Assignment 11:-

Nesterov Accelerated Gradient Descent

Manual calculation

step -1 : read [x, y], m=1, c=-1, η=0.1, γ=0.9

$v_m=0$, $v_c=0$, epochs: 2, no. of samples = 2

x	Y
0.2	3.4
0.4	3.8

step - 2 : iter = 1

step - 3 : sample = 1

step - 4 : $g_m = -(y_i^0 - (m+\gamma v_m)x_i^0 - (c+\gamma v_c))x_i^0$

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

$g_c = -4.02$

step - 5 : $v_m = \gamma v_m - \eta_c g_m = (0.9)(0) - (0.1)(-0.84)$

$= 0.084$

$v_c = \gamma v_c - \eta g_c = (0) - (0.1)(-4.02) = 0.42$

step - 6 : $m = m + v_m = 1 + 0.084 = 1.084$

$c = c + v_c = -1 + 0.42 = -0.58$

step - 7 : sample = 1 + 1 = 2

step - 8 : if sample > no: of samples ⇒ 2 > 2 ⇒ false

go to step 4

step - 9 : $g_m = -(3.8 - (1.084) + (0.9)\times(0.084))\times 0.4$

$- (-0.58 + (0.9)\times(0.42))\times 0.1$

$g_m = -(4.29416)\times 0.4 = -1.717664$

$g_c = -4.29416$

step - 10 : $v_m = \gamma v_m - \eta g_m = (0.9)(0.084) - (0.1)(-1.717664)$

$= 0.247366 4$

$v_c = \gamma v_c - \eta g_c = (0.9)(0.42) - (0.1)(-4.29416)$

$= 0.807416$

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step-11 : $m = m + V_m = 1.084 + 0.24736 = 1.33136$

$c = c + V_c = -0.058 + 0.0807416 = 0.0227416$

step-12 : sample = 2+1 = 3

step-13 : if sample > no: of samples = 3 > 2 = true

go to next step.

step-14 : iter = 1+1 = 2

step-15 : if iter > epochs ⇒ 2 > 2 ⇒ false

go to step 3

step-16 : Sample = 1

step-17 : $g_m = -(y_i - (m + \gamma V_m) x_i - (c + \gamma V_c)) x_i$

$= -(3.4 - [1.33136 + [(0.9) \times (0.24736)]] \times 0.2 -$

$(0.0227416 + (0.9) \times 0.0807416)]$

$= -(2.13511)$

$g_c = -(3.4 - 1.553984 - 0.95409) = 0.891926$

step-18 : $V_m = \gamma V_m - \eta g_m = (0.9) \times 0.24736 - (0.1) \times (-2.13511)$

$= 0.43614$

step-19 : $m = m + V_m = 1.3316 + 0.43614 = 1.76774$

$c = c + V_c = 0.0227416 + 0.815867 = 1.043283$

Step-20 : sample = sample + 1 = 1 + 1 = 2

Step-21 : if sample > n S ⇒ 2 > 2 ⇒ false

repeat step 4

step-22 : $g_m = -(y_i - (m + \gamma V_m) x_i - (c + \gamma V_c)) x_i$

$= -[3.8 - (1.76774 + (0.9) \times 0.43614)) \times 0.4 - (1.043283$

$+ (0.9) \times 0.815867)] \times 0.4$

$= -[3.8 - (2.160266) \times 0.4 - 1.777533] \times 0.4$

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$q = -(3.08 - (2.160266 \times 0.04) - 1.7725633)$

$= -1.1583308$

step 23: $v_m = \gamma v_m - \eta \frac{\partial E}{\partial m}$

$= (0.9) \times 0.043614 - (0.1) \times (-0.0463332)$

$= 0.043 88592$

$v_c = \gamma v_c - \eta \frac{\partial E}{\partial c}$

$= (0.9) \times 0.815867 - (0.1) \times (-1.1583303)$

$= 0.8501133$

step 24: $m = 1.76774 + 0.0388592 = 2.2065992$

$c = 1.043283 + 1.1583303 = 2.2016133$

step 25: sample = 2+1 = 3 > 2 — sample > epochs

go to step 26.

step 26: iters = 2+1 = 3 => epochs

step 27

step 27: point (m, c)

=) 2.2065992 , 2.2016133

step 28: mean squared error

$= \frac{(3.4 - (2.2065992 \times 0.2) - 2.2016133)^2 + (3.8 - (2.2065992 \times 0.4) - 2.266133)^2}{2}$

$= \frac{(0.57315) + (0.5122293)}{3}$

$= \frac{1.085443}{2} = 0.54271$

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