18K41A04C8

Assignment - 9:

Let consider a sample dataset have one input (X_i^a) and one output (Y_i^a), and a number of samples 4. Develop a simple linear regression model using momentum 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.

Step 1:- $[x, y]$, $m = 1$, $c = -1$, $\eta = 0.1$, epochs $= 2$, $\gamma = 0.9$,

$v_m = v_c = 0$, $ns = 2$

Step 2: iter = 1

Step 3: sample = 1

Step 4: $g_m = \frac{\partial E}{\partial m} = -(y_i - mx_i - c)\, x_i$

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

$g_m = -0.84$

$g_c = \frac{\partial E}{\partial c} = -(y_i - mx_i - c)$

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

$g_c = -4.2$

Step 5: $v_m = \gamma v_m - \eta g_m$

$= (0.9)(0) - (-0.1)(-0.84)$

$v_m = -0.084$

$v_c = \gamma v_c - \eta g_c$

$= (0.9)(0) - (-0.1)(-4.2)$

$v_c = -0.42$

Step 6: $m = m + v_m = 1 + (-0.084) = 0.916$

$c = c + v_c = -1 - 0.42 = -1.42$

Step 7: sample = sample + 1 = 1 + 1 = 2

Step 8: if (sample > ns)

2 > 2 → false

goto step 4.

Step 4: $g_m = \frac{\partial E}{\partial m} = -(3.8 - (0.916)(0.4) + 1.42)(0.4)$

$g_m = -1.941$

$g_c = \frac{\partial E}{\partial c} = -(3.8 - (0.916)(0.4) + 1.42)$

$g_c = -4.853$

Step 5: $v_m = \gamma v_m - \eta g_m$

$= (0.9)(-0.084) - (0.1)(-1.941)$

$v_m = -0.269$

$v_c = \gamma v_c - \eta g_c$

$= (0.9)(-0.42) - (-0.1)(-4.853)$

$v_c = -0.863$

Step 6 : $m = m + V_m = 0.916 + (-0.269)$

$m = 0.647$

$c = c + V_c = -1.42 - 0.863 = -2.283$

Step 7 : sample = sample + 1 = 2 + 1 = 3

Step 8 : if (sample > ns)

3 > 2 True

⇒ goto next step

Step 9 : iter = iter + 1 = 1 + 1 = 2

Step 10 : if (iter > epochs)

2 > 2 → false

goto step 3

Step 3 : sample = 1

Step 4 : $g_m = \frac{\partial E}{\partial m} = -(3.4 - (0.647)(0.2) + 2.283)(0.2)$

$g_m = -1.110$

$g_c = \frac{\partial E}{\partial c} = -(3.4 - (0.647)(0.2) + 2.283)$

$g_c = -5.553$

Step 5 : $V_m = \gamma V_m - \eta g_m$

$= (0.9)(-0.269) - (-0.1)(-1.110)$

$V_m = -0.353$

$V_c = \gamma V_c - \eta g_c$

$V_c = (0.9)(-0.863) - (0.1)(-5.553)$

$V_c = -1.332$

Step 6: $m = m + v_m = 0.6463 + (-0.353)$

$m = 0.293$

$c = c + v_c = -2.283 - 1.332$

$c = -3.615$

Step 7: sample = sample + 1 = 1 + 1 = 2

Step 8: if(sample > ns)

2 > 2 false

goto step 4

Step 4: $g_m = \frac{\partial E}{\partial m} = -(3.8 - (+0.293)(0.4) + 3.615)(0.4)$

$g_m = -2.919$

$g_c = \frac{\partial E}{\partial c} = -(3.8 - (0.293)(0.4) + 3.615)$

$g_c = -7.297$

Step 5: $v_m = \gamma v_m - \eta g_m$

$= (0.9)(-0.353) - (0.1)(-2.919)$

$v_m = -0.609$

$v_c = \gamma v_c - \eta g_c$

$= (0.9)(-1.332) - (-0.1)(-7.297)$

$v_c = -1.9285$

Step 6: $m = m + v_m$

$m = 0.293 - 0.609$

$m = -0.316$

$c = c + Vc = -3.615 - 1.9285$

$c = -5.5435$

Step 7: sample = sample + 1 = 2 + 1 = 3

Step 8 :- if (sample > ns)

3 > 2 True

⇒ goto next step

else goto step 4

Step 9: iter = iter + 1

= 2 + 1 = 3

Step 10: if (iter > epochs)

3 > 2 True

goto step 11

Step 11: print m, c values

m = -0.316, c = -5.543