Assignment - 2

18K41A0247

Gradient descent for multivariable Problems

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

Step 1: let $x = -1$, $y = +1$, $\eta = 0.1$, epoch = 2

Step 2: itr = 1

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

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

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

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

Step 5: $x = x + \Delta x \Rightarrow -1 + 0.2 = -0.8$

$y = y + \Delta y \Rightarrow 1 - 0.2 = 0.8$

Step 6: itr = itr + 1 $\Rightarrow 1 + 1 = 2$

Step 7: if (itr > epoch)

if (2 > 2)

false so 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: $x = x + \Delta x = -0.8 + 0.16 = -0.64$

$y = y + \Delta x = 0.8 - 0.16 = 0.64$

Step 6 : itr = itr + 1 $\Rightarrow$ 2 + 1 = 3

Step 7 : if (3 > 2)

true so

$x = -0.64$, $y = 0.64$

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

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

$\therefore f(x,y) = 10.8192$

Assignment -3

18K41A0247

Calculations for SGD

x	y
0.2	3.4
0.4	3.8

step 1: (x, y), m=1, c=-1, η = 0.1 epochs = 2

Step 2: itr = 1

step 3: Sample = 1

Step 4: $\frac{\partial E}{\partial m} = -[3.4 - 1(0.2) + 1](0.2)$

$\frac{\partial E}{\partial m} = -0.84$

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

$\frac{\partial E}{\partial c_1} = -4.2$

Step 5: $\Delta m = -\eta \frac{\partial E}{\partial m} = -0.1(-0.84)$

$\Delta m = 0.084$

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

$\Delta c = 0.42$

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

$m = 1.084$

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

$c = -0.58$

Step 7: sample = 1 + 1 = 2

Step 8: if (sample > ns)

(2 > 2)

false go to step (4)

Step 4: $\frac{\partial E}{\partial m} = -[3.8 - (1.084)(0.4) + 0.58)(0.4)$

$\frac{\partial E}{\partial m} = -1.578$

$\frac{\partial E}{\partial c} = -[3.8 - (1.084)(0.4) + 0.58]$

$\frac{\partial E}{\partial c} = -3.9464$

Step 5: $\Delta m = -\eta \frac{\partial E}{\partial m} = -0.1(-1.578)$

$\Delta m = 0.1578$

$\Delta c = -\eta \frac{\partial E}{\partial c} = -0.1(-3.9464)$

$\Delta c = 0.39464$

Step 6: $m = m + \Delta m = 1.084 + 0.1578$

$m = 1.2418$

$c = c + \Delta c = -0.58 + 0.39464$

$c = -0.18536$

Step 7: Sample = 2 + 1 = 3

Step (8): if (sample > ns)

3 > 2

true so

Step (9): itr = itr + 1 = 1 + 1 = 2

step (10): if (itr > epoch)

2 > 2

false

Step (3): Sample = 1

Step (4): $\frac{\partial E}{\partial m} = -[3.4 - 1.2418(3.4) + 0.18536](0.2)$

$\frac{\partial E}{\partial m} = 0.1273$

$$\frac{\partial E}{\partial c} = -[3.4 - 1.2418(3.4) + 0.18536]$$

$$\frac{\partial E}{\partial c} = 0.6367$$

Step5: $\Delta m = -\eta \frac{\partial E}{\partial m} = -0.1(0.1273)$

$\Delta m = -0.01273$

$\Delta c = -\eta \frac{\partial E}{\partial c} = -0.1(0.6367)$

$\Delta c = -0.06367$

Step 6: $m = m + \Delta m = 1.2418 + -0.01273$

$m = 1.229$

$c = c + \Delta c = -0.18536 - 0.06367$

$c = -0.249$

step 7: Sample $= 1+1 = 2$

Step 8: if (Sample > ne)

(2 > 2)

false.

