

	x_1	x_2	y
①	3	3	1
②	4	3	1
③	1	6	1
④	4	4	1
⑤	7	2	-1
⑥	6	4	-1
⑦	9	2	-1
⑧	8	6	-1

linear classifier using
perceptron algo.

$$w \rightarrow \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \text{ with } x_2 = 0.$$

Iter 1: ① $\text{sign}\left(\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \end{pmatrix}\right) = 1. \checkmark$

② $\text{sign}\left(\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \begin{pmatrix} 4 \\ 1 \end{pmatrix}\right) = 1 \checkmark$

③ $\text{sign}\left(\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix}\right) = 1 \checkmark$

④ $\text{sign}\left(\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \begin{pmatrix} 4 \\ 1 \end{pmatrix}\right) = 1 \checkmark$

⑤ $\text{sign}\left(\begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \begin{pmatrix} 3 \\ -1 \end{pmatrix}\right) = 1 \times \rightarrow w_1 = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} - \begin{pmatrix} 7 \\ 2 \\ -1 \end{pmatrix}$

⑥ $\text{sign}\left(\begin{pmatrix} -7 \\ 2 \\ -1 \end{pmatrix} \begin{pmatrix} 6 \\ 1 \end{pmatrix}\right) = -1 \checkmark$

⑦ $\text{sign}\left(\begin{pmatrix} -7 \\ 2 \\ -1 \end{pmatrix} \begin{pmatrix} 9 \\ 2 \end{pmatrix}\right) = -1 \checkmark$

⑧ $\text{sign}\left(\begin{pmatrix} -7 \\ 2 \\ -1 \end{pmatrix} \begin{pmatrix} 8 \\ 1 \end{pmatrix}\right) = -1 \checkmark$

Iter 2: ① $\text{sign}\left(\begin{pmatrix} -7 \\ 2 \\ -1 \end{pmatrix} \begin{pmatrix} 3 \\ 1 \end{pmatrix}\right) = -1 \times \rightarrow w_2 = \begin{pmatrix} -7 \\ 2 \\ -1 \end{pmatrix} + \begin{pmatrix} 3 \\ 1 \\ 0 \end{pmatrix}$

② $\text{sign}\left(\begin{pmatrix} -7 \\ 2 \\ -1 \end{pmatrix} \begin{pmatrix} 4 \\ 1 \end{pmatrix}\right) = -1 \times \rightarrow w_2 = \begin{pmatrix} -7 \\ 2 \\ -1 \end{pmatrix} + \begin{pmatrix} 4 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} -3 \\ 2 \\ 1 \end{pmatrix}$

③ $\text{sign}\left(\begin{pmatrix} -3 \\ 2 \\ 1 \end{pmatrix} \begin{pmatrix} 6 \\ 1 \end{pmatrix}\right) = 1 \checkmark$

④ $\text{sign}\left(\begin{pmatrix} -3 \\ 2 \\ 1 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \end{pmatrix}\right) = 1 \checkmark$

$w_3 = \begin{pmatrix} -3 \\ 2 \\ 1 \end{pmatrix} + \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 3 \\ 1 \end{pmatrix}$

$$\textcircled{5} \quad \text{sign} \left(\begin{pmatrix} 0 \\ 5 \\ 3 \end{pmatrix} \begin{pmatrix} 7 \\ 2 \\ -1 \end{pmatrix} \right) = 1 \quad \checkmark \quad w_4 = \begin{pmatrix} 0 \\ 5 \\ 3 \end{pmatrix} + \begin{pmatrix} 7 \\ 2 \\ -1 \end{pmatrix},$$

$$= \begin{pmatrix} -7 \\ 3 \\ 4 \end{pmatrix}$$

$$\textcircled{6} \quad \text{sign} \left(\begin{pmatrix} 7 \\ 3 \\ 4 \end{pmatrix} \begin{pmatrix} 6 \\ -1 \end{pmatrix} \right) = -1 \quad \checkmark$$

$$\textcircled{7} \quad \text{sign} \left(\begin{pmatrix} -7 \\ 3 \\ 4 \end{pmatrix} \begin{pmatrix} 9 \\ 2 \\ -1 \end{pmatrix} \right) = -1 \quad \checkmark$$

$$\textcircled{8} \quad \text{sign} \left(\begin{pmatrix} -7 \\ 3 \\ 4 \end{pmatrix} \begin{pmatrix} 8 \\ 6 \\ -1 \end{pmatrix} \right) = -1 \quad \checkmark$$

