Assignment-5

* Let us consider a sample dataset have one input (xi) and one Output (yi) and number of samples of, develop a simple linear regression model using mini Batch gradient descent.

Sample(i)	xi(a)	yi(a)
1	0.2	3.4
2	0.4	3.8
3	0.6	4.2
4	0.8	4.6

→ Do the manual calculations for 2 iterations with bs=2 (Batch size) = 2

	x	y
Batch 1 →	0.2	3.4
	0.4	3.8
Batch 2 →	0.6	4.2
	0.8	4.6

step 1 : [x, y], m = 1, c = -1 ; $\eta = 0.1$, epoches = 2, bs = 2

step 2 : $nb = \frac{ns}{bs} = \frac{4}{2} = 2$

step 3 : iter = 1

step 4 : Batch = 1

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

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

$= -1.34$

$\frac{\partial E}{\partial c} = -\frac{1}{2} \left[(3.4 - 0.241) + (3.8 - 0.4 + 1) \right]$

$= -4.3$

Step 6 : $\Delta m = -(0.1)(-1.34) = 0.134$

$\Delta c = -(0.1)(-4.3) = 0.43$

Step 7 : $m = m + \Delta m = 1 + 0.134 = 1.134$

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

Step 8 : Batch += 1

$1 + 1 = 2$

Step 9 : if (Batch > nb) : goto step 10

$2 > 2$

else : goto step 5

Step 5 : $\frac{\partial E}{\partial m} = -\frac{1}{2}[(4.2 - (1.134)(0.6) + 0.57)0.6 + (4.6 - (1.134)(0.8) + 0.57)0.8]$

$= -2.932$

$\frac{\partial E}{\partial c} = -1/2[(4.2 - (1.134)(0.6) + 0.57) + (4.6 - (1.134)(0.8) + 0.57)]$.

$= -4.1762$

Step 6 : $\Delta m = -(0.1)(-2.932) = 0.2932$

$\Delta m = -(0.1)(-4.1762) = 0.41762$

Step 7 : $m += \Delta m = 1.34 + 0.2932 = 1.4272$.

$c += \Delta c = -0.57 + 0.4176 = -0.1523$

Step 8 : Batch += 1 $\Rightarrow 2 + 1 = 3$

Step 9 : if (Batch > nb) : goto step 10

$3 > 2$

else : goto step 5

Step 10 : iter = iter + 1

$= 1 + 1 = 2$

Step 11 : if (iter > epoches) : goto step 12

$2 > 2$

else : goto step 4

Step 4 : Batch = 1

Step 5 : $\frac{\partial E}{\partial m} = -\frac{1}{2}[(3.4 - (1.4272)(0.2) + 0.1523)0.2 +$

$(3.8 - (1.4272)(0.4) + 0.1523)0.4]$

$= -1.0029$

$\frac{\partial E}{\partial c} = -\frac{1}{2}[(3.4) - (1.4272)(0.2) + 0.1523) +$

$(3.8) - (1.4272)(0.4) + 0.1523]$

$= -3.3241$

Step 6 : $\Delta m = (-0.1)(-1.0029) \Rightarrow 0.1002$

$\Delta c = (-0.1)(-3.3241) \Rightarrow 0.332$

Step 7 : $m = m + \Delta m \Rightarrow 1.4272 + 0.1002 = 1.5274$

$c = c + \Delta m \Rightarrow +0.1523 + 0.332 = 0.1797$

Step 8 : Batch = Batch + 1

$1 + 1 = 2$

Step 9 : if (Batch > nb) : goto step (10) 5

$2 > 2$

else : goto step 7

Step 5 : $\frac{\partial E}{\partial m} = \frac{-1}{2}\{(4.2 - (1.5274)(0.6) - 0.1797)0.6 +$

$(4.6 - (1.5274)(0.8) - 0.1797)0.8]$

$= -2.21$

$\frac{\partial E}{\partial c} = -3.151$

step 6 : $\Delta m = -0.1 \times -2.21$

$= 0.221$

$\Delta c = -0.1 \times -3.151 \Rightarrow 0.315$

step 7 : $m += \Delta m = 1.5274 + 0.221 = 1.748$

$c += \Delta c = 0.1797 + 0.315 = 0.494$

step 8 : Batch += 1

$2 + 1 = 3$

step 9 : if (Batch > n6) : goto step 10

else : goto step 5

step 10 : iter += 1 $\Rightarrow 2 + 1 = 3$

step 11 : if (iter > epochs) : goto step 12

$3 > 2$

else : goto step 4

step 12 : print m, c

$m = 1.748$, $c = 0.494$.