اسم الطالب: عثمان مصبوح عطية رمضان
رقم الطالب: 80226741
اسم المقرر: Neural Networks
المستوى / البرنامج: الرابع / IT

Question(1) Choose the correct answer

(1) D. Rosenblatt

(2) C. Neuron

(3) B. chemical process

(4) C. Transmission

(5) A. summing

(6) A. Mc Culloch-pitts neuron Model

(7) A. excitatory input

(8) B. inhibitory input

(9) D. weight

(10) C. learning

(11) B. no

(12) C. association unit

(13) B. learning enabled

---

question (e)

1

$\theta \geq nw - p$

$n = 2$ $\quad w = 1$ $\quad \theta = 2 \times 1 = 2$

$w_1 = w_2 = 1$

x_1	x_2	y
1	1	1
1	0	0
0	1	0
0	0	0

AND table

(1,1) $y_{in} = x_1 w_1 + x_2 w_2$
$= 1 \times 1 + 1 \times 1 = 2 = \theta$

(1,0) $y_{in} = x_1 w_1 + x_2 w_2$
$1 \times 1 + 0 \times 1 = 1 < \theta$

(0,1) $y_{in} = x_1 w_1 + x_2 w_2$
$0 \times 1 + 1 \times 1 = 1 < \theta$

(0,0) $y_{in} = x_1 w_1 + x_2 w_2$
$0 \times 1 + 0 \times 1 = 0 < \theta$

$F(y_{in}) = \begin{cases} 0 & y_{in} < \theta \\ 1 & y_{in} \geq \theta \end{cases}$

$F(y_{in}) = \begin{cases} 0 & y_{in} < 2 \\ 1 & y_{in} \geq 2 \end{cases}$

y_{in} (1,1) out 1 $\Rightarrow$ y_{in} (1,0) out 0

y_{in} (0,1) out 0 $\Rightarrow$ y_{in} (0,0) out 0

3

2 $y = x_1\bar{x}_2 + \bar{x}_1 x_2$

$z_1 = x_1\bar{x}_2$, $z_2 = \bar{x}_1 x_2$

$y = z_1 + z_2$

x_1	x_2	y
1	1	0
1	0	1
0	1	1
0	0	0

$z_1 = x_1\bar{x}_2$

$w_{11} = w_{12} = 1$

x_1	x_2	y
1	1	0
1	0	1
0	1	0
0	0	0

(1,1) $y_{in} = x_1 w_{11} + x_2 w_{12}$
$= 1 \times 1 + 1 \times 1 = 2$

(1,0) $y_{in} = x_1 w_{11} + x_2 w_{12}$
$= 1 \times 1 + 1 \times 0 = 1$

(0,1) $y_{in} = x_1 w_{11} + x_2 w_{12}$
$= 0 \times 1 + 1 \times 1 = 1$

(0,0) $y_{in} = x_1 w_{11} + x_2 w_{12}$
$= 0 \times 1 + 0 \times 1 = 0$

x_1	x_2	y
1	1	0
1	0	1
0	1	0
0	0	0

$\theta = nw - p = 1$
$2 \times 1 - 0 = 2$

it's not true

$f(y_{in}) = \begin{cases} 0 & y_{in} < \theta \\ 1 & y_{in} \geq \theta \end{cases}$

output $y_{in}(1,1) = 1$
output $y_{in}(1,0) = 0$
output $y_{in}(0,1) = 0$
output $y_{in}(0,0) = 0$

$f(y_{in}) = \begin{cases} 0 & y_{in} < \theta \\ 1 & y_{in} \geq \theta \end{cases}$

4

$w_{11} = 1$ $\quad$ $w_{12} = -1$ $\quad$ $\theta = nw - p$
$= 2 \times 1 - 1 = 1$

(1,1) $y_{in} = x_1 w_{11} + x_2 w_{12} = 1 \times 1 + 1 \times -1 = 0$
(1,0) $y_{in} = x_1 w_{11} + x_2 w_{12} = 1 \times 1 + 0 \times -1 = 1$
(0,1) $y_{in} = x_1 w_{11} + x_2 w_{12} = 0 \times 1 + 1 \times -1 = -1$
(0,0) $y_{in} = x_1 w_{11} + x_2 w_{12} = 0 \times 1 + 0 \times -1 = 0$

