Liang Barsky Line Clipping Algorithm.

- Line clipping approach is given by the Liang & Barsky is faster than cohen-sutherland line clipping.
- which is based on analysis of the parametric equations of the line which are as below.

$x = x_1 + u\Delta x$

$y = y_1 + u\Delta y$

where $0 \le u \le 1$, $\Delta x = x_2 - x_1$ & $\Delta y = y_2 - y_1$

Algorithm

1. Read two end points of line $P_1(x_1, y_1)$ & $P_2(x_2, y_2)$
2. Read two corner vertices, left top and right bottom of window : (x_{wmin}, y_{wmax}) & (x_{wmax}, y_{wmin})
3. Calculate values of parameters p_k and q_k for $k = 1, 2, 3, 4$ such that,

$p_1 = -\Delta x, \quad q_1 = x_1 - x_{wmin}$

$p_2 = \Delta x \quad q_2 = x_{wmax} - x_1$

$p_3 = -\Delta y \quad q_3 = y_1 - y_{wmin}$

$p_4 = \Delta y \quad q_4 = y_{wmax} - y_1$

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4. If $p_k = 0$ for any value of $k = 1, 2, 3, 4$ then,

Line is parallel to k^{th} boundary.

If corresponding $q_k < 0$ then,

Line is completely outside the boundary. therefore, discard line segment and go to step 8.

otherwise

check line is horizontal or vertical and accordingly check line end points with corresponding boundaries.

If line endpoints lie within the bounded area

then use them to draw line.

otherwise

Use boundary coordinates to draw line

And go to step 8.

5. For $k = 1, 2, 3, 4$ calculate r_k for nonzero value of p_k & q_k as follows:

$$r_k = \frac{q_k}{p_k}, \text{ for } k = 1, 2, 3, 4.$$

6. Find u_1 & u_2 as given below:

$u_1 = \max\{0, r_k \mid \text{where } k \text{ takes all values for which } p_k < 0\}$

$u_2 = \min\{1, r_k \mid \text{where } k \text{ takes all values for which } p_k > 0\}$

7. If $u_1 \leq u_2$ then
calculate endpoints of clipped line:
$x_1' = x_1 + u_1 \Delta x$
$y_1' = y_1 + u_1 \Delta y$
$x_2' = x_1 + u_2 \Delta x$
$y_2' = y_1 + u_2 \Delta y$
Draw line (x_1', y_1', x_2', y_2')

8. Stop.

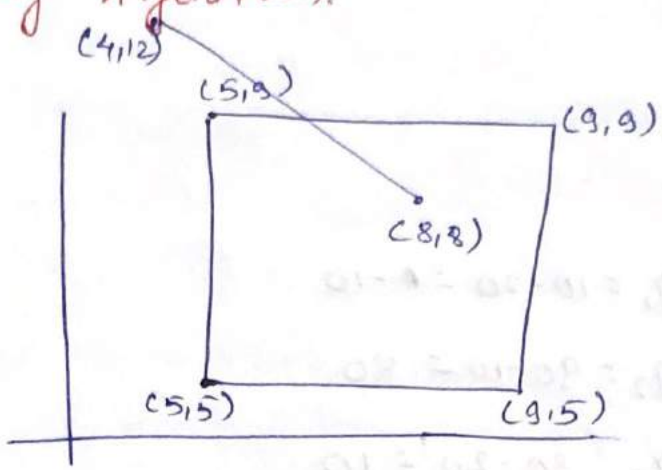
Advantages

1. More efficient.
2. Only requires one division to update u_1 & u_2.
3. Window intersections of line are calculated just once.

Example:

Q. window co-ordinates are given as (5,5) & (9,9). Line co-ordinates are given as (4,12) & (8,8). clip the line against the window using Liang Barskey Algorithm.

Sol.



$\Delta x = 4, \quad \Delta y = -4$

$P1 = -4 \qquad q1 = 4-5 = -1$

$P2 = 4 \qquad q2 = 9-4 = 5$

$P3 = 4 \qquad q3 = 12-5 = 7$

$P4 = -4 \qquad q4 = 9-12 = -3$

$u1 = max(0, 1/4, 3/4) = 3/4 = 0.75$

$x_1' = 4 + 0.75 * 4 = 7$

$y_1' = 12 + 0.75 * (-4) = 9$

Final co-ordinates of clipped line are (7,9) & (8,8)

Q. window co-ordinates are given as (20,20) & (90,70)
Line co-ordinates are given as (10,30) & (80,90)
clip the line agains the clipping window using
Liang Barsky Algorithm.

Sol.ⁿ

$\Delta x = 70$

$\Delta y = 60$

$p_1 = -70$ $\qquad$ $q_1 = 10-20 = -10$

$p_2 = 70$ $\qquad$ $q_2 = 90-10 = 80$

$p_3 = -60$ $\qquad$ $q_3 = 30-20 = 10$

$p_4 = 60$ $\qquad$ $q_4 = 70-30 = 40$

$u_1 = \max\left(0, \frac{-10}{-70}, \frac{10}{-60}\right)$ $\qquad$ $u_2 = \cancel{\max}\ \min\left(1, \frac{80}{70}, \frac{40}{60}\right)$

$= 1/7 = 0.14$ $\qquad$ $= \frac{2}{3} = 0.66$

$x_1' = 10 + 0.14 * 70 = 19.8$ $\qquad$ $x_2' = 10 + 0.66 * 70 = 56.2$

$y_1' = 30 + 0.14 * 60 = 38.4$ $\qquad$ $y_2' = 30 + 0.66 * 60 = 69.6$

Final co-ordinate of line after clipping are
(19.8, 38.4) & (56.2, 69.6)