Assignment 2

Find global minimum point and value for function $f(x,y) = x^2 + y^2 + 10$.

Do manual calculations of 2 iterations.

sol step 1:- $x = -1$, $y = 1$, $\eta = 0.1$, epoches $= 2$

Step 2:- itr $= 1$.

Step 3:- $\frac{\partial f}{\partial x} = 2x = -2$

$$\frac{\partial f}{\partial y} = 2y = 2.$$

Step 4:-

$$dx = -\eta \frac{\partial f}{\partial x} = -2(-0.1) = 0.2$$

$$\Delta y = -\eta \frac{df}{dy} = -(0.1)(2) = -0.2$$

Step 5:- $x = x + \Delta x = -1 + 0.2 = 0.8$

$$y = y + \Delta y = 1 - 0.2 = 0.8$$

Step 6:- itr = itr + 1 = 1 + 1 = 2

Step 7:- if (2 > 2)

go to step 8

else

go to step 3

Step 3 :- $\frac{\partial f}{\partial x} = 2x = 2(-0.8) = -1.6.$

$\frac{\partial f}{\partial y} = 2y = 2(0.8) = 1.6.$

Step 4 :- $\Delta x = -\eta \frac{\partial f}{\partial x} = -0.1(-1.6) = 0.16$

$\Delta y = -\eta \frac{\partial f}{\partial y}$

$= -(0.1)(1.6) = -0.16$

Step 5 :-

$x = x + \delta x = -0.8 + 0.16 = -0.64$

$y = y + \Delta y = 0.8 - 0.16 = 0.64.$

Step 6 :- itr = itr + 1 = 2 + 1 = 3.

Step 7 :- If (itr > epochs)

3 > 2.

go to step 8

else

go to step 3.

Step 8 :- $x = -0.64$

$y = 0.64.$

$f(x,y) = x^2 + y^2 + 10$

$= (-0.64)^2 + (0.64)^2 + 10$

$= 0.4 + 0.4 + 10$

$= 10.8.4$

Assignment - 3

Let us consider sample dataset have 1 input x_i a and one output (y_i a) and no. of samples. develop sample regression model using stochastic gradient descent optimiser.

sample	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

Sol

1) $x, y, m=1$; $c=-1$, $\eta=0.1$, epoches $=2$, $n_s=2$

2) it $=1$

3) sample $=1$

4) $\frac{\partial E}{\partial m} = -(8.4-(1))(0.2)-(-1))\,0.2$

$= -0.84$

$\frac{\partial f}{\partial c} = -(3.4(1))(0.2+1)$

$= -4.2.$

5) $\Delta m = -(0.1)(0.84)$

$= 0.084.$

$\Delta c = -(0.1)(-4.2)$

$= 0.42$

6) $m = m + \Delta m$

$= 1 + 0.84 = 1.084.$

$c = c + \Delta c$

$= -1 + 0.42 = 0.58.$

7) Sample + = 1 = 2.

8) if (2 > 2)

go to step 9

else

step 4.

4) $\frac{\partial f}{\partial m} = -(3.8 - (1.084)(0.4) + 0.58)\, 0.4$

$= -1.5785.$

$\frac{\partial f}{\partial c} = -(3.8 - (1.084)(0.4) + 0.58)$

$= -3.9464.$

5) $\Delta m = -(0.1)(-1.5785) = 0.1578$

$\Delta c = -(0.1)(-3.9464) = 0.3046.$

6) $m = m + \Delta m = 1.84 + 0.1578 = 1.2418.$

$c = c + \Delta c = -0.58 + 0.3946 = -0.1854.$

7) sample = +1

8) if (3 > 2)

go to step 9

else.

Step 4.

9) it+ = 1

10) if (2>2)

go to step 11

else

go to step 3.

4) $\frac{\partial E}{\partial m} = -(3.4 - (1.2)(0.2) + 0.18,$

$= -3.34.$

5) $\Delta m = -(0.1)(-0.668) = 0.0668.$

6) $m = \Delta m + m = 1.24 + 0.066 = 1.3.$

$c = \Delta c + c = 0.18 + 0.33 = 0.15.$

7) Sample = +1

8) if (2>2)

go to step 9

else

step 4.

4) $\frac{\partial E}{\partial m} = -(3.8 - (1.3)(0.4) - 0.15)\, 0.4.$

$= -1.25.$

$\frac{\partial E}{\partial c} = -(3.8 - (1.3)(0.4) - 0.15)$

$= -3.13$

5) $\Delta m = -(0.1)(-1.25) = 0.12$

$\Delta c = -(0.1)(-3.13) = 0.31.$

6) $m = m + \Delta m = 1.3 + 0.12 = 1.42$

$c = c + \Delta c = 0.15 + 0.31 = 0.46$

7) sample $+= 1$

8) if $(3 > 2)$

go to step 9.

9) $it = it + 1$

10) if $(it > ep)$

$3 > 2.$

step 11

11) print m & c.

$m = 2.38$

$c = 1.38.$

Assignment 5

Let us consider a sample dataset have 1 i/p (x_i) and one o/p (y_i) and no. of samples develop an SLR mode using MBGD.

sample	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

→ batch 1.

→ batch 2.

Sol

1) $[x, y]$; $m=1$, $c=-1$, $\eta=0.1$, epochs $=2$, $bs=2$

2) $nb = \frac{ns}{bs} = \frac{4}{2} = 2$.

