ID. U4-02-47-18-003.

Question-1

propositions of Cohen-Sutherland algorithm. step by step and finally establish the algorithms.

⇒ The algorithm divides a two-dimensional space into 9 regions (8 ~~side~~ outside regions and one inside region). and then efficiently determines the lines and portions of lines that are visible in the central region of interest.

- 9 regions with binary code.

	1001	1000	1010
Y_{max}			
	0001	0000	0010
Y_{min}			
	0101	0100	0110
	X_{min}	X_{max}	

- each bit records
position of x or y
  - 1^{st} bit : $> Y_{max}$
  - 2^{nd} bit : $< Y_{min}$
  - 3^{rd} bit : $> X_{max}$
  - 4^{th} bit : $< X_{min}$

establishing algorithms.

step-1 : Calculate positions of both end point code(P_1) and code(P_2).

step-2 : if (code(P_1) | code(P_2)) gives 0000
then the line is visible.
and stop.
else if (code(P_1) & code(P_2)) != 0000
then line is invisible. (outside)
and stop.

else line is intersect.

Line is considered the clipped case.

case-1: if 1st bit is "1" then Line intersects with ~~left~~ boundary of window.
upper

so, $Y = Y_{max}$

and, $x = x_0 + \frac{y - y_0}{y_1 - y_0}(x_1 - x_0)$

case-2: if 2nd bit is "1" then Line intersects with lower boundary of window.

so, $Y = Y_{min}$

$\therefore x = x_0 + \frac{y - y_0}{y_1 - y_0}(x_1 - x_0)$

case-3: if 3rd bit is "1" then Line intersects with Right boundary of window.

so, $x = X_{max}$

$\therefore Y = Y_0 + \frac{x - x_0}{x_1 - x_0}(Y_1 - Y_0)$

case-4 : if 4th bit is '1' then Line intersect with left boundary of window.

$$x = X_{min}.$$

$$\therefore y = y_0 + \frac{y - y_0}{y_1 - y_0}(y_1 - y_0)$$

step-3 : repeat these steps ~~untl~~ until accept / visible.

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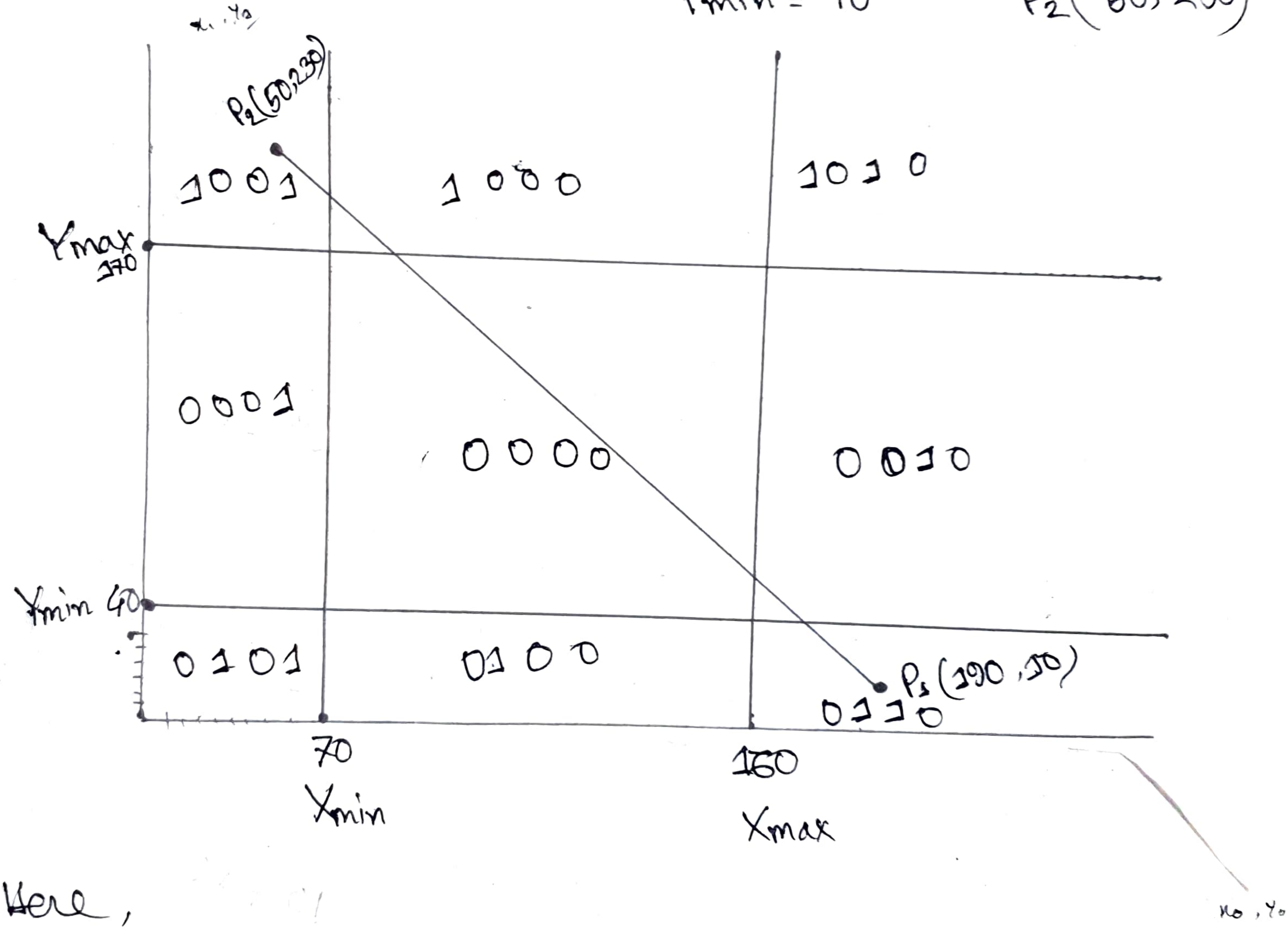
Question-2

