18K41A05F9

Assignment - 03

Stochastic Gradient Descent

Step-1: [x, y]

epochs = 2

$\eta = 0.1$

m = 1

c = -1

Data

X	Y
0.2	3.4
0.4	3.8

Step-2: iter = 1 , Step-3 : sample = 1

Step-4:

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

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

$$= 8.82$$

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

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

$$= -0.84$$

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

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

$$= -4.2$$

Step-5:

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

$$= -(0.1)(-0.84)$$

$$= 0.084$$

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

$$= -(0.1)(-4.2)$$

$$= 0.42$$

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 $\leq$ ns

Step-8:

Go to step-4

Hence

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

$$= \cancel{(0.5)(3.8 - (1)(0.4) - (-1))^2}$$

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

$$= 7.79$$

Here, $y = mx + c$

$y = (1.084)(0.4) + (-0.58)$

$= 0.1464$

Step-9:

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

$$= -\left(3.8 - (1.084)(0.4) - (-0.58)\right)(0.4)$$

$$= -1.58$$

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

$$= -3.9464 \simeq -3.94$$

Step-10:

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

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

Step-11:

$$m = m + \Delta m = 1.084 + 0.158 = 1.242$$

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

$$= -0.186$$

Step-12: Sample = 2+1 = 3 ≤ ns → False

Go to next step.

Step-13: iter = iter+1

= 1+1 = 2 ≤ epochs

Go to step-3

Step-14: sample = 1

Step-15: $Y = ((1.242)(0.2) + (-0.186))$

$$= 0.0624$$

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

step-16: $\frac{\partial E}{\partial m} = -(3.4 - (1.242)(0.2) - (-0.186))(0.2)$

$= -0.66752$

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

$= -3.3376$

step-17: $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-0.66752)$

$= 0.066752$

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

$= 0.33376$

step-18: $m = m + \Delta m$

$= 1.242 + 0.066752 = 1.90952$

$c = c + \Delta c$

$= -0.186 + 0.33376$

$= 0.14776$

step-19: sample $= 1+1 = 2 \leq ns$ — True

Go to step-4

step-20: $\frac{\partial E}{\partial m} = -(y_i - mx_i - c)x_i$

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

$= -1.155372$

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

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

$= -2.888432$

Step-21: $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.155372)$

$= 0.1155372$

$\Delta c = -\eta \frac{\partial E}{\partial c} = -(0.1)(-2.888432)$

$= 0.2888432$

Step-22:

$m = m + \Delta m = 1.90952 + 0.1155372$

$= 2.025057$

$c = c + \Delta c = 0.14776 + 0.2888432$

$= 0.4366032$

Step-23: sample = 2+1 = 3 ≤ ns — false

-Go to next step

Step-24: iter = 2+1 = 3 ≤ epochs — False

Go to next step

Step-25: Print m, c

$m = 2.025057$

$c = 0.4366032$

Step-26: Calculating Mean Square-Error

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

$$= \frac{(2.558386)^2 + (2.55374)^2}{2}$$

MSE = ~~2.556063~~ 13.06692