Assignment -13:

1. Let us Consider a sample dataset have one input (x;a) and one output (y;a) and number of samples 4. Develop a simple linear regression model using ADAGRAD optimizer.

Sample (i)	x;a	y;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 2 samples.

1. [x,y], epochs = 2, m = 1, c = -1, $G_m = G_c = 0$, $\eta = 0.1$, $\varepsilon = 10^{-8}$.
2. iter = 1
3. Sample = 1
4. $g_m = -(3.4 - (1)(0.2)+1)0.2 = -0.84$

   $g_c = -(3.4 - (1)(0.2)+1) = -4.2$
5. $G_m = 0 + (-0.84)^2 = +0.7086$

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

6. $\Delta m = \frac{-\eta}{\sqrt{G_m + \varepsilon}} g_m = \frac{-0.1}{\sqrt{0.70 + 10^{-8}}} \times 0.8 = 0.09$

$\Delta c = \frac{-(0.1)}{\sqrt{17.6 + 10^{-8}}} \times -4.2 = 0.09.$

7. $m = m + \Delta m = 1 + 0.09 = 1.09$

$c = c + \Delta c = -1 + 0.09 = -0.91$

8. sample = sample + 1

= 1 + 1 = 2

9. if (sample > ns) 2 > 2

goto step 10

else

goto step 4.

4. $g_m = -(3.8 - (1.09)(0.4) + 0.91) 0.4 = -1.7$

$g_c = -(3.8 - (1.09)(0.4) + 0.91) = -4.27$

5. $G_m = 0.70 + (-1.7)^2 = 3.59$

$G_c = 17.64 + (-4.27)^2 = 35.37$

6. $\Delta m = \frac{-0.1}{\sqrt{3.5 * 10^{-8}}} \times -1.7 = 0.08$

$\Delta c = \frac{-0.1}{\sqrt{35.8 + 10^{-8}}} \times -4.27 = 0.07$

7. $m = m + \Delta m = 1.09 + 0.08 = 1.17$

$c = c + \Delta c = -0.91 + 0.07 = -0.84$

8. sample += 1 = 3

9. if (sample > ns)

goto 10

else

goto 4

10. iter += 1 = 2

11. if (iter > epochs)

goto 12

else

goto 3

3. Sample = 1

4. $g_m = -(3.4 - (1.17)(0.2) + 0.84)\,0.2 = -0.180$

$g_c = -((3.4 - (1.17)(0.2) + 0.84) = -4.0$

5. $G_m = 3.59 + (-0.180)^2 = 4.23$

$G_c = 35.89 + (-4.0)^2 = 51.89$

6. $\Delta m = \frac{-0.1}{\sqrt{4.23 + 10^{-8}}} \times -0.80 = 0.038$

$\Delta c = \frac{-0.1}{\sqrt{51.34 + 10^{-8}}} \times -4.0 = 0.05$

7. $m = m + \Delta m = 0.038 + 1.17 = 1.208$

$c = c + \Delta c = -0.84 + 0.05 = -0.79$

8. if (Sample > ns)
   goto step 10
   else
   goto step 4

9. $g_m = -(3.8 - (1.20)(0.4) + 0.79)\,0.4 = -1.64$

$g_c = -(3.8 - (-1.20)(0.4) + 0.79) = -4.11$

5. $G_m = 4.23 + (-1.64)^2 = 6.9$

$G_c = 51.89 + (-4.11)^2 = 68.7$

6. $\Delta m = \frac{-0.1}{\sqrt{6.9 + 10^{-8}}} \times -1.64 = 0.06$

$\Delta c = \frac{-0.1}{\sqrt{68.7 + 10^{-8}}} \times -4.11 = 0.04$

7. $m = m + \Delta m = 1.208 + 0.06 = 1.26$

$c = c + \Delta c = -0.79 + 0.04 = -0.75$

8. Sample + = 1 = 3

9. if (Sample > ns)
   goto step 10
   else
   goto step 4

10. Iter + = 1 = 3

11. if (Iter > epochs) goto 12
    else goto 3

12. m = 1.26
    c = -0.75