Let us consider a sample dataset have one input (x_i, a) and one input (y_i^a) and no. of sample 4. Develop a simple linear regression model using ADAGRAD optimizer.

sample(i)	x_i^a	y_i^a
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 first two samples.

S-1: $[x, y]$, epoches = 2, $m = 1, c = -1, gm = 0$ $gc = 0, \eta = 0.1$,
$\varepsilon = 10^{-8}$

S-2: itr = 1

C-3: sample = 1

S-4: $gm = -(3.4 - (1)(0.2) + 1) 0.2 = -0.84$

$gc = (3.4 - (1)(0.2) + 1) = -4.2$

S-5: $gm = 0 + (-0.84)^2 = 0.7056$,

$fc = 0 + (-4.2)^2 = 17.64$

S-6: $\Delta m = \dfrac{-\eta}{\sqrt{gm + \varepsilon}} gm = \dfrac{-(0.1)}{\sqrt{0.7056 + 10^{-3}}}$ ✳ -0.84

$= 0.09.$

$$\Delta c = \frac{-(0.1)}{\sqrt{17.64 + 10^{-8}}} \quad * -4.2$$

$$= 0.09$$

S-7: $m = m + \Delta m = 1 + 0.09 = 1.09$

$c = c + \Delta c = -1 + 0.09 = -0.91$

S-8: sample = sample + 1

$$= 1 + 1$$
$$= 2$$

S-9: If (sample > ns) goto S-10

$2 > 2$

else

S-4

S-4: $gm = -(3.8 - (1.09)(0.4) + 0.91)0.4 = -1.7$

$gc = -(3.8 - (1.09)(0.4) + 0.91) = -4.27$

S-5: $Gm = 0.7056 + (-1.7)^2 = 3.59$

$Gc = 17.64 + (-4.22)^2 = 35.87$

S-6: $\Delta m = \frac{-0.1}{\sqrt{3.59 + 10^{-8}}} \quad * -1.7 = 0.08$

$$\Delta c = \frac{-0.1}{\sqrt{35.87 + 10^{-8}}} \quad * -4.27 = 0.07$$

S-7: $m = m + \Delta m = 1.09 + 0.08 = 1.17$

$c = c + \Delta c = -0.91 + 0.07 = -0.84$

S-8: sample = sample + 1

$$= 2 + 1 = 3.$$

S-9: If (sample > ns) goto s-10

else $3 > 2$

goto s-4

S-10: itr = itr + 1

= 1 + 1 = 2

S-11: if (itr > epoches) goto s-12

$2 > 2$

else

goto s-3

S-3: Sample = 1

S-4: $gm = -(3.4 - (1.17)(0.2) + 0.84) 0.2 = -0.80$

$gc = -((3.4) - (1.17)(0.2) + 0.84) = -4.0$

S-5: $gm = 2.59 + (-0.80)^2 = 4.23$

$gc = 35.89 + (-4.0)^2 = 51.89$

S-6: $\Delta m = \dfrac{-0.1}{\sqrt{4.23 + 10^{-8}}} \ast -0.80 = 0.038$

$\Delta c = \dfrac{-0.1}{\sqrt{51.89 + 10^{-8}}} \ast -4.0 = 0.05$

S-7: $m = m + \Delta m = 0.038 + 1.17 = 1.208$

$c = c + \Delta c = -0.84 + 0.05 = -0.79$

S-8: Sample = sample + 1

= 1 + 1 = 2

S-9: If (sample > ns) goto s-10

$2 > 2$

else

goto s-4

S-4: $g_m = -(3.8 - (1.20)(0.4) + 0.79) * 0.04 = -1.64$

$g_c = (3.8 - (1.20)(0.4) + 0.79) = -4.11$

S-5: $g_m = 4.23 + (4.64)^2 = 6.9$

$g_c = 51.89 + (-4.11)^2 = 68.7$

S-6: $\Delta m = \dfrac{-0.1}{\sqrt{6.9 + 10^{-8}}}$ * $-1.64 = 0.06$

$\Delta c = \dfrac{-0.1}{\sqrt{68.7 + 10^{-8}}}$ * $-4.11 = 0.004$

S-7: $m = m + \Delta m = 1.208 + 0.06 = 1.26$

$c = c + \Delta c = -0.79 + 0.64 = -0.75$

S-8: $sample = sample + 1$

$= 2 + 1 = 3$

S-9: if $(sample > ns)$
$\quad\quad 3 > 2 \quad$ goto S-10

else
$\quad\quad$ goto S-4

S-10: $itr = itr + 1$
$\quad\quad = 2 + 1 = 3$

S-11: if $(itr > epoches)$
$\quad\quad 3 > 2 \quad$ goto S-12

$\quad\quad$ else goto S-3.

S-12: $m = 1.26$

$c = -0.75$