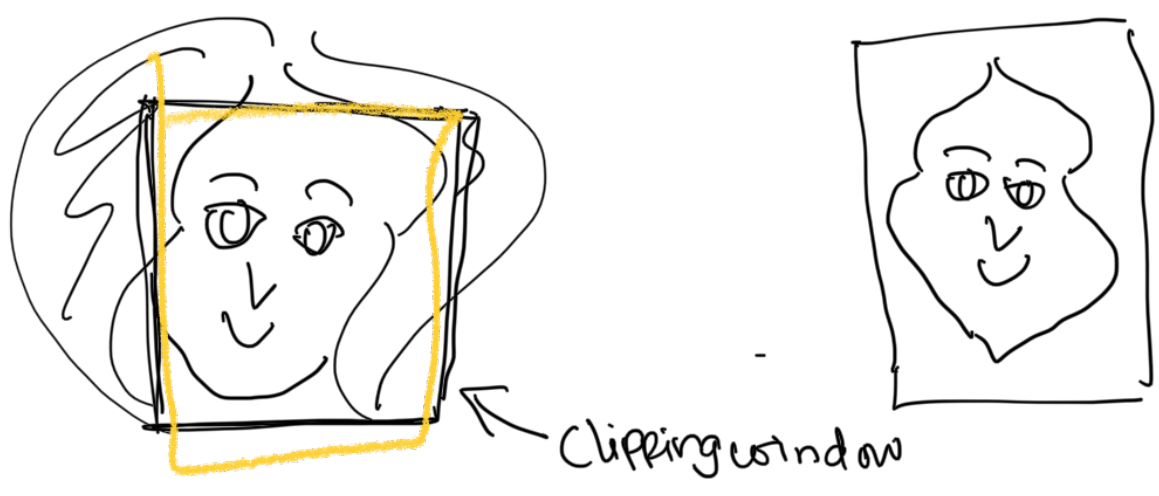


CSE 423 Week 3 Clipping.

