Line Clipping

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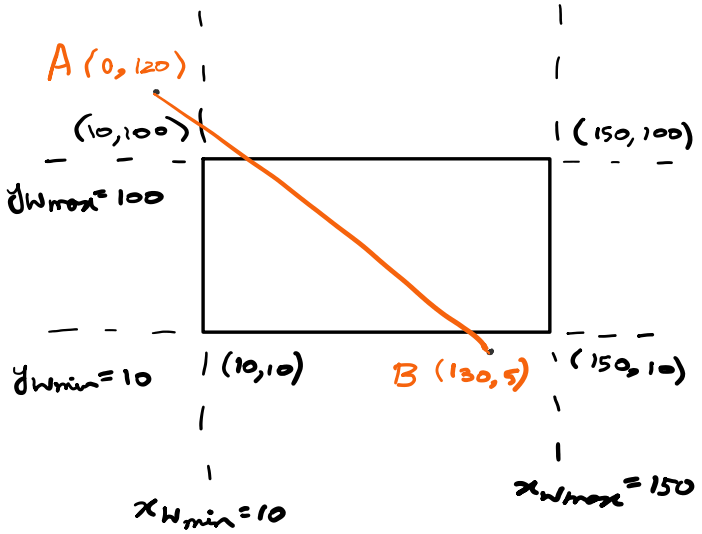
Cohen-Sutherland Line Clipping

Q. (ppt. slide 19/33)



TBRL

Step 1: Region codes

A - 1001
B - 0100

Step 2: Bitwise OR

⇒ 1101
∴ not trivially accepted

Step 3: Bitwise AND

⇒ 0000
∴ not trivially rejected

Step 4: Intersection points

$$m = \frac{5 - 120}{130 - 0} = -0.88$$

① $x = x_{min} = 10$

$$\Rightarrow y = y_A + m(x - x_A)$$
$$= 120 - 0.88(10 - 0)$$
$$= 120 - 8.8$$
$$= 111.2$$

TBRL
T: 1000

$= 111.2$

$\therefore I_1 (10, 111.2)$

TBRL

I_1 : 1000

B : 0100

$\Rightarrow$ OR = 1100

AND = 0000

$\therefore$ neither trivially accepted nor rejected

② $y = y_{max} = 100$

$\Rightarrow x = x_A + \frac{1}{m}(y - y_A)$

$= 0 + \frac{1}{-0.88}(100 - 120)$

$= 22.73$

$\therefore I_2 (22.73, 100)$

I_2 : 0000

B : 0100

$\Rightarrow$ OR = 0100

AND = 0000

$\therefore$ neither trivially accepted nor rejected

③ $y = y_{min} = 10$

$\Rightarrow x = x_A + \frac{1}{m}(y - y_A)$

$= 0 + \frac{1}{-0.88}(10 - 120)$

$= 125$

$\therefore I_3 (125, 10)$

I_3 : 0000

I_2 : 0000

I_3 : 0000

$\Rightarrow$ OR = 0000

$\therefore$ trivially accept

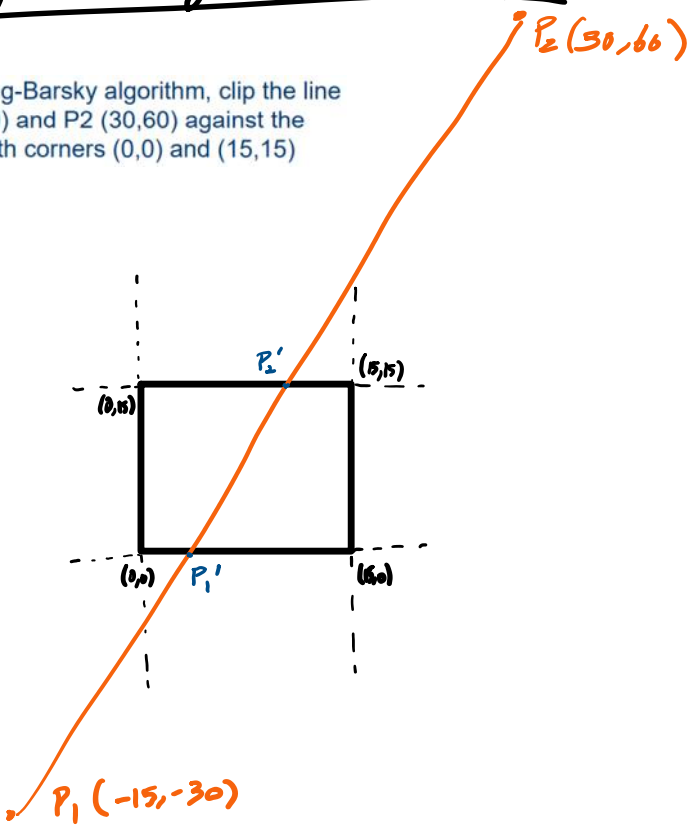
??

$\therefore$ Clipped line endpts :

$I_2 (22.73, 100)$, $I_3 (125, 10)$

Liang-Barsky Line Clipping

Q. Using Liang-Barsky algorithm, clip the line P1(-15,-30) and P2 (30,60) against the window with corners (0,0) and (15,15)



$\Delta x = x_2 - x_1 = 30 - (-15) = 45$

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

$p_k \neq 0$

Computing r_k $\forall$ $k = 1, 2, 3, 4$:

$$r_1 = \frac{q_1}{p_1} = \frac{x_1 - x_{min}}{-\Delta x} = \frac{-15 - 0}{-45} = \frac{1}{3} \checkmark$$

$$r_2 = \frac{q_2}{p_2} = \frac{x_{max} - x_1}{\Delta x} = \frac{15 - (-15)}{45} = \frac{2}{3} \checkmark$$

$$r_3 = \frac{q_3}{p_3} = \frac{y_1 - y_{min}}{-\Delta y} = \frac{-30 - 0}{-90} = \frac{1}{3} \checkmark$$

$$r_4 = \frac{q_4}{p_4} = \frac{y_{max} - y_1}{\Delta y} = \frac{15 - (-30)}{90} = \frac{1}{2} \checkmark$$

$p_k < 0$: $u_{min} = \max(0, \frac{1}{3}) = \frac{1}{3}$

$p_k > 0$: $u_{max} = \min(\frac{1}{2}, 1) = \frac{1}{2}$

$u_{min} < u_{max}$

$\Rightarrow$ line within clipping window ✓

Computing intersection points:

$$x_1' = x_1 + u_{min} \cdot \Delta x$$
$$= -15 + \frac{1}{3} \cdot 45 = 0$$

$$y_1' = y_1 + u_{min} \cdot \Delta y$$
$$= -30 + \frac{1}{3} \cdot 90 = 0$$

$$x_2' = x_1 + u_{max} \cdot \Delta x$$
$$= -15 + \frac{1}{2} \cdot 45 = 7.5$$

$$y_2' = y_2 + u_{max} \cdot \Delta y$$
$$= -30 + \frac{1}{2} \cdot 90 = 15$$

$\therefore P_1'(0,0)$ and $P_2'(7.5, 15)$ are the endpts. of the clipped line.