Assignment - 5

Develop the simple linear regression model for the following data set using MBGD where no. of samples 4 :

sample	x_i	y_i
1	0.2	3.4
2	0.4	3.8
3	0.6	4.2
4	0.8	4.6

→ Do Manual calculations for 2 iterations with batch size 2

Batch - 1	
0.2	3.4
0.4	3.8

Batch - 2	
0.6	4.2
0.8	4.6

$bs = 2$

step 1 :- $[x, y]$, $m = 1$, $c = -1$, $\eta = 0.1$, epochs $= 2$, $bs = 2$

$n_s = 4$

step 2 :- split training data on batch size.

$$n_b = \frac{n_s}{b_s} \Rightarrow n_b = \frac{4}{2} = 2$$

step 3 :- iter = 1

step 4 :- batch = 1

step 5 :- $$\epsilon = \frac{1}{2bs} \cdot \sum_{i=1}^{bs} (y_i - mx_i - c)^2$$

$$\frac{\partial \epsilon}{\partial m} = -\frac{1}{bs} \sum_{i=1}^{bs} (y_i - mx_i - c) x_i$$

$$= -\frac{1}{2} \sum_{i=1}^{2} (y_i - mx_i - c) x_i$$

$$= -\frac{1}{2} (y_1 - mx_1 - c) x_1 + (y_2 - mx_2 - c) x_2)$$

$$= -\frac{1}{2} ((3.4 - 1(0.2) + 1)0.2 + (3.8 - 1(0.4) + 1)0.4)$$

$$= -\frac{1}{2} (0.84 + 1.76)$$

$$\frac{\partial E}{\partial m} = -1.3$$

$$\frac{\partial E}{\partial c} = -\frac{1}{2}\sum_{i=1}^{2}(y_i - mx_i + c)$$

$$= -\frac{1}{2}\left[(y_1 - mx_1 + c) + (y_2 - mx_2 - c)\right]$$

$$= -\frac{1}{2}\left[(3.4 - 0.2 + 1) + (3.8 - 0.4 + 1)\right]$$

$$= -\frac{1}{2}\left[4.2 + 4.4\right]$$

$$= -\frac{1}{2}\left[8.6\right]$$

$$\frac{\partial E}{\partial c} = -4.3$$

Step 6 :- $\Delta m = -\eta \times \frac{\partial E}{\partial m}$ $\Delta c = -\eta \times \frac{\partial E}{\partial c}$

$= -0.1 \times -1.3$ $= -0.1 \times -4.3$

$\Delta m = 0.13$ $\Delta c = 0.43$

Step 7 :- $m = m + \Delta m$ $c = c + \Delta c$

$m = 1 + 0.13$ $c = -1 + 0.43$

$m = 1.13$ $c = -0.57$

Step 8 :- batch = 1+1 = 2

Step 9 :- if (batch > nb)

2 > 2

goto step 10

else

goto step 5

Step 5 :- $\frac{\partial E}{\partial m} = -\frac{1}{2}\left[(y_1 - mx_1 - c)x_1 + (y_2 - mx_2 - c)x_2\right]$

$$= -\frac{1}{2}[(4.2 - 1.13\times0.6 + 0.57)0.6 + (4.6 - 1.13\times0.8 + 0.57)0.8]$$

$$= -\frac{1}{2}[(4.092)0.6 + (4.266)0.8$$

$$= -\frac{1}{2}[2.4552 + 3.4128]$$

$$= -\frac{1}{2}[5.868]$$

$$\frac{\partial \epsilon}{\partial m} = -2.934$$

$$\frac{\partial \epsilon}{\partial c} = -\frac{1}{2}[(y_1 - mx_1 - c) + (y_2 - mx_2 - c)]$$

$$= -\frac{1}{2}[(4.2 - 1.13\times0.6 + 0.57) + (4.6 - 1.13\times0.8 + 0.57)]$$

$$= -\frac{1}{2}[4.092 + 4.266]$$

$$= -\frac{1}{2}[8.358]$$

$$\frac{\partial \epsilon}{\partial c} = -4.179$$

step 6:- $\Delta m = -\eta \frac{\partial \epsilon}{\partial m}$

$= -0.1 \times -2.934$

$\Delta m = 0.2934$

$\Delta c = -\eta \frac{\partial \epsilon}{\partial c}$

$= -0.1 \times -4.179$

$\Delta c = 0.4179$

step 7 :- $m = m + \Delta m$

$m = 1.13 + 0.2934$

$m = 1.42$

$c = c + \Delta c$

$= -0.57 + 0.4179$

$c = -0.1521$

step 8 :- batch += 1 = batch = 3

step 9 :- if (batch > batch)