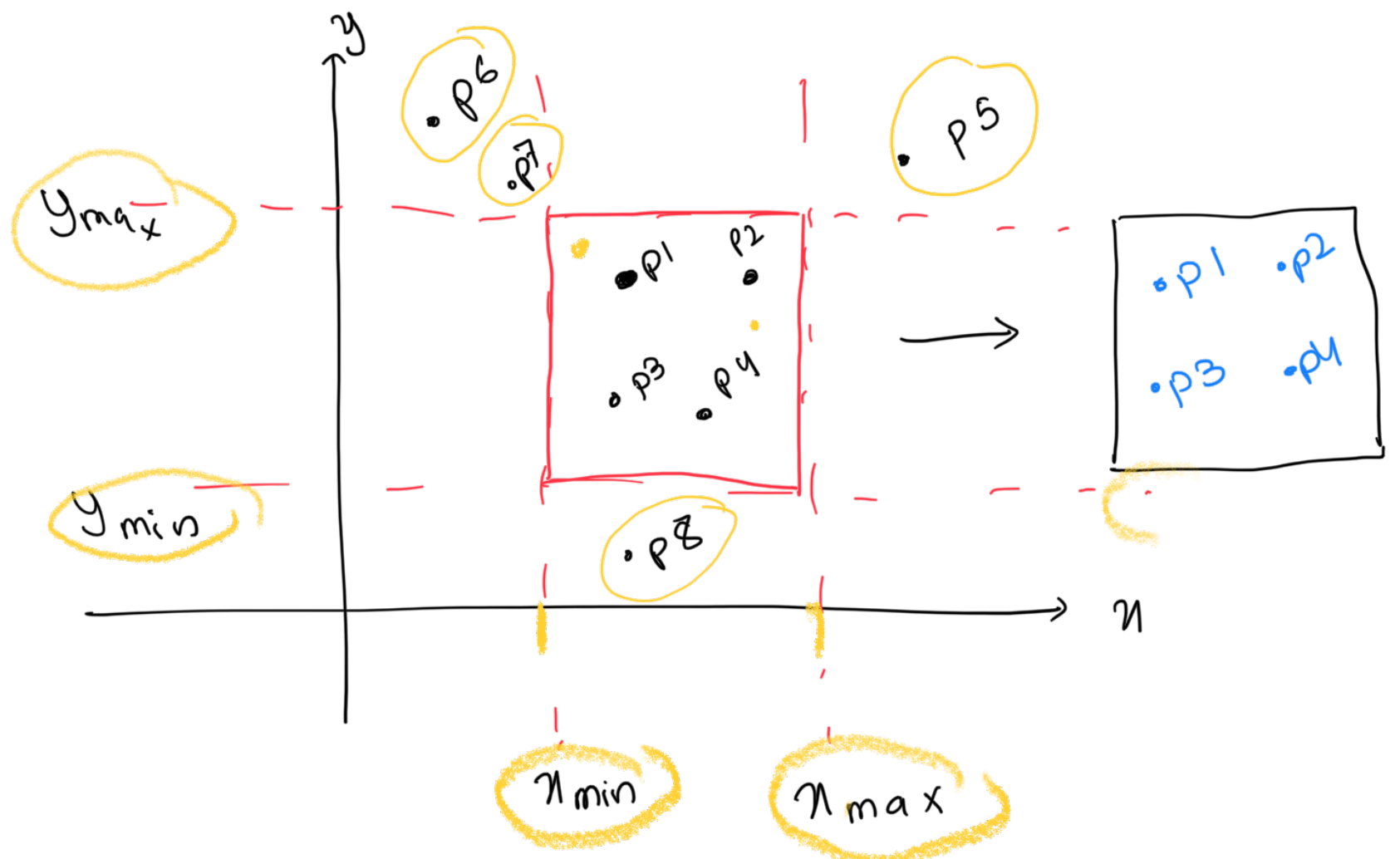
discarding



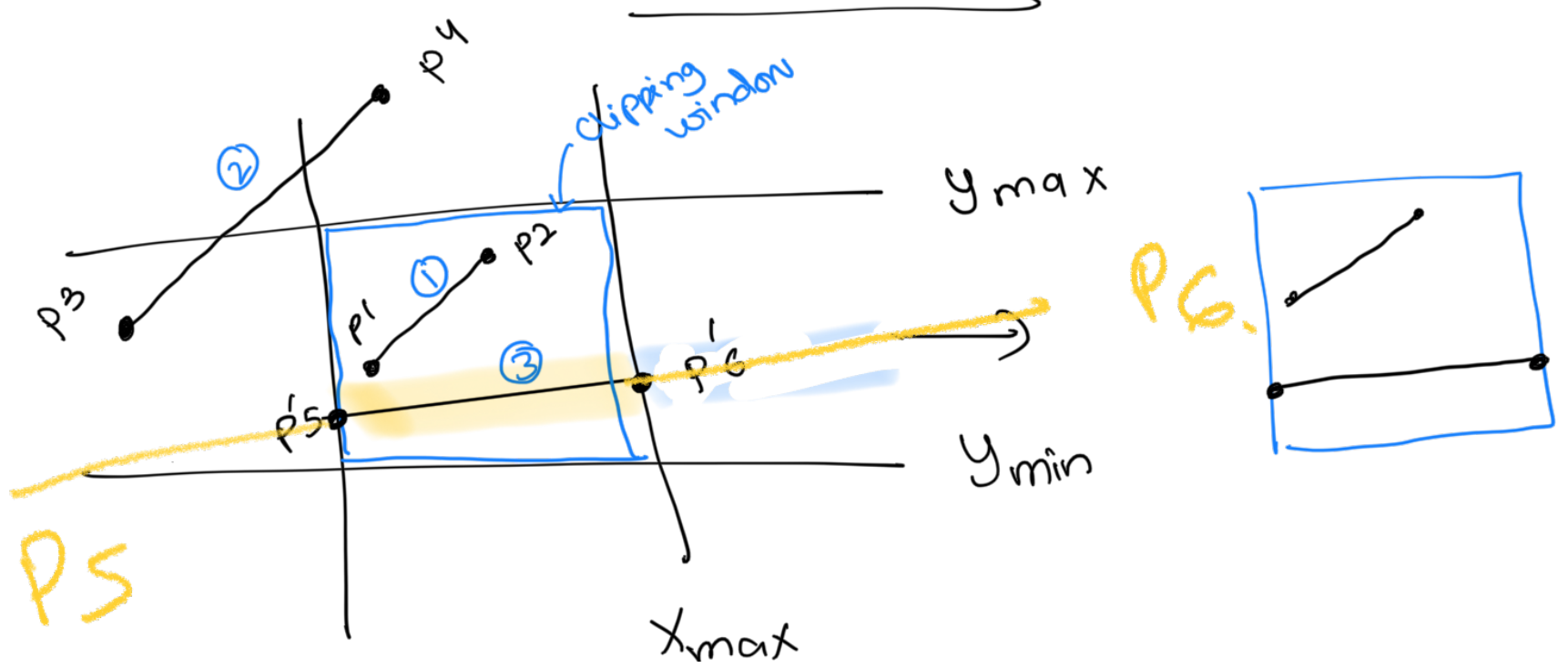
A point (x, y) is not clipped if:

