Let us consider a sample dataset have one input (x_i^a) and one output (y_i^a) and number of samples 4. Develop a simple linear regression model using BGD.

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

• Do manual calculations for two iterations with first two samples.
• Write the python code to build simple linear regression model using BGD optimizer (consider all 4 samples).

Step-1: $[x, y]$, $m = 1$, $c = -1$, $\eta = 0.1$, epoches $= 2$, $ns = 2$

Step-2: $itr = 1$

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

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

$$= -1.34$$

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

$$= -4.3$$

Step-4: $\Delta m = -\eta \frac{\partial E}{\partial m}$

$$= -0.1 \times -1.34$$

$$= 0.134$$

$$\Delta c = -\eta \frac{\partial E}{\partial c}$$
$$= -0.1 \times -4.3 = 0.43$$

Step-5: $m+ = \Delta m$
$$1 + 0.134$$
$$= 1.134$$

$c + \Delta c$
$$= -0.1 \times 4.3$$
$$= 0.43$$

Step-6: $itr+ = 1$
$$1 + 1 = 2$$

Step-7: if $(itr > epochs)$
      goto step-8
$$2 > 3$$
else goto step-3.

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

$$= -1.157$$

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

$$= -3.829$$

Step-4: $\Delta m = -0.1 \times -1.157 = 0.1157$
$$\Delta c = -0.1 \times 3.829 = 0.3829$$

Step-5: $m + = \Delta m$
$$1.134 + 0.1157$$
$$= 1.2497$$

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

step-6: itr += 1
       2+1 = 3

step-7: if (itr > epochs)
        3>2   goto step-8
        else
              goto step-3

step-8: m = 1.2497, c = -0.1871