3 > 2

goto step 10

else

goto step 5

step 10 :- iter = iter + 1 = 2

step 11 :- if (iter > epoch)

2 > 2

goto step 12

else

goto step 4

step 4 :- batch = 1

step 5 :- $\frac{\partial \epsilon}{\partial m} = -\frac{1}{2}[(y_1 - mx_1 - c)x_1 + (y_2 - mx_2 - c)x_2]$

$= -\frac{1}{2}[(3.4 - 1.42 \times 0.2 + 0.15)0.2 + (3.8 - 1.42 \times 0.4 + 0.15)0.4]$

$= -\frac{1}{2}[(3.266)0.2 + (3.382)0.4]$

$= -\frac{1}{2}[0.6532 + 1.3528]$

$= -\frac{1}{2}[2.006)$

$\frac{\partial \epsilon}{\partial m} = -1.003$

$$\frac{\partial \epsilon}{\partial c} = -\frac{1}{2}[(y_1 - mx_1 - c) + (y_2 - mx_2 - c)]$$

$$= -\frac{1}{2}[(3.4 - 1.42 \times 0.2 + 0.15) + (3.8 - 1.42 \times 0.4 + 0.15)]$$

$$= -\frac{1}{2}[3.266 + 3.382]$$

$$= -\frac{1}{2}[6.648]$$

$$\frac{\partial \epsilon}{\partial c} = -3.324$$

Step 6 :- $\Delta m = -\eta \times \frac{\partial \epsilon}{\partial m}$

$= -0.1 \times -1.003$

$\Delta m = +0.1003$

$\Delta c = -\eta \times \frac{\partial \epsilon}{\partial c}$

$= -0.1 \times -3.324$

$\Delta c = 3.30.0.3324$

Step 7 :- $m = m + \Delta m$

$= 1.42 + 0.1003$

$m = 1.52$

$c = c + \Delta c$

$= -0.15 + 0.3324$

$c = 0.18$

Step 8 :- batch $= 1 + 1 = 2$

Step 9 :- if (batch > nb)

$2 > 2$

go to step 10.

else

goto step 5

Step 5 :- $\frac{\partial \epsilon}{\partial m} = -\frac{1}{2}[(y_1 - mx_1 - c)x_1 + (y_2 - mx_2 - c)x_2]$

$= -\frac{1}{2}[(3.4 - 1.52 \times 0.6 - 0.18)0.6 + (4.6 - 1.52 \times 0.$

$0.18)0.8$

$= -\frac{1}{2}[(3.108) \times 0.6 + (3.204) \times 0.8]$

$$= -\frac{1}{2}[1.8648 + 2.5632]$$

$$= -\frac{1}{2}[4.428]$$

$$\frac{\partial E}{\partial m} = -2.214$$

$$\frac{\partial E}{\partial c} = -\frac{1}{2}[(y_1 - mx_1 - c) + (y_2 - mx_2 - c)]$$

$$= -\frac{1}{2}[(4.2 - 1.52 \times 0.6 - 0.18) - (4.6 - 1.52 \times 0.6 - 0.18)]$$

$$= -\frac{1}{2}[3.108 + 3.204]$$

$$= -\frac{1}{2}[6.312]$$

$$\frac{\partial E}{\partial c} = -3.156$$

step 6 :- $\Delta m = -\eta \times \frac{\partial E}{\partial m}$

$= -0.1 \times -2.214$

$\Delta m = 0.2214$

$\Delta c = -\eta \times \frac{\partial E}{\partial c}$

$\Delta c = -0.1 \times -3.156$

$\Delta c = 0.3156$

step 7 :- $m = m + \Delta m$

$= 1.52 + 0.2214$

$m = 1.74$

$c = c + \Delta c$

$= 0.18 + 0.3156$

$c = 0.4956$

step 8 :- batch $= 2 + 1 = 3$

step 9 :- if (batch > nb)

$3 > 2$

goto step 10

else

goto step 5

step 10 :- iter = 2+1 = 3

step 11 :- if (iter > epcons)

3 > 2

go to step 12

else

goto step 4

step 12 :- print m, c

m = 1.74, c = 0.495

MSE = $y' = y - mx - c$.

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