18K41A05F9

Assignment- 05

Mini-Batch Gradient Descent Optimizer

Step-1:

X	Y
0.2	3.4
0.4	3.8
0.6	4.2
0.8	4.6

$[x, y]$, $\eta = 0.1$, $m = 1$, $c = -1$

epochs = 2, batch_size (bs) = 2

Step-2:

Slipting data

$Nb = 4/2 = 2$ batches

batch-1

X	Y
0.2	3.4
0.8	4.6

Step-3: iter = 1 , **Step-4:** batch = 1

batch-2

X	Y
0.4	3.8
0.6	4.2

Step-5:

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

$$= \frac{-1}{2}\Big[(3.4 - (1)(0.2) - (-1))(0.2) + (4.6 - (1)(0.8) - (-1))(0.8) \Big]$$

$$= \frac{-1}{2}\Big[0.84 + 3.84 \Big] = \frac{-1}{2}(4.68)$$

$$= -2.34$$

$$\frac{\partial E}{\partial m} = \frac{-1}{nbs} \sum_{i=1}^{bs} [y_i - mx_i - c]$$

$$= \frac{-1}{2}\Big[\big(3.4 - (1)(0.2) - (-1)\big)(0.2) + \big(4.6 - (1)(0.8) - (-1)\big)(0.8) \Big]$$

$$= \frac{-1}{2}[4.2 + 4.8] = \frac{-1}{2}(9) = -4.5$$

Step-6:

$$\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-2.34) = 0.234$$

$$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-4.5) = 0.45$$

Step-7:

$$m = m + \Delta m = 1 + 0.234 = 1.234$$

$$c = c + \Delta c = -1 + 0.45 = -0.55$$

Step-8:

batch = batch + 1 = 2 ≤ nb — True

Go to step-5

Step-9:

$$\frac{\partial E}{\partial m} = \frac{-1}{2}\Big[\big((3.8) - (1)(0.4) - (-1)\big)(0.4) + \big(4.2) - (1)(0.6) - (-1)\big)(0.6) \Big]$$

$$= -1.97416$$

$$\frac{\partial E}{\partial c} = -3.933$$

Step-10:

$$\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.97416) = 0.197416$$

$$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-3.933) = 0.3933$$

Step-11:

$$m = m + \Delta m = 1.234 + 0.197416 = 1.4314$$

$$c = c + \Delta c = 0.3933 + (-0.55) = -0.1567$$

Step-14: batch = batch + 1 = 3 ≤ nb — False

Go to Next step i.e, step-15

Step-15: iter = iter + 1 = 2 ≤ epochs — True

Goto Step-4

Step-16: batch = 1

Step-17:

$$\frac{\partial E}{\partial m} = \frac{-1}{2}\Big[(3.4 - (1.4314)(0.2) - (-0.1567))(0.2) + (4.6 - (1.4314)(0.8) - (-0.1567))(0.8)\Big]$$

$$= -1.77167$$

$$\frac{\partial E}{\partial c} = \frac{-1}{2}\Big[(3.4 - (1.4314)(0.2) - (-0.1567)) + (4.6 - (1.4314)(0.8) - (-0.1567))\Big]$$

$$= -3.441$$

Step-18:

$$\Delta m = -\eta \frac{\partial E}{\partial m} = 0.177167$$

$$\Delta C = -\eta \frac{\partial E}{\partial C} = +0.3441$$

Step-19:

$$m = m + \Delta m = 1.4314 + 0.177167 = 1.60856$$

$$C = C + \Delta C = -0.1567 + 0.3441 = 0.1874$$

Step-20: batch = batch+1 = $2 \leq nb$ — True

Go to step-5

Step-21:

$$\frac{\partial E}{\partial m} = -\frac{1}{2}\Big[(3.8 - (1.60856)(0.4) - (0.1874))(0.4) + (4.2 - (1.60856)(0.6) - (0.1874))0.6 \Big]$$

$$= -1.50807$$

$$\frac{\partial E}{\partial C} = -\frac{1}{2}\Big[(3.8 - (1.60856)(0.4) - (0.1874)) + (4.2 - (1.60856)(0.8) - (0.1874)) \Big]$$

$$= -3.00831$$

Step-22:

$$\Delta m = -\eta \frac{\partial E}{\partial m} = 0.150807$$

$$\Delta C = -\eta \frac{\partial E}{\partial C} = 0.300831$$

Step-23: $m = m + \Delta m = 1.608564 - 0.150807 = 1.759061$

$c = c + \Delta c = 0.1874 + 0.300831 = 0.488231$

Step-24: batch = batch + 1

$= 2 + 1 = 3 \leq nb \rightarrow$ False

Goto next step

Step-25:

iter = iter + 1 = $3 \leq$ epochs → False

Go to next step

Step-26:

Print (m, c)

Step-27:

Mean Square Error:

$$MSE = \frac{(3.4 - 0.84004)^2 + (3.8 - 1.19185)^2 + (4.2 - 1.54367)^2 + (4.6 - 1.89548)^2}{4}$$

$= 6.91$