* Manual Calculations of ADAGRAD:

step1: $[x, y]$, $\eta = 0.1$, epochs $= 1$, $m = 1$, $c = -1$, $\epsilon = 10^{-8}$,

$G_m = 0$, $G_c = 0$

step2: iter $= 1$

step3: sample $= 1$

step 4: $g_m = -[y_i - m x_i - c] x_i$

$= -[3.4 - (1 \times 0.2) + 1] \times 0.2$

$= -[3.4 - 0.2 + 1] \times 0.2 = [4.2] \times 0.2 = 0.84$

$g_c = -[4.2]$

step 5: $G_m = G_m + (g_m)^2 = 0 + (0.84)^2 = 0.7056$

$G_c = G_c + (g_c)^2 = 0 + (4.2)^2 = 17.64$

step 6: $\Delta m = \dfrac{-0.1}{\sqrt{0.7056 + 10^{-8}}} \times (-0.\cancel{7056}\,84) = \cancel{0.1194}$ 0.09999

=

$\Delta C = \dfrac{-0.1}{\sqrt{17.64 + 10^{-8}}} \times (-4.2) = 0.09999$

step 7: $m = m + \Delta m = 1 + 0.9999 = 1.9999$

$c = c + \Delta c = -1 + 0.9999 = -0.001$

step 8: sample = sample + 1 = 1 + 1 = 2

step 9: 2 > 2 ⇒ false

goto step 4

step 10: $g_m = -[y_i - m x_i - c] x_i$

$= -[3.8 - (1 \times 1.9999) + 0.001] \times 0.4$

$= -[1.8011] \times 0.4 = -0.72044$

$g_c = -1.8011$

step-11: $G_m = G_m + (g_m)^2 = 0.7056 + 0.5190 = 1.2246$

$G_c = G_c + (g_c)^2 = 17.64 + 3.2439 = 20.8839$

step-12: $\Delta m = \frac{-0.1}{\sqrt{1.2246 + 10^{-8}}} \times (-0.72044) = 0.065102$

$\Delta c = \frac{-0.1}{\sqrt{20.8839 + 10^{-8}}} \times (-1.8011) = 0.03941$

step-13: $m = 1.9999 + 0.065102 = 2.0650$

$c = -0.001 + 0.3941 = 0.3931$

step-14: sample = sample + 1 $= 2 + 1 = 3 > 2$ true.

Goto step-15

step-15: iter = iter + 1 = 1+1 = 2.

step-16: iter > epochs $\Rightarrow 2 > 2 \Rightarrow$ false Goto step 17

step-17: sample = 1

step-18: $g_m = -[3.4 - (2.0650 \times 0.2) - 0.3931] \times 0.2$

$g_m = -[2.5939] \times 0.2 = -0.5187$

$g_c = -2.5939$

step-19: $G_m = G_m + (g_m)^2 = 1.2246 + 0.2690 = 1.4936$

$G_c = (G_c) + (g_c)^2 = 20.8839 + 6.7283 = 27.6122$

step-20: $\Delta m = \frac{-0.1}{\sqrt{1.4936 + 10^{-8}}} \times (-0.5187) = 0.01789$

$$\Delta C = \frac{-0.1}{\sqrt{27.6122 + 10^{-8}}} \times (-2.5939) = 0.04936$$

Step 21: $m = m + \Delta m = 2.0650 + 0.01789 = 2.08289$

$c = c + \Delta c = 0.3931 + 0.04936 = 0.44246$

Step-22: sample = sample + 1 = 1 + 1 = 2 > 2 = false.

Goto step 23

Step-23: $g_m = -[3.8 - (2.08289 \times 0.4) - 0.44246) \times 0.4$

$= -[2.5243] \times 0.4 = -1.00972.$

$g_c = -2.5243$

Step-24: $G_m = G_m + (g_m)^2 = 1.4936 + (-1.00972)^2 = 2.5131$

$G_c = G_c + (g_c)^2 = 27.6122 + (-2.5243)^2 = 33.9842$

Step-25: $$\Delta m = \frac{-0.1}{\sqrt{2.5131 + 10^{-8}}} \times (-1.00972) = 0.06369$$

$$\Delta c = \frac{-0.1}{\sqrt{33.9842 + 10^{-8}}} \times (-2.5243) = 0.0433$$

step-26: $m = m + \Delta m = 2.08289 + 0.06369 = 2.14658$

$c = c + \Delta c = 0.44246 + 0.0433 = 0.48576$

step-27: sample = sample+1 = 2+1 = 3 > no-of-samples
Goto next step

step-28: iter = iter+1 = 2+1 = 3 > epochs
Goto next step.

step-29: Print(m, c)

step-30: calculate mean square error

$$= \frac{1}{2\times 2}\Sigma[y_i - y_p]^2 = \frac{1}{4}\Big[(3.4 - (2.14658 \times 0.2) - 0.48576)^2 + (3.8 - (2.14658 \times 0.4) - 0.48576)^2\Big]$$

mse = 3.05121