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CG Assignment 2

Question 1

Liang-Barsky algorithm is also called parametric algorithm aproach & as it uses parametric equation of line.
Cohen-Sutherland 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)
$p_4 = \Delta y = 20$ (>0)

$q_1 = x_1 - x_{min} = -5$
$q_2 = x_{max} - x_1 = 15$
$q_3 = y_1 - y_{min} = 0$
$q_4 = y_{max} - y_1 = 10$

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

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

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

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

$x'_1 = x_1 + \Delta x . u_1 = 5 + (30 \times 1/6) = 10$

$y'_1 = y_1 + \Delta y . u_1 = 10 + (20 \times 1/6) = 13.33$

$x'_2 = x_2 + \Delta x . u_2 = 5 + (30 \times 1/2) = 20$

$y'_2 = y_1 + \Delta y . u_2 = 10 + (20 \times 1/2) = 20$

$(x_1', y_1') = (10, 13.33)$ $\qquad$ $(x_2', y_2') = (20, 20)$

Question 3

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

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

$P_1 = -\Delta x = -45$ $\qquad$ (<0)

$P_2 = \Delta x = 45$ $\qquad$ (>0)

$P_3 = -\Delta y = 35$ $\qquad$ (>0)

$P_4 = \Delta y = -35$ $\qquad$ (<0)

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$q_1 = 25$ $\qquad$ $q_2 = 15$

$q_3 = 50$ $\qquad$ $q_4 = -10$

$r_1 = -0.556$ $\qquad$ $r_2 = 0.333$

$r_3 = 1.428$ $\qquad$ $r_4 = 0.285$

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

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

$x'_1 = x_1 + \Delta x \cdot u_1 = 35 + (45 \times 0.285) = 47.825$

$y'_1 = y_1 + \Delta y \cdot u_1 = 60 + (-35 \times 0.285) = 50.025$

$x'_2 = x_1 + \Delta x \cdot u_2 = 35 + (45 \times 0.333) = 50$

$y'_2 = y_1 + \Delta y \cdot u_2 = 60 + (-35 \times 0.333) = 48.345$

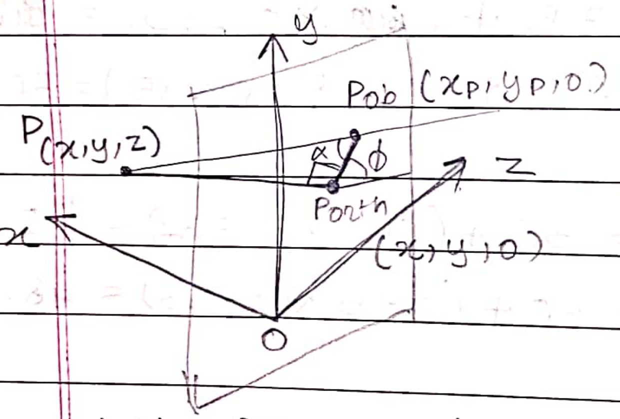
$(x'_1, y'_1) = (47.825, 50.025)$

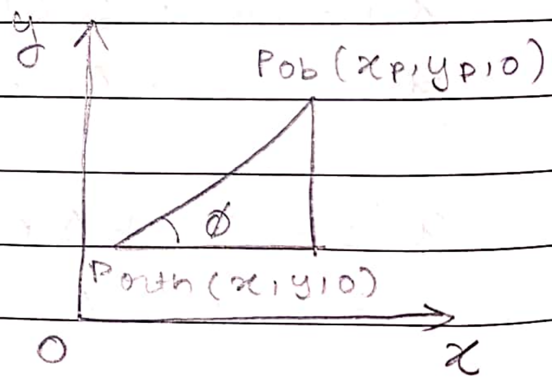
$(x'_2, y'_2) = (50, 48.345)$

Question 2.

Parallel projection is acheived by passing parallel rays from the object vertices and projecting the object on view plane. All projection vectors are parallel to each other and it preserves true shape and size of object on view plane.

In Perspective 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 depth information but not true shape and size of object.





Let $P(x, y, z)$ be a point in space and Porth and Pob be its orthographic and obliques projection respectively.

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

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

Putting in above equations,

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$x_p = x + z \cdot L_1 \cdot \cos\phi \qquad y_p = y + z \cdot L_1 \cdot \sin\phi$

So, the tranformation matrix for any parallel projection on view plane $X_v Y_v$ is written as,

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

Question 4

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

Matrix representation :

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

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

Equation of Bezier curve would be,

$$Q(t) = \cancel{\Sigma}$$
$$= [-7t^3 + 15t^2 + 4 \quad 16t^3 - 33t^2 + 21t + 1]$$

$t \to 0$, $Q(0) = [4 \quad 1]$

$t \to 0.2$, $Q(0.2) = [4.544 \quad 4.008]$

$t \to 0.4$, $Q(0.4) = [5.952 \quad 5.144]$

$t \to 0.6$, $Q(0.6) = [7.888 \quad 5.176]$

$t \to 0.8$, $Q(0.8) = [10.016 \quad 4.872]$