Assignment-15

Develop a simple linear regression model using RMSprop optimizer.

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

Do manual calculations for 2 iterations with first 2 samples.

Step.1: Read dataset, set $\eta = 0.1$, epochs = 2, $m = 1$, $c = -1$, $E^2_{gm,0} = E^2_{gc,0} = 0$

Step.2: Set ~~sample~~ iter = 1

Step 3: Set Sample = 1

Step.4: Calculate g_m and g_c

$$g_m = \frac{\partial E}{\partial m} = -(3.4 + 0.8) * 0.2$$

$$= -0.84$$

$$g_c = \frac{\partial E}{\partial c} = -(3.4 + 0.8)$$

$$= -4.2$$

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Step.5: Calculate exponential decay average $E_{g_m,t}^2$ & $E_{g_c,t}^2$

$$E^2_{g_m,t} = \gamma E^2_{g_m,t-1} + (1-\gamma)[g_m]^2$$

$$= 0.9 * 0 + (1-0.9) \cdot (-0.84)^2$$

$$= 0.071$$

$$E^2_{g_c,t} = \gamma E^2_{g_c,t-1} + (1-\gamma)[g_c]^2$$

$$= 0.9 * 0 + (1-0.9) * (-4.2)^2$$

$$= 1.764$$

Step.6: Update m and c

$$m = m - \frac{\eta}{\sqrt{E^2_{g_m,t} + \epsilon}} * g_m$$

$$= 1 - \frac{0.1}{\sqrt{0.071 + 10^{-8}}} * (-0.84)$$

$$= 1.315$$

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$$c = c - \frac{\eta}{\sqrt{E^2_{g_{c,t}} + \epsilon}} * g_c$$

$$= -1 - \frac{0.1}{\sqrt{1.764 + 10^{-8}}} * (-4.2)$$

$$= -0.683$$

Step. 7. Sample = Sample + 1 = 2 not > n_s

Step. 8 : Calculate g_m and g_c

$$g_m = \frac{\partial E}{\partial m} = -(3.8 - 0.157) * 0.4$$
$$= -1.46$$

$$g_c = \frac{\partial E}{\partial c} = -(3.8 - 0.157)$$
$$= -3.643$$

Step. 9 : Calculate exponential decay args.

$\epsilon^2_{g_{m,t}}$ and $\epsilon^2_{g_{c,t}}$

$$E^2_{g_{m,t}} = 0.9 * 0.071 + (1-0.9)*(-1.46)^2$$

$$= 0.277$$

$$E^2_{g_{c,t}} = 0.9 * 1.764 + (1-0.9)*(-3.64)^2$$

$$= 2.92$$

Step.10: Update m and c

$$m = 1.315 - \frac{0.1}{\sqrt{0.277 + 10^{-8}}}(-1.46)$$

$$= 1.315 - (-0.277)$$

$$= 1.592$$

$$c = -0.683 - \frac{0.1}{\sqrt{2.92 + 10^{-8}}}(-3.64)$$

$$= -0.47$$

Step.11: Sample = Sample + 1 = 3 > n_s = 2

Step.12: iter = iter + 1 = 2 $\overset{\text{not}}{>}$ epochs = 2

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Step.13: Calculate g_m and g_c

$$g_m = \frac{\partial \epsilon}{\partial m} = -(3.4 - 1.592 \times 0.2 - 0.47)(0.2)$$

$$= -0.52232$$

$$g_c = \frac{\partial \epsilon}{\partial c} = -(3.4 - 1.592 \times 0.2 - 0.42)$$

$$= -2.6116$$

Step.14: Calculate exponential decay avgs $\epsilon^2_{g_{m,t}}$ and $\epsilon^2_{g_{c,t}}$

$$\epsilon^2_{g_{m,t}} = 0.9 \times \overset{0.277}{\cancel{0.071}} + (1-0.9)(-0.52232)^2$$

$$= 0.27658$$

$$\epsilon^2_{g_{c,t}} = 0.9 \times 2.92 + (1-0.9)(-2.6116)^2$$

$$= 3.31004$$

Step.15: Update m and c

$$m = 1.572 - \frac{0.1}{\sqrt{0.27658 + 10^{-8}}} \times (-0.5223)$$

$$= 1.6713$$

$$c = -0.47 - \frac{0.1}{\sqrt{3.31004 + 10^{-8}}} \times (-2.611)$$

$$= -0.3264$$

Step.16: Sample = Sample + 1 = 2 not > $n_s = 2$

Step.17: Calculate g_m and g_c

$$g_m = \frac{\partial G}{\partial m} = -(3.8 - 1.6713 \times 0.4 + 0.3264)(0.4)$$

$$= -1.383152$$

$$g_c = \frac{\partial E}{\partial c} = -(3.8 - 1.6713 \times 0.4 + 0.3264)$$

$$= -3.45788$$

Step. 18: Calculate exponential decay avgs $E^2_{g_{m,t}}$ and $E^2_{g_{c,t}}$

$$E^2_{g_{m,t}} = 0.9 \times 0.27658 + (1-0.9)(-1.383152)^2$$

$$= 0.44033$$

$$E^2_{g_{c,t}} = 0.9 \times 3.31004 + (1-0.9)(-3.45788)^2$$

$$= 4.17472$$

Step. 19: Update m and c

$$m = 1.6713 - \frac{0.1}{\sqrt{0.44033 + 10^{-8}}} \times (-1.383152)$$

$$= 1.879739857$$

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$$c = -0.3264 - \frac{0.1}{\sqrt{4.17472 + 10^{-8}}} \times (-3.445788)$$

$$= -0.1571$$

$$MSE = \frac{1}{2}\left((3.4 - (1.8797)(0.2) + 0.1571)^2 + (3.8 - (1.8797)(0.4) + 0.1571)^2 \right)$$

$$= 10.1966071$$

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