18K41A04C8

Assignment - 11 :

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 Nesterov Accelerated Gradient (NAG) 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: $g_m = \frac{\partial E}{\partial m} = -(y_i - (m + \gamma v_m)x_i - (c + \gamma v_c))x_i$

$= -(3.4 - (1 + (0.9)(0))0.2 - (-1 + (0.9)(0)))(0.2)$

$= -(3.2 + 1)\,0.2$

$g_m = -0.84$

$$g_c = \frac{\partial E}{\partial c} = -(y_i - (m+\gamma V_m)x_i - (c+\gamma V_c))$$

$$= -(3.4 - (1+(0.9)(0))0.2 - (-1+(0.9)(0)))$$

$$g_c = -4.2$$

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: $g_m = \frac{\partial E}{\partial m} = -(3.8 - (0.916 + (0.9)(-0.084))0.4$

$-(-1.42 + (0.9)(-0.42)))0.4$

$= -(3.463 + 1.798)0.4$

$g_m = -2.104$

$$g_c = \frac{\partial E}{\partial c} = -(3.8 - (0.916 + (0.9)(-0.084)(0.4) - (-1.42 + (0.9)(-0.42)))$$

$$= -(2.914 + 1.798)$$

$$g_c = -4.712$$

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

$= (0.9)(-0.084) - (-0.1)(-2.104)$

$v_m = -0.286$

$v_c = \gamma v_c - \eta g_c$

$= (0.9)(-0.42) - (-0.1)(-4.712)$

$v_c = -0.849$

Step 6: $m = m + v_m = 0.916 - 0.286 = 0.63$

$c = c + v_c = -1.42 - 0.849 = -2.269$

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: $g_m = \frac{\partial E}{\partial m} = -\big(3.4 - (0.63 + (0.9)(-0.286))(0.2)$

$- (-2.269 + (0.9)(-0.849))\big) 0.2$

$= -(3.325 - (-3.0331)\ 0.2$

$g_m = -1.271$

$g_c = \frac{\partial E}{\partial c} = -\big(3.4 - (0.63 + (0.9)(-0.286))(0.2)$

$- (-2.269 + (0.9)(-0.849))\big)$

$g_c = -6.3581$

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

$= (0.9)(-0.286) - (-0.1)(-1.271)$

$v_m = -0.384$

$v_c = \gamma v_c - \eta g_c$

$= (0.9)(-0.849) - (-0.1)(-6.3581)$

$v_c = -1.399$

Step 6: $m = m + v_m = 0.63 - 0.384 = 0.246$

$c = c + v_c = -2.269 - 1.399 = -3.668$

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

if (sample > ns)

2 > 2 False

goto step 4

Step 4:

$$g_m = \frac{\partial E}{\partial m} = -\Big[3.8 - (0.246 + (0.9)(-0.384))(0.4) - (-3.668 + (0.9)(-1.399))\Big](0.4)$$

$$= -\big[3.839 - (-4.927)\big](0.4)$$

$$g_m = -3.506$$

$$g_c = \frac{\partial E}{\partial c} = -\Big[3.8 - (0.246 + (0.9)(-0.384))(0.4) - (-3.668 + (0.9)(-1.399))\Big]$$

$$g_c = -8.766$$

Step 5: $V_m = \gamma V_m - \eta g_m = (0.9)(-0.384) - (-0.1)(-3.506)$

$$V_m = -0.696$$

$$V_c = \gamma V_c - \eta g_c = (0.9)(-1.399) - (-0.1)(-8.766)$$

$$V_c = -2.1357$$

Step 6: $m = m + V_m = 0.246 + (-0.696)$

$$m = -0.45$$

$$c = c + V_c = -3.668 + (-2.1357)$$

$$c = -5.803$$

Step 7: sample = sample + 1

$$= 2 + 1$$

$$= 3$$

Step 8: if (sample > ns)

3 > 2 → True

goto next step

Step 9: iter = iter + 1

= 2 + 1 = 3

Step 10: if (iter > epochs)

3 > 2 → True

goto next step

Step 11 :- print m, c values.

m = − 0.45

c = − 5.803