Assignment-5

18K41A0278

Mini Batch Gradient Descent

X	Y
0.2	3.4
0.4	3.8
0.6	4.2
0.8	4.6

step1: $[x, y]$; $\eta = 0.1$, $m = 1$, $c = -1$

epochs = 2, batch-size = 2

step2: Splitting data into batches

batch-1	
0.2	3.4
0.8	4.6

batch-2	
0.4	3.8
0.6	4.2

step3: iteration = 1

step4: batch = 1

step5: calculate gradient descent

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

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

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

$$\Rightarrow -2.34$$

$$\frac{\partial f}{\partial c} = -\frac{1}{2}\left[4.2 + 4.8\right] \Rightarrow -9.0/2 = -4.5$$

step6: $\Delta m = -\eta\left(\frac{\partial f}{\partial m}\right) \Rightarrow 0.234$

$\Delta c = -\eta\left(\frac{\partial f}{\partial c}\right) \Rightarrow 0.45$

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Step7: $m = m + Dm$

$= 1 + 0.234 = \underline{1.234}$

$C = C + DC$

$= -1 + 0.45 = \underline{-0.58}$

Step8: batch = batch + 1 $\Rightarrow$ 1+1 = 2

Step9: if (batch > no. of batches) 2 > 2 (false)

go to step 5

Step11: $\frac{\partial f}{\partial m} = \frac{-1}{2}[y_i - mx_i - c)x_i$

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

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

$\Rightarrow -1.97416$

$\frac{\partial f}{\partial c} = -\frac{1}{2}[3.856 + 4.0096] \Rightarrow \underline{-3.933}$

$\Delta m = -n\frac{\partial f}{\partial m} = \underline{0.197416}$

$\Delta c = -n\frac{\partial f}{\partial c} = \underline{0.3933}$

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

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

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step14: batch = batch + 1 = 2 + 1 = 3

step15: if (batch > no. of batches)

3 > 2

Go to step 16

step16: iteration = iteration + 1 ⇒ 1 + 1 ⇒ 2

step17: if (iteration > epochs)

2 > 2

go to step 4

step18: batch = 1

step19: $\frac{\partial f}{\partial m} = -\frac{1}{2}[3.4 - (1.4314)(0.2) + (0.1567)(0.2) + (4.6) - (1.4314)(0.8) + (0.1567)(0.8)]$

$\Rightarrow -\frac{1}{2}[(3.27042)(0.2) + (7.61158)(0.8)]$

$\Rightarrow -\frac{1}{2}[0.654684 + 2.889264] = -1.77167$

$\frac{\partial f}{\partial c} = -\frac{1}{2}[3.27042 + 3.61155] \Rightarrow -3.441$

step20: $\Delta m = -\eta \frac{\partial f}{\partial m} \Rightarrow 0.177167$

$\Delta c = -\eta \frac{\partial f}{\partial c} \Rightarrow 0.3441$

step21: $m = m + \Delta m$

$= 1.4314 + 0.177167$

$= 1.60856$

$c = c + \Delta c$

$= +0.1567 + 0.3441$

$= 0.1874$

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Step 23:

if (batch > no. of batches)

2 > 2 (false)

go to step 5

step 24: $\frac{\partial f}{\partial m} = \frac{-1}{2}[(3.5)-(1.60856)(0.4)-0.1874)(0.4)+$

$(4.2)-(1.60856)(0.6)-(0.1874)(0.6)]$

$= \frac{-1}{2}[(2.96917)(0.4)+(3.047464)(0.6)]$

$= \frac{-1}{2}[1.187668+1.823478] = -1.50807$

$\frac{\partial f}{\partial c} = \frac{-1}{2}[6.01663]$

$= -3.0081$

$\Delta m = 0.150307 \Rightarrow -n\frac{\partial f}{\partial m} \Rightarrow (0.1)(-1.50807)$

$\Delta c = 0.30081 \Rightarrow -n\left(\frac{\partial f}{\partial c}\right) \Rightarrow -(0.1)(-3.0081)$

$m + \Delta m = 1.60886 + 0.150807 = 1.759067$

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

step 27: batch = 2+1 = 3

step 28: if (batch > no. of batches)

3 > 2

go to step 29

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Step 29: iteration = iteration + 1

= 2 + 1

= 3

Step 30: if (iteration > epochs)

3 > 2

go to step 31

Step 31: print (m, c)

1.759067,

0.488231

Step 32:

$$\frac{[(3.4)-(0.84004)] + (3.8-1.19185) + (4.2-1.54367) + (4.6-1.89548)}{4}$$

MSE = 2.63224