step ④ $\frac{\partial E}{\partial m} = -[3.8 - (1.229)(0.4) + 0.249](0.4)$

$\frac{\partial E}{\partial m} = -1.4229$

$\frac{\partial E}{\partial c} = -[3.8 - (1.229)(0.4) + 0.249]$

$\frac{\partial E}{\partial c} = -3.5574$

Step ⑤: $\Delta m = -\eta \frac{\partial E}{\partial m} = -0.1(-1.4229)$

$\delta m = 0.14229$

$\Delta c = -\eta \frac{\partial E}{\partial c} = -0.1(-3.5574)$

$\Delta c = 0.35574$

Step ⑥: $m = m + \Delta m = 1.229 + 0.14229$

$m = 1.37129$

$C = C + \Delta C = -0.249 + 0.35574$

$C = 0.10674$

Step 7: sample = 2 + 1 = 3

Step 8: if (Sample > no)

3 > 2

true

Step 9: itr = 2 + 1 = 3

step 10: if (itr > epoch)

3 > 2

Step 11: $m = 1.37129$, $C = 0.10674$

Assignment-5

Calculations for MBGD

x	y	
0.2	3.4	} 1
0.4	3.8	
0.6	4.2	} 2
0.8	4.6	

1) (x, y), m = 1, c = -1, η = 0.1 epochs = 2, bs = 2

2) $n_b = \frac{n_s}{bs} = \frac{4}{2} = 2$

3) itr = 1

4) Batch = 1

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

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

$= -1.34$

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

$= -4.3$

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)

false so

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) $\Delta m = 0.2932$

$\Delta c = 0.417$

7) $m = 1.13 + 0.243 = 1.42$

$c = -0.57 + 0.4 = -0.15$

8) Batch += 1

9) if (batch >nb)

$3 > 2$

10) itr += 1

11) if (2>2)

false

4) Batch = 1

$\frac{\partial E}{\partial m} = -\frac{1}{2}[3.4 - (1.4)(0.2) - (0.5)0.2 +$

$3.8 - (1.4)(0.4) + 0.15)0.4]$

$= -1.0029$

$\frac{\partial E}{\partial c} = -\frac{1}{2}[3.4 - (1.42)(0.2) + 0.1523] +$

$[3.8 - (1.4)(0.4) + 0.15)]$

$= -3.3241$

6) $\Delta m = -0.1(-1.0029) = 0.1002$

$\Delta c = -0.1(-3.3241) = 0.3324$

7) $m+ = \Delta m = 1.62 + 0.1002 = 1.5$

$C+ = \Delta C = -0.15 + 0.3 = 0.17$

8) Batch $+ = 1$

9) if $(2 > 2)$

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

$= -2.21$

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

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

$\Delta C = -0.1 \times -3.15 = 0.315$

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)

10) itr $+ = 1$

11) if $(3 > 2)$

12) $m = 1.7163$

$C = 0.4994$

Assigment -7

Calculation for BGD

X	Y
0.2	3.4
0.4	3.8
0.6	4.2
0.8	4.6

1) (x, y), m=1, c=-1, η=0.1, epochs=2, ns=2

2) itr=1

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

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

$= -1.34$

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

$= -4.3$

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

7) if (2>2)