given,

$X_{max} = 160$ $\quad$ $Y_{max} = 170$ $\quad$ $P_1(190, 10)$

$X_{min} = 70$ $\quad$ $Y_{min} = 40$ $\quad$ $P_2(50, 230)$



Here,

code (P_1) = 0110

code (P_2) = 1001

1st test: $(\text{code}(P_1) \mid \text{code}(P_2)) = 1111$

→ No conclusion.

2nd test: $(\text{code}(P_1) \,\&\, \text{code}(P_2)) = 0000$

→ intersect

→ replace P_1, P_2 with new points.

Here, $\text{code}(P_1) = 0110$ 2nd bit = 1

so that the line intersect with Y_{min}.

$y = Y_{min} = 40$

and, $x = x_0 + \frac{y - y_0}{y_1 - y_0}(x_1 - x_0)$

$= 190 + \frac{40-10}{230-10}(50-190)$

$= 190 + \frac{30}{220}(-140)$

$= 170.91$.

New point P_1 is $(170.91, 40)$

And, $\text{code}(P_2) = 1001$ 1st bit = 1

so that $y = Y_{max} = 170$

and,

$x = x_0 + \frac{y - y_0}{y_1 - y_0}(x_1 - x_0)$

=

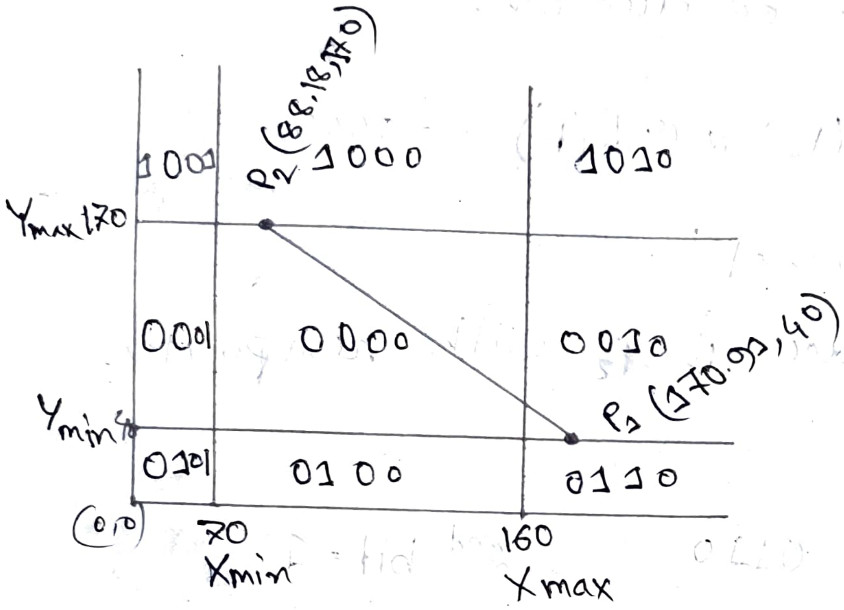
$= 190 + \frac{170-10}{230-10}(50-190)$

