2023BCS0187

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Exercise problem - 2:

Use ADALINE to train AND NOT. Complete task with 2 epoche of training. the truth table with bipolar inputs & bipolar targets is given as follows:

Initial weights = 0.1

x_1	x_2	1	t
1	1	1	-1
1	-1	1	1
-1	1	1	-1
-1	-1	1	-1

Initial weights & bias have assumed 0.1

$w_1 = w_2 = b = 0.1$

$\alpha = 0.1$

for the 1st input

$x_1 = 1, x_2 = 1,$ & $t = -1$

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

$\therefore \quad 0.1 + 1 \times 0.1 + 1 \times 0.1$

$= 0.1 + 0.1 + 0.1 = 0.3$

Compute $(t - y_{in}) = -(-1 - 0.3) = -1.3$

Updating all weights

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

$$w_1(new) = 0.1 + 0.1 \times (-1.3) \times 1$$

$$= 0.1 + -.13$$

$$= -0.03$$

$$w_2(new) = w_2(old) + \alpha (t - y_{in}) x_2$$

$$= 0.1 + 0.1 \times (-1.3) \times 1$$

$$= -0.07$$

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

$$= 0.1 + 0.1 \times (-1.3)$$

$$= 0.03$$

Now compute the error

$$E = (t - y_{in})^2 = (-1.3)^2 = 1.69$$

final weight after presenting 1st input sample are $w = (-0.03 \; -0.03 \; -0.03) \; b = -0.09$

$E = 1.69$

for ~~epoch~~ 2

2nd input

$x_1 = 1 \quad x_2 = -1 \quad , t = 1$

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

$= -0.03 + 1 \times -0.03 + -1 \times -0.03$

$= -0.1 + 0.1 + -0.1$

$y_{in} = -0.03$

$(t - y_{in})$

$(1 - (-0.03))$

$= 1 + 0.03$

$= 1.03$

$\times 0.9$

Update weights

$$w_1(new) = 0.3 + (0.1 \times 0.9) \times 1$$

$$= 0.1 + 0.09$$

$$= 0.19$$

$w_2(new) = 0.1 + 0.1 \times (0.$

Update weight

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

$= -0.03 + 0.1 (1.03) \times 1$

$= 0.073$

$w_2(new) = w_2(old) + \alpha (t - y_{in}) \times x_2$

$= -0.03 + 0.1 \times (1.03) \times -1$

$= -0.03 + -.103 = -0.133$

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

$= -0.03 + 0.1 (1.03)$

$= -0.03 + 0.103 = 0.073$

Error $= (t - y_{in})^2 = (1.03)^2$

$= 1.0609$

Final $w = (0.073 + (-0.133) + 0.073)$

$= 0.013$

for epoch 3-3

Input

$x_1 = -1 \quad x_2 = 1 \quad b = 1$

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

$= 0.073 + (0.073) \times (-1) + (-.133) \times 1$

$= 0.073 + (-0.073) + (-.133)$

$y_{in} = -.133$

$(t - y_{in}) = -1 - (-.133)$

$= -1 + .133$

$= -0.867$

∴ Update weight

$w_1(new) = 0.073 + 0.1 (-0.867) \times (-1)$

$= 0.073 + 0.0867 = 0.1597$

$w_2(new) = (-0.133) + 0.1 (-0.867) \times 1$

$= -0.133 - .0867 = -0.2197$

$b(new) = 0.073 + 0.1 \times (-0.867)$

$= -0.0137$

for Pair 4

Sa. x_1 x_2 1

(-1, -1, -1)

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

$= -0.0137 + (-1) \times (-0.1597) + (-1) \times (-0.2197)$

$= 0.0463$

$(t - y_{in})$

$\cdot (-1 - 0.0463)$

$= -1.0463$

$\therefore$ updated weight

$w_1(new) = 0.1597 + 0.1 (-1.0463) \times (-1) = 0.2643$

$w_2(new) = -0.2197 + 0.1 (-1.0463)(-1) = -0.1151$

$b(new) = -0.1183$

End of epoch 1

$\therefore w_1 = 0.2643 \quad w_2 = -0.1151 \quad b = -0.1183$

Epoch-2

(1, 1, -1)

$y_{in} = -0.1183 + 1 \times 0.2643 + 1 \times (-0.1151) = 0.809$

$(t-y_{in}) = -1-0.0304 = -1.0304$

$w_1(new) = 0.2643 + (0.1)(-1.0304)\times(1) = 0.1612$

$w_2(new) = -0.4907 + (0.1)\times(-1.0304)\times 1 = -0.2188$

$b(new) = -0.1183 + (0.1)(-1.0304) = -0.2214$

$E = (-1.0304)^2 = 1.0621$

$S(1,-1,1)$

$y_{in} = -0.2214 + 1\times(0.1612) + (-1)\times(-0.2182)$

$= 0.158$ //

$t-y_{in} = 1-0.158 = 0.842$

$w_1(new) = 0.1612 + (0.1)\times(0.842)(1) = 0.2454$

$w_2(new) = -0.2182 + (0.1)(0.842)(-1) = -0.3024$

$b(new) = -0.2214 + (0.1)(0.842) = -0.1372$

$E = (0.842)^2 = 0.7089$

$S(-1,1,-1)$

$y_{in} = -0.1372 + (-1)(0.2454) + 1\times(-0.3024)$

$= -0.685$

$(t-y_{in}) = -1-(-0.685) = -1+0.685 = -0.315$

$w_1(new) = 0.2454 + (0.1)(-0.316)(-1) = 0.2769$

$w_2(new) = -0.3024 + (0.1)(-0.315)(-1) = 0.2769$

$b(new) = -0.1372 + (0.1)(-35) = -0.1687$

$E = (t-y_{in})^2 = (-0.35)^2 = 0.0992$

B(-1, -1, -1)

$y_{in} = -0.682 + (-1)(0.2764) + (-1)(-0.3334) =$

$= 0.1117$ //

$1 - y_{in} = (-1 - (-0.1117) = -1 + 0.1117 = -0.8883$

$w_1(new) = 0.2764 + (0.1)(-0.8883)(-1) = 0.36573$

$w_2(new) = -0.3334 + (0.1)(-0.8883)(-1) =$

0.24507

$b(new) = -0.1687 + (0.1)(-0.0883)$

$= -0.825783$

$E = (1 - y_{in})^2 = (-0.9883)^2$

$= 0.789$ //

Epoch	Total Mean Square error
1	4.586
2	2.648