P.x},$$

which is used on the left edge, find similar formulas for $R.x$ and $R.y$ for the top edge, the right edge, and the bottom edge.

2. Let the clipping rectangle be defined by $x_{min} = -4.0$, $x_{max} = 4.0$, $y_{min} = -3.0$, and $y_{max} = 3.0$. Let $A = (2, 4)$ and $B = (5, 1)$. Compute the codeword $c_3c_2c_1c_0$ to see if we can trivially accept or trivially reject the segment $overline AB$.

3. Use the formulas for the intersection point on the top edge to find the point where the segment $\overline{AB}$ of the previous exercise intersects the top edge.

4. Use the formulas for the intersection point on the right edge to find the point where the segment $\overline{AB}$ intersects the right edge.

5. Clip-space is the coordinate system obtained after multiplying by the projection matrix. In this coordinate system, a point (x, y, z, w) lies within the view frustum if and only if

   (a) $-w \leq x \leq w$,

   (b) $-w \leq y \leq w$, and

   (c) $-w \leq z \leq w$.

   Let the projection matrix be

$$\mathbf{P} = \begin{pmatrix} \frac{1}{4} & 0 & 0 & 0 \\ 0 & \frac{1}{3} & 0 & 0 \\ 0 & 0 & -\frac{11}{9} & -\frac{20}{9} \\ 0 & 0 & -1 & 0 \end{pmatrix}.$$

   (This matrix is derived from $l = -4, r = 4, b = -3, t = 3, n = 1, f = 10$.) Find the clip-space coordinates for the point $A = (10, 5, -2, 1)$. Should this point be clipped?

6. Using the same projection matrix as in the previous exercise, find the clip-space coordinates of the point $B = (25, -10, -8, 1)$. Should this point be clipped?

7. Parametrize the line segment $\overline{AB}$ of the previous two exercises as $P(t) = tA + (1-t)B$. Use the parametric forms of the x and w coordinates to set $x(t) = w(t)$ and solve for t. Use this value of t to find the point R where the segment $\overline{AB}$ intersects the right side of the view frustum.