$= 190 + -101.818$

$= 88.18$

new point P_2 is $(88.18, 170)$

Here, Now, $P_1 = (170.91, 40)$ and $P_2 = (88.18, 170)$



Here,

code (P_2) = 0000

code (P_1) = 0010

1st test code (P_1) | code (P_2) = 0010

→ No conclusion

2nd test, code (P_1) & code (P_2) = 0000

→ intersect

→ replace P_1, P_2 with new points.

Here, code (P_1) = 0010 3rd bit = 1

∴ so the line is intersect with Xmax

$\therefore x = X_{max} = 160$

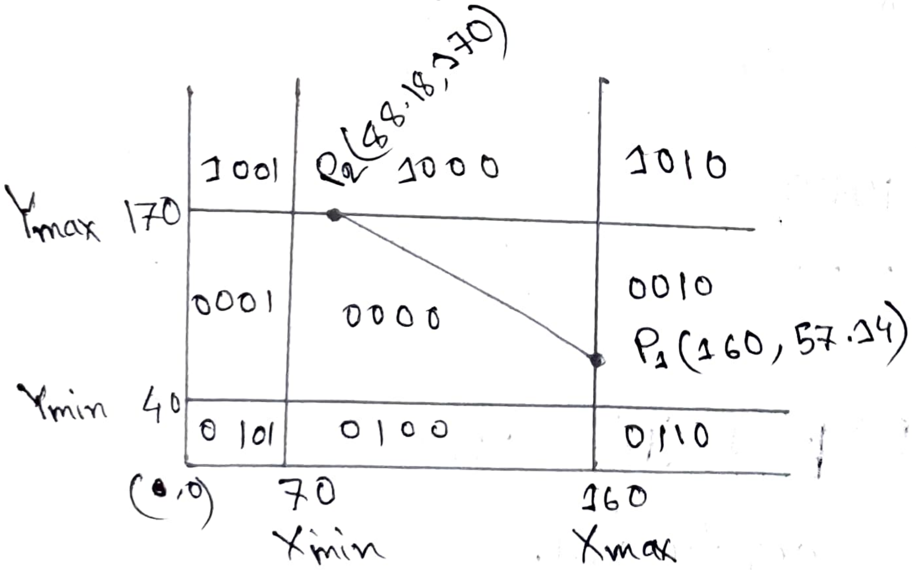
$$\therefore y = y_0 + \frac{x - x_0}{x_1 - x_0}(y_1 - y_0)$$

$$= 40 + \frac{160 - 170.91}{88.18 - 170.91}(170 - 40)$$

$$= 57.14.$$

$\therefore$ new point of P_1 is $(160, 57.14)$

Therefore, P2 is inside the window so there no intersecting point. P2 $(88.18, 170)$



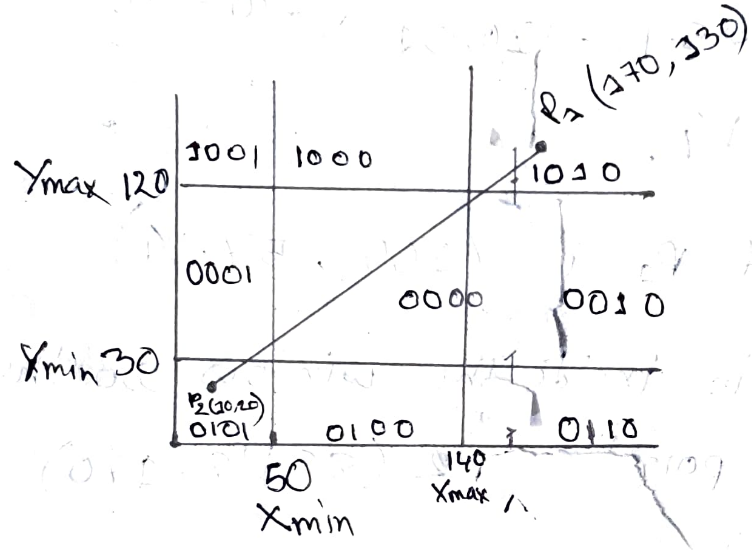
Node, code (P_1) | code (P_2) = 0000

→ Accept.

