

Assignment - 9

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Let us consider a sample dataset have 1 input (x_i) and one output (y_i) and number of samples 4, Develop a simple linear regression model using momentum optimiser.

sample (i)	x_i	y_i
1	0.2	3.4
2	0.4	3.8
3	0.6	4.2
4	0.8	4.6

* Do manual calculations for 2 iterations with 1st 2 samples.

Step 1: $[x, y]$, $m = 1$, $c = -1$, $\eta = 0.1$, epochs = 2

$$\beta = 0.9, \quad \partial_m = \partial_c = 0, \quad n_s = 2$$

Step 2: $itr = 1$

Step 3: sample = 1 $E = \frac{1}{2} (y_i - m x_i - c)^2$

$$\begin{aligned} \text{Step 4: } g_m &= \frac{dE}{dm} = -(y_i - m x_i - c) x_i \\ &= -(3.4 - (1)(0.2) - (-1))(0.2) \\ &= -0.84 \end{aligned}$$

$$g_c = \frac{dE}{dc} = -(y_i - m x_i - c) = -4.2$$

Step 5 : $V_m = \gamma V_m - \eta \frac{dE}{dm}$

$$= 0.9 \times 0 - (0.1)(-0.84)$$

$$V_m = 0.084$$

$$V_c = \gamma V_c - \eta \frac{dE}{dc}$$

$$= 0.9 \times 0 - (0.1)(-0.42)$$

$$V_c = 0.42$$

Step 6 : $\bar{m} = m + V_m = 1 + 0.084 = 1.084$

$$\bar{c} = c + V_c = -1 + 0.42 = -0.58$$

Step 7 : sample + 1 = 2

Step 8 : if (sample > 2)

goto Step 9

else

go to step 4

Step 4 : $\frac{dE}{dm} = -0.4 (3.8 - (1.084)(0.6) + 0.58)$

$$= -1.578$$

Step 5 : $V_m = \gamma V_m - \eta \frac{dE}{dm}$

$$V_m = 0.9 \times (0.084) - (0.1)(-1.578)$$

$$= 0.233$$

$$V_c = \gamma V_c - \eta \frac{dE}{dc} = 0.9 \times 0.42 - (0.1)(-3.94)$$

$$V_c = 0.772$$

step 6 : $m = m + V_m = 1.084 + 0.233 = 1.317$

$c = c + V_c = -0.53 + 0.722 = 0.192$

step 7 : Sample = 3

step 8 : if (3 > 2) ✓
go to step 9

step 9 : itr = 2

step 10 : if (itr > epochs) ✗
2 > 2 ✗

go to step 3

step 3 : sample = 1

step 4 : $\frac{dE}{dm} = -(3.4 - 1.317 + 0.2 - 0.192) \cdot 0.2 = -0.58$

$\frac{dE}{dc} = -(3.4 - 1.317 + 0.2 - 0.192) = -2.944$

step 5 : $\Delta m = \Delta V_m - \eta \frac{dE}{dm}$

$\Delta m = 0.9 \cdot 0.233 + (0.1)(0.58) = 0.268$

$\Delta c = \Delta V_c - \eta \frac{dE}{dc}$

$= 0.9 \cdot 0.722 + 0.1(2.944) = 0.989$

Step 6 : $m = m + V_m = 1.317 + 0.268 = 1.58$

$c = c + V_c = 0.192 + 0.989 = 1.18$

Step 7 : Sample = 2

step 8 : if (2 > 2)
step 9 ✗
go to step 4.

$$\text{Step 4 : } \frac{dE}{dm} = -(3.8 - 1.58 * 0.4 - 1.18) 0.4$$

$$= -0.79$$

$$\frac{dE}{dc} = -(3.8 - 1.58 * 0.4 - 1.18) c$$

$$= -1.98$$

$$\text{Step 5 : } V_m = \eta V_m - \eta \frac{dE}{dm}$$

$$= 0.9 * 0.26 + (0.1) * (0.79)$$

$$= 0.313$$

$$\text{Step 6 : } m = m + V_m = 1.58 + 0.313$$

$$= 1.89$$

$$c = c + V_c = 1.58 + 1.08$$

$$= 2.26$$

Step 7 : Sample 3.

Step 8 : if (3 > 2) step 9 ✓

Step 9 : $itr = 3$

Step 10 : if (3 > 2) ✓

Step 11

Step 11 : $m = 1.89$, $c = 2.26$,