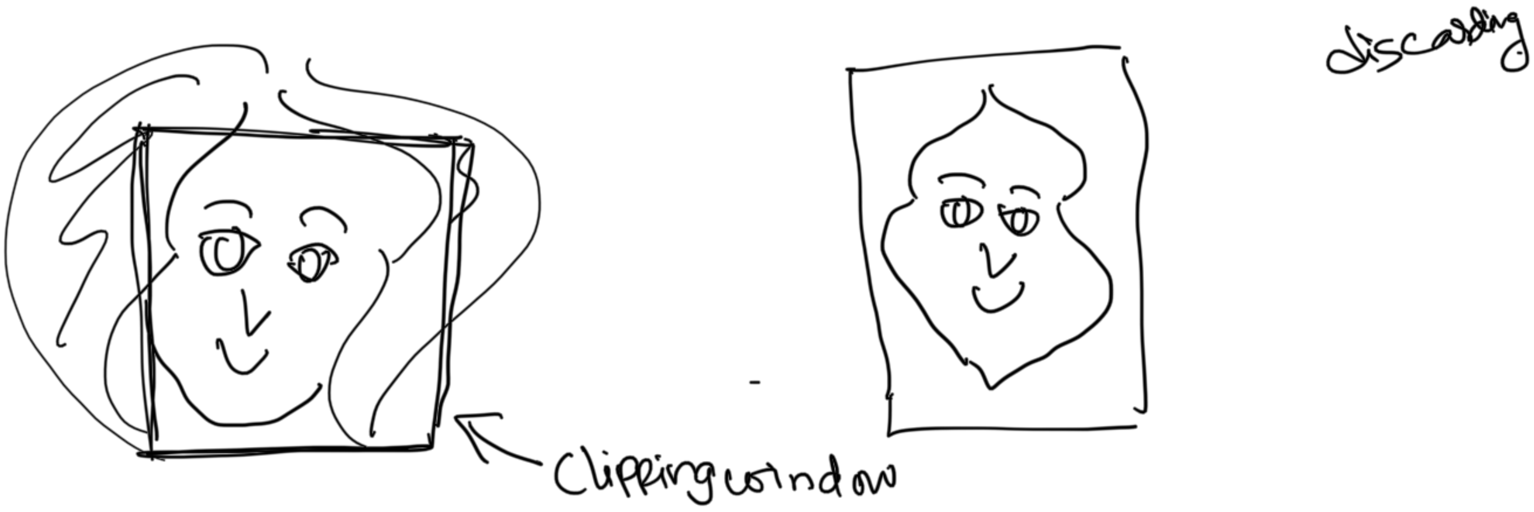
CSE 423 Week 3

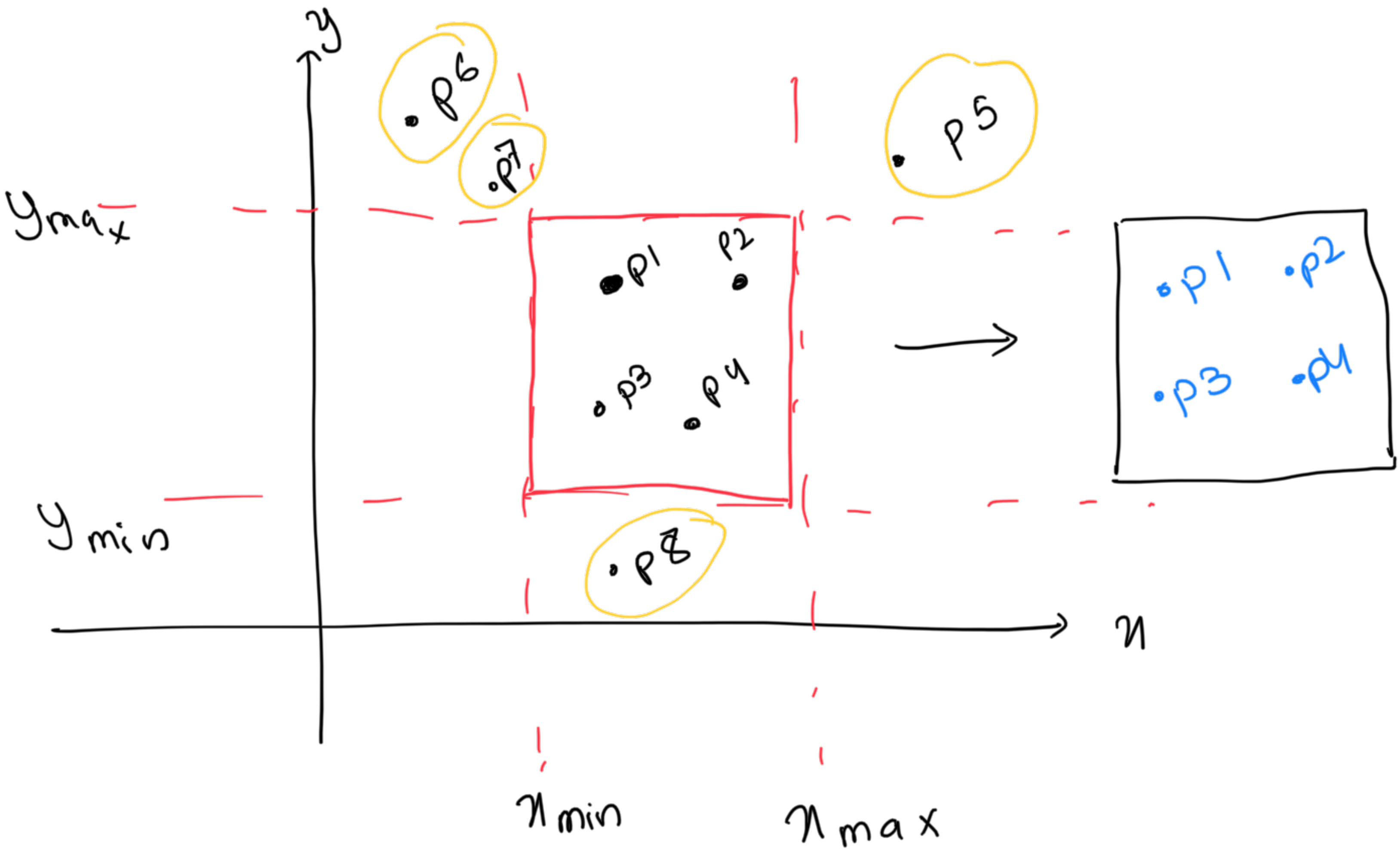
