

## Lecture 3

## عملية التعلم

## Quiz 1

$$w = b = 0.2, \quad \eta = 0.2$$

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

first input  $y_{in} = \sum x_i w_i + b$   
 $x_1 w_1 + x_2 w_2 + b$

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

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

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

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

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

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

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

## second input

$$w_1 = w_2 = b = -0.12$$

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

$$w_1(\text{new}) = -0.12 + 0.2 (1 + 0.12) \times 1 = 0.104$$

$$w_2(\text{new}) = -0.12 + 0.2 (1 + 0.12) \times -1 = -0.344$$

$$b = -0.12 + 0.2 (1 + 0.12) = 0.344$$

$$E_2 = (1 + 0.12)^2 = 1.2544$$

## third input

$$y_{in} = -0.104 + 0.344 + 0.344 = -0.104$$

$$w_1(\text{new}) = 0.104 + 0.2 (1 + 0.104) \times 1 = 0.1168$$

$$w_2(\text{new}) = -0.344 + 0.2 (1 + 0.104) \times 1 = -0.1232$$

$$b = 0.344 + 0.2 (1 + 0.104) = 0.5648$$

$$E_3 = (1 + 0.104)^2 = 1.218816$$

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Fourth input

$$y_{in} = 0.1168 + 0.1232 + 0.5648 = 0.8048$$

$$w_1(\text{new}) = -0.1163 + 0.2(1 - 0.8048) \times -1 = -0.15584$$

$$w_2(\text{new}) = -0.1232 + 0.2(1 - 0.8048) \times -1 = -0.16224$$

$$b = 0.5648 + 0.2(1 - 0.8048) = 0.60384$$

$$E_1 = (1 - 0.8048)^2 = 0.03810304$$

Epoch 1

$x_1$	$x_2$	$y_{in}$	$y$	$\Delta w_1$	$\Delta w_2$	$\Delta b$	$w_1$	$w_2$	$b$	error
1	1	0.6	0	-0.32	-0.32	-0.32	0.12	-0.12	-0.12	2.56
1	-1	-0.12	1	0.224	-0.224	0.448	0.104	-0.344	0.344	1.2644
-1	1	-0.104	1	-0.228	0.2208	-0.1108	-0.1108	-0.1232	0.5648	1.216816
-1	-1	0.8048	0	-0.0324	-0.0324	-0.0648	-0.1558	-0.16224	0.6038	0.03810304

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$$E_T = \sum (1 - y_i)^2 = 2.56 + 1.2519 + 1.218816 + 0.03816379$$

$$= 5.07$$

Epoch 2

$x_1$	$x_2$	$y$	$y_{in}$	$\Delta w_1$	$\Delta w_2$	$\Delta b$	$w_1$	$w_2$	bias
1	1	-1	0.2858	-0.2876	-0.28176	-0.25827	-0.412	-0.414	0.346
1	-1	1	0.35312	0.12938	-0.12938	0.19419	-0.2836	-0.5483	0.476
-1	1	1	0.21688	0.1578	0.1578	0.1578	-0.444	-0.341	0.6327
-1	-1	1	1.9663	0.0433	0.0433	-0.0433	-0.2981	-0.2477	0.5406

$$E_T = \sum (t - y_{in})^2 = 0.61 + 0.4185 + 0.6227 +$$

$$0.2174 = 1.766$$

error

0.61

0.4185

0.6227

0.2174



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Quiz 2

$$w_1 + w_2 = 0$$

$$b = 0$$

$$w_{\text{new}} = w_{\text{old}} + \Delta w$$

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

$$(1,1) \quad w_1(\text{new}) = 0 + 1 = 1$$

$$w_2(\text{new}) = 0 + 1 = 1$$

$$b(\text{new}) = 0 + 1 = 1$$

$$(1,0)$$

$$w_1 = 1 - 1 = 0$$

$$b = 1 - 1 = 0$$

$$w_2 = 1 + 0 = 1$$



$$(0,1)$$

$$w_1 = 0 + 0 = 0$$

$$b = 0 - 1 = -1$$

$$w_2 = 1 - 1 = 0$$

Decision Boundary  $b = \text{not}$

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

$$(1,1)$$

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

$$w_2 = 0 + 1 = 1$$

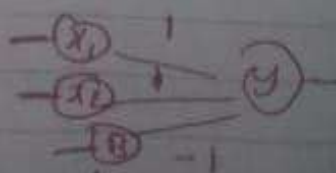
$x_1$	$x_2$	$b$	$y$
1	1	1	1
1	-1	1	-1
-1	1	1	-1
-1	-1	1	-1

$$(1,-1)$$

$$w_1 = 1 - 1 = 0$$

$$b = 1 - 1 = 0$$

$$w_2 = 1 + 1 = 2$$



$$(-1,1)$$

$$w_1 = 0 + 1 = 1$$

$$b = 0 - 1 = -1$$

$$w_2 = 2 - 1 = 1$$

Decision Boundary  $x_1 + x_2 - 1 = \text{not}$