→ $x_{min} \leq x \leq x_{max}$ AND

→ $y_{min} \leq y \leq y_{max}$



Line clipping



3 Cases:

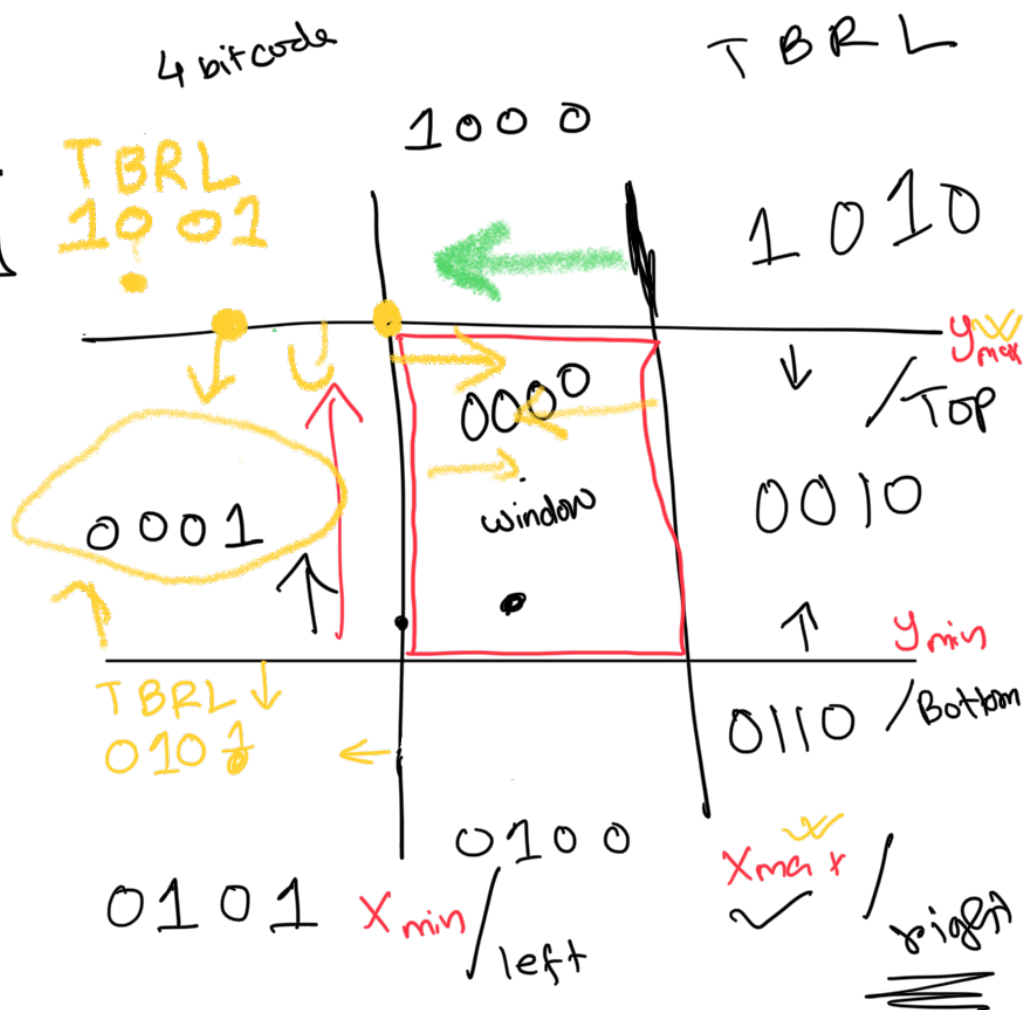
- ① line completely inside
- ② line completely outside
- ③ line partially inside

First work, find where the coordinates are situated and denoted with bit-code

Condition :-

$\leq \text{Top} / y_{\max}$
 $y > \text{Bottom} / y_{\min}$

 $> \text{left} / x_{\min}$
 $\leq \text{right} / x_{\max}$



Calculate $\text{outcode}(x, y)$ &

if ($x \geq x_{\min}$) bit0 = 0
else bit0 = 1 ✓

```

if (  $x \leq x_{\max}$  ) bit 1 = 0
else bit 1 = 1