Clipping



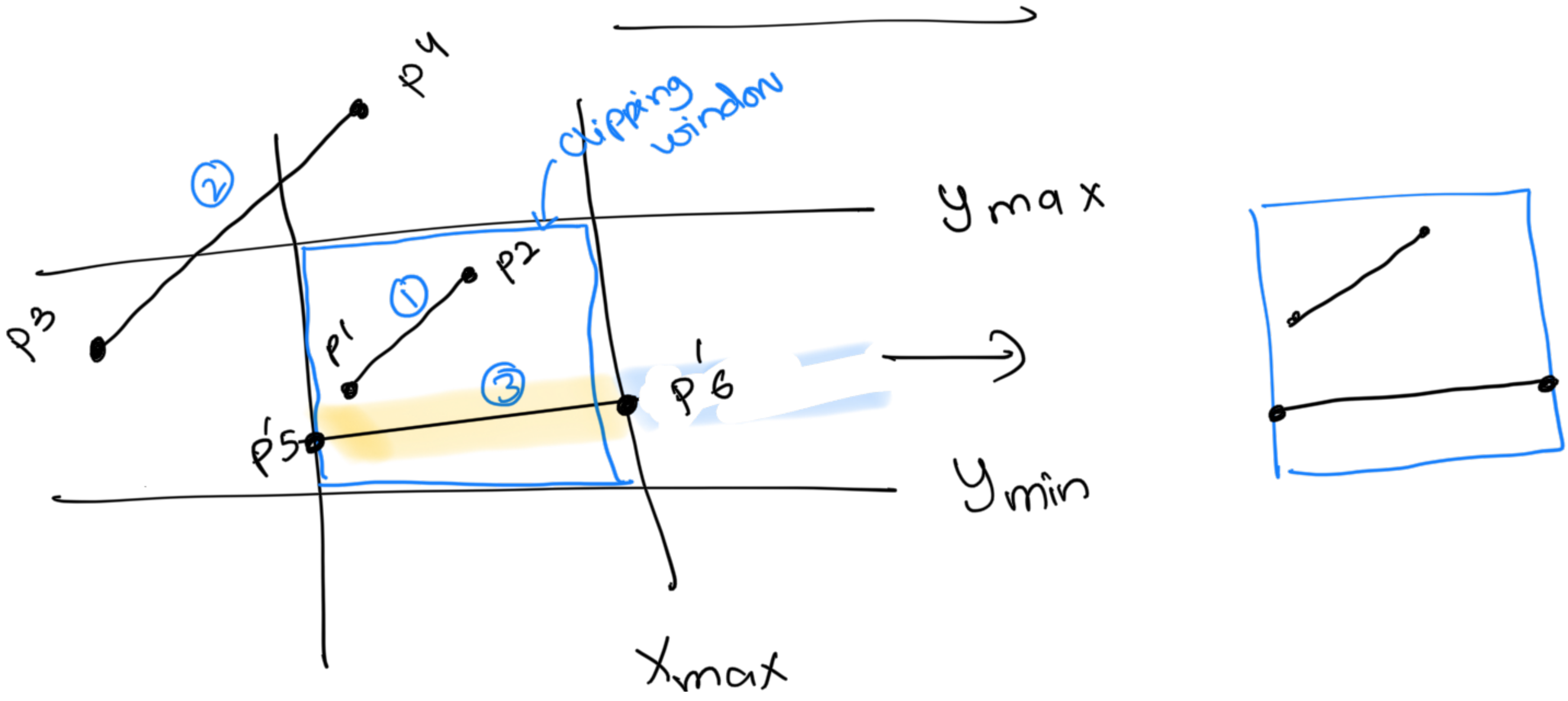
A point (x, y) is not clipped if:

→ $X_{min} \leq x \leq X_{max}$ AND

→ $y_{min} \leq y \leq y_{max}$



Line clipping



X_{min}

3 Cases :

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

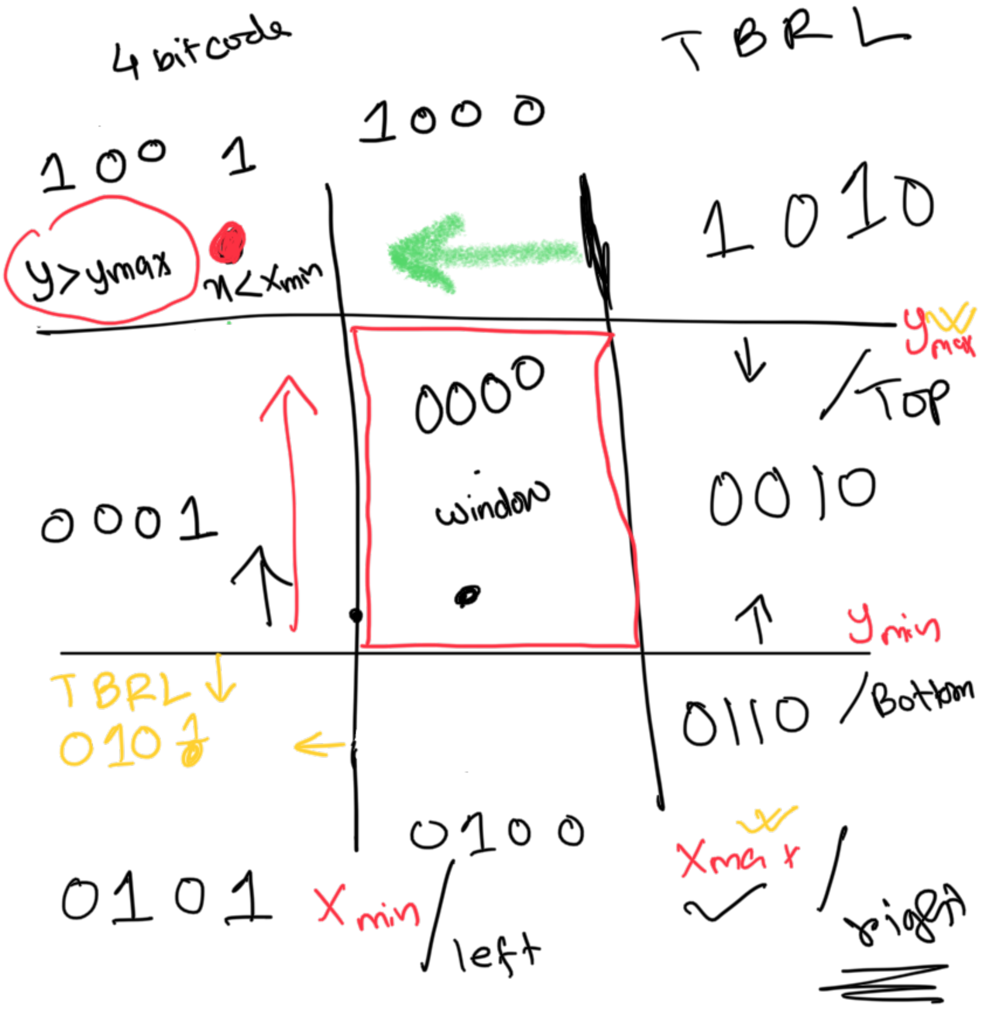
Firstwork, find where the coordinates are situated
regions are denoted with bit-code

outcode.

3	2	1	0
Top	bottom	right	left

Conditions :

$\leq$ Top / y_{max}
$y \geq$ Bottom / y_{min}
$\geq$ left / x_{min}
$\leq$ right / x_{max}



Calculate_outcode (x, y) {
if $(x \geq x_{min})$ bit0 = 0
else bit0 = 1
if $(x \leq X_{max})$ bit1 = 0
else bit1 = 1
if $(y \geq y_{min})$ bit2 = 0
else bit2 = 1
if $(y \leq y_{max})$ bit3 = 0
else bit 3 = 1

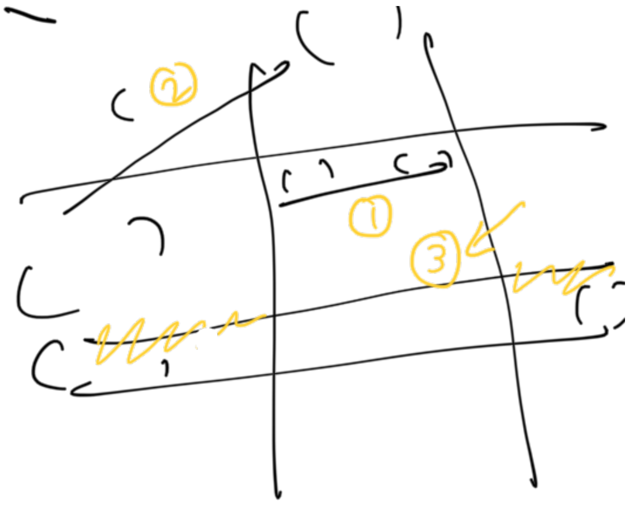
3 2 1 0
1 0 0 1

outcode = 1001

oc1 = (   )