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

$= -1.157$

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

$= -3.829$

4) $\Delta m = -0.1 \times 1.15 = 0.1157$

$\Delta C = -0.1 \times -3.8 = 0.3829$

5) $m+ = \Delta m = 1.134 + 0.1157 = 1.2497$

$c+ = \Delta c = -0.57 + 0.3829 = -0.187$

6) iter + = 1

7) if (iter > epoch

3 > 2

8) $m = 1.24$

$c = -0.187$

Assignment -9

18K41A0247

Momentum optimizer

X	Y
0.2	3.4
0.4	3.8

step 1: (x, y), $m = 1$, $c = -1$, $\eta = 0.1$ epochs = 2, $\gamma = 0.9$

$v_m = v_c = 0$

Step 2: itr = 1

Step 3: sample = 1

Step 4: $g_m = \frac{\partial E}{\partial m} = -(y_i - mx_i - c)x_i$

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

$\frac{\partial E}{\partial m} = -0.84$

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

$\frac{\partial E}{\partial c} = -4.2$

Step 5: $v_m = \gamma v_m - \eta g_m$

$= (0.9)(0) - (0.1)(-0.84)$

$v_m = 0.084$

$v_c = \gamma v_c - \eta g_c$

$= (0.9)(0) - (0.1)(-4.2)$

$v_c = 0.042$

Step 6: $m = m + v_m = 1 + 0.084 = 1.084$

$c = c + v_c = -1 + 0.042 = -0.958$

Step 7: sample = 1 + 1 = 2

Step 8: If (sample $\geq$ ns)

$2 \geq 2$

Step 4: $g_m = \frac{\partial E}{\partial m} = -[3.8 - (1.084)(0.4) + 0.458](0.4)$

$g_m = -1.57856$

$g_c = \frac{\partial E}{\partial c} = -[3.8 - (1.084)(0.4) + 0.458]$

$g_c = \frac{\partial E}{\partial c} = -3.9464$

Step 5: $v_m = \gamma v_m - \eta g_m$

$= (0.9)(0.084) - (0.1)(-1.57856)$

$v_m = 0.233456$

$v_c = \gamma v_c - \eta g_c$

$= (0.9)(0.42) - (0.1)(-3.9464)$

$v_c = 0.77264$

Step 6: $m = m + v_m = 1.084 + 0.233456$

$m = 1.3174$

$c = c + v_c = -0.58 + 0.77264$

$c = 0.19264$

Step 7: Sample = 2 + 1 = 3

Step 8: if (3 > 2)

Step 9: itr = itr + 1 = 1 + 1 = 2

Step 10: if (2 > 2)

Step 3: Sample = 1

Step 4: $g_m = \frac{\partial E}{\partial m} = -[3.4 - (1.3174)(0.2) - 0.19264](0.2)$

$g_m = -0.5887$

$$g_c = \frac{\partial E}{\partial c} = -[3.4 - (1.3174)(0.2) - 0.19264]$$

$$g_c = -2.9438$$

Step 5: $v_m = \delta v_m - \eta g_m$

$$= (0.9)(0.23345) - (0.1)(-0.5887)$$

$$v_m = 0.26897$$

$$v_c = \delta v_c - \eta g_c$$

$$= (0.9)(0.77264) - (0.1)(-2.9438)$$

$$v_c = 0.9897$$

Step 6: $m = m + v_m = 1.3174 + 0.26897$

$$m = 1.5863$$

$$c = c + v_c = 0.19264 + 0.9897$$

$$c = 1.18234$$

Step 7: Sample = 1 + 1 = 2

Step 8: If (Sample > no)

$$2 > 2$$

Step 4: $g_m = \frac{\partial E}{\partial m} = -[3.8 - (1.586)(0.4) + 1.1823](0.4)$

$$g_m = -1.7391$$

$$g_c = \frac{\partial E}{\partial c} = -[3.8 - (1.586)(0.4) + 1.1823]$$

$$g_c = -4.3479$$

Step 5: $v_m = \delta v_m - \eta g_m$

$$= (0.9)(0.26897) - (0.1)(-1.7391)$$

$$v_m = 0.41604$$

$$v_c = \delta v_c - \eta g_c$$

$$= (0.9)(0.9897) - (0.1)(-4.3479)$$

$$v_c = 1.3255$$

Step 6: $m = m + V_m = 1.5863 + 0.41604$

$m = 2.0023$

$c = c + V_c = 1.18234 + 1.3255$

$c = 2.507$

Step 7: Sample = 2 + 1 = 3

Step 8: if (3 > 2)

Step 9: itr = 2 + 1 = 3

Step 10: if (3 > 2)

Step 11: m = 2.00, c = 2.507