Question-#3

$Y_{max} = 120$ $X_{max} = 140$ $P_1 (170, 130)$

$Y_{min} = 30$ $X_{min} = 50$ $P_2 (10, 20)$



Here,

code (P_1) = 1010

code (P_2) = 0101

1st test : code (P_1) | code (P_2) = 1111

→ No conclusion.

2nd test : code (P_1) & code (P_2) = 0000

→ Intersect

→ Replace P_1, P_2 with new Points.

Here, $\text{code}(P_1) = 1010$ $\quad$ 1^{st} bit $= 1$

so the line intersect with Y_{max}.

$$Y = Y_{max} = 120$$

$$x = x_0 + \frac{Y - Y_0}{Y_1 - Y_0}(x_1 - x_0)$$

$$= 170 + \frac{120 - 130}{20 - 130}(10 - 170)$$

$$= 155.455$$

new Point of P_1 is $(155.45, 120)$

And, $\text{code}(P_2) = 0101$ $\quad$ 2^{nd} bit $= 1$

so the line intersect with Y_{min}.

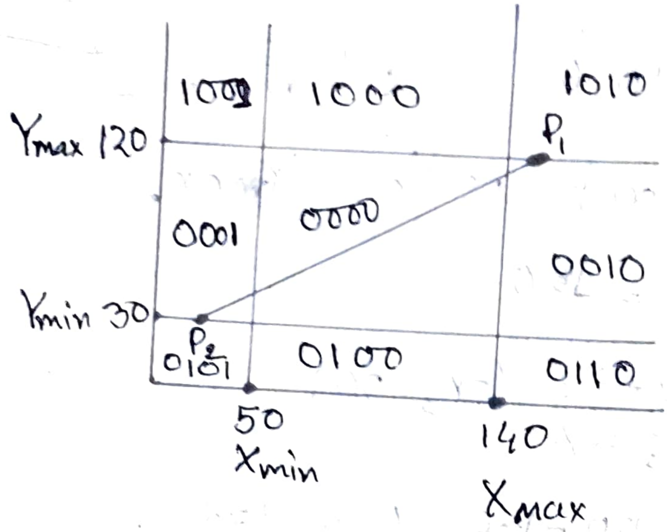
$$Y = Y_{min} = 30$$

$$x = x_0 + \frac{Y - Y_0}{Y_1 - Y_0}(x_1 - x_0)$$

$$= 170 + \frac{30 - 130}{20 - 130}(10 - 170)$$

$$= 24.545$$

new point of P_2 is $(24.55, 30)$



Here,

$P_1 = (155.4, 120)$

$P_2 = (24.55, 30)$

Here,

code (P_1) = 0010

code (P_2) = 0001

1st test : code(P_1) | code(P_2) = 0011

→ No conclusion

2nd test : code(P_1) & code (P_2) = 0000

→ Intersect

→ Replace P_1 and P_2 with new point

Now, code (P_1) = 0010   3nd bit = 1

so the line intersect with xmax

$x = X_{max} = 140$

$$\therefore \; y = y_0 + \frac{x - x_0}{x_1 - x_0}(y_1 - y_0) = 120 + \frac{140 - 155.4}{24.55 - 155.4}(30 - 120)$$