Iter 3: $\textcircled{1} \quad \text{sign} \left(\begin{pmatrix} -7 \\ 3 \\ 4 \end{pmatrix} \begin{pmatrix} 8 \\ 6 \\ -1 \end{pmatrix} \right) = -1 \quad \checkmark \quad w_5 = \begin{pmatrix} -7 \\ 3 \\ 4 \end{pmatrix} + \begin{pmatrix} 8 \\ 6 \\ -1 \end{pmatrix}$

$$\textcircled{2} \quad \text{sign} \left(\begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix} \begin{pmatrix} 4 \\ 3 \\ 1 \end{pmatrix} \right) = -1 \quad \checkmark$$

$$\textcircled{3} \quad \text{sign} \left(\begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix} \begin{pmatrix} 6 \\ 1 \end{pmatrix} \right) = 1 \quad \checkmark$$

$$\textcircled{4} \quad \text{sign} \left(\begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix} \begin{pmatrix} 9 \\ 1 \end{pmatrix} \right) = 1 \quad \checkmark$$

$$\textcircled{5} \quad \text{sign} \left(\begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix} \begin{pmatrix} 7 \\ 2 \\ -1 \end{pmatrix} \right) = -1 \quad \checkmark$$

$$\textcircled{6} \quad \text{sign} \left(\begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix} \begin{pmatrix} 6 \\ 1 \end{pmatrix} \right) = -1 \quad \checkmark$$

$$\textcircled{7} \quad \text{sign} \left(\begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix} \begin{pmatrix} 9 \\ 2 \\ -1 \end{pmatrix} \right) = -1 \quad \checkmark$$

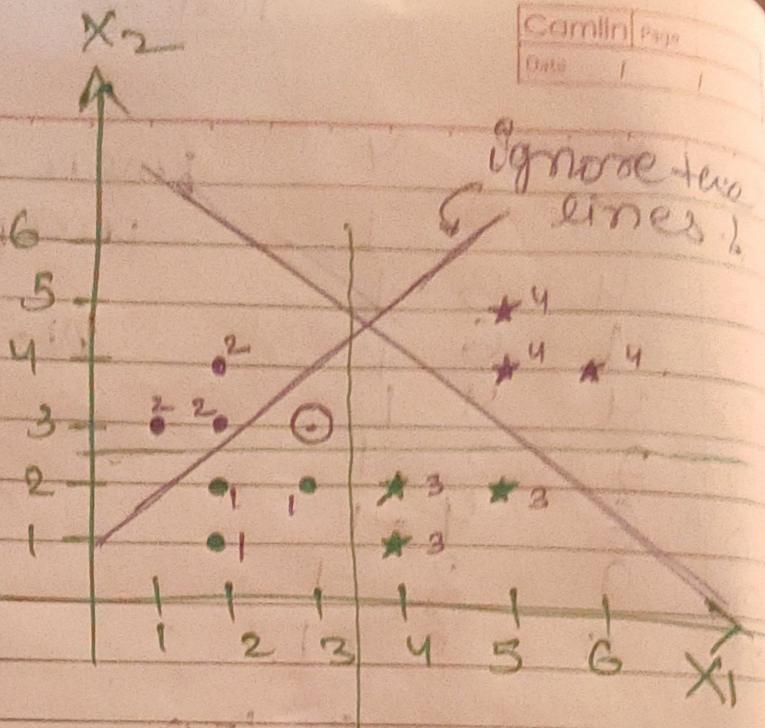
$$\textcircled{8} \quad \text{sign} \left(\begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix} \begin{pmatrix} 8 \\ 6 \\ -1 \end{pmatrix} \right) = -1 \quad \checkmark$$

$$\boxed{w = \begin{pmatrix} -4 \\ 6 \\ 5 \end{pmatrix}}$$

after 3 iterations

	x_1	x_2	y
2	1	1	
2	2	1	
3	2	1	
1	3	2	
2	3	2	
2	4	2	
4	1	3	
4	2	3	
5	2	3	
5	4	4	
5	5	4	
6	4	4	

Test: 3 3 ?

