Assignment-3

Stochastic gradient Descent

Date

x	y
0.2	3.4
0.4	3.8

Step1:- [x, y]

epochs = 2

$\eta = 0.1$

m = 1

c = -1

Step2:- itr = 1

Step3:- sample = 1

Step4:- error $(\epsilon) = \frac{1}{2}(y_i - mx_i - c)^2$

$= \frac{1}{2}(3.4 - (1)(0.2) - (-1))^2$

$= 8.82$

$\frac{\partial \epsilon}{\partial m} = -(y_i - mx_i - c)$

$= -(3.4 - (1)(0.2) - (-1)$

$= -4.2$

Step5: $\Delta m = -\eta \frac{\partial \epsilon}{\partial m}$

$= -(0.1)(-0.84)$

$= 0.084$

$$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-4.2) = 0.42$$

Step 6:- $m = m + \Delta m = 1 + 0.084 = 1.084$

$c = c + \Delta c = -1 + 0.42 = -0.58$

Step 7:- sample = sample + 1 = 1 + 1 = 2

sample = 2 ≤ ns

Step 8:- go to Step-4

Hence

$$E = \frac{1}{2}(y_i - mx_i - c)^2$$

$$= \frac{1}{2}(3.8 - (1.084)(0.4) - (-0.58)^2$$

$$= 7.79$$

Step 9:- $\frac{\partial E}{\partial m} = -(y_i - mx_i - c)x_i$

$$= -(3.8 - (1.084)(0.4) - (-0.58))0.4$$

$$= -1.58$$

$$\frac{\partial E}{\partial c} = -(y_i - mx_i - c)$$

$$= -3.9464 \simeq -3.94$$

Step 10:- $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.58) = 0.158$

$$\Delta c = -\eta \frac{\partial E}{\partial m} = -(0.1)(-3.94) = 0.394$$

Step11:- $m = m + \Delta m = 1.084 + 0.158 = 1.242$

$c = c + \Delta c = -0.58 + 0.394 = -0.186$

Step12:- Sample = 2+1 = 3 $\leq$ ns → false

go to next step

Step13: iter = itr + 1

= 1+1 = 2 $\leq$ epochs

Step14: sample = 1

Step15:- $Y = (1.242)(0.2) + (-0.186)$

$= 0.0624$

$E = \frac{1}{2}(3.4 - 0.0624) = 1.6688$

Step16:- $\frac{\partial E}{\partial m} = -(3.4 - (1.242)(0.2) - (-0.186)(0.2)$

$= -0.66752$

$\frac{\partial E}{\partial c} = -(3.4 - (1.242)(0.2) - (-0.186))$

$= -3.3376$

Step17:- $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-0.66752)$

$= 0.066752$

$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-3.3376)$

$= 0.33376$

Step18:- $m = m + \Delta m$

$= 1.242 + 0.066752 = 1.90952$

$C = C + \Delta C$

$= -0.186 + 0.33376$

$= 0.14776$

Step19:- Sample $= 1+1 = 2 \leq ns \rightarrow$ True

Step20:- $\frac{\partial \epsilon}{\partial m} = -(y_i - mx_i - C)x_i$

$= -(3.8 - (1.90952)(0.4) - (0.14776)(0.4)$

$= -1.155372$

$\frac{\partial \epsilon}{\partial m} = -(y_i - mx_i - C)$

$= -(3.8 - (1.90952)(0.4) - (0.14776)$

$= -2.888432$

Step21:- $\Delta m = -\eta \frac{\partial \epsilon}{\partial m} = -(0.1)(-1.155372)$

$= 0.1155372$

$\Delta C = -\eta \frac{\partial \epsilon}{\partial C} = -(0.1)(-2.888432)$

$= 0.2888432$

Step23:- $m = m + \Delta m = 1.90952 + 0.1155372$

$= 2.025057$

$c = c + \Delta c = 0.14776 + 0.2888$

$= 0.4366032$

Step23:- sample = 2+1 = 3 ≤ ns → false

Step24:- itr = 2+1 = 3 ≤ epochs → false

Step25:- print m, c values

$m = 2.025057$

$c = 0.4366032$

Step26:- mean square error

$$= \frac{(3.4) - (2.025057)(0.2) - (0.4366032)}{3.8 - (2.025057)(0.4) - (0.436603))^2}$$

$$= \frac{(2.558386)^2 + (2.553774)^2}{2}$$

$= 13.06692$