

Manual Calculations for two iterations with batchsize-2  
(MBGD optimizer)

	Sample	x	y
Batch-1	1	0.2	3.4
	2	0.4	3.8
Batch-2	3	0.6	4.2
	4	0.8	4.6

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

Step-1:  $m=1, c=-1, \text{epochs}=2, \eta=0.1, b=2$ .

Step-2: split data into batches

Step-3:  $\text{itr}=1$

Step-4:  $\text{batch}=1$

$$\begin{aligned} \text{Step-5: } \frac{\partial E}{\partial m} &= -\frac{1}{b} \sum_{i=1}^b (y_i - m x_i - c) x_i \\ &= -\frac{1}{2} [(3.4 - 0.2 + 1)0.2 + (3.8 - 0.2 + 1)0.4] \\ &= -\frac{1}{2} [0.84 + 1.76] \\ &= -1.3 \end{aligned}$$

$$\begin{aligned} \frac{\partial E}{\partial c} &= -\frac{1}{2} [(3.4 - 0.2 + 1) + (3.8 - 0.2 + 1)] \\ &= -\frac{1}{2} (4.2 + 4.4) \\ &= -4.3 \end{aligned}$$

$$\text{Step-6: } \Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.3) = 0.13$$

$$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-4.3) = 0.43$$

$$\text{Step-7: } m = m + \Delta m = 1 + 0.13 = 1.13$$

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

Step-8: batch = 1+1 = 2

Step-9: if (<sup>2 > 2</sup> batch > b) (x)

go to step-5

$$\text{Step-5: } \frac{dE}{dm} = \frac{-1}{2} \left[ (4.2 - (1.13) * (0.6) + 0.57) * 0.6 + (4.6 - (1.13) * (0.8) + 0.57) * 0.8 \right]$$

$$\frac{dE}{dm} = -2.934$$

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

$$\frac{dE}{dc} = -4.179$$

$$\text{Step-6: } \Delta m = (-0.1) * (-2.934) = 0.2934$$

$$\Delta c = (-0.1) * (-4.179) = 0.417$$

$$\text{Step-7: } m = m + \Delta m = 1 + 0.2934 = 1.2934$$

$$c = c + \Delta c = -1 + 0.417 = -0.583$$

Step-8: batch = 2+1 = 3

Step-9: if (3 > 2)

go to next step

Step-10: ite = 1+1 = 2

Step-11: if (<sup>2 > 2</sup> ite > epochs)

go to step 12

else

go to step-4



Step-4: Batch = 1

$$\text{Step-5: } \frac{\partial E}{\partial m} = -0.54 \left[ (3.4 - (1.29)(0.2) + 0.58) \times 0.2 + (3.8 - (1.29)(0.4) + 0.58) \times 0.4 \right]$$

$$\frac{\partial E}{\partial m} = -0.54 (0.744 + 1.5456) = -1.14$$

$$\frac{\partial E}{\partial c} = -0.5 \left[ (3.4 - (1.29)(0.2) + 0.58) + (3.8 - (1.29)(0.4) + 0.58) \right]$$

$$\frac{\partial E}{\partial c} = -0.5 (3.722 + 3.864) = -3.793$$

$$\text{Step-6: } \Delta m = (-0.1)(-1.14) = 0.114$$

$$\Delta c = (-0.1)(-3.793) = 0.379$$

$$\text{Step-7: } m = m + \Delta m = 1.2934 + 0.114 = 1.4074$$

$$c = c + \Delta c = -0.583 + 0.379 = -0.204$$

Step-8: Batch = 2

Step-7 if (2 > 2)

Step 10

else

Step 5

$$\text{Step-5: } \frac{\partial E}{\partial m} = -0.5 \left[ (4.2 - (1.407) \times (0.6) + 0.204) \times 0.6 + (4.6 - (1.407) \times (0.8) + 0.204) \times 0.8 \right]$$

$$= -0.5 (3.55 \times 0.6 + 3.67 \times 0.8)$$

$$\frac{\partial E}{\partial m} = -2.533$$

$$\frac{\partial E}{\partial c} = -0.5 (3.557 + 3.67)$$

$$= -3.61$$

Step-6:  $\Delta m = (-0.1) * (-2.533) = 0.253$

$$\Delta C = (-0.1) * (-3.61) = 0.361$$

Step-7:  $m = m + \Delta m = 1.407 + 0.253 = 1.66$

$$C = C + \Delta C = -0.204 + 0.361 = 0.157$$

Step-8: Batch = 3

Step-9: if (3 > 2)

Step-10

Step-10: iters = 3

Step-11: if (iters <sup>3 > 2</sup> epochs)

Step-12

Step-12:  $m = 1.66, C = 0.157$