$f(y_{in}) = \begin{cases} 0 & y_{in} < 1 \\ 1 & y_{in} \geq 1 \end{cases}$

output $y_{in}(1,1) = 0$; output $y_{in}(1,0) = 1$
output $y_{in}(0,1) = 0$; output $y_{in}(0,0) = 0$

It's true

$w_{21} = w_{22} = 1$ $\quad$ $Z_2 = \bar{x}_1 x_2$
$\theta = nw - p = 2 \times 1 - 0$
$= 2$

x_1	x_2	y
1	1	0
1	0	0
0	1	1
0	0	0

(1,1) $y_{in} = x_1 w_{21} + x_2 w_{22}$
$1 \times 1 + 1 \times 1 = 2$ $\quad$ output = 1

(1,0) $y_{in} = x_1 w_{21} + x_2 w_{22}$
$1 \times 1 + 0 \times 1 = 1$ $\quad$ output = 0

(0,1) $y_{in} = x_1 w_{21} + x_2 w_{22}$
$0 \times 1 + 1 \times 1 = 1$ $\quad$ output = 0

(0,0) $y_{in} = x_1 w_{21} + x_2 w_{22}$
$0 \times 1 + 0 \times 1 = 0$ $\quad$ output = 0

It's not true

$w_{21} = -1$, $w_{22} = 1$ $\theta = n w - p$

$= 2\times1 - 1 = 1$

(1,1) $y_{in} = x_1 w_{21} + x_1 w_{22}$

$= 1\times-1 + 1\times1 = 0$ out = 0

(1,0) $y_{in} = x_1 w_{21} + x_1 w_{22}$

$= 1\times-1 + 0\times1 = -1$ out = 0 $f(y_{in}) = \begin{cases} 0 & y_{in}<1 \\ 1 & y_{in}\geq1 \end{cases}$

(0,1) $y_{in} = x_1 w_{21} + x_1 w_{22}$

$= 0\times-1 + 1\times1 = 1$ out = 1

(0,0) $y_{in} = x_1 w_{21} + x_1 w_{22}$

$= 0\times-1 + 0\times1 = 0$ out = 0

∴ $y = Z_1 \text{ OR } Z_2$

$= Z_1 + Z_2 = x_1\bar{x}_2 + \bar{x}_1 x_2$

$y_{in} = Z_1 W_1 + Z_2 W_2$

assume that ⇒ $W_1 = W_2 = 1$

x_1	x_2	y	Z_1	Z_2
1	1	0	0	0
1	0	1	1	0
0	1	1	0	1
0	0	0	0	0

(0,0) $y_{in} = Z_1 W_1 + Z_2 W_2$

$= 0\times1 + 0\times1 = 0$

(1,0) $y_{in} = Z_1 W_1 + Z_2 W_2$

$= 1\times1 + 0\times1 = 1$

(0,1) $y_{in} = Z_1 W_1 + Z_2 W_2$

$= 0\times1 + 1\times1 = 1$

(0,0) $y_{in} = 0\times1 + 0\times1 = 0$

$y = f(y_{in}) = \begin{cases} 0 & y_{in} < 1 \\ 1 & y_{in} \geq 1 \end{cases}$

3

$w_1 = w_2 = b =$ صفر

$w_{new} = w_{old} + x_i y$

$b_{new} = b_{old} + y$

في هذه الحالة
سوف نجعل b=1
ونكمل المسألة

x_1	x_2	y	b
1	1	1	1
1	-1	1	1
-1	1	1	1
-1	-1	-1	1

لا حظ

(1,1)

$w_1 =$ صفر $+ 1 \times 1 = 1$

$w_2 =$ صفر $+ 1 \times 1 = 1$

$b =$ صفر $+ 1 = 1$

(1,-1)

$w_1 = 1 + 1 \times 1 = 2$

$w_2 = 1 + -1 \times 1 = 0$

$b = 1 + 1 = 2$

(-1,1)

$w_1 = 2 + 1 \times -1 = 1$

$w_2 = 0 + 1 \times 1 = 1$

$b = 2 + 1 = 3$

for Bipolar

(-1,-1)

