Assignment 03 SGD

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AREEFA
CSE III A

Simple linear regression model
using Stochastic Gradient Descent Optimizer (1)

Sample(i)	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

2 samples

Manual calculations for 2 iterations with 1st two samples

Step1: $m=1$, $c=-1$, $\eta=0.01$, epochs $=2$ iter $=0$
ns $=2$

Step2: iter = iter + 1 = 1

step3: sample = 1

step4: $E = \frac{1}{2(1)}(y_i - mx_i - c)^2$

Gradient w.r.to model parameters

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

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

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

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

$$= -(4.2)(0.2) = -0.84$$

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step5: $\Delta m = -\eta \frac{\partial E}{\partial m}$

$= -(0.01) * (-0.84)$

$\Delta m = 0.0084$

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

$\Delta c = -(0.01)(-4.2) = 0.042$

step6: $m = m + \Delta m$
$= 1 + 0.084$
$= 1.084$

$c = c + \Delta c$
$= -1 + 0.042$
$= -0.958$

step7: sample = sample+1
sample = 2

step8 if(sample>ns)
$2 > 2$ ✗

goto step 4

step4 $\frac{\partial E}{\partial m} = -(y_i - mx_i - c)x_i$ } sample 2 y_2 & x_2

$= -(3.8 - (0.4) + 1)(0.4)$

$= -(4.4)(0.4) = -1.76$

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

$= -(3.8 - (0.4) + 1)$

$= -4.4$

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

$= -0.01(-1.76)$

$= \underline{0.0176}$

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

$= -(0.01)(-4.4)$

$= \underline{0.044}$

step 6: $m = m + \Delta m$

$= \cancel{1.084}\,1.0847 + 0.0176$

$\underline{m = 1.1016}$

$c = c + \Delta c$

$= \cancel{-1}\,-0.958 + (0.044)$

$\underline{c = -0.914}$

step7: sample = sample+1

= 3

step8: if(sample>ns)

3>2 ✓

go to step9

step9: iter=iter+1 = 2

step 10: if(iter>epoch)

2>2 ×

go to step2

step2: iter=iter+1 = 3

step3: sample=1

step4: $\frac{\partial E}{\partial m} = -(y_1 - mx_1 - c)x_1$

$= -(3.4 - (1.1016)(0.2) + 0.914)(0.2)$

$= \underline{-0.8187}$

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$$\frac{\partial E}{\partial c} = -(y_i - mx_i - c)$$
$$= -4.0936$$

step5: $\Delta m = -\eta \frac{\partial E}{\partial m}$
$$= -0.01(-0.8187)$$
$$\underline{\Delta m = 0.008187}$$

$\Delta c = -\eta \frac{\partial E}{\partial c}$
$$= -0.01(-4.0936)$$
$$\underline{\Delta c = 0.0409}$$

step6: $m = m + \Delta m$
$$= 1.1016 + 0.00818$$
$$\underline{m = 1.10978}$$

$c = c + \Delta c$
$$= -0.914 + 0.0409$$
$$\underline{c = -0.8730}$$

step7: sample = sample+1
= 2

step8: if(sample>ns)
2>2 X

go to step 3

step3: sample = 2

step 4 $\frac{\partial E}{\partial m} = -(y_2 - mx_2 - c)x_2$
$$= -(3.8 - (1.1097)(0.4) + 0.8730)(0.4)$$
$$= \underline{-1.6916}$$

$$\frac{\partial E}{\partial c} = -(y_2 - mx_2 - c)$$
$$= \underline{-4.229}$$

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step5: $\Delta m = -\eta \frac{\partial E}{\partial m}$

$= -(0.01)(-1.6916)$

$= 0.0169$

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

$= -(0.01)(-4.227)$

$= 0.0422$

step6 $m = m + \Delta m$

$= 1.10978 + 0.0169$

$m = 1.1266$

$c = c + \Delta c$

$= -0.8730 + 0.0422$

$c = -0.8308$

step7 sample = sample + 1 = 3

step8 if(sample > ns)

3 > 2 ✓

goto next step

step9 iter = 2 + 1 = 3

step10 if (iter > epoch)

3 > 2 ✓

break (next step)

step11: Optimal values

m, c

$\boxed{\begin{array}{l} m = 1.1266 \\ c = -0.8308 \end{array}}$

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