Assignment 2

Find global minimum point and value for function

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

Do manual calculations to 2 iterations.

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

step 2 :- iter $=1$

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 :- iter $=$ iter $+1 = 1+1 = 2$

step 7 :- if $(2>2)$

go to step 8

else

go to step 3

step 3 :- $\frac{df}{dx} = 2x = 2(-0.8) = -1.6$

$\frac{df}{dy} = 2y = 2(0.8) = 1.6$

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:- $it = it + 1 = 2 + 1 = 3$

step 7:- if (it > epoches)

$3 > 2$

go to step 8

else

go to step 3

step 8: $x = -0.64$

$y = 0.64$

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

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

$= 0.4 + 0.4 + 10 = 10.8$

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Assignment - 3

let us consider sample dataset have 1 input $x_i{:}a$ and one o/p $(y_i{:}a)$ and no. of samples. develop a 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

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

2) it $= 1$

3) sample $= 1$

4) $\frac{\partial E}{\partial m} = -(3.4 - (1)) (0.2) - (-1)) 0.2$

$= -0.84$

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

$= -4.2$

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

step 3

3) sample $= 1$

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

$= -0.668$

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

$= -3.34$

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

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

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

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

$m = 1.42$

$c = 0.46$

Assignment-5

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

sample (i)	x_i^a	y_i^a	
1	0.2	3.4	→ batch = 1
2	0.4	3.8	
3	0.6	4.2	
4	0.8	4.6	→ batch = 2

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

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

$$= -1.34$$

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

$$= -4.3$$

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

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

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

$c = c + \Delta c = -1 + 0.43 = -0.57$

8) Batch $+= 1$

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9) if $(2>2)$

go to step10 else step 5.

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

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

$=2.932$

$\frac{\partial E}{\partial c} = \frac{-1}{2}\{4.2-(1.134)(0.6)+0.57)+$

$4.6-(1.34)(0.8)+0.57)]$

$= -4.17$

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 step10

10) it $+=1$

11) if $(2>2)$ go to step12 else step 4

4) Batch $=1$

$\frac{\partial E}{\partial m} = \frac{-1}{2}[3.4-(1.4)(0.2)+0.5)0.2+$

$3.8-(1.4)(0.4)+0.15)0.4]$

$= -1.0029$

$\frac{\partial E}{\partial m} = \frac{-1}{2}\{3.4-(1.42)(0.2)+0.1523)+$

$3.8-(1.4)(0.4)+0.15]$

$= -3.3241$

6) $\Delta m = -0.1(-1.0029) = 0.1002$

$\Delta c = -0.1(-3.3241) = 0.332$

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 step10 else step7

10) $\frac{\partial E}{\partial m} = \frac{-1}{2}\left[4.2 - (1.5(0.6) - 0.17)0.6 + 4.6 - (1.5(0.8) - 0.17(0.8))\right)$

$= -2.21$

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

6) $\Delta m = -0.1 \times -2.21 = 0.221$

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

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 step5

10) itt=1

11) if (3>2) go step 12

12) print m, c

$m = 1.748$

$c = 0.494$

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Assignment-7

let consider a sample dataset have one i/p (x_i) and (y_i) and 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

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

2) $it = 1$

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

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

$$= -1.34$$

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

$$= -4.3$$

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;

3) $\frac{\partial E}{\partial m} = \frac{1}{2}[3.4 - (1.134)(0.2) + 0.54)(0.2) + 3.8 - (1.134)(0.4) + 0.57)0.4)$

$= -1.157$

$\frac{\partial E}{\partial c} = -\frac{1}{2}[3.4 - (1.34)(0.2) + 0.57) + 3.8 - (1.134)(0.4) + 0.57)]$

$= -3.829$

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

$\Delta c = -0.1 \times -3.8 = 0.3829$

5) $m += \Delta m \Rightarrow 1.134 + 0.1157 = 1.2497$

$c += \Delta c \Rightarrow -0.57 + 0.3829 \Rightarrow -0.187$

6) it += 1

7) if (it > epo) go to step 8

$3 > 2$

8) $m = 1.24$ $c = -0.187$