$w_1 = 1 + -1 \times -1 = 2$

$w_2 = 1 + -1 \times -1 = 2$

$b = 3 + 1 = 4$ 2

$y = x_1 w_1 + x_2 w_2 + b$ $\quad w_1 = w_2 = b = 2$

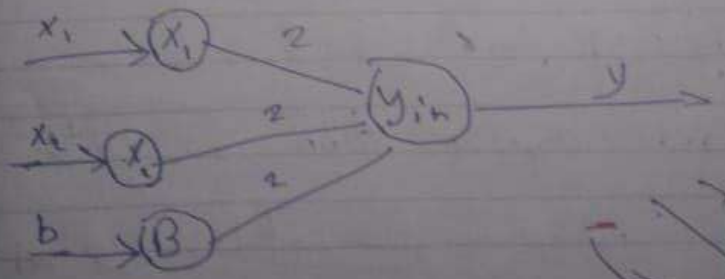
(1,1) • $y = 1\times2 + 1\times2 + 2 = 6 > 0$ output 1
(1,-1) $y = 1\times2 + -1\times2 + 2 = 2 > 0$ output 1
(-1,1) $y = -1\times2 + 1\times2 + 2 = 2 > 0$ output 1
(-1,-1) $y = -1\times2 + -1\times2 + 2 = -2 < 0$ output -1

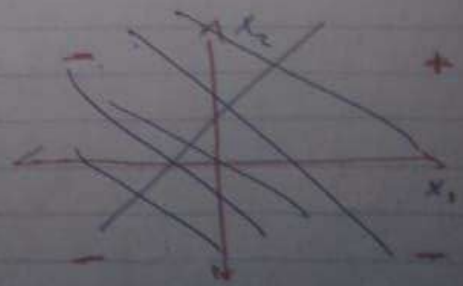
Decision Boundry ←

$x_1 w_1 + x_2 w_2 + b = 0$

$2x_1 + 2x_2 + 2 = 0 \quad \div 2$

$x_1 + x_2 + 1 = 0$





For binary:

inputs			target	weight changes			new weights		
x_1	x_2	bias	y	Δw_1	Δw_2	Δb	w_1	w_2	bias
1	1	1	1	1	1	1	1	1	1
1	0	1	1	1	0	1	2	0	2
0	1	1	1	0	1	1	2	2	3
0	0	1	0	0	0	0	2	2	3

لاحظ يمكن تمثيل OR بطريقة Hebb

لأن دور Hebb إنما تقوى الحالات إذا $x_1 = x_2 = 1$

لو أخذنا $b = 0$ سنجد أن

$w_1 = 1$, $w_2 = 1$, $b = 2$

$w_1 = 2$, $w_2 = 0$, $b = 3$

$w_1 = 1$, $w_2 = 1$, $b = 9$

$w_1 = 2$, $w_2 = 2$, $b = 5$

وبالتعويض سنجد أن الـ output خاطئ

4

$$y_{in} = b + x_1 w_1 + x_2 w_2$$

$w_1 = w_2 = b =$ صفر

$$\Delta w = \alpha x t \qquad \Delta b = \alpha t$$

x_1	x_2	y
1	1	1
1	-1	-1
-1	1	-1
-1	-1	-1

$$w_{new} = w_{old} + \Delta w \qquad b_{new} = b_{old} + \Delta b$$

$$\hat{y} = f(y_{in}) = \begin{cases} 1 & y_{in} > \theta \\ 0 & y_{in} = \theta \\ -1 & y_{in} < \theta \end{cases}$$

$\theta = 0$

(1,1) $y_{in} = 0 + (1)(0) + (1)(0) = 0$

$\hat{y} = f(0) =$ صفر $\quad , t = 1 \quad , \alpha = 1$

$\Delta w_1 = 1 \times 1 \times 1 = 1$

$\Delta w_2 = 1 \times 1 \times 1 = 1 \qquad \Delta b = 1 \times 1 = 1$

$w_{1new} = 0 + 1 = 1$

$w_{2new} = 0 + 1 = 1$

$b_{new} = 0 + 1 = 1$

(1,-1) $y_{in} = 1 + (1)(1) + (-1)(1) = 1$

$\hat{y} = f(1) = 1 \quad , t = -1$

$\Delta w_1 = 1 \times -1 \times 1 = -1 \quad , \Delta w_2 = 1 \times -1 \times -1 = 1$

