Cohen-Sutherland

Practice - 1(i)

$x_{min} = -200$, $y_{min} = -100$

$x_{max} = 200$, $y_{max} = 100$

$(-100, -100)$ to $(200, 0)$

$x_1 = -100$, $y_1 = -100$, $x_2 = 200$, $y_2 = 0$

Opcode 1 $(x_1, y_1) = 0000$

Opcode 2 $(x_2, y_2) = 0000$

Opcode 1 = Opcode 2 = 0000

$\therefore$ the line is completely inside.

$\therefore$ Coordinates of start and end points : $(-100, -100)$ to $(200, 0)$

1(ii)

$x_{min} = -200$, $y_{min} = -100$

$x_{max} = 200$, $y_{max} = 100$

$(50, -105)$ to $(150, -200)$

$x_1 = 50$, $y_1 = -105$, $x_2 = 150$, $y_2 = -200$

Opcode 1 $(x_1, y_1) = 0100$

Opcode 2 $(x_2, y_2) = 0100$

Opcode1 AND opcode2 = 0100

$\therefore$ Opcode1 AND opcode2 $\neq$ 0000

$\therefore$ So the line is completely outside.

<u>1(iii)</u>

$x_{min} = -200$, $y_{min} = -100$
$x_{max} = 200$, $y_{max} = 100$

$(-160, 140)$ to $(-240, 80)$
$x_1 \quad y_1 \qquad x_2 \quad y_2$

Opcode 1 (x_1, y_1) = 1000
Opcode 2 (x_2, y_2) = 0001

Opcode1 AND opcode2 = 0000

$\therefore$ partially inside.

Opcode1 $\neq$ 0000

Opcode1 has top bit.

$y = y_{max} = 100$

[We have to take the fraction for both m and $\frac{1}{m}$]

$$x = x_1 + \frac{1}{m}(y_{max} - y_1)$$
$$= -160 + \frac{4}{3} \cdot (100 - 140)$$
$$= -213.3$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$
$$= \frac{80 - 140}{-240 + 160}$$
$$= \frac{3}{4}$$
$$\therefore \frac{1}{m} = \frac{4}{3}$$

$(x, y) = (-213.3, 100)$

Opcode 1 = 0001 [recalculated]

Opcode 2 = 0001

Opcode 1 AND opcode 2 = 0001

$\therefore$ opcode 1 AND opcode 2 $\neq$ 0000

$\therefore$ Completely outside.

1(iv)

$x_{min} = -200$, $y_{min} = -100$
$x_{max} = 200$, $y_{max} = 100$

$(-300, 120)$ to $(250, -110)$, with $x_1 = -300$, $y_1 = 120$, $x_2 = 250$, $y_2 = -110$

Opcode 1 (x_1, y_1) = 1001

Opcode 2 (x_2, y_2) = 0110

Opcode1 AND Opcode2 = 0000

$\therefore$ partially inside.

Opcode1 $\neq$ 0000

Opcode1 has top bit.

$$y = y_{max} = 100$$

$$x = x_1 + \frac{1}{m}(y_{max} - y_1)$$

$$= -300 - \frac{55}{23}(100 - 120)$$

$$= -252.173913$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{-110 - 120}{250 + 300}$$

$$= -\frac{23}{55}$$

$$\therefore \frac{1}{m} = -\frac{55}{23}$$

$\therefore (x, y) = (-252.17391, 100)$

Opcode1 = 0001 [recalculated]

Opcode2 = 0110

Opcode1 AND opcode2 = 0000

partially inside.

Opcode1 $\neq$ 0000

Opcode1 has left bit.

$$x = x_{min} = -200$$

$y = y_1 + m(x_{min} - x)$

$= 100 + \left(\frac{-23}{55}\right)(-200 + 252.173913)$

$= 78.1818182$

$(x, y) = (-200, 78.1818182)$

Opcode 1 = 0000 [recalculated]

opcode 2 = 0110

Opcode 1 AND opcode 2 = 0000

Opcode 2 ≠ 0000

Opcode 2 has bottom bit

$y = y_{min} = -100$

$x = x_1 + \frac{1}{m}(y_{min} - y_1)$

$= 250 - \frac{55}{23}(-100 + 110)$

$= 226.0869565$

$(x, y) = (226.0869565, -100)$

Opcode2 = 0010 [recalculated]

Opcode1 AND opcode2 = 0000

Opcode2 ≠ 0000

Opcode2 has right bit.

$$x = x_{max} = 200$$

$$y = y_1 + m(x_{max} - x_1)$$

$$= -100 - \frac{23}{55}(200 - 226.0869565)$$

$$= -89.0909091$$

~~$(x, y) = (-89.0909091, 200)$~~

$$(x, y) = (200, -89.0909091)$$

Opcode2 = 0000

Opcode1 = 0000

∴ Opcode1 = Opcode2 = 0000

∴ Completely inside.

$(-200, 78.1818182)$ to $(200, -89.0909091)$