```

```
if (y >= y_min) bit 2 = 0
else bit 2 = 1
```

if $(y \leq y_{\max})$ bit3 = 0

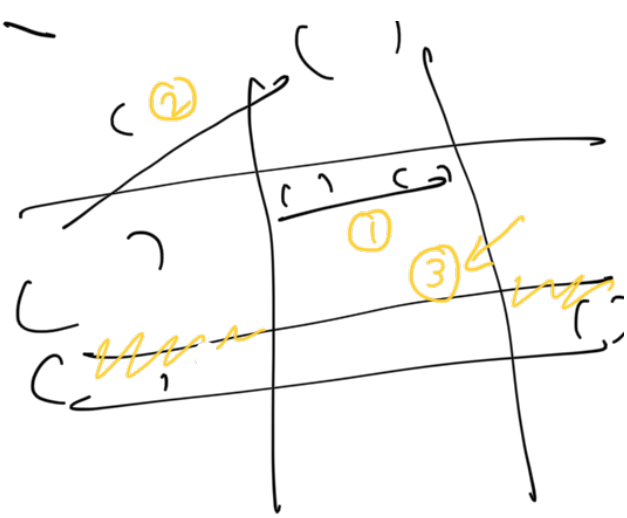
also bit 3 = 1

3 2 1 0
1 0 0 1

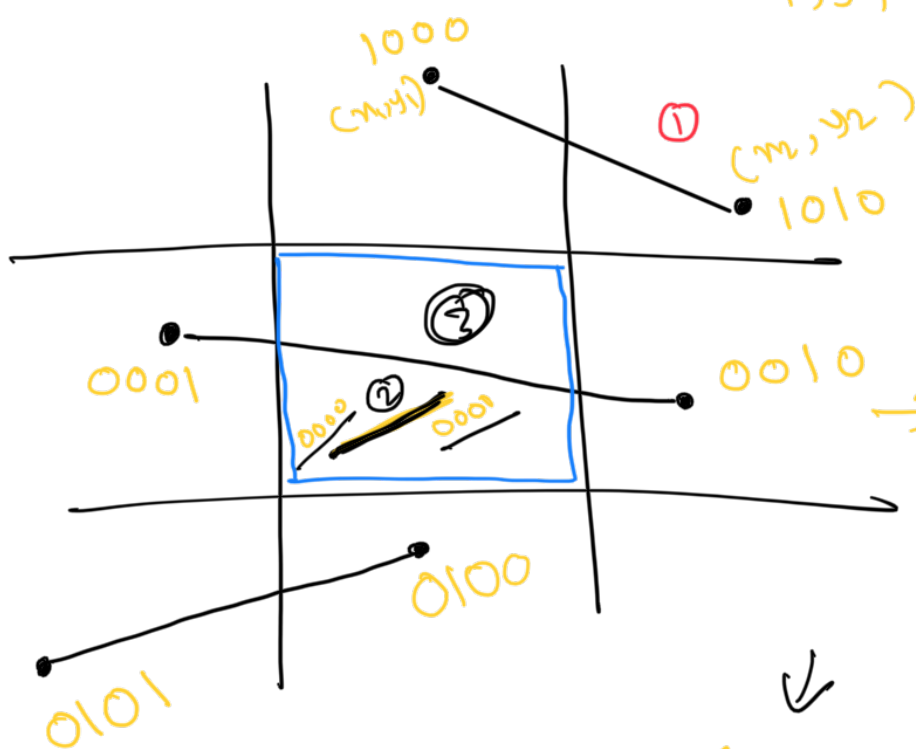
outcode = 1001

$$OC1 = (\quad)$$

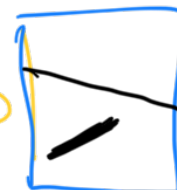
Starting () outside ending () outside



→ To check the cases we need to "AND" the bit-codes of starting and ending point x_1, y_1 x_2, y_2



AND Table (7,8)



00	0
01	0
10	0
11	1

Result →

①

1	0	0	0
1	0	1	0
AND			
1	0	0	0

← this line is completely outside the window

②

0	0	0	0
0	0	0	0
AND			
0	0	0	0

← the line is completely inside the window

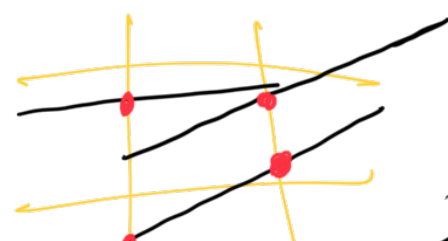
AND

③

0	1	0	0	0	1
0	2	0	0	1	0
AND					
0	0	0	0	0	0

← has at least 1 bit on

← the line is partially inside.



x_2, y_2



Cohen-Sutherland (x_1, y_1, x_2, y_2)

→ $oc1 = \text{Calculate_outcode}(x_1, y_1)$

→ $oc2 = \text{Calculate_outcode}(x_2, y_2)$

while (true)

if $(oc1 == oc2 == 0000)$ // completely inside.

