SIES Graduate School of Technology

Subject : ~~119A1076~~ CG

Roll No.: 119A1076

Assignment No. 2

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Q1)

Liang-Barsky algorithm is also called parametric algorithm approach as it uses parametric equation of line. Cohen-Sutherland and is good at trivial acceptance and rejection cases, Liang-Barsky algorithm is significantly more efficient when actual clipping is required.

$(x_1, y_1) = (5, 10)$ $(x_2, y_2) = (35, 30)$

$(x_{min}, y_{min}) = (10, 10)$ $(x_{max}, y_{max}) = (20, 20)$

$p_1 = -\Delta x = -(x_2 - x_1) = -30$ (<0)

$p_2 = \Delta x = 30$ (>0)

$p_3 = -\Delta y = -(y_2 - y_1) = -20$ (<0)

$p_4 = \Delta y = 20$

$q_1 = x_1 - x_{min} = -5$

$q_2 = x_{max} - x_1 = 15$

$q_3 = y_1 - y_{min} = 0$

$q_4 = y_{max} - y_1 = 10$

$r_1 = \frac{q_1}{p_1} = \frac{1}{6}$ $r_2 = \frac{q_2}{p_2} = \frac{1}{2}$

$r_3 = \frac{q_3}{p_3} = 0$ $r_4 = \frac{q_4}{p_4} = \frac{1}{2}$

$u_1 = max(0, 1/6, 0) = 1/6 = 0.167$

$u_2 = min(1, 1/2, 1/2) = 0.5$

$x_1' = x_1 + \Delta x \cdot u_1 = 5 + (30 \times 1/6) = 10$
$y_1' = y_1 + \Delta y \cdot u_1 = 10 + (20 \times 1/6) = 13.33$
$x_2' = x_2 + \Delta x \cdot u_2 = 5 + (30 \times 1/2) = 20$
$y_2' = y_2 + \Delta y \cdot u_2 = 10 + (20 \times 1/2) = 20$

$(x_1', y_1') = (10, 13.33)$

$(x_2', y_2') = (20, 20)$

Q3)

$(x_1, y_1) = (35, 60)$ $(x_2, y_2) = (80, 25)$

$(x_{min}, y_{min}) = (10, 10)$ $(x_{max}, y_{max}) = (50, 50)$

$p_1 = -\Delta x = -45$ (<0)
$p_2 = \Delta x = 45$ (>0)
$p_3 = -\Delta y = 35$ (>0)
$p_4 = \Delta y = -35$ (<0)

$q_1 = 25$ $q_2 = 15$
$q_3 = 50$ $q_4 = -10$

$r_1 = -0.556$ $r_2 = 0.333$
$r_3 = 1.428$ $r_4 = 0.285$

$u_1 = max(0, -0.556, 0.285) = 0.285$

$u_2 = min(1, 1.428, 0.333) = 0.333$

$x' = x_1 + \Delta x \cdot u_1 = 35 + (45 \times 0.285) = 47.85$
$y' = y_1 + \Delta y \cdot u_1 = 60 + (-35 \times 0.285) = 50.025$

$x_2' = x_1 + \Delta x . u_2 = 35 + (45 \times 0.333) = 50$
$y_2' = y_1 + \Delta y\ u_2 = 60 + (-35 \times 0.333) = 48.345$

$(x_1', y_1') = (47.825, 50.025)$

$(x_2', y_2') = (50, 48.345)$

Question 2

Parallel projection is achieved by passing parallel rays from the object vertices and projecting the objects on view plane. All projection vectors are parallel to each other and it preserves the shape and size of object on view plane.
In prospective projection rays are fired from a point source called center of projection which intersects the object coordinates and projects it on view plane. It preserves shape & size of object

$x_p = x + L\cos\phi \qquad y_p = y + L\sin\phi$

$\tan\alpha = \frac{z}{L} \qquad L = \frac{z}{\tan\alpha} \qquad = z \cdot L_1$

$x_p = x + zL_1\cos\phi \qquad y_p = y + zL_1\sin\phi$

$$M = \begin{bmatrix} 1 & 0 & L_1\cos\phi & 0 \\ 0 & 1 & L_1\cos\phi & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Q 4)

The curve passes through endpoints
$(4,1)$ & $(12,5)$

$$Q(t) = T \cdot M_B \cdot G_B = \begin{bmatrix} t^3 & t^2 & t & 1 \end{bmatrix} \begin{bmatrix} -1 & 3 & -3 & 1 \\ 3 & -6 & 3 & 0 \\ -3 & 3 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} 4 & 1 \\ 4 & 8 \\ 9 & 4 \\ 12 & 5 \end{bmatrix}$$

$$= \begin{bmatrix} t^3 & t^2 & t & 1 \end{bmatrix} \begin{bmatrix} -7 & 16 \\ 15 & -33 \\ 0 & 21 \\ 4 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} -7t^3 + 15t^2 + 4 & 16t^3 - 33t^2 + 21t + 1 \end{bmatrix}$$

$t \to 0$, $Q(0) = \begin{bmatrix} 4 & 1 \end{bmatrix}$

$t \to 0.2$, $Q(0.2) = \begin{bmatrix} 4.544 & 4.008 \end{bmatrix}$

$t \to 0.4$, $Q(0.4) = \begin{bmatrix} 5.952 & 5.144 \end{bmatrix}$

$t \to 0.6$, $Q(0.6) = \begin{bmatrix} 7.888 & 5.176 \end{bmatrix}$

$t \to 0.8$, $Q(0.8) = \begin{bmatrix} 10.016 & 4.872 \end{bmatrix}$