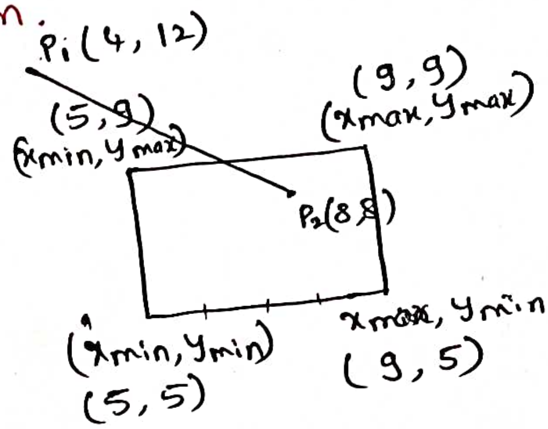
Liang - Barsky Numerical Problems :: —

① . Clip a line $P_1(4,12)$ and $P_2(8,8)$ with clipping window $(x_{min}, y_{min}) = (5,5)$ and $(x_{max}, y_{max}) = (9,9)$ using Liang - Barsky line clipping algorithm.



Soln:- Given $P_1(4,12)$ and $P_2(8,8)$

$(x_{min}, y_{min}) = (5,5)$

$(x_{max}, y_{max}) = (9,9)$

$\Delta x = x_2 - x_1 = 8 - 4 = 4$

$\Delta y = y_2 - y_1 = 8 - 12 = -4$

Using Liang - Barsky line clipping algorithm

$P_1 = -\Delta x = -4$ $\quad q_1 = x_1 - x_{min} = 4 - 5 = -1$

$P_2 = \Delta x = 4$ $\quad q_2 = x_{max} - x_1 = 9 - 4 = 5$

$P_3 = -\Delta y = -(-4) = 4$ $\quad q_3 = y_1 - y_{min} = 12 - 5 = 7$

$P_4 = \Delta y = -4$ $\quad q_4 = y_{max} - y_1 = 9 - 12 = -3$

Case 1: $P_K = 0$ (Not Required $\because P_K > 0$ & $P_K < 0$)

