Assignment - 13

Develop a simple linear regression Model using ADAGRAD Optimizer for the adjacent data set

→Do manual calculations for two iterations with the 1st two samples.

Sample(i)	X_i^2	Y_i^2
1	0.2	3.4
2	0.4	3.8
3	0.6	4.2
4	0.8	4.6

ADAGRAD Optimizer:

step 1) $[x, y]$, epochs $= 2$, $m = 1$, $c = 1$,

$G_m = G_c = 0$, $\eta = 0.1$, $\epsilon = 10^{-8}$

Sample

x	y
0.2	3.4
0.4	3.8

Step 2: iter $= 0$

Step 3: sample $= 0$

Step 4: $g_m = -(y_i - mx_i - c)\,x_i = -0.44$

$g_c = -(y_i - mx_i - c) = -(3.4 - (1)(0.2) - 1)$

$= -2.2$

Step 5: $G_m = G_m + (g_m)^2 = 0 + (-\cancel{0.44})^2 = 0.1936$

$G_c = G_c + (g_c)^2 = 0 + (-2.2)^2 = 4.84$

Step 6: $\Delta m = \dfrac{-\eta}{\sqrt{G_m + \epsilon}}\, g_m = \dfrac{-0.1}{\sqrt{0.1936 + 10^{-8}}} \times (-0.44)$

$= 0.1$

$$\Delta c = \frac{-\eta}{\sqrt{G_c + \epsilon}} g_c = \frac{-0.1}{\sqrt{4.84 + 10^{-8}}} (-2.2)$$

$$= 0.1.$$

Step 7: $m = m + \Delta m = 1 + 0.1 = 1.1$

$c = c + \Delta c = 1 + 0.1 = 1.1.$

Step 8: Sample $= 1 + 1 = 2$

Step 9: if (sample $> n_s$) false $1 > 2$

~~else~~ goto step 4.

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

$= -(3.8 - (1.1)(0.4) - 1.1)(0.4)$

$= -0.904$

$g_c = -(y_i - m x_i - c)$

$= -(3.8 - (1.1)(0.4) - 1.1)$

$= -2.26.$

Step 5: $G_m = G_m + (g_m)^2 = 0.1936 + (-0.904)^2$

$= 1.010816$

$G_c = G_c + (g_c)^2 = 4.84 + (-2.26)^2$

$= 9.94760001.$

step 6: $\Delta m = \frac{-\eta}{\sqrt{a_m + E}} g_m = \frac{-0.1}{\sqrt{1.010816 + 10^{-8}}} (-0.904)$

$= 0.08991505$

$\Delta c = \frac{-\eta}{\sqrt{a_c + E}} g_c = \frac{-0.1}{\sqrt{-2.26 + 10^{-8}}} (-2.26)$

$= 0.07165546.$

Step 7: $m = m + \Delta m = 1.1 + 0.08991505 = 1.18991504$

$c = c + \Delta c = 1.1 + 0.07165546 = 1.17165546$

Step 8: Sample $= 2 + 1 = 3$

$3 > 2$

Step 9: if (sample $> n_s$) $\Rightarrow$ True $\therefore$ go to next step

Step 10: iter = iter + 1 = 1 + 1 = 2

$2 > 2$

Step 11: if (iter > epochs) false

else go to step 3.

Step 4: Sample = 1

Step 5: $g_m = -(y_i - m x_i - c) x_i$

$= -(3.4 - (1.1899)(0.2) - 1.17165)(0.2)$

$= -0.39807231$

Step 5: $g_c = -(y_i - m x_i - c)$

$= -(3.4 - (1.899)(0.2) - 1.17165)$

$= -1.99036153$

Step 5: $G_m = G_m + (g_m)^2 = 1.010816 + (-0.39807)^2$

$= 1.16927756$

$G_c = G_c + (g_c)^2 = 9.9476001 + (-1.99036153)^2$

$= 13.90913903$

Step 6: $\Delta m = \dfrac{-\eta}{\sqrt{G_m + \epsilon}} g_m = \dfrac{-0.1}{\sqrt{1.169 + 10^{-8}}} (-0.39807)$

$= 0.03681316.$

$\Delta c = \dfrac{-\eta}{\sqrt{G_c + \epsilon}} g_c = \dfrac{-0.1}{\sqrt{13.909 + 10^{-8}}} (-1.9903)$

$= 0.05336811$

Step 7: $m = m + \Delta m = 1.18991504 + 0.03681316 = 1.226724$

$c = c + \Delta c = 1.17165546 + 0.053368 = 1.2250235$

Step 8: $\text{Sample} = 1 + 1 = 2$

Step 9: $2 > 2$

if (sample $> n_s$) no else goto step 4.

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

$= -(3.8 - (1.2267)(0.4) - 1.22502)(0.4)$

$= -0.83371406$

$g_c = -(y_i - mx_i - c) = -(3.8 - (1.2267)(0.4) - 1.2250)$

$= -2.08428514.$

step 5: $G_m = G_m + (g_m)^2 = 1.1692 + (-0.8337)^2$

$= 1.85435689$

$G_c = G_c + (g_c)^2 = 18.2533836.$ //

Step 6: $\Delta m = \frac{-\eta}{\sqrt{G_m + E}} g_m = \frac{-0.1}{\sqrt{1.8543 + 10^{-8}}}(-0.833714)$

$= 0.06105941$ //

$\Delta c = \frac{-\eta}{\sqrt{G_c + E}} g_c = \frac{-0.1}{\sqrt{18.2533 + 10^{-8}}}(-12.0842)$

$= 0.0487849$ //

Step 7: $m = m + \Delta m = 1.226128 + 0.06105941 = 1.28778762$

$c = c + \Delta c = 1.2250235 + 0.0487849 = 1.27380847$

step 8: Sample $= 2 + 1 = 3$

$3 > 2$

step 9: if (sample $> n_s$) yes, go to next step.

step 10: iter $= 2 + 1 = 3$.

$3 > 2$

step 11: if (iter $>$ epochs) go to next step

step 12: print (m, c) $m = 1.28778762$ $c = 1.27380847$