Assignment 3 : Manual Calculations

- Stochastic Gradient Descent

Data:

x	y
0.2	3.4
0.4	3.8

step 1 : [x, y], epochs = 2, $\eta = 0.1$, m = 1, c = -1,

step 2 : iter = 1

step 3 : sample = 1

step 4 : error $E = \frac{1}{2} \times (1 \quad 3.4 - (1 \times 0.2 - 1))^2$

$= 0.5 \times (3.4 + 0.8)^2$

$= 8.82$

$\frac{\partial E}{\partial m} = -(y_i - mx_i - c)x_i = -(3.4 - (1)(0.2) - (-1))(0.2)$

$= -(3.4 - 0.2 + 1)(0.2) = (4.2)(0.2) = 0.84$

$\frac{\partial E}{\partial c} = -(y_i - mx_i - c) = -4.2$

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

step 8 : sample < total no of sample. ⇒ True

go to next step 4

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eq9: $y = (1.084)(0.4) - 0.58$

$y = -0.1464$

$E = (0.5) * (3.8 + 0.1464)^2 = 7.79$

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

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

$= -(3.8 + 0.1464) * 0.4 = -1.58$

$\frac{\partial E}{\partial c} = -(y_i - m x_i - c) = -3.94$

Step10: $\Delta m = -\eta \frac{\partial E}{\partial m} = -(0.1)(-1.58) = 0.158$

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

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

Step13: Sample = 3 > no of samples

go to next step

Step14: iter = iter + 1. = 1+1 = 2

Step15: iter < epochs

goto step 3

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Step 16: sample = 1

Step 17: $Y = (1.242)(0.2) + (-0.186) = 0.0624$

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

$\frac{\partial E}{\partial m} = -(3.4 - 0.0624)0.2 = -0.66752$

$\frac{\partial E}{\partial c} = -3.3376$

Step 18: $\Delta m = -\eta\left(\frac{\partial E}{\partial m}\right) = -(0.1)(-0.66752) = 0.066752$

$\Delta c = -(0.1)(-3.3376) = 0.33376)$

Step 19: $m = m + \Delta m = 1.242 + 0.66752 = 1.90952$

$c = c + \Delta c = -0.186 + 0.33376 = 0.14776$

Step 20: Sample = 1 + 1 = 2

Step 21: Sample < no of samples

goto step 4

Step 22: $\frac{\partial E}{\partial m} = -(3.8 - (1.90952)(0.4) - (0.14776))(0.4)$

$= -(2.888432)(0.4) = -1.155372$

$\frac{\partial E}{\partial c} = -2.888432$

Step 23: $\Delta m = -\eta\left(\frac{\partial E}{\partial m}\right) = +0.1155372$

$\Delta c = +0.2888432$

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Step 24: $m = m + \Delta m$

$= 2.025057$

$c = c + \Delta c = 0.4366032$

Step 25: ~~ster~~ sample = 2+1 = 3

step 26: sample > no of sample
goto ~~next~~ step

Step 27: ~~ster~~ = ~~ster~~ + 1 = 2+1 = 3

step 28: ~~ster~~ > epoch
goto step 29

Step 29: Print m, c

$\Rightarrow m = 2.025057$

$c = 0.4366032$

Step 30: Compute mse.

$$= \frac{(3.4 - 0.841614) + (3.8 - 1.246626)}{2}$$

$$= \frac{(2.5583861 + (2.55374)}{2}$$

mse $= 2.556063$

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