Assignment-15:-

Let consider a sample dataset have one input (x_i^9) and one output (y_i^9), and number of samples 4. Develop a simple linear regression model using RMSprop optimizer

sample (i)	x_i^9	y_i^9
1	0.2	3.4
2	0.4	3.8
3	0.6	4.2
4	0.8	4.6

* Do manual calculations for two iterations with first two samples.

Soln:-

step1:- $[x, y]$, $\eta = 0.1$, epochs $= 2$, $m = 1$, $c = 1$, $\gamma = 0.9$, $E_m = E_c = 0$, $\varepsilon = 10^{-8}$.

step2:- iter $= 1$

step3:- sample $= 1$

step4:- $g_m = -(y_i - mx_i - c)(x_i)$

$= -(3.4 - (1)(0.2) - 1)(0.2)$

$$\boxed{g_m = -0.44}$$

$g_c = +(y_i - mx_i - c)$

$$\boxed{g_c = -2.2}$$

step5:- $E_m = \gamma E_m + (1-\gamma)(g_m)^2$

$= (0.9)(0) + (1-0.9)(-0.44)^2$

$= 0 + 0.01936$

$$\boxed{E_m = 0.01936.}$$

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$$E_c = \gamma E_c + (1-\gamma)(g_c)^2$$

$$= (0.9)(0) + (1-0.9)(-2.2)^2$$

$$= 0 + 0.484$$

$$\boxed{E_c = 0.484}$$

step6:- $$\Delta m = \frac{-\eta}{\sqrt{E_m + \varepsilon}} (g_m)$$

$$= \frac{-0.1}{\sqrt{0.01936 + 10^{-8}}} (-0.44)$$

$$\boxed{\Delta m = 0.3162}$$

$$\Delta c = \frac{-\eta}{\sqrt{E_c + \varepsilon}} (g_c)$$

$$= \frac{-0.1}{\sqrt{0.484 + 10^{-8}}} (-2.2)$$

$$\boxed{\Delta c = 0.31622}$$

step7:- $m = m + \Delta m = 1 + 0.3162$

$$m = 1.3162$$

$$c = c + \Delta c = 1 + 0.31622$$

$$\boxed{c = 1.31622}$$

step8:- sample = sample + 1

$= 1 + 1$

$= 2$

step9:- if (sample > ns)

$2 > 2$

false: goto step4

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Step 4:- $g_m = -(y_i - mx_i - c)(x_i)$

$= -[3.8 - 1.3162(0.4) - 1.31622)(0.4)$

$= -(3.8 - 0.56248 - 1.31822)(0.4)$

$g_m = -0.76852$

$g_c = -(y_i - mx_i - c)$

$= -(3.8 - 1.3162(0.4) - 1.31622)$

$g_c = -1.9213$

Step 5:- $E_m = \gamma E_m + (1-\gamma)(g_m)^2$

$= (0.9)(0.01936) + (1-0.9)(-0.7685)^2$

$E_m = 0.0764$

$E_c = \gamma E_c + (1-\gamma)(g_c)^2$

$= (0.9)(0.484) + (1-0.9)(-1.9213)^2$

$E_c = 0.8047$

Step 6:- $\Delta m = \frac{-\eta}{\sqrt{E_m + \varepsilon}}(g_m)$

$= \frac{-0.1}{\sqrt{0.0764 + 10^{-8}}}(-0.768)$

$\Delta m = 0.2778$

$\Delta c = \frac{-\eta}{\sqrt{E_c + \varepsilon}}(g_c)$

$= \frac{-0.1}{\sqrt{0.8047 + 10^{-8}}}(-1.9213)$

$\Delta c = 0.21417$

Step 7:- $m = m + \Delta m = 1.3162 + 0.2778$

$m = 1.594$

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$c = c + \Delta c$

$= 1.31622 + 0.21417$

$C = 1.53039$

step8:- sample = sample + 1

$= 2 + 1$

$= 3$

step9:- if (sample > ns)

$3 > 2$

True; go to next step

step10:- iter = iter + 1

$= 1 + 1 = 2$

step11:- if (iter > epochs)

$2 > 2$

false: go to step3

step3:- sample = 1

step4:- $g_m = -(y_i - mx_i - c)(x_i)$

$= -(3.4 - (1.594)(0.2) - 1.5803)(0.2)$

$g_m = -0.318108$

$g_c = -(y_i - mx_i - c)$

$= -(3.4 - (1.594)(0.2) - 1.5300)$

$g_c = -1.5509$

step5:- $E_m = \delta E_m + (1-\delta)(g_m)^2$

$= (0.9)(0.0764) + (1-0.9)(-0.3181)^2$

$E_m = 0.0788$

$E_c = \delta E_c + (1-\delta)(g_c)^2$

$= (0.9)(0.8047) + (1-0.9)(-1.5509)^2$

$E_c = 0.9647$

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step6:- $\Delta m = \frac{-\eta}{\sqrt{Em+\varepsilon}}(gm)$

$= \frac{-0.1}{\sqrt{0.0788+10^{-8}}}(-0.318)$

$\Delta m = 0.1132$

$\Delta c = \frac{-\eta}{\sqrt{Ec+\varepsilon}}(gc)$

$= \frac{-0.1}{\sqrt{0.9647+10^{-8}}}(-1.5509)$

$\Delta c = 0.1579$

step7:- $m = m + \Delta m$

$m = 1.594 + 0.1132$

$m = 1.7072$

$c = c + \Delta c$

$= 1.53039 + 0.1579$

$c = 1.68829$

step8:- sample = sample + 1

$= 1 + 1 = 2$

step9:- if (sample > 2s)

$2 > 2$

false:- goto step 4°

step4:- $gm = -(yi - mxi - c)(xi)$

$= -(3.8 - (1.707)(0.4) - 1.6882)(0.4)$

$gm = -0.5716$

$gc = -(yi - mxi - c)$

$= -(3.8 - (1.707)(0.4) - 1.6882)$

$gc = -1.429$

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step5:- $E_m = \gamma E_m + (1-\gamma)(g_m)^2$

$= (0.9)(0.10788) + (1-0.9)(-0.5716)$

$E_m = 0.0137$

$E_c = \gamma E_c + (1-\gamma)(g_c)^2$

$= (0.9)(0.19647) + (1-0.9)(-1.429)$

$E_c = 0.172533$

step6:- $\Delta m = \frac{-\eta}{\sqrt{E_m + \varepsilon}} (g_m)$

$= \frac{-0.1}{\sqrt{0.0137 + 10^{-8}}} (-0.5716)$

$\Delta m = 0.488$

$\Delta c = \frac{-\eta}{\sqrt{E_c + \varepsilon}} (g_c)$

$= \frac{-0.1}{\sqrt{0.725 + 10^{-8}}} (-1.429)$

$\Delta c = 0.1678$

step7:- $m = m + \Delta m$

$= 1.7072 + 0.488$

$m = 2.1952$

$c = c + \Delta c$

$= 1.6882 + 0.1678$

$c = 1.856$

step8:- sample = sample + 1

$= 2 + 1 = 3$

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step 9:- if (sample > ns)

3 > 2

True : go to next step

step 10:- iter = iter + 1

= 2 + 1

= 3

step 11:- if (iter > epochs)

3 > 2

True : go to next step

step 12:- print m & c values

m = 2.1952

c = 1.856

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