

Assignment-5

Sample (i) x_i^a y_i^a

b1	1	0.2	3.4
	2	0.4	3.8
b2	3	0.6	4.2
	4	0.8	4.6

Do manual calculations for two iterations with batch size 2 using MBGD

Step. 1: Read the dataset, $m=1$, $c=-1$

Step. 2: epochs = 2, no. of batches = 2, learning rate = 0.1

Step. 3: Set iteration = 1, set batch = 1

Step. 4: $y_i = mx_i + c$

$$y_1 = 1(0.2) - 1 = -0.8$$

$$y_2 = 1(0.4) - 1 = -0.6$$

Step 5:
$$e = \frac{1}{2n} \sum_{i=1}^2 (y_i - mx_i - c)^2$$

$n=2$ (no. of samples in a batch)

$$= \frac{1}{4} \left((3.4 - (-0.8))^2 + (3.8 - (-0.6))^2 \right)$$

$$= \frac{1}{4} (4.2^2 + 4.4^2)$$

$$= 9.25$$

Step 6:
$$\frac{\partial e}{\partial m} = \frac{\sum_{i=1}^2 (y_i - mx_i - c)(-x_i)}{n}$$

$$= \frac{(4.2)(-0.2) + (4.4)(-0.4)}{2}$$

$$= -2.6$$

$$= -1.3$$

$$\frac{\partial e}{\partial c} = \frac{\sum_{i=1}^2 (y_i - mx_i - c)(-1)}{n}$$

$$= \frac{-4.2 - 4.4}{2}$$

$$= -4.3$$

$$\text{Step. 7: } \Delta m = -(0.1)(-1.3) \\ = 0.13$$

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

$$\text{Step. 8: } m = m + \Delta m \\ = 1 + 0.13 \\ = 1.13$$

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

$$\text{Step. 9: } \text{batch} = \text{batch} + 1 = 2 \leq \text{no. of batches} \\ \text{true} \\ \text{false}$$

$$\text{Step. 10: } y_3 = 1.13(0.6) - 0.57$$

$$= 0.678 - 0.57$$

$$= 0.108$$

$$y_4 = 1.13(0.8) - 0.57$$

$$= 0.904 - 0.57$$

$$= 0.334$$

$$\text{Step. 11: } e = \frac{1}{2n} \sum_{i=1}^4 (y_i - mx_i - c)^2$$

$$= \frac{1}{4} ((4.2 - 0.108)^2 + (4.6 - 0.334)^2)$$

$$= \frac{1}{4} (16.744464 + 18.198756)$$

$$= \frac{34.94322}{4}$$

$$= 8.735805$$

$$\text{Step. 12: } \frac{\partial e}{\partial m} = \frac{(4.2 - 0.108)(-0.6) + (4.6 - 0.334)(-0.8)}{2}$$

$$= \frac{(4.092)(-0.6) + (4.266)(-0.8)}{2}$$

$$\frac{\partial e}{\partial m} = \frac{(4.2 - 0.108)(-1) + (4.6 - 0.334)(-1)}{2}$$

$$= \frac{-4.092 - 4.266}{2} = -4.179$$

$$\text{Step. 13: } \Delta m = -(0.1)(-2.934) \\ = 0.2934$$

$$\Delta c = -(0.1)(-4.179) \\ = 0.4179$$

$$\text{Step. 14: } m = m + \Delta m \\ = 1.13 + 0.2934 \\ = 1.4234$$

$$c = c + \Delta c \\ = -0.57 + 0.4179 \\ = -0.1521$$

$$\text{Step. 15: } \text{batch} = \text{batch} + 1 = 3 > \text{no. of batches} \\ \text{true}$$

$$\text{Step. 16: } \text{iter} = \text{iter} + 1 = 2 > \text{epochs} \Rightarrow \text{false} \\ \text{set batch} = 1$$