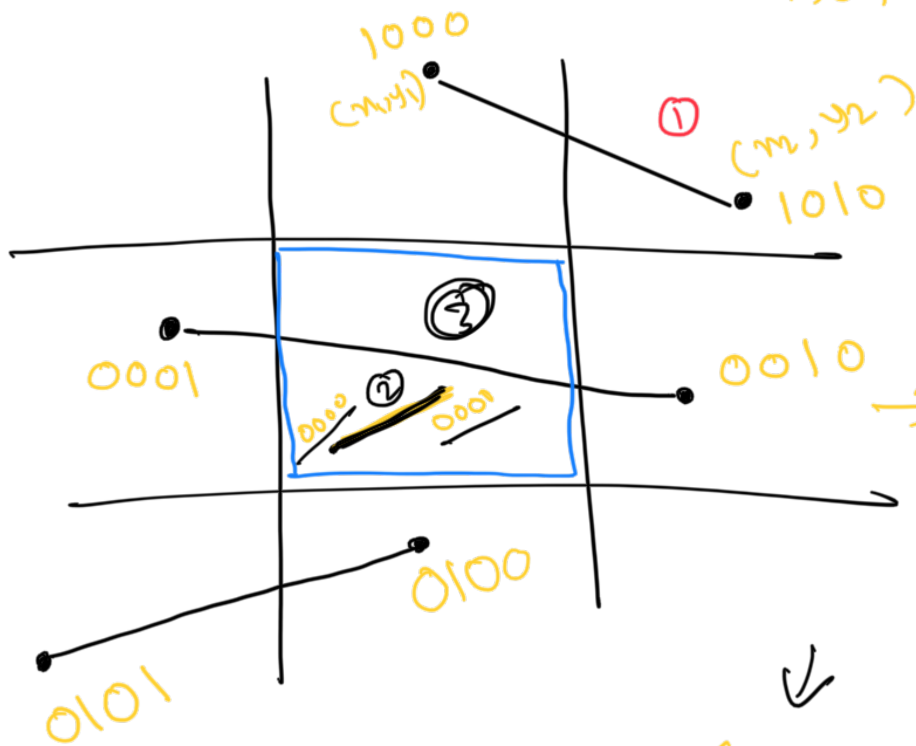
else ...

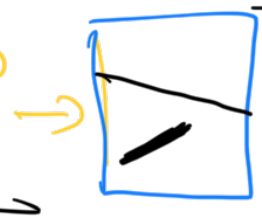
}



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

x, y
$(5, 6)$
$(7, 8)$





AND Table

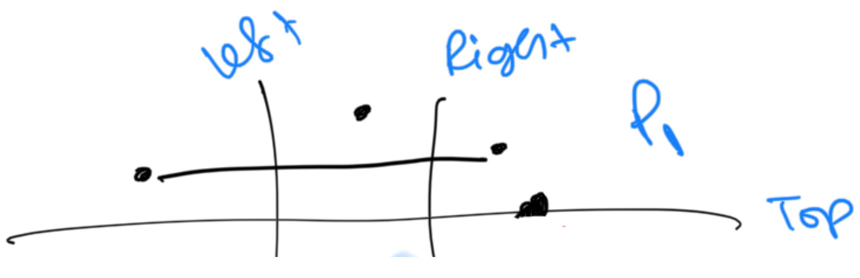
0 0	0
0 1	0
1 0	0
1 1	1

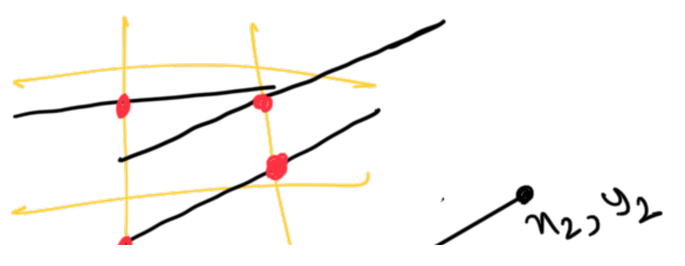
① 1 0 0 0 AND
1 0 1 0
Result → 1 0 0 0 ← this line is completely outside the window

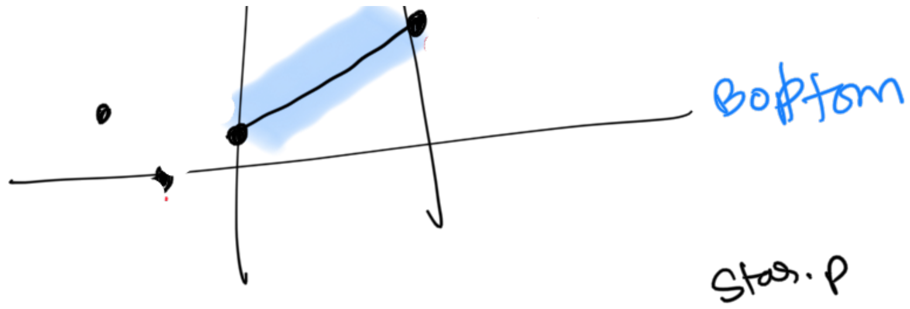
② 0 0 0 0 AND
0 0 0 0
→ 0 0 0 0 ← the line is completely inside the window

has atleast 1 bit on

③ o_1 → 0 0 0 1
o_2 → 0 0 1 0
0 0 0 0 ← the line is partially inside.