$\Delta b = 1 \times -1 = -1$

$w_1 = 1 - 1 = 0$

$w_2 = 1 + 1 = 2$

$b = 1 - 1 = 0$

$(-1,1)\ y_{in} = 2 + (-1)(2) + (1)(0) = -1$ جيد

$y = f(y_{in}) = f(-1) = -1$ جيد ، $t = 1$

$\Delta w_1 = 1 \times -1 \times 1 = -1$ ، $\Delta w_2 = 1 \times 1 \times 1 = 1$ ، $\Delta b = 1 \times 1 = 1$

$w_1 = 2 + -1 = 1$ ، $w_2 = 0 + 1 = 1$ ، $b = 2 + 1 = 3$

$(-1,-1)\ y_{in} = 3 + (-1)(1) + (-1)(1) = 1$

$y = f(y_{in}) = f(1) = 1$ ، $t = -1$

$\Delta w_1 = 1 \times -1 \times -1 = 1$ ، $\Delta w_2 = 1 \times -1 \times 1 = -1$

$\Delta b = -1 \times 1 = -1$

$w_1 = 1 + 1 = 2$ ، $w_2 = 1 + -1 = 0$ ، $b = 3 - 1 = 2$

Epoch 1

Inputs		Target	net input	output	weight change			weight		
x_1	x_2	y	y_{in}	y	Δw_1	Δw_2	Δb	w_1	w_2	bias
1	1	1	0	0	1	1	1	1	1	1
1	-1	1	1	1	1	-1	1	2	0	2
-1	1	1	0	0	-1	1	1	1	1	3
-1	-1	-1	1	1	1	-1	-1	2	2	2

11

Epoch 2 | $w_1 = 2$ | $w_2 = 0$ | bias = 2

inputs		target	Net input	output	weight change			weights		
x_1	x_2	y	y_{in}	$\hat{y}$	Δw_1	Δw_2	Δb	w_1	w_2	bias
1	1	1	6	1	1	1	1	3	3	3
1	-1	1	3	1	1	-1	1	4	2	4
-1	1	1	2	1	-1	1	1	3	3	5
-1	-1	-1	-1	-1	1	1	-1	4	4	4

Epoch 3

inputs		target	Net input	output	weight change			weights		
x_1	x_2	y	y_{in}	$\hat{y}$	Δw_1	Δw_2	Δb	w_1	w_2	bias
1	1	1	12	1	1	1	1	5	5	5
1	-1	1	5	1	1	-1	1	6	4	6
-1	1	1	4	1	-1	1	1	5	5	7
-1	-1	-1	-3	-1	1	1	-1	6	6	6

EPOCH 3

inputs		target	net input	output	weight changes			weights		
x_1	x_2	y	y_{in}	$\hat{y}$	Δw_1	Δw_2	Δb	w_1	w_2	bias
1	1	1	12	1	1	1	1	5	5	5
1	-1	1	5	1	1	-1	1	6	4	6
-1	1	1	4	1	-1	1	1	5	5	7
-1	-1	-1	-3	0	1	1	-1	6	6	6

EPOCH 4

x_1	x_2	y	y_{in}	$\hat{y}$	Δw_1	Δw_2	Δb	w_1	w_2	bias
1	1	1	18	1	1	1	1	7	7	7
1	-1	1	7	1	1	-1	1	8	6	8
-1	1	1	6	1	-1	1	1	7	7	9
-1	-1	-1	-5	0	1	1	-1	8	8	8

$8 = 8x_1 + 8x_2 + 8 = 0$ ← $w_1x_1 + w_2x_2 + b = 0$

DECISION BOUNDRY

$y = x_1 + x_2 + 1 = 0$

$w_1 = w_2 = b = 1$

13

5

	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	y
A	-1	1	-1	1	-1	1	1	1	1	1	-1	1	1	-1	1	1
E	1	1	1	1	-1	-1	1	1	1	1	-1	-1	1	1	1	-1