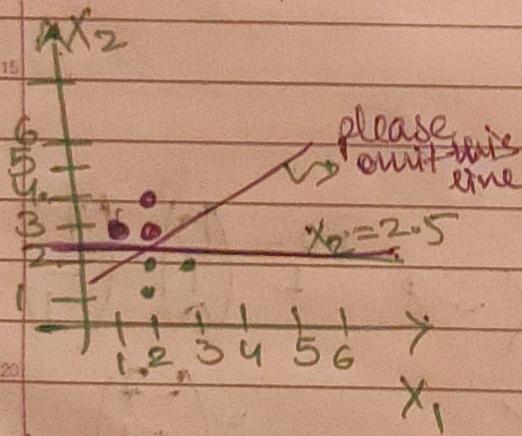


using method of

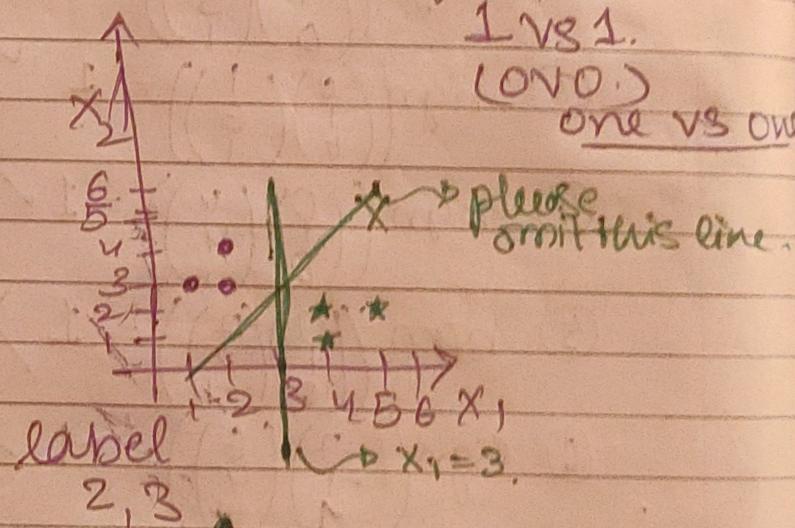
1 vs 1.

(ovo.)

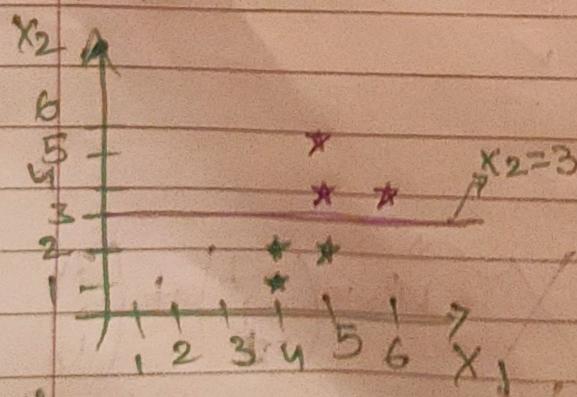
one vs one.



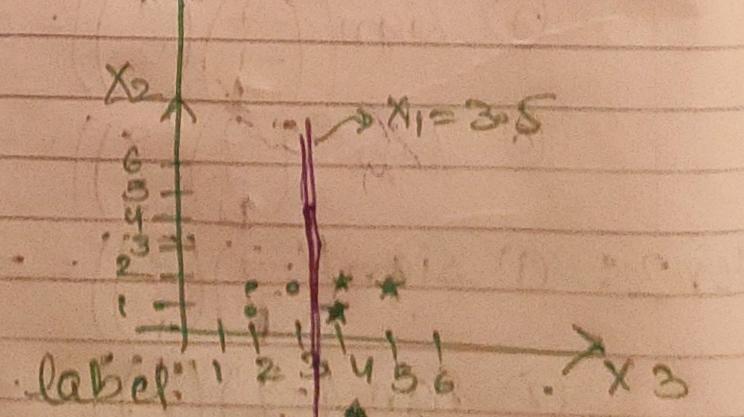
label
1,2,3



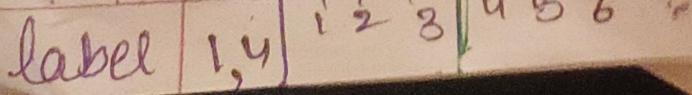
label
2,3



label
3,4



label
1,3



label
2,4

Date _____
Page _____

Given test $(3, 3)$

\therefore label $1, 2$ $x_1 = 2.5$ 2 Predicted label

label $2, 3$ $x_1 = 3$ 2

label $3, 4$ $x_1 = 3$ 3

label $1, 3$ $x_1 = 3.5$ 1

label $1, 4$ $x_1 = 4$ 1

label $2, 4$ $x_1 = 3.5$ 2

If greater
then label
shown by arrow.

$(3, 3) \rightarrow 2$
Predicted
test label
Ans.

\therefore predicted label
on test $(3, 3)$ is 2 .