$y = 109.375$

$\therefore$ new point of $P(1) = (140, 109.375)$

and, $code(P_2) = 0001$ 4th bit is 1

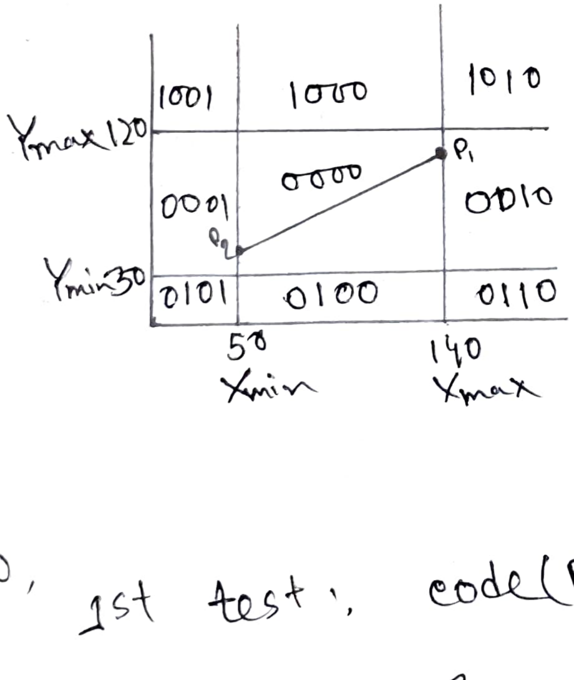
so line intersect with Xmin.

$x = X_{min} = 50$

$$\therefore y = 120 + \frac{50 - 155.4}{24.55 - 155.4}(30 - 120)$$

$= 47.5$

$\therefore$ new point of P_2 is $(50, 47.5)$



Here, $P_1 = (140, 109.38)$

$P_2 = (50, 47.5)$

Now, 1st test: $code(P_1) \mid code(P_2) = 0000$

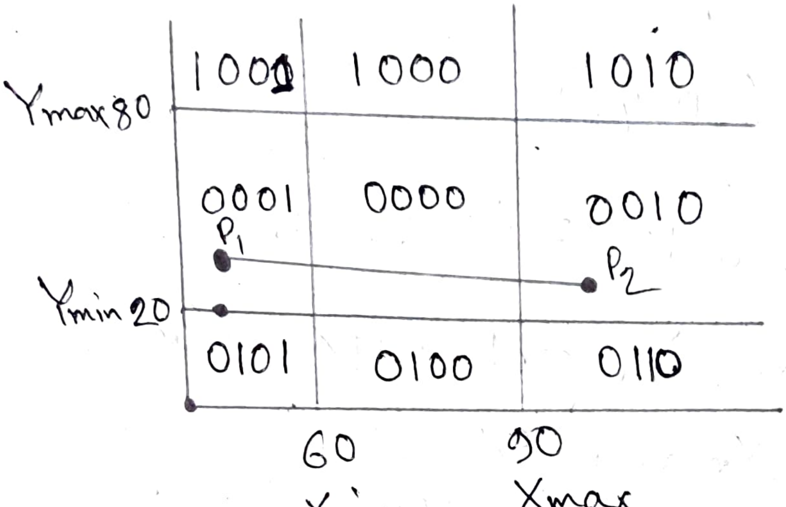
$\rightarrow$ Accepted.

Question no-4

20, 50

$X_{max} = 90$ $Y_{max} = 80$ $P_1 = (\cancel{170, 130})$

$X_{min} = 60$ $Y_{min} = 20$ $P_2 = (100, 40)$



Here,

code (P_1) = 0001
code (P_2) = 0010

1st test: code (P_1) | code (P_2) = 0011
— No conclusion

2nd test: code (P_1) & code (P_2) = 0000
→ Intersect
→ replace P_1, P_2 with new points.

Now, code (P_1) = 0001 4th bit = 1
so the line intersect with Xmin.

$x = X_{min} = 60$

so, $y = 50 + \frac{60-20}{100-20}(40-50)$

$= 45$

$\therefore$ point $P_1 = (60, 45)$.

and, code $(P_2) = 0010$. 3rd bit is 1.