$$\text{Step. 17: } y_i = mx_i + c$$

$$y_1 = 1.4234(0.2) - 0.1521 \\ = 0.13258$$

$$y_2 = 1.4234(0.4) - 0.1521 \\ = 0.41726$$

$$\text{Step. 18: } e = \frac{1}{2n} \sum_{i=1}^2 (y_i - mx_i - c)^2$$

$$= \frac{1}{4} ((2.4 - 0.13258)^2 + (3.8 - 0.41726)^2)$$

$$= \frac{1}{4} ((4.06742)^2 + (4.18274)^2)$$

$$= \frac{1}{4} (10.67603346 + 11.442991)$$

$$= 8.50980485 \quad 5.529756114$$

$$\text{Step. 19: } \frac{\partial e}{\partial m} = (4.06742)(-0.2) + (4.18274)(-0.4)$$

$$= -1.24829$$

$$\frac{\partial e}{\partial c} = -4.06742 - 4.18274$$

$$= -4.12508$$

$$\text{Step. 20: } \Delta m = -(0.1)(-1.24329) \\ = 0.124329$$

$$\text{i) } \Delta c = -(0.1)(-4.12508) \\ = 0.412508$$

$$\text{Step. 21: } m = 1.4234 + 0.124329 \\ = 1.547729$$

$$c = -0.1521 + 0.412508 \\ = 0.260408$$

Step. 22; batch = batch + 1 = 2 > no. of batches
false

$$\text{Step. 23: } y_i = mx_i + c$$

$$y_3 = 1.547729(0.6) + 0.260408 \\ = 1.1890454$$

$$y_4 = 1.547729(0.8) + 0.260408 \\ = 1.4985912$$

$$\text{Step 24: } e = \frac{1}{2n} \sum_{i=3}^n (y_i - m x_i - c)^2$$

$$= \frac{1}{4} \left((4.2 - 1.1890454)^2 + (4.6 - 1.4985912)^2 \right)$$

$$= \frac{1}{4} \left((3.0109546)^2 + (3.101409)^2 \right)$$

$$= \frac{9.065847603 + 9.618737785}{4}$$

$$= 4.671146342$$

$$\text{Step 25: } \frac{\partial e}{\partial m} = \frac{(3.0109546)(-0.6) + (3.101409)(-0.8)}{2}$$

$$= -2.14384998$$

$$\frac{\partial e}{\partial c} = \frac{-3.0109546 - 3.101409}{2}$$

$$= -3.0561818$$

$$\text{Step. 27: } \Delta m = -0.1(-2.14384998)$$

$$= 0.214384998$$

$$\Delta c = -(0.1)(-3.0561818)$$

$$= 0.30561818$$

$$\text{Step. 28: } m = m + \Delta m$$

$$= 1.547729 + 0.214384998$$

$$= 1.762114$$

$$c = c + \Delta c$$

$$= 0.260408 + 0.30561818$$

$$= 0.56602618$$

$$\text{Step. 29: } \text{batch} = \text{batch} + 1 = 3 > \text{no. of batches} \quad \text{true}$$

$$\text{Step. 30: } \text{iter} = \text{iter} + 1 = 3 > \text{epochs} \quad \text{true}$$

∴ end

$$m = 1.762114$$

$$c = 0.56602618$$

$$mse = \frac{1}{n} \sum_{i=1}^4 (y_i - mx_i - c)^2$$

$$n \Rightarrow \text{no. of samples} = 4$$

$$= \frac{(3.4 - (1.762114)(0.2) - 0.56602618)^2 + (3.8 - (1.762114)(0.4) - 0.56602618)^2 + (4.2 - (1.762114)(0.6) - 0.56602618)^2 + (4.6 - (1.762114)(0.8) - 0.56602618)^2}{4}$$

$$= \frac{6.15809546 + 6.39648955 + 6.6894339 + 2.62428262}{4}$$

$$= \underline{\underline{5.45457538}}$$