	x	
x		x
x	x	x
x		x
x		x

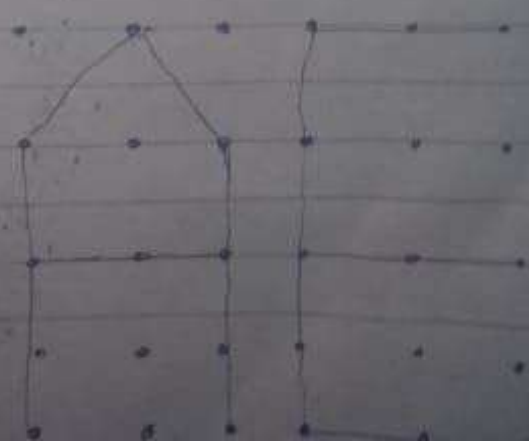
x	x	x
x		
x	x	x
x		
x	x	x

$\Delta w_i = \eta y x_i$ A E

	Δw_1	Δw_2	Δw_3	Δw_4	w_5	Δw_6	Δw_7	Δw_8	Δw_9	Δw_{10}	Δw_{11}	Δw_{12}	Δw_{13}	w_{14}	w_{15}
A	-1	1	-1	1	-1	1	1	1	1	1	-1	1	1	-1	1
E	-1	-1	-1	-1	1	1	-1	-1	-1	-1	1	1	-1	-1	-1

$\Delta b\ (A) = 1$

$\Delta b\ (E) = -1$



Weights

	w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8	w_9	w_{10}	w_{11}	w_{12}	w_{13}	w_{14}	w_{15}
A	-1	1	-1	1	-1	1	1	1	1	1	-1	1	1	-1	1
E	-2	0	-2	0	0	2	0	0	0	0	0	2	0	-2	0

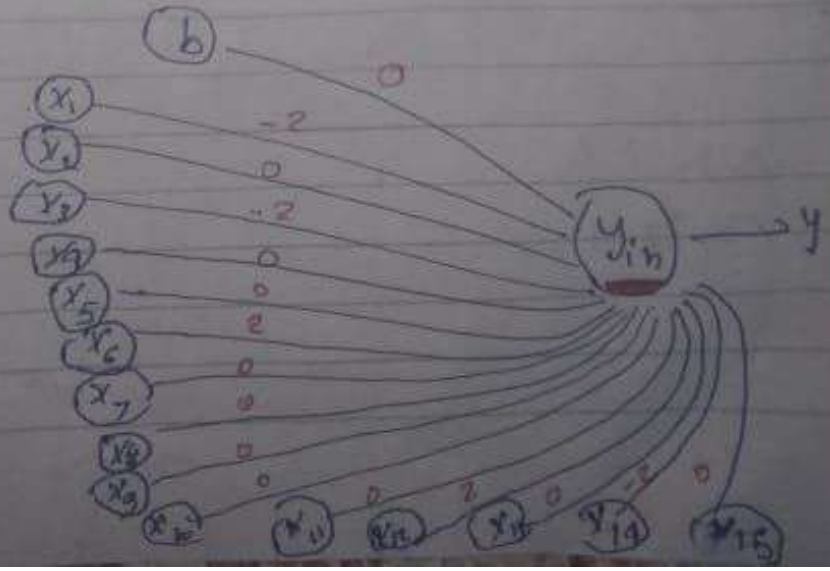
$w_i = w_{old} + \Delta w_i$

$$y = -2x_1 - 2w_3 + 2w_6 + 2w_{12} - 2x_{14}$$

Decision Boundary

$b_A = b_{old} + \Delta b_A = 0 + 1 = 1$

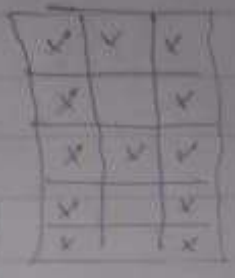
$b_E = b_{old} + \Delta b_E = 1 - 1 = 0$



5

حل آخر

A



E

$w_i = \mu$ $\quad$ $b = \mu$

$\Delta w_i = x_i y$ $\quad$ $w_i(new) = w_i(old) + \Delta w_i$

	inputs															target
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}	x_{15}	y
A	1	1	1	1	-1	1	1	1	1	1	-1	1	1	-1	1	1
B	1	1	1	1	-1	-1	1	1	1	1	-1	-1	1	1	1	-1