Start.p   end.p

Cohen_Suderland(x_1, y_1, x_2, y_2)

oc1 = Calculate_outcode(x_1, y_1)

oc2 = Calculate_outcode(x_2, y_2)

while(true) {

if (oc1 == oc2 == 0000) { // completely inside ①

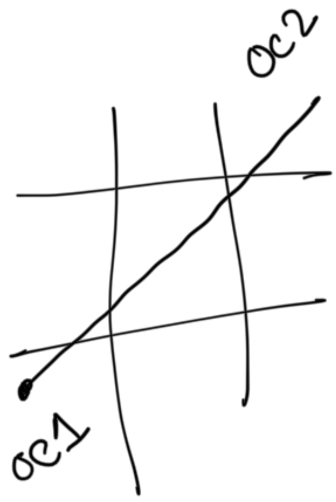
output (x_1, y_1) (x_2, y_2)

break }

// complety outside ②

else if ((oc1 AND oc2) != 0000) {

break }



// partially inside

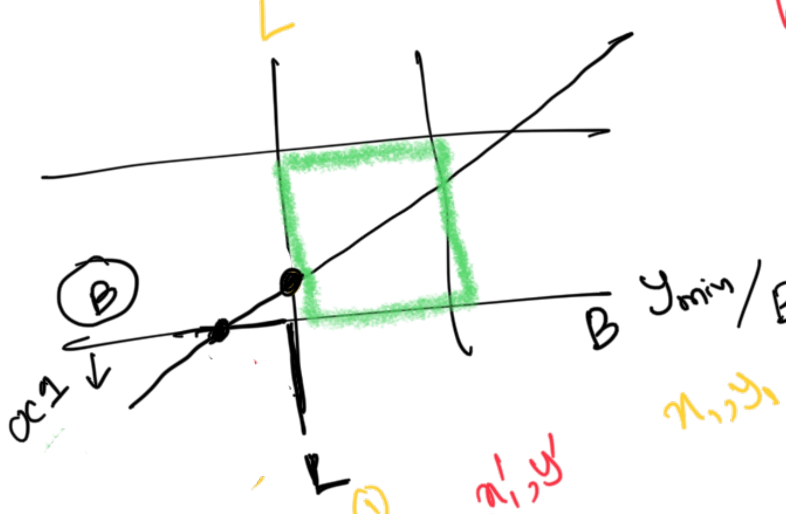
else {

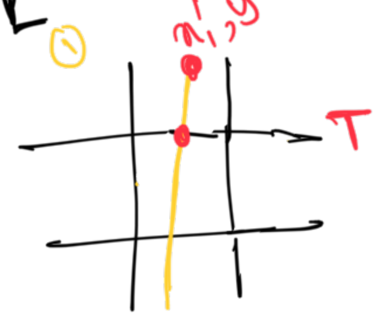
if (oc1 != 0000) {

① if (oc1 & Top) {

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

$\rightarrow y_1 = y_{max}$ }





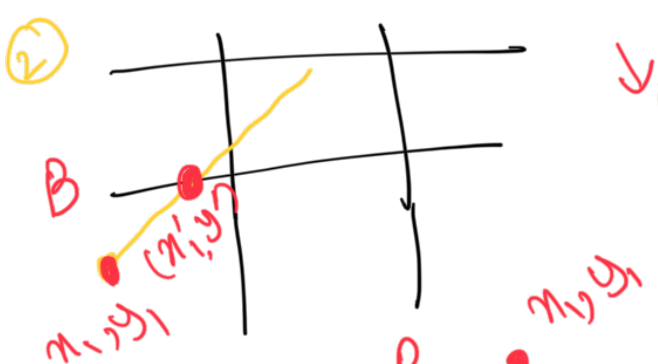
② if (oc1 & Bottom) {

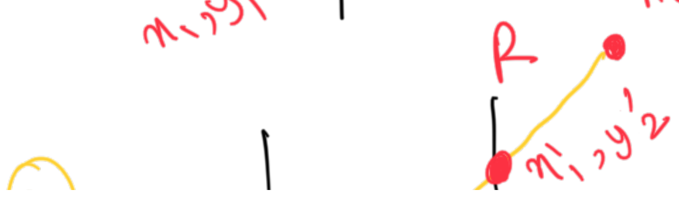
$$x_1 = x_1 + \frac{x_2 - x_1}{y_2 - y_1}(y_{min} - y_1)$$

