Assignment 2

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

Do manual calculations for 2 iterations

Step 1 :- $x = -1$, $y = 1$, $\eta = 0.1$, epochs $= 2$

Step 2 :- iter $= 1$

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

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

Step 4 :- $dx = -\eta \frac{\partial f}{\partial x} = -2(-0.1) = 0.2$

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

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) ×

goto 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 > epoches)

$3 > 2$

goto step 8

else go to step3

Step 8 : $x = -0.64$

$y = 0.64$

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

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

$= 0.4 + 0.4 + 10 = 10.8$

Assignment - 3

Let us consider sample dataset have 1 input x_{ia} & one opp (y_{ia}) & no. of sample. Develop a sample regression model using stochastic gradient descent optimiser.

Sample	x_{ia}	y_{ia}
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) $itr = 1$

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) $\Delta m = -(0.1)(0.84) = 0.084$ $\quad \Delta c = -(0.1)(-4.2)$

$= 0.42$

6) $m = m + \Delta m$

$= 1 + 0.84 = 1.084$

$c = c + \Delta c$

$= -1 + 0.42 = -0.58$

7) $m = m + \Delta m$

$= 1 + 0.84 = 1.084$

$c = c + \Delta c$

$= -1 + 0.42 = -0.58$

7) sample $t:1 = 2$

8) if $(2>2)$
goto step 9
else
step 4

4) $\frac{\partial f}{\partial m} = -(3.8-(1.084)(0.4)+0.58)\,0.4$
$= -1.5785$

$\frac{\partial f}{\partial c} = -(3.8-(1.084)(0.4)+0.58)$
$= -3.9964$

5) $\Delta m = -(0.1)(-1.5785) = 0.1578$
$\Delta c = -(0.1)(-3.9464) = 0.3046$

6) $m = m+\Delta m = 1.84+0.15738 = 1.2418$
$c = c+\Delta c = -0.58+0.3946 = -0.1854$

7) Sample $= +1$

8) if $(3>2)$
goto step 9
else
step 4

9) itrt $= 1$

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) $\Delta m = -(0.1)(-0.668) = -6.0668$

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 $(2 > 2)$

goto 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) $m = m + \Delta m = 1.3 + 0.12 = 1.02$

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

7) sample $+= 1$

8) if $(3 > 2)$

go to step 9

9) itr = itr + 1

10) if (itr > epoch)

$3 > 2$

step 11

11) print m & c

$m = 1.42$

$c = 0.46$

det
and
SLR

Assignment - 5

Let us consider a sample dataset have 1 I/p (x_i) and 1 O/P (y_i) & no. of samples develop a SLR model using MBGD.

Sample (i)	x_i^a	y_i^a	
1	0.2	3.4	
2	0.4	3.8	→ batch = 1
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) $nb = \frac{ns}{bs} = 4/2 = 2$

3) itr = 1

4) Batch = 1

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

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

$$= -1.34.$$

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

$$= -4.3$$

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

9) if $(2 > 2)$
go to step 10 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) $\Delta m = 0.2932 \quad \Delta c = 0.417$

7) $m = 1.13 + 0.293 = 1.42$

$c = -0.57 + 0.4 = -0.15$

8) Batch += 1

9) if (batch > nb)

3 > 2

goto step 10

10) itr += 1

11) if (2 > 2) goto step 12 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) goto step 10 else step 7

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

$= -2.21$

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

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

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

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) goto step 10

10) itr += 1

11) if (3 > 2) go to step 12

12) print m, c

$m = 1.748$

$c = 0.494$

Assignment-7

Let consider a sample dataset have one i/p & (y_i) & no. of samples a develop a sample linear regression model for 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) itr $= 1$

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

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

$= -1.34$

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

$= -4.3$

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) itr $+= 1$

2) if (3 > 2)
goto step 8

3) $\frac{\partial E}{\partial m} = -\frac{1}{2}[3.6 - (1.130)(0.2) + 0.57)(0.2) +$
$3.8 - (1.130)(0.4) + 0.57)(0.4)]$

$= -1.157$

$\frac{\partial E}{\partial c} = -\frac{1}{2}[3.6 - (1.130)(0.2) + 0.57) +$
$3.8 - (1.130)(0.4) + 0.57)]$

$= -3.829$

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) itr += 1
7) if (itr > epoch) go to step 8
$3 > 2$

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

7) if (7 > 2)
goto step 8

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

$= -1.157$

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

$= -3.829.$

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) itr + = 1
7) if (itr > epoch) go to step 8
3 > 2

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