weight changes

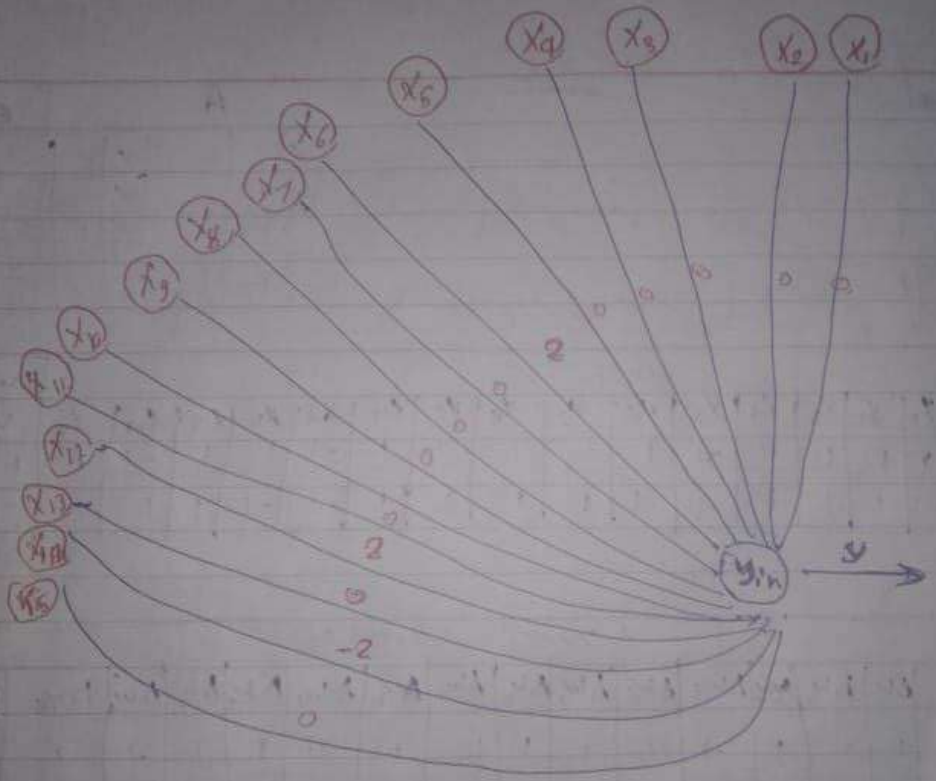
Δw_1	Δw_2	Δw_3	Δw_4	Δw_5	Δw_6	Δw_7	Δw_8	Δw_9	Δw_{10}	Δw_{11}	Δw_{12}	Δw_{13}	Δw_{14}	Δw_{15}	Δb
1	1	1	1	-1	1	1	1	1	1	-1	1	1	-1	1	1
-1	-1	-1	-1	1	1	-1	-1	-1	-1	1	1	-1	-1	-1	-1

weights

	w_1	w_2	w_3	w_4	w_5	w_6	w_7	w_8	w_9	w_{10}	w_{11}	w_{12}	w_{13}	w_{14}	w_{15}	b
A	1	1	1	1	-1	1	1	1	1	1	-1	1	1	-	1	1
E	0	0	0	0	0	2	0	0	0	0	0	-2	0	-2	0	0