output $(x_1, y_1) (x_2, y_2)$ ✓

break

else if $((oc1 \text{ AND } oc2) \neq 0000)$ // completely outside

break

else

// partially inside

if $(oc1 \neq 0000)$

① if $(oc1 \& \text{Top})$

$$x_1 = x_1 + \frac{x_2 - x_1}{y_2 - y_1} (y_{\max} - y_1)$$

$$\rightarrow y_1 = y_{\max}$$

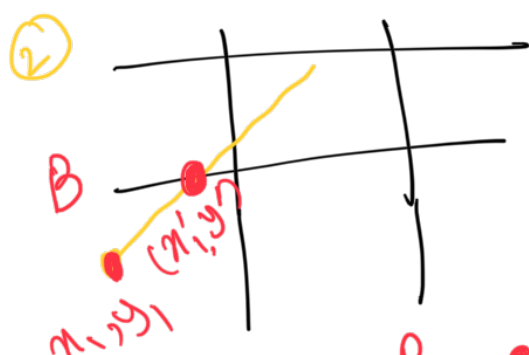
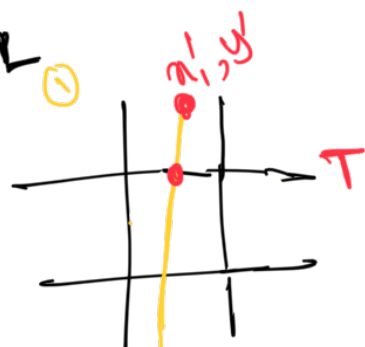
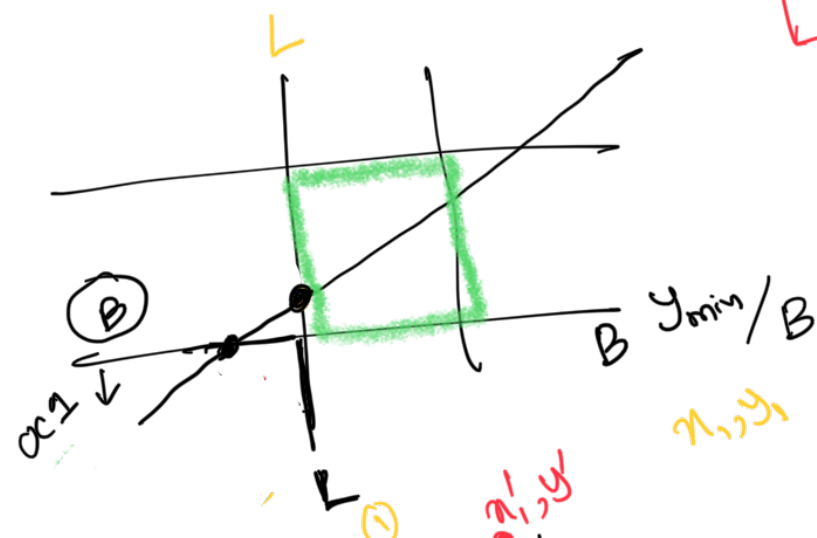
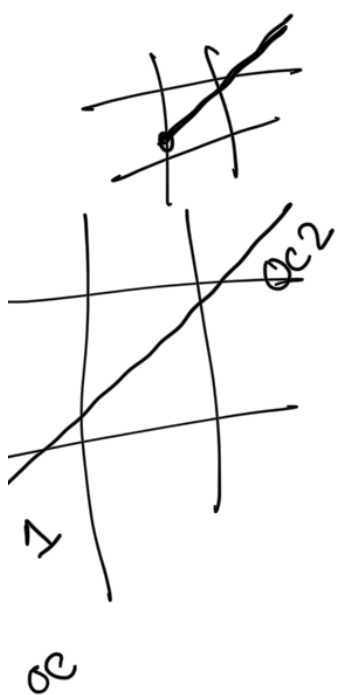
② if $(oc1 \& \text{Bottom})$

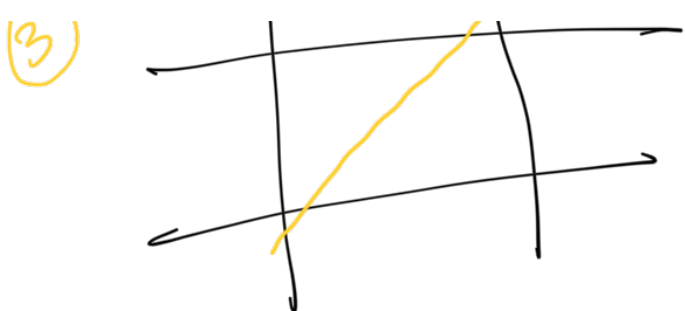
$$\underline{x_1} = \underline{x_1} + \frac{x_2 - x_1}{y_2 - y_1} (y_{\min} - y_1)$$

