

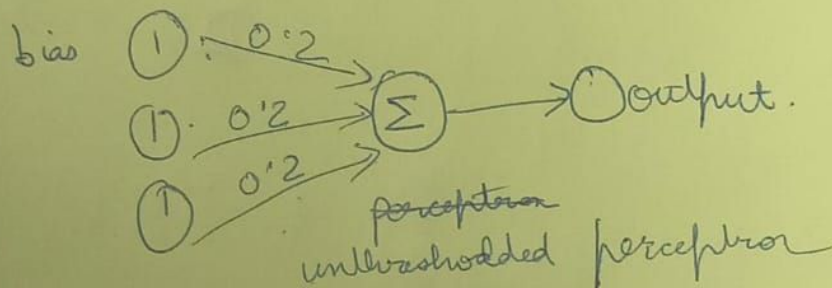
Q3(a)

Homework 4

Ritwik Raj Samra

$$\lambda = 0.1, w_i = 0.2$$

x_1	x_2	y
1	1	1.2
0	1	0.3

~~Iteration 1~~ Epoch 1

Iteration 1:

$$\Delta w_i = \Delta w_i + \lambda (t_d - o_d) x_{id}$$

$$\Delta w_i = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \quad t_d = y = 1.2$$

$$o_d = (1) \times (0.2) + (1 \times 0.2) + (1 \times 0.2) = 0.6$$

$$x_d = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$\uparrow \quad \uparrow \quad \uparrow$
 bias x_1 x_2

$$\begin{aligned} \Delta w_i &= \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + 0.1 (1.2 - 0.6) \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \\ &= \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix} = \begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix} \end{aligned}$$

$$O_d = 0.6$$

$$y = t_d = 1.2$$

$$w_{00} = 0$$

$$x_{0d} =$$

Iteration 2

$$x_d = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$t_d = 0.3$$

weights stay same.

$$O_d = 1 \times 0.2 + 0 \times 0.2 + 1 \times 0.2$$

$$= 0.4$$

$$\Delta w_i = \begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix} + 0.1 (0.3 - 0.4) \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix} + 0.1 (0.3 - 0.4) \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0.05 \\ 0.06 \\ 0.05 \end{pmatrix}$$

Epoch 2

Iteration 1

$$\Delta w_i = \begin{pmatrix} 0.05 \\ 0.06 \\ 0.05 \end{pmatrix}$$

$$O_d = (1 \times 0.05) + (1 \times 0.06) + (1 \times 0.05) = 0.16$$

$$x_d = (1, 1, 1)$$

$$\Delta w_i = \begin{pmatrix} 0.05 \\ 0.06 \\ 0.05 \end{pmatrix} + 0.1 (1.2 - 0.16) \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$$\begin{pmatrix} 0.05 \\ 0.06 \\ 0.05 \end{pmatrix} + \begin{pmatrix} 0.104 \\ 0.104 \\ 0.104 \end{pmatrix} = \begin{pmatrix} 0.154 \\ 0.164 \\ 0.154 \end{pmatrix}$$

Iteration 2

$$X_d = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix} \quad b_d = 0.3$$

$$Q_d = (1 \times 0.05) + (0 \times 0.06) + (1 \times 0.05) = 0.1$$

$$\Delta w_i = \begin{pmatrix} 0.154 \\ 0.164 \\ 0.154 \end{pmatrix} + 0.1(0.3 - 0.1) \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0.154 \\ 0.164 \\ 0.154 \end{pmatrix} + \begin{pmatrix} 0.02 \\ 0 \\ 0.02 \end{pmatrix}$$

$$= \begin{pmatrix} 0.174 \\ 0.164 \\ 0.174 \end{pmatrix}$$

Q3(b) Stochastic Gradient

$$w_i = w_i + \lambda (t_d - o_d) x_{id}$$

Epoch 1:

Iteration 1 $w_i = w_i + \lambda (t_d - o_d) x_{id}$

$$w_i = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$o_d = (1 \times 0.2) + (1 \times 0.2) + (1 \times 0.2) = 0.6$$

$$x_d = (1, 1, 1)$$

$$\Delta w_i = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} + (0.1)(1.2 - 0.6) \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix}$$

Iteration 2

$$x_d = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$t_d = 0.3$$

weights $\begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix}$

$$o_d = (1 \times 0.06) + (0 \times 0.06) + (1 \times 0.06) = 0.12$$

$$\Delta w_i = \begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix} + (0.1)(0.3 - 0.12) \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0.06 \\ 0.06 \\ 0.06 \end{pmatrix} + \begin{pmatrix} 0.018 \\ 0 \\ 0.018 \end{pmatrix} = \begin{pmatrix} 0.078 \\ 0.06 \\ 0.078 \end{pmatrix}$$

Epoch 2

Iteration 1.

$$w_i = \begin{pmatrix} 0.078 \\ 0.06 \\ 0.078 \end{pmatrix}$$

$$x_d = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$$\begin{aligned} o_d &= 1 \times 0.078 + 1 \times 0.06 + 1 \times 0.078 = \\ &= 0.216. \end{aligned}$$

$$w_i = \begin{pmatrix} 0.078 \\ 0.06 \\ 0.078 \end{pmatrix} + (0.1)(1.2 - 0.216) \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0.078 \\ 0.06 \\ 0.078 \end{pmatrix} + \begin{pmatrix} 0.0984 \\ 0.0484 \\ 0.0984 \end{pmatrix}$$

$$= \begin{pmatrix} 0.1764 \\ 0.1584 \\ 0.1764 \end{pmatrix} \approx \begin{pmatrix} 0.18 \\ 0.16 \\ 0.18 \end{pmatrix}$$

Iteration 2.

$$x_d = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$\begin{aligned} t_d &= 0.3 \\ \text{weights} &= \begin{pmatrix} 0.1764 \\ 0.1584 \\ 0.1764 \end{pmatrix} \end{aligned}$$

$$o_d = 0.3528$$

$$w_i = \begin{pmatrix} 0.1764 \\ 0.1584 \\ 0.1764 \end{pmatrix} + 0.1(0.3 - 0.3528) \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 0.17112 \\ 0.1584 \\ 0.17112 \end{pmatrix}$$