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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 $= 1$

Step4: $g_m = -[y_i - mx_i - c]x_i$

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

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

$g_c = -[4.2]$

Step5: $G_m = G_m + (g_m)^2 = 0 + (0.84)^2 = 0.7056$

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

Step6: $\Delta m = \dfrac{-0.1}{\sqrt{0.7056 + 10^{-8}}} \times (-0.84) = 0.09999$

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

Step7: $m = m + \Delta m = (1 + 0.09999) = 1.09999$

$c = c + \Delta c = (-1 + 0.09999) = \cancel{-0.00001}$ -0.001

Step8: Sample $=$ sample $+ 1 = 1 + 1 = 2$

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Step 9: $2 > 2$ = false

go to step 4

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

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

$= (-1.8011) \times 0.4 \Rightarrow -0.72044$

$g_c = -1.8011$

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: $\Delta m = \frac{-0.1}{\sqrt{1.2246 + 10^{-8}}} \times (-0.72044) = 0.065702$

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

Step 13:

$m = 1.9999 + 0.065702 = 2.0650$

$c = -0.001 + 0.3941 = 0.3931$

Step 14: Sample = Sample + 1 = 2 + 1 = 3 > 2 true

Go to step 15

Step 15: iter = iter + 1 = 1 + 1 = 2

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Step 16: iter > epochs = 2>2 = false

Go-to 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: $\Delta m = \dfrac{-0.1}{\sqrt{1.4936 + 10^{-8}}} \times (-0.5187) = 0.01789$

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

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

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

Step 22: ~~Samle~~ Sample = sample + 1 = 1+1 = 2>2 false

Go to step 23.

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

$= 0.06369$

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

$= 0.0433$

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

Go to next step.

Step 28: iter = iter + 1 = 2 + 1 = 3 > epochs

Go to next step.

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Step29: print (m,c)

Step 30 : Calculate mean square error.

$$= \frac{1}{2\times 2} \Sigma (y_i - y_p)^2 = \frac{1}{4}\left[(3.4 - (2.14658 \times 0.2) - 0.4876)^2 + (3.8 - (2.14658 \times 0.4) - 0.48576)^2\right]$$

$$mse = 3.05121$$