Assignment 5: Manual calculations:

- Mini Batch Gradient Descent:

Step 1: read dataset [x, y], $\eta = 0.1$, $m = 1$, $c = -1$
epochs = 2, batch-size = 2

X	Y
0.2	3.4
0.4	3.8
0.6	4.2
0.8	4.6

Step 2: Splitting data into batches

batch 1

0.2	3.4
0.8	4.6

batch 2

0.4	3.8
0.6	4.2

Step 3: iter = 1

Step 4: batch = 1

Step 5: calculate gradient descents

$$\frac{\partial E}{\partial m} = -\frac{1}{2}\left[(3.4-(1)(0.2)-(-1))(0.2)+(4.6-(1)(0.8)-(-1))(0.8)\right]$$

$$= -\frac{1}{2}\left[(3.4-0.2+1)(0.2)+(4.6-0.8+1)(0.8)\right]$$

$$= -\frac{1}{2}\left[(4.2)(0.2)+(4.8)(0.8)\right] = -\frac{1}{2}[4.68]$$

$$= -2.34$$

$$\frac{\partial E}{\partial c} = -\frac{1}{2}[4.2+4.8] = -9.0/2 = -4.5$$

Step 6: $\Delta m = -\eta \frac{\partial E}{\partial m} = 0.234$, $\Delta c = 0.45$

Step 7: $m = m + \Delta m \Rightarrow 1 + 0.234 = 1.234$

$c = c + \Delta c = -1 + 0.45 = -0.55$

Step 8: batch = batch + 1 = 1+1 = 2

Step 9: if batch > no of batches $2 > 2$ = false
then go to step 5

step 5 : $\frac{\partial E}{\partial m} = -\frac{1}{n_b} \sum_{i x}^{n_b} (y_i - m x_i - c) x_i$

$= \frac{-1}{2} [(3.8 - (1.234 \times 0.4) + 0.55)(0.4) + (4.2 - (1.234 \times 0.6) + (0.55)(0.6))]$

$= -\frac{1}{2} \times [3.8564 \times 0.4 + 4.00961 \times 0.6]$

$= -1.97416$

$\frac{\partial E}{\partial c} = \frac{-1}{2} [3.8564 + 4.0096] = -3.933$

step 6 : $\Delta m = -\eta \frac{\partial E}{\partial m} = 0.197416$ $\quad \Delta c = -\eta \frac{\partial E}{\partial c} = 0.3933$

step 7 : $m = 1.234 + 0.197416 = 1.4314$

$c = -0.55 + 0.3933 = -0.1567$

step 8 : batch = batch+1 = 2+1 = 3

step 9 : if batch > $n_b \Rightarrow 3 > 2$ then go to step 10.

step 10 : iter = iter+1 = 1+1 = 2

step 11 : if iter > epoch $2 > 2 \Rightarrow$ false

go to step 4

step 4 : batch = 1

step 5 : $\frac{\partial E}{\partial m} = \frac{-1}{2} [(3.4 - (1.4314)(0.2) + 0.1567 \times 0.2 + (4.6 - (1.4314)(0.8) + 0.1567 \times 0.8]$

$= \frac{-1}{2} [(3.27042)(0.2) + (3.61156)(0.8)]$

$= -1.77167$

$\frac{\partial E}{\partial c} = \frac{-1}{2} [3.27042 + 3.61156] = -3.441$

step 6 : $\Delta m = -\eta \frac{\partial E}{\partial m} = 0.177167$

$\Delta c = -\eta \frac{\partial E}{\partial c} = 0.3441$

Step 7: $m = m + \Delta m = 1.4314 + 0.177167 = 1.60856$

$c = c + \Delta c = -0.1567 + 0.3441 = 0.1874$

step 8: batch = batch + 1 = 1 + 1 = 2

step 9: if batch > n_b = 2 > 2 ⇒ false

go to step 5

step 5: $\frac{\partial E}{\partial m} = -\frac{1}{2}[(3.8-(1.6085)(0.4)-0.1874)(0.4) + (4.2-(1.608)(0.6)-0.1874)(0.6)]$

$= -\frac{1}{2}[1.187668 + 1.828478] = -1.50807$

$\frac{\partial E}{\partial c} = -\frac{1}{2}[6.01663] = -3.00831$

Step 6: $\Delta m = 0.150807$, $\Delta c = 0.300831$

Step 7: $m = 1.60856 + 0.150807 = 1.759067$

$c = 0.1874 + 0.300831 = 0.488231$

step 8: batch = 2+1 = 3

step 9: if batch > n_b = 3 > 2 go to step 10

step 10: iter = iter + 1 = 2 + 1 = 3

step 11: if iter > epoch ⇒ 3 > 2 - goto step 12

step 12: print(m, c) ⇒ 1.759067, 0.488231

step 13:- Mean square error

$= \frac{(3.4-0.84004)+(3.8-1.19185)+(4.2-1.54)+(4.6-1.89548)}{4}$

mse = 2.63224