Case 2: $P_K < 0$

$P_1 = -4 \quad q_1 = -1 \quad t = q_1 / P_1 = -1/-4 = 1/4$

$P_4 = -4 \quad q_4 = -3 \quad t = q_4 / P_4 = -3/-4 = 3/4$

$t_1 = max(0, q/P) \Rightarrow max(0, 1/4, 3/4)$

$\boxed{t_1 \Rightarrow 3/4}$

Case 3: $P_K > 0$

$P_2 = 4 \quad q_2 = 5 \quad t = q_2 / P_2 = 5/4$

$P_3 = 4 \quad q_3 = 7 \quad t = q_3 / P_3 = 7/4$

$t_2 = min(1, q/P) \Rightarrow min(1, 5/4, 7/4)$

$\boxed{t_2 \Rightarrow 1}$

Finally,

(i) $t_1 \le t_2$

$\frac{3}{4} \le t_2$

$\frac{3}{4} \le 1$ ✓

(ii) $t_1 \geq 0$

$\frac{3}{4} \geq 0$ ✓

So $x_1' = x_1 + t_1 \Delta x$

$= 4 + \frac{3}{4}(4)$

$\boxed{x_1' = 7}$

$y_1' = y_1 + t_1 \Delta y$

$= 12 + \frac{3}{4}(-4)$

$= 12 - 3$

$\boxed{y_1' = 9}$

$\therefore \boxed{P_1'(x,y) \Rightarrow P_1'(7,9)}$

(iii) $t_2 \le 1$

$1 \le 1$ ✓

So $x_2' = x_1 + t_2 \Delta x$

$= 4 + 1(4)$

$\boxed{x_2' = 8}$

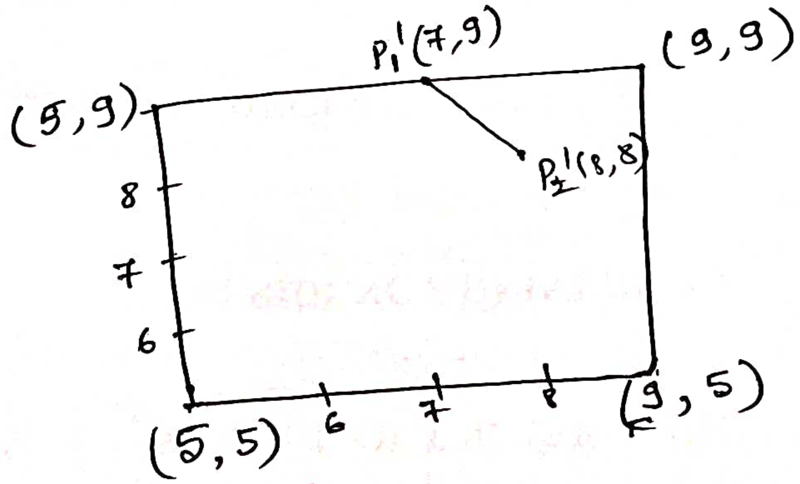
$y_2' = y_1 + t_2 \Delta y$

$= 12 + 1(-4)$

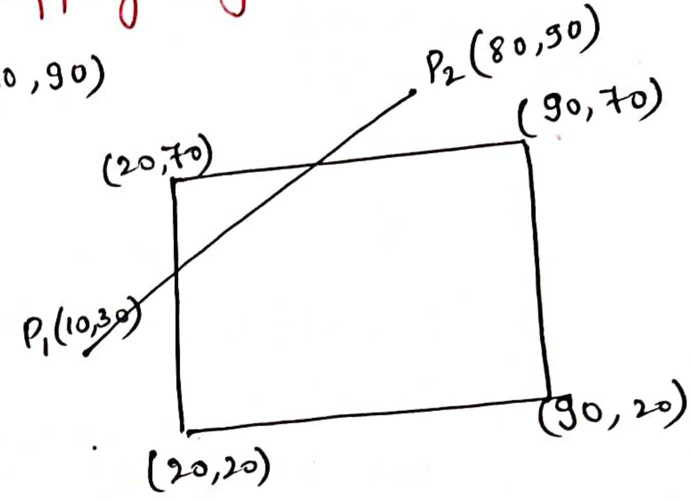
$= 12 - 4$

$\boxed{y_2' = 8}$

$\therefore \boxed{P_2'(x,y) = P_2'(8,8)}$



Q. Clip a line $P_1(10, 30)$ and $P_2(80, 90)$ with respective clipping window $(x_{min}, y_{min}) = (20, 20)$ and $(x_{max}, y_{max}) = (90, 70)$ using Liang - Barsky line clipping algorithm.



Soln :- Given $P_1(10, 30)$ and $P_2(80, 90)$

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

$(x_{max}, y_{max}) = (90, 70)$

$\Delta x = x_2 - x_1 = 80 - 10 = 70$

$\Delta y = y_2 - y_1 = 90 - 30 = 60$

Using Liang- Barsky line clipping algorithm

$P_1 = -\Delta x = -70$ $\quad q_1 = x_1 - x_{min} = 10 - 20 = -10$

$P_2 = \Delta x = 70$ $\quad q_2 = x_{max} - x_1 = 90 - 10 = 80$

$P_3 = -\Delta y = -60$ $\quad q_3 = y_1 - y_{min} = 30 - 20 = 10$

$P_4 = \Delta y = 60$ $\quad q_4 = y_{max} - y_1 = 70 - 30 = 40$

Case 1: $P_K \neq 0$ (Not Required)

Case 2: $P_K < 0$

$P_1 = -70$ $\quad q_1 = -10$ $\quad t = q_1/P_1 = -10/-70 = 10/70$

$P_3 = -60$ $\quad q_3 = 10$ $\quad t = q_3/P_3 = 10/-60 = -10/60$

$t_1 = \max(0, q/p) \Rightarrow \max(0, 10/70, -10/60)$

$\boxed{t_1 \Rightarrow 10/70}$

Case 3: $P_K > 0$

$P_2 = 70$ $\quad q_2 = 80$ $\quad t = 80/70$

$P_4 = 60$ $\quad q_4 = 40$ $\quad t = 40/60$

$t_2 = \min(1, q/p) \Rightarrow \min(1, 80/70, 40/60)$

$\boxed{t_2 \Rightarrow (40/60)}$

Finally,

(i) $t_1 \le t_2$

$\frac{10}{70} \le \frac{40}{60}$ ✓

(ii) $t_1 \ge 0$

$\frac{10}{70} \ge 0$ ✓

so $x_1' = x_1 + t_1 \Delta x$

$= 10 + \left(\frac{10}{\cancel{70}}\right)(\cancel{70})$

$= 10 + 10$

$\boxed{x_1' = 20}$

$y_1' = y_1 + t_1 \Delta y$

$= 30 + \left(\frac{10}{70}\right)(60)$

$= 38.57$

$\boxed{y_1' \simeq 39}$

$\therefore \boxed{P_1'(x, y) = (20, 39)}$

(iii) $t_2 \le 1$

$\frac{40}{60} \le 1$ ✓

so $x_2' = x_1 + t_2 \Delta x$

$= 10 + \left(\frac{40}{60}\right)(70)$

$= 56.66$

$\boxed{x_2' \simeq 57}$

$y_2' = y_1 + t_2 \Delta y$

$= 30 + \left(\frac{40}{\cancel{60}}\right)(\cancel{60})$

$= 30 + 40$

$\boxed{y_2' = 70}$

$\therefore \boxed{P_2'(x, y) = (57, 70)}$