$2x_6 + 2x_{10} - 2x_{11} = \mu$ $\quad$ Decision Boundry

16



17

lecture 3 المحاضرة الثالثة

Quiz1

$w_1 = b = 0.2$, $\alpha = 1$

x_1	x_2	y
1	1	-1
1	-1	1
-1	1	1
-1	-1	1

First input $y_{in} = \sum x_i w_i + b$

$x_1 w_1 + x_2 w_2 + b$

$y_{in} = 0.2 \times 1 + 1 \times 0.2 + 0.2 = 0.6$

$w_1(new) = w_1(old) + \alpha (t - y_{in}) x_1$

$0.2 + 0.2(-1 - 0.6) \times 1 = -0.12$

$w_2(new) = 0.2 + 0.2(-1 - 0.6) \times 1 = -0.12$

$b(new) = b(old) + \alpha (t - y_{in})$

$= 0.2 + 0.2 (-1 - 0.6) = -0.12$

$E_1 = (t - y_{in})^2 = (-1 + 0.6)^2 = 2.56$

second input $w_1 = w_2 = b = -0.12$

$y_{in} = -0.12 + 0.12 \times 1 + 0.12 = -0.12$

$w_1(new) = -0.12 + 0.2 (1 + 0.12) \times 1 = 0.109$

$w_2(new) = -0.12 + 0.2 (1 + 0.12) \times -1 = -0.399$

$b = -0.12 + 0.2 (1 + 0.12) = 0.349$

$E_2 = (1 + 0.12)^2 = 1.2599$

third input

$y_{in} = -0.109 - 0.399 + 0.349 = -0.109$

$w_1(new) = 0.109 + 0.2 (1 + 0.109) \times 1 = 0.1168$

$w_2(new) = -0.349 + 0.2 (1 + 0.109) \times 1 = -0.1232$

$b = 0.349 + 0.2 (1 + 0.109) = 0.5648$

$E_3 = (1 + 0.109)^2 = 1.218816$

Fourth input

$y_{in} = 0.1168 + 0.1232 + 0.5618 = \underline{0.8018}$

$w_1(new) = -0.1163 + 0.2(1 - 0.8093)x_1 = \boxed{-0.15584}$

$w_2(new) = -0.1232 + 0.2(1 - 0.8093)x_1 = \boxed{-0.10127}$

$b = 0.5618 + 0.2(1 - 0.8018)$

$= 0.60389$

$E_4 = (1 - 0.8018)^2 = \boxed{0.0381030}$

EPOCH 1

x_1	x_2	y_{in}	y	Δw_1	Δw_2	Δb	w_1	w_2	b	error
1	1	0.6	1	-0.32	-0.32	-0.32	-0.12	-0.12	-0.12	2.56
1	-1	-0.12	1	0.224	-0.224	0.14	-0.104	-0.344	0.34	1.2544
-1	1	-0.104	1	-0.208	0.2288	-0.112	-0.1168	-0.1232	0.5618	1.216816
-1	-1	0.8018	1	0	-0.0384	-0.0384	0.03909	-0.15584	-0.16224	0.6038	0.0381030

19

$E_T = \sum (t - y_{in})^2 = 2.56 + 1.2599 + 1.218816 + 0.0381639$

$= 5.07$

Epoch 2

x_1	x_2	y	y_{in}	Δw_1	Δw_2	Δb	w_1	w_2	bias
1	1	-1	0.2868	-0.2576	-0.25176	-0.2587	-0.412	-0.414	0.346
1	-1	1	0.35312	0.12938	-0.12938	0.1293	-0.2836	+0.5483	0.476
-1	1	1	0.21686	0.1578	0.1578	0.1578	-0.1414	-0.391	0.6377
-1	-1	1	1.9663	0.0433	0.0433	-0.0433	-0.3981	-0.2477	0.5106

error
0.51
0.9185
0.1227
0.2174

$E_T = \sum (t - y_{in})^2 = 0.51 + 0.1185 + 0.6277 +$

$0.2174 = 1.0766$

Ex

quiz ②

$w_1 + w_2 = 0$ $\quad b = 0$

$w_i(new) = w(old) + \Delta w$

x_1	x_2	b	y
1	1	1	1
1	0	1	-1
0	1	1	-1
0	0	1	-1

(1,1) $w_1(new) = 0 + 1 = 1$

$w_2(new) = 0 + 1 = 1$

$b(new) = 0 + 1 = 1$

(1,0)

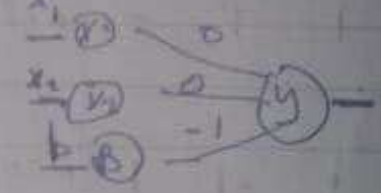
$w_1 = 1 - 1 = 0$ $\quad b = 1 - 1 = 0$

$w_2 = 1 + 0 = 1$

(0,1)

$w_1 = 0 + 0 = 0$ $\quad b = 0 - 1 = -1$

$w_2 = 1 - 1 = 0$



Decision Boundary $b = 0$

x_1	x_2	b	y
1	1	1	1
1	-1	1	-1
-1	1	1	-1
-1	1	1	-1

$w_1 = w_2 = 0$, $b = 0$

(1,1)

$w_1 = 0 + 1 = 1$, $b = 0 + 1 = 1$

$w_2 = 0 + 1 = 1$

(1,-1)

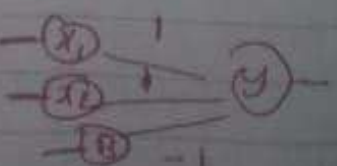
$w_1 = 1 - 1 = 0$ $\quad b = 1 - 1 = 0$

$w_2 = 1 + 1 = 2$

(-1,1)

$w_1 = 0 + 1 = 1$, $\quad b = 0 - 1 = -1$

$w_2 = 2 - 1 = 1$



Decision Boundary $x_1 + x_2 - 1 = 0$