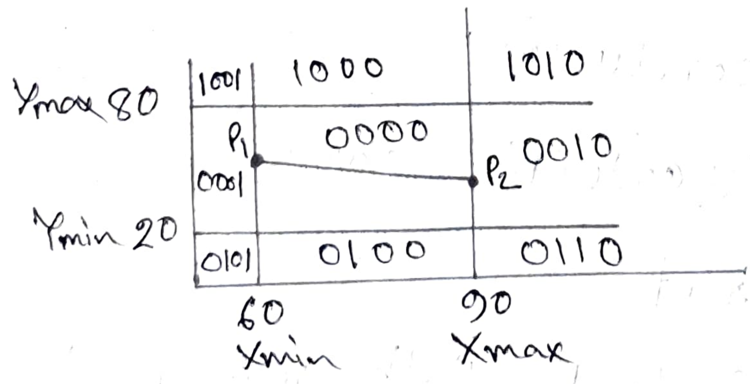
so the line intersect with X_{max}

$x = X_{max} = 90$

so, $y = 50 + \frac{90-20}{100-20}(40-50)$

$= 41.25$

$\therefore$ point $P_2 = (90, 41.25)$



Here,

$P_1 = (60, 45)$

$P_2 = (90, 41.25)$

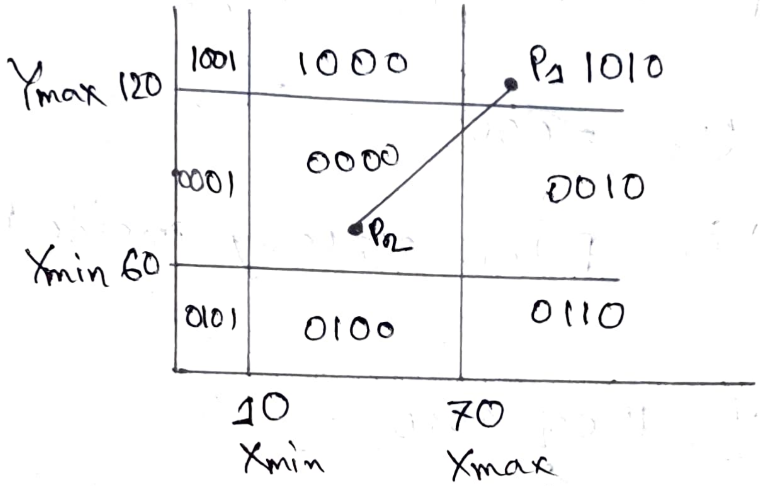
1st teste: code (P_1) | code $(P_2) = 0$

$\rightarrow$ Accepted.

Question no-5:

$X_{max} = 70$ $Y_{max} = 120$ $P_1 = (75, 125)$

$X_{min} = 10$ $Y_{min} = 60$ $P_2 = (55, 65)$



Here,

1st test: code(P_1) | code (P_2)

$\Rightarrow$ (1010) | (0000) = 1010

$\rightarrow$ no conclusion

Now,

2nd test: code (P_1) & code (P_2) = 0000

$\rightarrow$ Intersect

$\rightarrow$ replace P_1, P_2 with new points

Now, code (P_1) = 1010 3rd bit is 1

so the line intersect with Xmax

$x = X_{max} = 70$

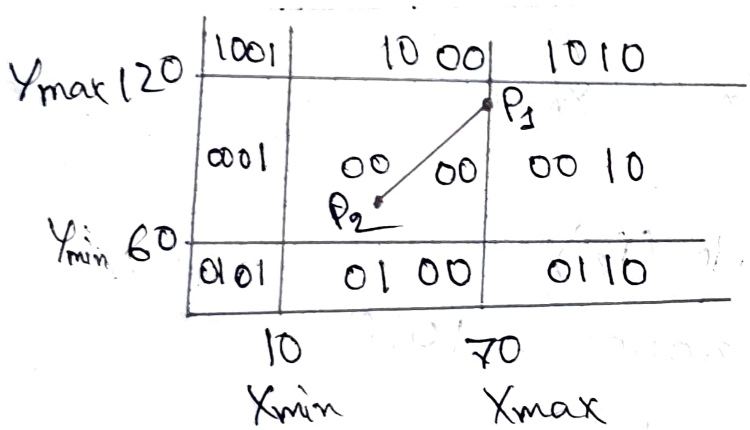
so, $Y = 125 + \frac{70-75}{55-75}(65-125)$

$= 110$

so new point of $P_1 = (70, 110)$

and code $(P_2) = 0000$

so this point already inside the window.



