Assignment - 5

18K41A05D6

Develop the Simple linear regression model for the following dataset using MBGD. where no. of Samples - 4.

Sample (i)	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
0.8	4.6

Batch - 2	
0.4	3.8
0.6	4.2

$bs = 2$

Step 1: $[x, y]$, $m = 1$, $c = -1$, $\eta = 0.1$, epochs = 2, $bs = 2$ [batch size], $ns = 4$.

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

$\rightarrow nb = \frac{4}{2} = 2$

Step 3: iter = 1

Step 4: batch = 1

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

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

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

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

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

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

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

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

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

$$= -4.3$$

Step 6: $\Delta c = -\eta \cdot \frac{\partial E}{\partial c} = -(0.1)(-1.3) = 0.43$

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

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

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)

no

else

goto step 5.

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

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

$$= \frac{-1}{2}\left[\left[4.2 - (1.13)(0.6) + 0.57\right)(0.6) + (4.6 - (1.13)(0.1) + 0.57)(0.8)\right]$$

$$= -2.934$$

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

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

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

$$= -4.179 //.$$

step 6: $\Delta m = -\eta \frac{\partial \epsilon}{\partial m} = -(0.1)(-2.934) = 0.2934 //.$

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

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

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

Step 8: batch = 2 + 1 = 3.

step 9: if (batch > nb) yes, go to step 10 : (3 > 2)

Step 10: iter = 1 + 1 = 2.

step 11: if (iter > epochs) no, else go to step 5. (2 > 2)

step 5: batch = 1

step 6:

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

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

$$= -1.00329 //.$$

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

$$= -3.32508 //.$$

step 7: $\Delta m = -\eta \cdot \frac{\partial \epsilon}{\partial m} = -(0.1)(-1.00329) = 0.100329 //$

$$\Delta c = -\eta \cdot \frac{\partial \epsilon}{\partial c} = -(0.1)(-3.32508) = 0.332508 //.$$

Step 9 : batch = 1+1 = 2

Step 10: if (batch = 2) no, else goto 6.

Step 6: $\frac{\partial E}{\partial m} = \frac{-1}{2}[(4.2 - (1.523729 \times 0.6) - 0.180408)(2.5) + (4.6 - (1.523729)(0.8) - 0.18049)(0.8)]$

$= -2.248499$

$\frac{\partial E}{\partial c} = \frac{-1}{2}[(4.2 - (1.523729 \times 0.6) - 0.180405) + (4.6 - (1.523729 \times 0.8) - 0.18048)]$

$= -3.1529817$

Step 7: $\Delta m = -\eta \cdot \frac{\partial E}{\partial m} = -(0.1)(-2.2118499) = 0.22118499$

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

Step 8: $m = m + \Delta m = 1.523729 + 0.22118499 = 1.74491399$

$c = c + \Delta c = 0.180408 + 0.31529817 = 0.49570617$

Step 9 : batch = 2+1 = 3

Step 10: if (batch > 2) yes, goto step 11.

Step 11 : iter = 2+1 = 3

Step 12: if (iter > epochs) yes, goto next step.

Step 13 : print (m, c) $m = 1.74491399$

$c = 0.49570617$