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

$$y_1 = y_{\min}$$

③ if $(oc1 \& \text{Right})$





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

$$x_1 = x_{max}$$



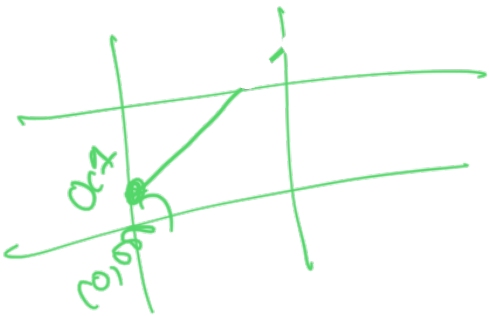
④ else { // test

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

$$x_1 = x_{min}$$

oc2

oc1 = calculate_outcode(x1, y1)



}

}

else {

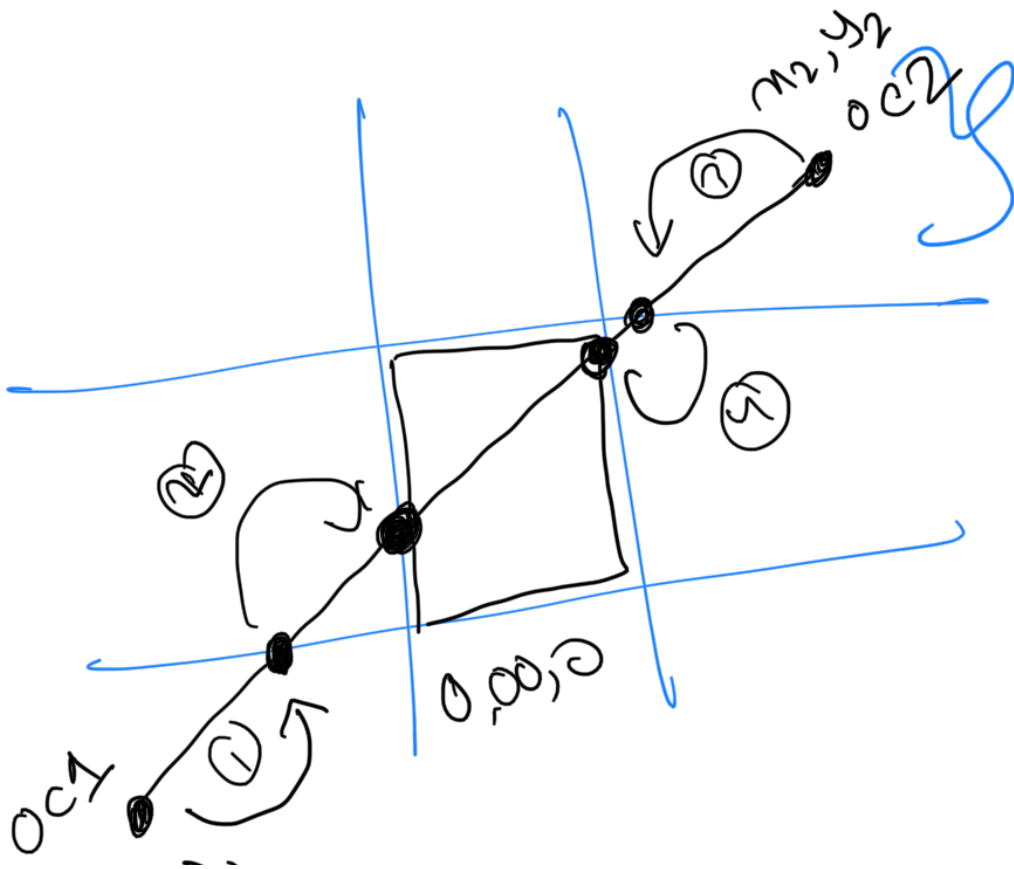
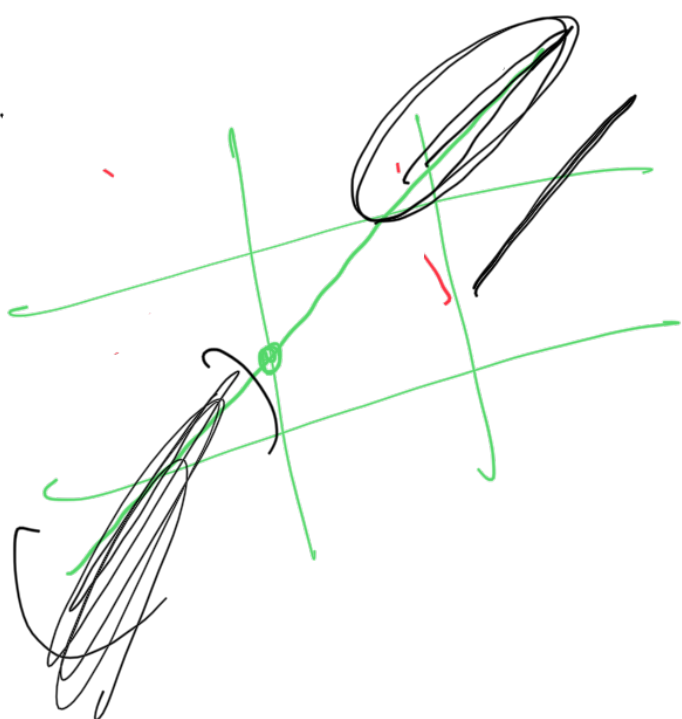
oc2 = !00000