$\rightarrow \frac{1}{m}$

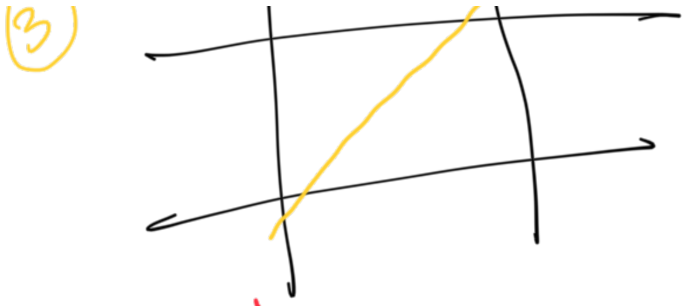
$$x_1 = x_1 + \frac{1}{m}(y_{min} - y_1)$$

$y_1 = y_{min}$ }



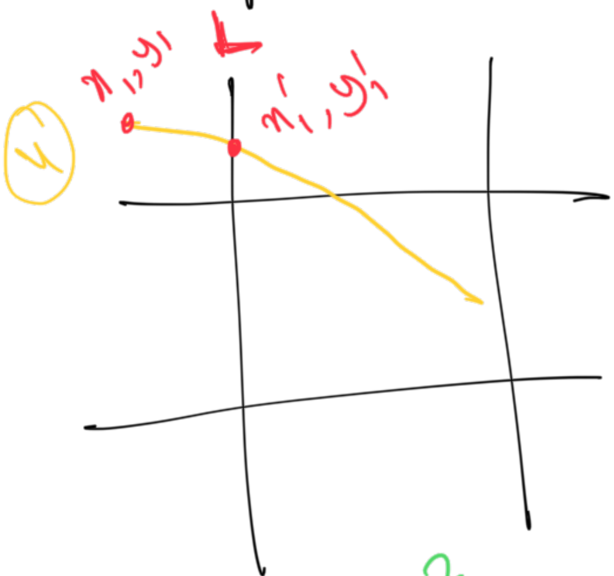


③ if (oc1 & Right) {



$$\boxed{\begin{aligned} y_1 &= y_1 + m\,(x_{max} - x_1) \\ x_1 &= x_{max} \end{aligned}}$$

else { } // left



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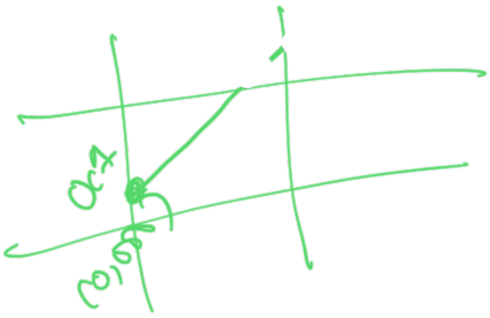
$$\boxed{\begin{aligned} y_1 &= y_1 + m\,(x_{min} - x_1) \\ x_1 &= x_{min}. \end{aligned}}$$

}

oc2

oc1 = calculate_outcode(x1,y1)

