

# Assignment - 7      Batch Gradient Descent

Step 1:  $(x, y)$ , epochs  $\geq 2$ ,  $m \geq 4$ ,  $c = -1$ ,  $\eta = 0.01$

$$n_s = 2$$

consider 2 samples only

Step 2: Iteration = 1

Step 3:  $\frac{dE}{d\theta}$

$x$	$y$
0.2	3.4
0.4	3.8
0.6	4.2
0.8	4.6

$$\frac{dE}{d\theta} = -\frac{1}{n_s} \left[ \sum_{i=1}^{n_s} (y_i - m x_i - c) (x_i) \right]$$

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

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

$$= -\frac{1}{2} \left[ (4.2)(0.2) + (4.4)(0.4) \right]$$

$$= -\frac{1}{2} [0.84 + 1.76]$$

$$= -1.3$$

$$\frac{dE}{dc} = -\frac{1}{n_s} \left[ \sum_{i=1}^{n_s} (y_i - m x_i - c) \right]$$

$$= -\frac{1}{2} [4.2 + 4.4]$$

$$= -\frac{1}{2} [8.6]$$

$$= -4.3$$

$$\text{Step 4: } \Delta m = -\eta \frac{dE}{dm} \Rightarrow = -(0.1)(-1.3) \\ = 0.13$$

$$\Delta c = -\eta \frac{dE}{dc} \Rightarrow = -(0.1)(-0.43) \\ = 0.043$$

$$\text{Step 5: } m = 1 + 0.13 \\ = 1.13$$

$$c = -1 + 0.043 \\ = -0.957$$

$$\text{Step 6: } \text{Iteration} = \text{Iteration} + 1 \\ = 1 + 1 = 2$$

$$\text{Step 7: } \text{if}(\text{Iteration} \geq \text{epochs}) \\ 2 \geq 2 \quad \text{false}$$

Then go to step 3

$$\text{Step 8: } \frac{dE}{dm} = -\frac{1}{n_s} \left[ \sum_{i=1}^{n_s} (y_i - m x_i - c) x_i \right]$$

$$= -\frac{1}{2} \left[ ((3.4) - (1.13 \times 0.2) + 0.957) \times 0.2 + (3.8 - (1.13 \times 0.4) + 0.957) \times 0.4 \right]$$

$$= -\frac{1}{2} \left[ (3.744) \times (0.2) + (3.918) \times (0.4) \right]$$

$$= -\frac{1}{2} [3.2994 + 1.5672]$$

$$= -2.4333$$

Step 9:

$$\frac{dE}{dC} = -\frac{1}{2} [3.744 + 3.9157]$$

$$= -3.83$$

Step 9:  $\Delta m = -\eta \frac{dE}{dm} = -(0.1) \times (-2.4333)$

$$= 0.24333$$

$$\Delta C = -\eta \frac{dE}{dC} = -(0.1) (-3.831) = 0.3831$$

Step 10:  $m = m + \Delta m \Rightarrow 1.13 + 0.24333 = 1.37333$

$$C = C + \Delta C \Rightarrow -0.57 + 0.3831 = -0.1869$$

Step 11:  $\text{Iteration} = \text{Iteration} + 1$

$$2 + 1 = 3$$

Step 12: If  $\text{Iteration} > \text{epoch}$

$$3 > 2$$

goto step 13

Step 13: Print( $m, C$ )

$$1.37333, 0.1869$$

Step 14: mse of dd =

$$\text{mse} = \frac{[3.4 - (1.37333 \times 0.2) + 0.1869]^2 + [3.8 - (1.37333 \times 0.4) + 0.1869]^2}{2}$$

$$\frac{[10.97089] + [11.81687]}{2} = 11.39388$$