

Assignment - 5

Mini Batch Gradient Descent

Step 1:

$$[x, y], \eta = 0.3, m = 4, c = -1$$

$$\text{epochs} = 2, \text{batch-size} = 2$$

x	y
0.2	3.4
0.4	3.8
0.6	4.2
0.8	4.6

Step 2:

splitting data into batches

batch 1

0.2	3.4
0.8	4.6

batch 2

0.4	3.8
0.6	4.2

Step 3: Iteration = 1

Step 4: batch = 1

Step 5: calculate gradient descent

$$\frac{\partial E}{\partial m} = -\frac{1}{2} \left[(3.4 - (1)(0.2) - (-1)(0.2)) + \right.$$

$$\left. (4.6 - (1)(0.8) - (-1)(0.8)) \right]$$

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

$$= -\frac{1}{2} \left[(4.2)(0.2) + (4.8)(0.8) \right] = -\frac{1}{2} [4.68]$$

$$= -2.34$$

$$\frac{dE}{dC} = -\frac{1}{2}[4.2 + 4.8]$$

$$= 9.0/2 = -4.5$$

$$\text{step 6} \quad \Delta m = -\eta \frac{dE}{dm}$$

$$= 0.234$$

$$\Delta C = -\eta \frac{dE}{dC}$$

$$= 0.45$$

$$\text{step 7: } m = m + \Delta m$$

$$\rightarrow 1 + 0.234 = 1.234$$

$$C = C + \Delta C$$

$$= 1 + 0.45 = -0.55$$

$$\text{step 8: } \text{batch} = \text{batch} + 1 \rightarrow 1 + 1 = 2$$

$$\text{if}(\text{batch} > \text{no. of batches})$$

$$2 > 2 \rightarrow \text{false}$$

go to step 5

$$\text{step 11: } \frac{dE}{dm} = -\frac{1}{nb} (y_i - m x_i - C) x_i$$

$$= -\frac{1}{2} \left[(3.8 - (1.234 \times 0.4) + 0.55)(0.4) + (4.2 - (1.234 \times 0.6) + 0.55)(0.6) \right]$$

$$= -\frac{1}{2} \times [(3.8564)(0.4) + (4.0096)(0.6)]$$

$$= -1.97416$$

$$\frac{J_c}{J_c} = -\frac{1}{2} (3.8564 + 4.0096)$$

$$= -3.933$$

$$\Delta m = -\eta \frac{J_c}{J_m} = 0.197416$$

$$-\eta \frac{J_c}{J_c} = 0.3933$$

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

$$C_{FAC} = -0.55 + 0.3933 = -0.1567$$

Step 14: batch = batch + 1 $2 + 1 = 3$

Step 15: If batch $\geq 76 \Rightarrow 3 \geq 76$

Go to Step 16

Step 16

$$\text{iteration} = \text{iteration} + 1$$

$$= 1 + 1$$

$$= 2$$

Step 17: If iteration $\geq 272 \Rightarrow 2 \geq 272$

Go to Step 4

Step 18: batch = 1

Step 19:

$$\begin{aligned} \text{Step 19: } \frac{dE}{dm} &= -\frac{1}{2} \left[34 - (1.4314)(0.2) + (0.1567)(0.2) + \right. \\ &\quad \left. (4.6 - (1.4314)(0.8) + (0.1567)(0.8)) \right] \\ &= -\frac{1}{2} \times \left[(3.27042)(0.2) + (3.61158)(0.8) \right] \\ &= -\frac{1}{2} \times [0.65408 + 2.88926] = -1.77167 \end{aligned}$$

$$\begin{aligned} \frac{dE}{dc} &= -\frac{1}{2} (3.27042 + 3.61158) \\ &= -3.441 \end{aligned}$$

$$\begin{aligned} \text{Step 20: } \Delta m &= -\eta \frac{dE}{dm} \\ &= 0.177167 \end{aligned}$$

$$\begin{aligned} \Delta c &= -\eta \frac{dE}{dc} \\ &= 0.3441 \end{aligned}$$

$$\text{Step 21: } m = m + \Delta m$$

$$m = 1.4314 + 0.177167$$

$$m = 1.60856$$

$$c = c + \Delta c$$

$$= 0.1567 + 0.3441$$

$$= 0.50074$$

if batch 776

272 false

go to step 5

$$\text{Step 24: } \frac{dE}{dm} = -\frac{1}{2} \left[(3.5 - (1.60856)(0.4) - 0.1874)(0.4) + \right.$$

$$\left. (4.2 - (1.60856)(0.6) - (0.1874)(0.6)) \right]$$

$$= -\frac{1}{2} \left[(2.96917)(0.4) + (3.04746)(0.6) \right]$$

$$= -\frac{1}{2} \left[1.187668 + 1.828478 \right]$$

$$= -1.50807$$

$$\frac{dE}{dc} = -\frac{1}{2} \left[6.01663 \right]$$

$$= -3.00831$$

$$\Delta m = 0.150807 \approx -\eta \left(\frac{dE}{dm} \right) = -(0.1)(-1.50807)$$

$$\Delta c = 0.300831 \approx -\eta \left(\frac{dE}{dc} \right) = -(0.1)(-3.00831)$$

$$m = m + \Delta m \Rightarrow 1.60856 + 0.150807 = 1.759367$$

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

Step 27 batch = 2+1=3

Step 28: if batch 776 = 372 go to step 29

step 29 iteration = iteration + 1

2 + 1

> 3

step 30 if iteration > epoch

3 > 2

go to step 21

step 31 print(m, c)

1.759057,

0.488231

step 32

$$\frac{(3.4 - 0.84004) + (3.8 - 1.19185) + (4.2 - 1.54360) + (4.6 - 1.89548)}{4}$$

$$MSE = 2.63229$$