18KU1A05D2

Assignment-5

Develop the simple linear regression model for the following dataset using MBGD. where no. of samples = 4

Sample(i)	$X_i^{(i)}$	$Y_i^{(i)}$
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
0.8	4.6
x	y

Batch - 2	
0.4	3.8
0.6	4.2

bs = 2

Step1: [x, y], m = 1, c = -1, η = 0.1, epochs = 2, bs = 2 [batch size], $n_s = 4$.

Step 2: Split training data on batch size, $n_b = \frac{n_s}{bs}$.

$\Rightarrow n_b = \frac{4}{2} = 2$.

Step3: iter = 1

Step4: batch = 1

Step5:

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

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

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

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

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

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

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

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

$= \frac{-1}{2}[3.4 - (0.2)(1) - (-1) + (-0.4 + 3.8 + 1)]$
$\quad\quad m(x_1) \quad\quad y \quad\quad c$

$= -0.6$ // -1.3 //.

step 6: $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.3) = 0.13$

$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-4.3) = 0.43$

$\therefore$ $\boxed{\Delta m = 0.13}$ $\boxed{\Delta c = 0.43}$

step 7: $m = m + \Delta m = 1 + 0.13 = 1.13$

$c = c + \Delta c = -1 + 0.43 = -0.57$ //

$\boxed{m = 1.13}$ $\boxed{c = -0.57}$

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

step 9: if (batch $>$ nb)
$\quad\quad\quad\quad 2 > 2$
no
else
goto step 5.

step 5: $\frac{\partial E}{\partial m} = \frac{-1}{2} \sum_{i=1}^{2} (y_i - mx_i - c)x_i$

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

$$= \frac{-1}{2}\left[(4.2-(1.13)(0.6)+0.57)(0.6)+(4.6-(1.13)(0.8)+0.57)(0.8)\right]$$

$$= -2.934 //$$

$$\frac{\partial L}{\partial c} = \frac{-1}{2}\sum_{b_s=1}^{2}(y_i - mx_i - c)$$

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

$$= \frac{-1}{2}\left[(4.2-(1.13\times 0.6)+0.057)+(4.6-(1.13\times 0.8)+0.57)\right]$$

$$= -4.179 //$$

Step 6: $\Delta m = -\eta \frac{\partial L}{\partial m} = -(0.1)(-2.934) = 0.2934 //$

$\Delta c = -\eta \frac{\partial L}{\partial c} = -(0.1)(-4.179) = 0.4179 //$

Step 7: $m = m + \Delta m = 1.13 + 0.2934 = 1.4234 //$

$c = c + \Delta c = -0.57 + 0.4179 = -0.1521 //$

Step 8: batch = 2+1 = 3.

Step 9: if (batch $\overset{3>2}{>}$ nb) yes, goto step 10.

Step 10: iter = 1+1 = 2

Step 11: if (iter $\overset{2>2}{>}$ epochs) no, else goto step 5.

Step 5: batch = 1.

Step 6: $\frac{\partial L}{\partial m} = \frac{-1}{2}\left[(y_1 - mx_1 - c)x_1 + (y_2 - mx_2 - c)x_2\right]$

$$= \frac{-1}{2}\left[(3.4-(1.4234)(0.2)+0.1521)(0.2)+(3.8-(1.4234)(0.4)+0.1521)(0.4)\right]$$

$= -1.00329$ //

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

$= -3.32508$ //

Step 7: $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.00329) = 0.100329$ //

Step8: $\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-3.32508) = 0.332508$ //

Step8: $m = m + \Delta m = 1.4234 + 0.100329 = 1.523729$ //

$c = c + \Delta c = -0.1521 + 0.332508 = 0.180408$ //

Step9: batch = 1+1 = 2

Step10: if (batch >2) no, else goto step 6.

Step6: $\frac{\partial E}{\partial m} = \frac{-1}{2}[(4.2 - (1.523729 \times 0.6) - 0.180408)(0.6)$

$+ (4.6 - (1.523729)(0.8) - 0.18048)(0.8)]$

$= -2.2118499$ //

$$\frac{\partial E}{\partial c} = \frac{-1}{2}[(4.2 - (1.523729 \times 0.6) - 0.180408) +$$

$(4.6 - (1.523729 \times 0.8) - 0.18048)]$

$= -3.1529817$ //

Step7: $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-2.2118499) = 0.22118499$ //

$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-3.1529817) = 0.31529817$ //

Step8: $m = m + \Delta m = 1.523729 + 0.22118499 = 1.7449139$ //

$c = c + \Delta c = 0.18040408 + 0.31529817 = 0.49570617$ //

step9: batch = 2+1 = 3.

step10: if (batch $\overset{3>2}{>}$ ns) yes, goto step11.

step11: iter = 2+1 = 3

step12: if (iter $\overset{3>2}{>}$ epochs) yes, go to nxt step.

step13: print(m,c) m = 1.74491399

c = 0.49570617