}



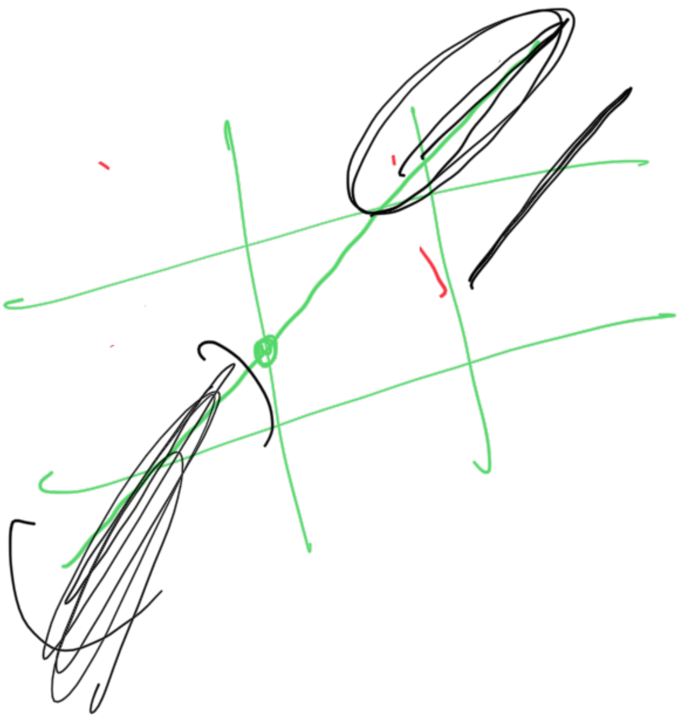
}

else {

oc2 = !0000

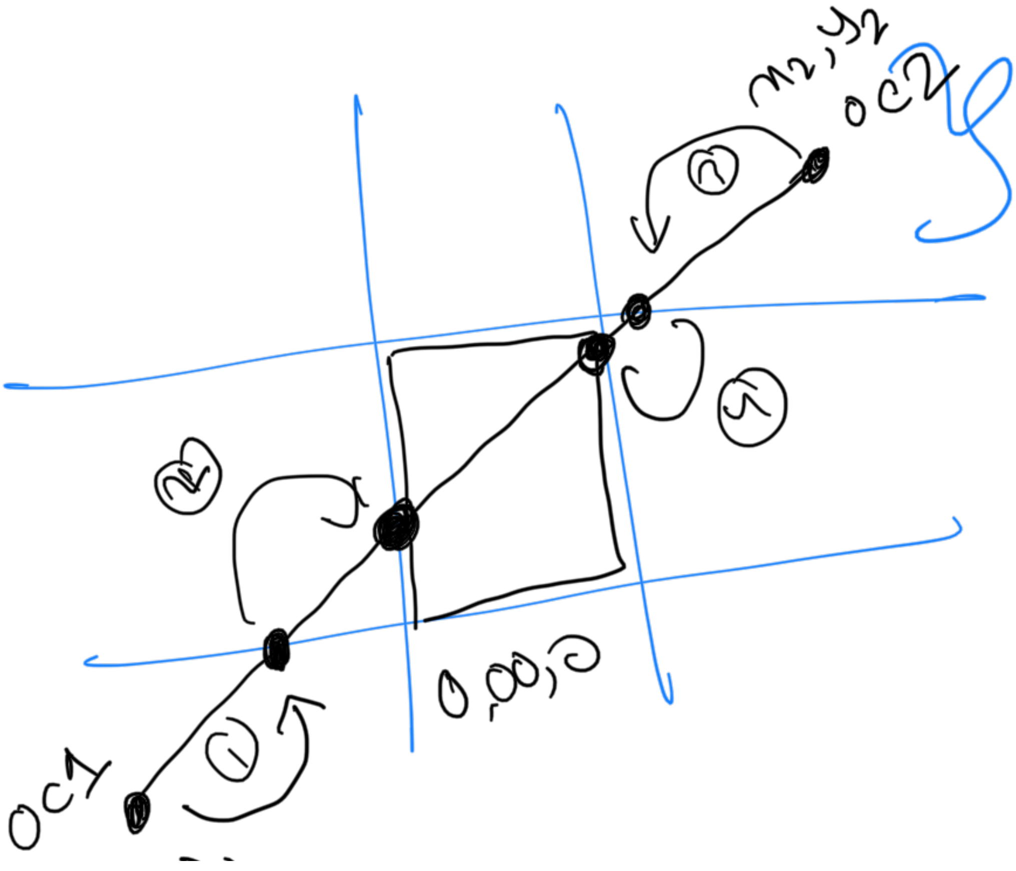
// Repeat with oc_2

oc2 = cal . . . (x,



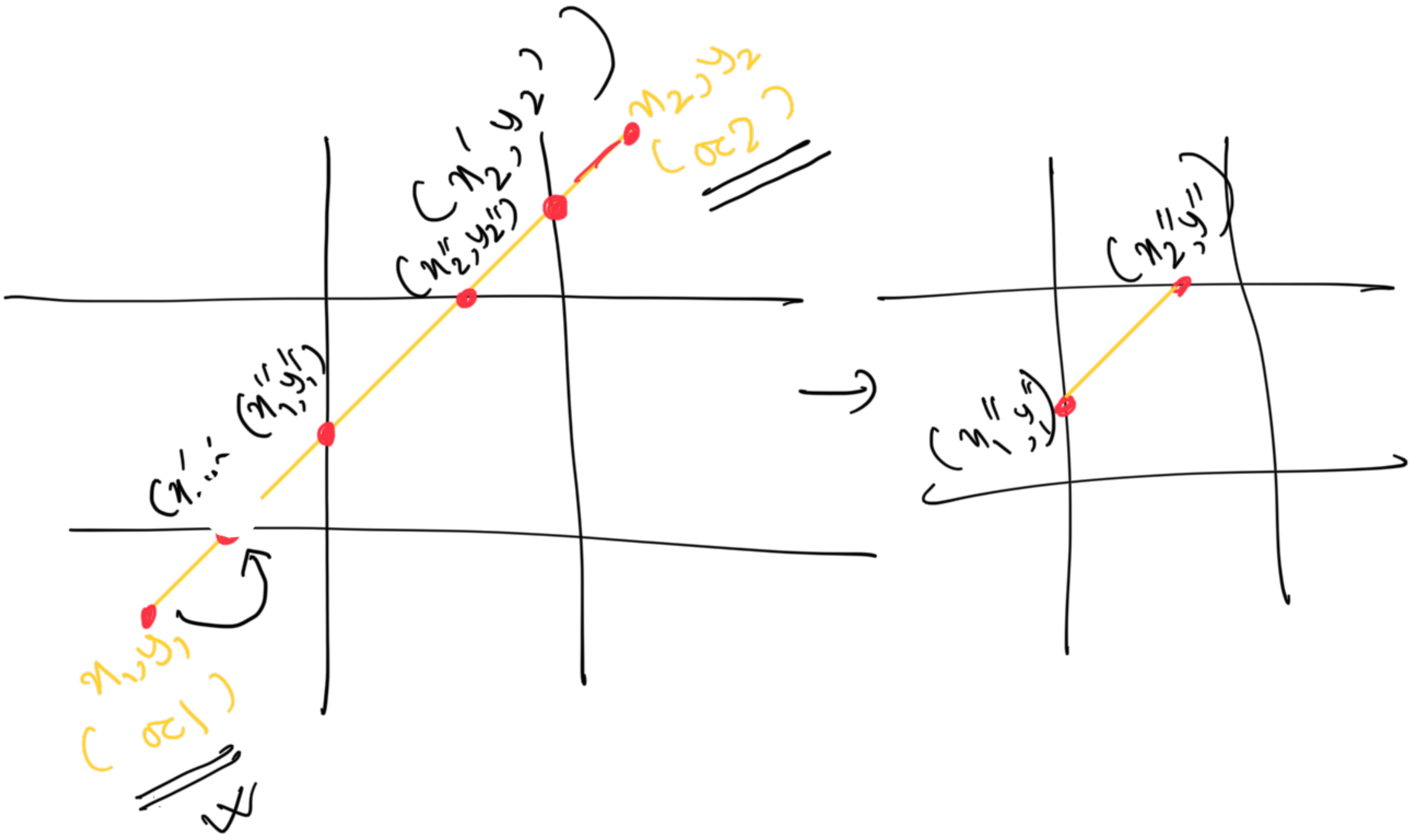
}

continue



}

x_1, y_1



Example

Window

x_{min} y_{min} x_{max} y_{max}

(0, 0) to (300, 200).

(1) (−250, 200) to (250, −200)

x_1, y_1 x_2, y_2

points

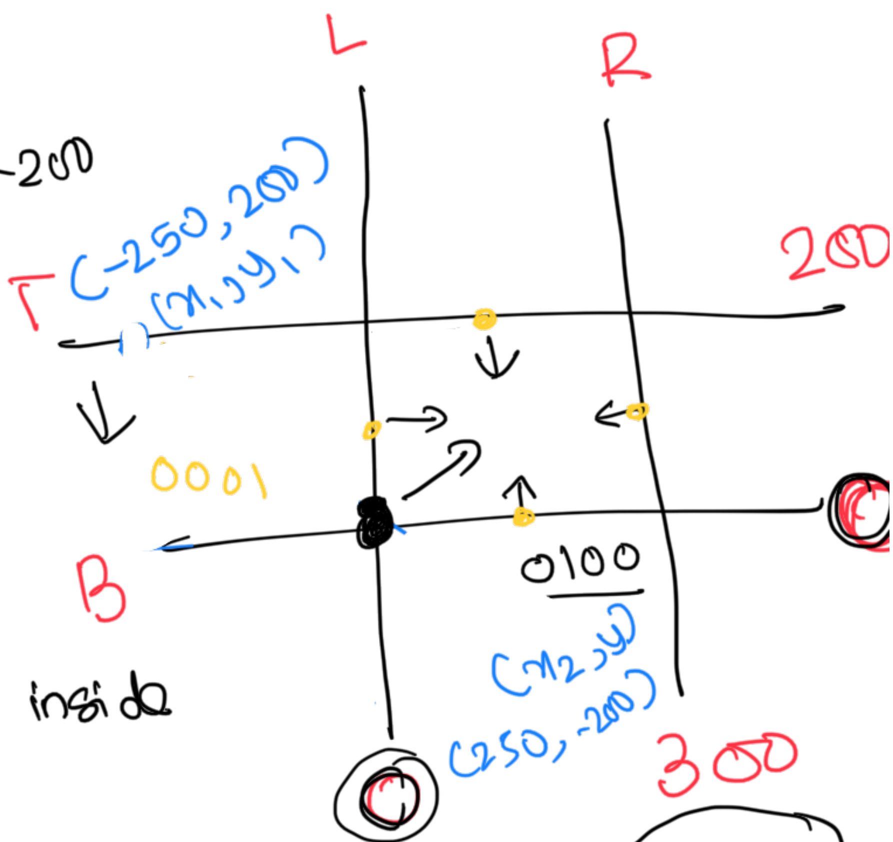
$x_1 = 250, y_1 = 200, x_2 = 250, y_2 = -200$

//outcode calculation

oct 1 = 0001
oct 2 = 0100 AND

0000

Partially inside



Left

$x_1 = x_{min}$

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

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

$= 200 + \frac{-200 - (200)}{250 - (-250)} (0 - (-250))$

$= 0$

$$\boxed{\begin{array}{l} x_1 = 0 \qquad (x_1, y_1) \\ \text{New Coordinate} = (0, 0) \end{array}}$$

New $OC1 = 0000$

$OC1$ And $OC2 = 0000 \ \& \ 0100$

$$\begin{array}{r} 0000 \\ 0100 \\ \hline 0000 \end{array} \leftarrow \text{Partially inside}$$

$OC2 \neq 0$

Code & Bottom

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

$x_1 = 0, y_1 = 0$

$x_2 = 250, -200$

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

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

$$= 250 + \frac{250 - 0}{-200 - 0}(0 - (-200))$$

$= 0$

$y_2 = 0$

$x_2, y_2 = (0, 0)$

$OC2 = [0000]$

$OC1$ AND $OC2$

0000 AND $0000 = 0000$

$$\overset{x_1,\ y_1}{(0, 0)} \ \& \ \overset{x_2 \quad y_2}{(0 \quad 0)}$$