Here,

$P_1 = (70, 110)$

$P_2 = (55, 65)$

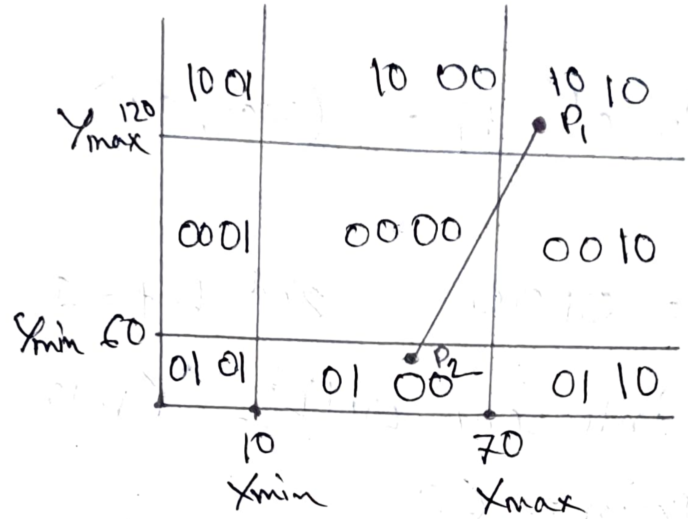
3rd test: code (P_1) | code $(P_2) = 0$

→ Accepted.

Question-6/7

$X_{max} = 70$ $\quad$ $Y_{max} = 120$ $\quad$ $P_1 = (75, 125)$

$X_{min} = 10$ $\quad$ $Y_{min} = 60$ $\quad$ $P_2 = (65, 55)$



Here, code (P_1) = 1010

code (P_2) = 0100

1st test : code (P_1) | code (P_2) = 1110

→ No conclusion

2nd test : code(P_1) & code (P_2) = 0000

– Intersect

→ replace P1, P2 with new points

Here, code (P_1) = 1010 $\quad$ 3rd bit = 1

So the line intersect with Xmax.

$x = X_{max} = 70$

$$\text{so, } y = 125 + \frac{70-75}{65-75}(55-125)$$

$$= 90$$

New points of $P_1 = (70, 90)$

and, code $(P_2) = 0100$ 2^{nd} bit $= 1$

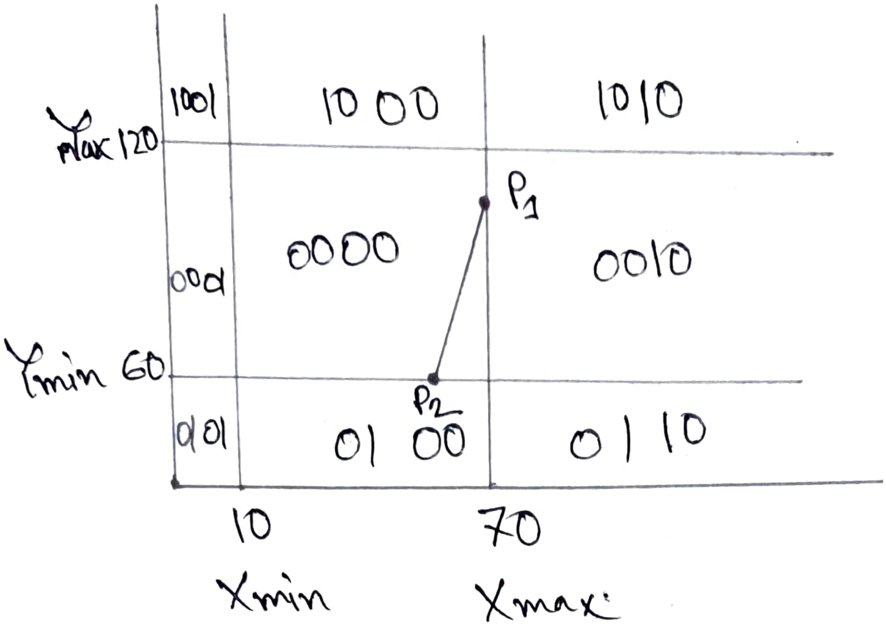
so the line intersect with Y_{min},

$$y = Y_{min} = 60$$

$$x = 75 + \frac{60-125}{55-125}(65-75)$$

$$= 65.71$$

$\therefore$ point of $P_2 = (65.71, 60)$



Here,

$P_1 = (70, 90)$

$P_2 = (65.71, 60)$

Here,

code (P_1) = 0000

code (P_2) = 0000

1st test: code (P_1) | code (P_2) = 0000

→ Accepted.