3) $it = 1$

4) Batch $=1$

5) $\frac{\partial E}{\partial m} = \frac{-1}{bs} \sum_{i=1}^{bs} (y_i - mx_i - c) x_i$

$= \frac{-1}{2} \left[(3.4 - (1)(0.2) + 1) 0.2 \right] + \left[3.8 - 0.4 \right] 0.4$

$= -1.34$.

$\frac{\partial E}{\partial c} = \frac{-1}{2} \left[(3.4 - 0.2 + 1) + (3.8 - 0.4 + 1) \right]$

$= -4.3$

6) $\Delta m = -(0.1)(-1.34) = 0.134.$

$= -(0.1)(-4.3) = 0.43.$

7) $m = m + \Delta m = 1 + 0.134 = 1.134.$

$\cancel{c = c} + \Delta c = -1 + 0.43 = -0.57.$

8) Batch += 1

9) if (2 > 2)

go to step 10

else

go to step 5.

5) $\frac{\partial E}{\partial m} = \frac{-1}{2}\left[4.2 - (1.1(0.6)) + 0.57\right) 0.6 +$

$(4.6 - (1.134)(0.8) + 0.57) 0.8].$

$= 2.982.$

$\frac{\partial E}{\partial c} = \frac{-1}{2}\left[4.2 - (1.134)(0.6) + 0.57\right) + 4.6 - (1.34)$

$(0.8) + 0.57)].$

$= -4.17.$

6) $\Delta m = 0.2932$

$\Delta c = 0.417$

7) $m = 1.13 + 0.293 = 1.42$

$c = -0.57 + 0.4 = 0.15.$

8) Batch += 1

9) if (batch > nb)

3 > 2

go to step 10

10) itr += 1

11) if (2 > 2)

go to step 12

else

step 4.

4) Batch = 1

$$\frac{\partial E}{\partial m} = \frac{-1}{2}\left[3.4 - (1.4)(0.2) + 0.5)0.2 + 3.8 - (1.4)\cdot(0.4) + 0.15)0.4\right].$$

$= -1.00291.$

$$\frac{\partial E}{\partial m} = \frac{-1}{2}\left[3.4 - (1.42)(0.2) + 0.1523) + 3.8 - (1.4)(0.4) + 0.15\right].$$

$= -3.3241$

6) $\Delta m = -0.1\,(-1.00291) = 0.1002$

$\Delta c = -0.1\,(-3.3241) = 0.832.$

7) $m += \Delta m = 1.42 + 0.1002 = 1.5$

$c += \Delta c = -0.15 + 0.3 = 0.17.$

8) batch += 1

9) if (2 > 2).

go to step 10

else

10) $\frac{\partial E}{\partial m} = \frac{-1}{2}\Big[4.2 - (1.5(0.6) - 0.17)) 0.6 +$

$4.6 - (1.5(0.8) - 0.17(0.8))$.

$= -2.21$.

$\frac{\partial E}{\partial c} = -3.151$.

6) $\Delta m = -01 \times -2.21 = 0.221$

$\Delta c = -0.1 \times 3.15 = 0.315$

7) $m += \Delta m = 1.5 + 0.22 = 1.7$

$c += \Delta c = 0.17 + 0.3 = 0.4$.

8) Batch += 1

9) if (Batch > nb) go to step 10 else step 5

10) itr += 1

11) if (3>2) got step 12

12) print m, c

$m = 2.72$

$c = 2.33$.

Assignment 7.

Let us consider a sample dataset have one i/p (x_i) and o/p (y_i) & no. of samples a. develop a sample Linear regression model by BGD

sample	x_i	y_i
1	0.2	3.4
2	0.4	3.8
3	0.6	4.2
4	0.8	4.6.

Sol

1) $[x, y]$; $m = 1$, $c = 1$, $\eta = 0.1$, epochs $= 2$, $ns = 2$

2) it $= 1$

3) $$\frac{\partial E}{\partial m} = \frac{-1}{ns} \sum_{i=1}^{ns} (y_i - m x_i - c) x_i$$

$$= \frac{-1}{2} \left[(3.4 - (1)(0.2) + 1) 0.2 + (3.8\ (1)(0.4) + 1) 0.4 \right)$$

$$= -1.34$$

$$\frac{\partial E}{\partial c} = \frac{-1}{2} \left([3.4 - 0.2 + 1] + [3.8 - 0.4 + 1] \right)$$

$$= -4.3.$$

4) $$\Delta m = -\eta \frac{\partial E}{\partial m}$$

$$= -0.1 \times -1.34 = 0.134$$

$\Delta c = -\eta \frac{\partial E}{\partial c}$.

$= -0.1(4.3) = 0.43$.

5) $m += \Delta m$

$= 1 + 0.134 = 1.13$.

$c += \Delta c$

$= -0.1 \times -4.3 = 0.43$

6) $it += 1$

7) if $(2>2)$

go to step 8; else step 3.

3) $\frac{\partial E}{\partial m} = \frac{1}{2}[3.4 - (1.134)(0.2) + 0.54)(0.2)$

$+ 3.8 - (1.134)(0.4) + 0.57)\,0.4)$

$= -3.829$.

4) $\Delta m = -0.1 \times 1.15 = 0.1157$

$\Delta C = -0.1 \times -3.8 = 0.0328$

5) $m += \Delta m \Rightarrow 1.134 + 0.1157 = 1.7097$

$c += \Delta C \Rightarrow -0.57 + 0.3829 \Rightarrow + \; +3.10$.

6) $it += 1$

7) if $(it > epo)$ gotostep 8.

8) $m = 1.70$, $C = 3.10$.