Repeat with oc+2

oc2 = calculate_outcode(x1, y1)

}

Continue



$x_{\min} \quad y_{\min}$
 $(0, 0)$ to $x_{\max} \quad y_{\max}$
 $(300, 200)$.

points

$$x_1 = -250, y_1 = 200, x_2 = 250, y_2 = -200$$

Oct 1 = 0001
Oct 2 = 0100
AND
0000 ←

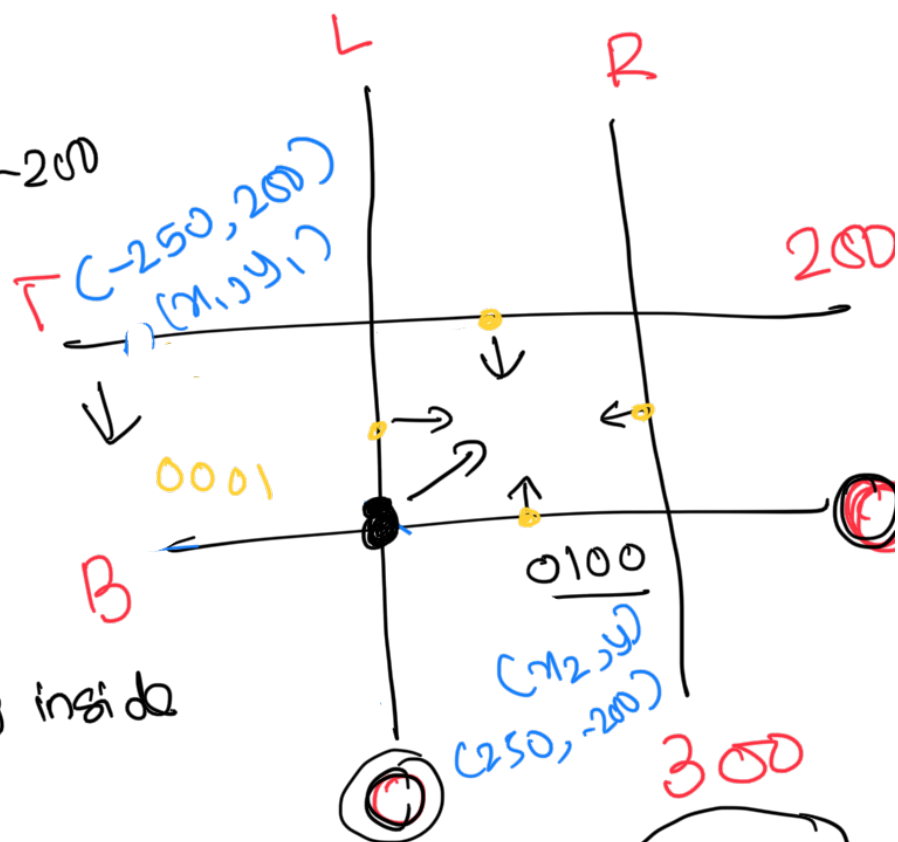
Partially inside

Left

$$\gamma_1 = \gamma_{min}$$

$$y_1 = y_1 + m (x_{\min} - x_1) \quad \begin{matrix} x_2 = \frac{25}{2} \\ y_2 = -250 \end{matrix}$$

$$= 250 + \frac{-250 - (-250)}{250 - (-250)} (0 - (-250))$$



$$= 0$$

$$\begin{aligned} x_1 &= 0 \\ \text{New Coordinate} &= (0, 0) \end{aligned}$$

$$\text{New Oc1} = 0000$$

$$\begin{array}{r} \text{Oc1 AND Oc2} = 0000 \ 30100 \\ \underline{0100} \\ 0000 \leftarrow \text{partially inside} \end{array}$$

$$\text{Oc2} \neq 0$$

Code 3 Bottom

$$y_2 = \underline{y_{\min}}$$

$$\begin{aligned} x_1 &= 0, y_1 = 0 \\ x_2 &= 250, -250 \end{aligned}$$

$$x_2 = x_2 + \left(\frac{1}{m} (y_{\min} - y_2) \right)$$

$$\begin{aligned} x_2 &= x_2 + \frac{x_2 - x_1}{y_2 - y_1} (y_{\min} - y_2) \\ &= 250 + \frac{250 - 0}{-250 - 0} (0 - (-250)) \end{aligned}$$

