# ASSIGNMENT - 15

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

## Manual calculations:

step 1: $[x, y]$, $\eta = 0.1$, $\gamma = 0.9$, epochs = 1, $m = 1$, $c = -1$, $\varepsilon = 10^{-8}$,

step: $E_m = E_c = 0$

step 2: itr = 1

step 3: sample = 1

step 4: $g_m = -(3.4 - (1)(0.2) + 1)(0.2) = -0.84$

$g_c = -4.2$

step 5: $E_m = (0.9)(0) + (0.1)(-0.84)^2 = 0.0705$

$E_c = (0.9)(0) + (0.1)(-4.2)^2 = 1.764$

step 6: $\Delta m = \dfrac{-0.1}{\sqrt{0.07 + 10^{-8}}} \times (-0.841) = 0.317$

$\Delta c = \dfrac{-0.1}{\sqrt{1.76 + 10^{-8}}} \times (-4.2) = 0.322$

Step 7: $m = m + \Delta m = 1 + (-0.314) = 0.686$

$c = c + \Delta c = -1 - 0.322 = -1.322$

Step 8: sample = sample + 1

$= 1 + 1 = 2$

Step 9: if (sample > ns)

$2 > 2$ false → goto step 4

Step 4: $g_m = -(3.8 - (0.686) \times (0.4) + 1.322)(0.4)$

$= -1.93904$

$g_c = -4.8476$

Step 5: $E_m = (0.9) \times (0.0705) + (0.1) \times (-1.93904)$

$= 0.4394$

$E_c = (0.9) \times (1.764) + (0.1)(-4.847)$

$= 3.9375$

Step 6: $\Delta m = \frac{-0.1}{\sqrt{0.4394 + 10^{-8}}} (-1.93904) = 0.2925$

$\Delta c = \frac{-0.1}{\sqrt{3.9375 + 10^{-8}}} (-4.8476) = 0.2442$

Step 7: $m = m + \Delta m = 0.9785$

$c = c + \Delta c = -1.0778$

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

Step 9: $3 > 2$

true → goto next step

step 10: itr = itr + 1 = 1+1 = 2

step 11: 2 > 2

false → goto step 3

step 3: sample = 1

step 4: $g_m = -(3.4 - (0.9785 \times 0.2) + 1.0798)\, 0.2$

$= -0.85642$

$g_c = -4.2821$

step 5: $E_m = 0.46957$

$E_c = 5.3773$

step 6: $\Delta m = \frac{-0.1}{\sqrt{0.469571 + 10^{-8}}} (-0.85642) = 0.05868$

$\Delta c = \frac{-0.1}{\sqrt{5.3773 + 10^{-8}}} \cdot (-4.2821) = 0.18466.$

step 7: $m = m + \Delta m = 0.9785 + 0.0586 = 1.0371$

$c = c + \Delta c = -1.07781 + 0.18466 = -0.89314$

step 8: sample = sample + 1

= 1+1 = 2

step 9: 2 > 2

false → goto step 4

step 4: $g_m = -(3.8 - (1.0371 \times 0.4) + 0.89314)\, 0.4$

$= -1.71132$

$g_c = -4.2783$

step5: $E_m = (0.9)\times(5.3773) + (0.1) + (-4.2783)^2$

$= 6.6699$

step6: $\Delta m = \frac{-0.1}{\sqrt{0.71547+10^{-8}}} (-1.7132) = 0.20231$

$\Delta c = \frac{-0.1}{\sqrt{6.699+10^{-8}}} \cdot (-4.27883) = 0.16565$

step7: $m = m + \Delta m = 1.0371 + 0.20231 = 1.23941$

$c = c + \Delta c = -0.89374 + 0.16565 = -0.72749$

step8: sample $= 2+1 = 3$

step9: $3 > 2$

true → goto next step

step10: $itr = itr + 1$

$= 2+1 = 3$

$3 > 2$

step11: true → goto next step

step12: print (m, c) ⇒ (1.23941, -0.72749)

Calculate MSE

$= \frac{1}{2\times2}\left[\left(3.4-(1.23941\times0.2+0.72749)\right)^2 + \left(3.8-(1.23941\times0.4+0.72749)\right)^2\right]$

$= 7.82654$