Assignment - 13

Sample (i)	x_i^a	y_i^a
1	0.2	3.4
2	0.4	3.8

Do manual calculations for two iterations with first two cases using ADAGRAD optimizer

Step. 1: Read dataset, $\eta = 0.1$, epochs = 2, $m = 1$, $c = 1$, $\epsilon = 10^{-8}$, $G_m^2 = 0$ and $G_c^2 = 0$

Step. 2: Set iteration = 1

Step. 3: Set Sample = 1

Step. 4: $\epsilon = \frac{1}{2}(y_i^a - mx_i^a - c)^2 = \frac{1}{2}(4.2)^2 = 8.82$

Step. 5: Calculate G_m^2 and G_c^2

$$G_m = \frac{\partial \epsilon}{\partial m} = -(y_i^a - mx_i^a - c)(x_i^a)$$

$$= -(3.4 + 0.8)(0.2)$$

$$= -0.84$$

$$G_c = \frac{\partial \epsilon}{\partial c} = -(y_i^a - mx_i^a - c)$$

$$= -(3.4 + 0.8)$$

$$= -4.2$$

$G_m^2 = 0 + (-0.84)^2$

$= 0.7056$

$G_c^2 = 0 + (-1.2)^2$

$= 17.64$

Step 6: Update m and c

$$m = m - \frac{\eta}{\sqrt{G_m^2 + \epsilon}} * g_m$$

$$m = 1 - \frac{0.1}{\sqrt{0.7056 + 10^{-8}}} * -0.84 = 1.1$$

$$c = c - \frac{\eta}{\sqrt{G_c^2 + \epsilon}} * g_c$$

$$= -1 - \frac{0.1}{\sqrt{17.64 + 10^{-8}}} * -4.2$$

$$c = -0.9$$

Step. 7: Sample = Sample + 1 = 2 ≤ 2

Step. 8: $\epsilon = \frac{1}{2}(y_i^a - m x_i^a - c)^2 =$

$= \frac{1}{2}(3.8 - (1.1)(0.4) - (-0.9))^2 = 9.0738$

Step.9: Calculate G_m^2 and G_c^2

$$g_m = \frac{\partial E}{\partial m} = -(3.8 + 0.46) * 0.4$$

$$= -1.704$$

$$g_c = \frac{\partial E}{\partial c} = -(3.8 + 0.46)$$

$$= -4.26$$

$$G_m^2 = G_m^2 + [g_m]^2$$

$$= 0.7056 + (-1.704)^2$$

$$= 3.61$$

$$G_c^2 = G_c^2 + [g_c]^2$$

$$= 17.64 + (-4.26)^2$$

$$= 35.78$$

Step.10: Update m and c

$$m = m - \frac{\eta}{\sqrt{G_m^2 + \epsilon}} * g_m$$

$$= 1.1 - \frac{0.1}{\sqrt{3.61 + 10^{-8}}} * (-1.704)$$

$$= 1.2$$

$$c = c - \frac{\eta}{\sqrt{\sigma_c^2 + \epsilon}} * g_c$$

$$= -0.9 - \frac{0.1}{\sqrt{35.78 + 10^{-8}}} * (-4.26)$$

$$= -0.83$$

Step. 11 : Sample = Sample + 1 = 3 ≥ 2

Step. 12 : iteration = iteration + 1 ≤ epochs = 2

set sample = 1

Step. 13 : $\epsilon = \frac{1}{2}(3.4 - 1.2 * 0.2 + 0.83)^2$

$$= \frac{1}{2}(3.90)^2$$

$$= 7.96005$$

Step. 14 : Calculate σ_m^2 & σ_c^2

$$g_m = \frac{\partial \epsilon}{\partial m} = -(3.90)(0.2)$$

$$= 0.78$$

$$g_c = \frac{\partial \epsilon}{\partial c} = -3.90$$

$$\sigma_m^2 = 3.61 + (0.78)^2 = 4.2184$$

$$G_c^2 = 35.78 + (-3.90)^2$$

$$= 50.99$$

Step.15: Update m and c

$$m = m - \frac{\eta}{\sqrt{G_m^2 + \epsilon}} \times g_m$$

$$= 1.2 - \frac{0.1}{\sqrt{4.2184 + 10^{-8}}} \times 0.78$$

$$= 1.2 - 0.0379$$

$$= 1.1621$$

$$c = -0.83 - \frac{0.1}{\sqrt{50.99 + 10^{-8}}} \times (-3.90)$$

$$= -0.83 + 0.0546$$

$$= -0.7754$$

Step.16: Sample = Sample + 1 = 2 ≤ 2

Step.17: $\epsilon = \frac{1}{2}(3.8 - 1.1621 * 0.4 + 0.7754)^2$

$= \frac{1}{2}(4.11056)^2$

$= 8.44835$

Step. 18: Calculate G_m^2 & G_c^2

$$g_m = \frac{\partial \epsilon}{\partial m} = -4.11056 \times 0.4$$

$$= -1.644224$$

$$g_c = \frac{\partial \epsilon}{\partial c} = -4.11056$$

$$G_m^2 = 4.2184 + (-1.644224)^2$$

$$= 6.92187$$

$$G_c^2 = 50.99 + (-4.11056)^2$$

$$= 67.88670851$$

Step. 19: Update m and c

$$m = 1.1621 - \frac{0.1}{\sqrt{6.92187 + 10^{-8}}} \times (-1.644224)$$

$$m = 1.1621 + 0.06249$$

$$= 1.22459$$

$$c = -0.7754 - \frac{0.1}{\sqrt{67.8867 + 10^{-8}}} \times -4.1105$$

$$= -0.7754 + 0.0498$$

$$= -0.7256$$

$$MSE = \frac{1}{2}\left((3.4 - (1.22459)(0.2) + 0.7256)^2 + (3.8 - (1.22459)(0.4) + 0.7256)^2\right)$$

$$= 15.6735$$