$$= 0$$

$$y_2 = 0$$

$$x_2, y_2 = (0, 0)$$

$$\text{Oc2} = [0000]$$

$$\text{Oc1 AND Oc2}$$

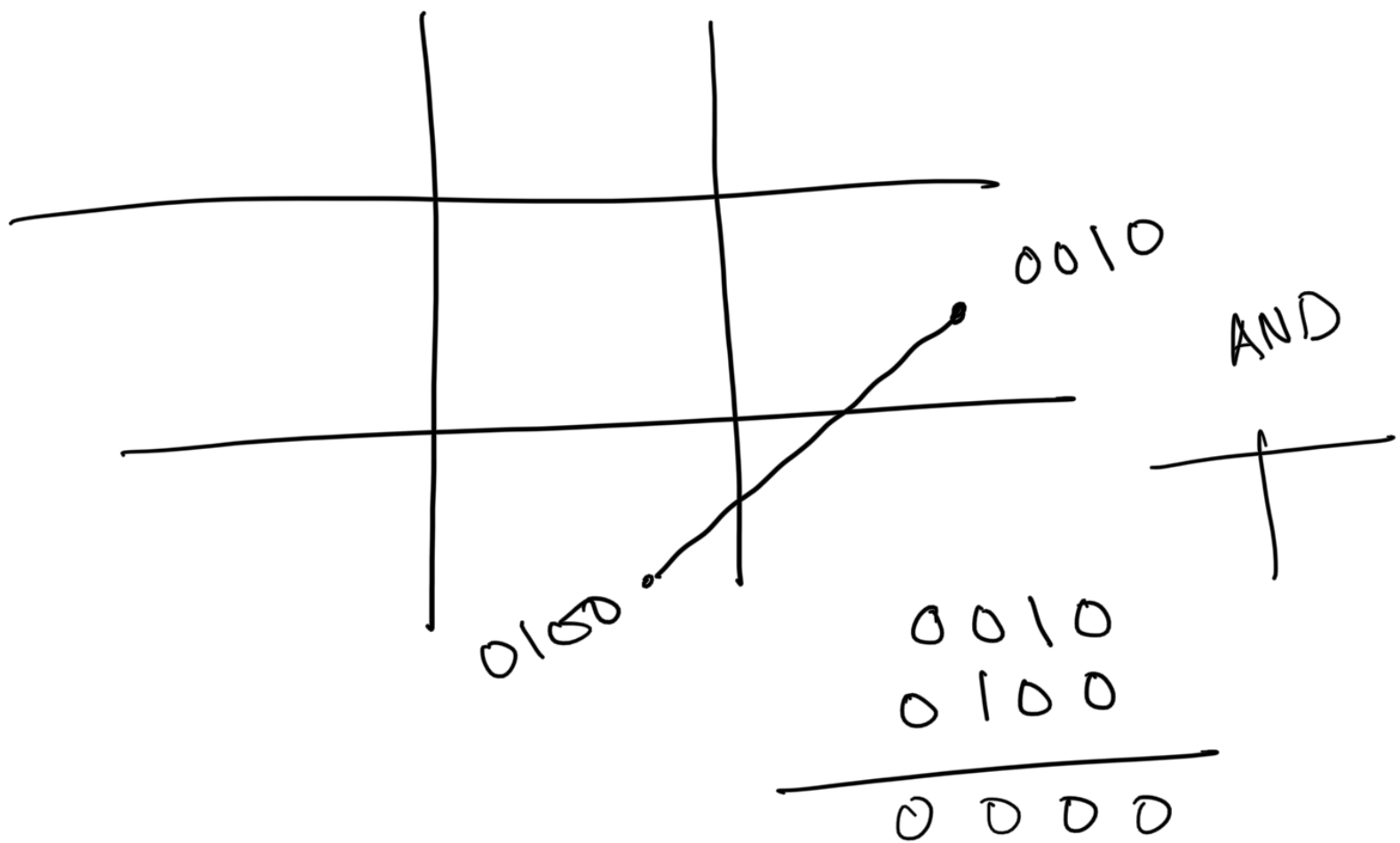
$$0000 \text{ AND } 0000 = 0000$$

$$\begin{pmatrix} x_1 & y_1 \\ 0 & 0 \end{pmatrix} \text{ \& } \begin{pmatrix} x_2 & y_2 \\ 0 & 0 \end{pmatrix}$$

Drawbacks of Cohen Sutherland

→ Clipping window has to be rectangular in shape & no other polygon shapes.

→ Edges of rectangular shaped clipping window has to be parallel to x-axis and y-axis



According to this, it should have been partially inside but it is completely inside.

Doesn't work for diagonal lines.