Shivang Soni SID:915623718

Part 1:
Que1.) Code in part1Que1andQue2.py
1.)**For stepsize = 0.0001**
weight vector = [[0.15926872 0.86883319 0.01207877 0.95277955 0.07638897 0.70607346
0.50586056 0.02169045 0.71666128 0.91473624 0.23018374 0.27750287]]
2.)**For stepsize = 0.001**
w_train [[0.15437248 0.8098884 0.04045094 0.37086803 0.00253649 0.97119233
0.94980446 0.86916483 0.96558469 0.16544478 0.44819129 0.28926478]]
3.)**For stepsize = 0.01**
w_train [[0.65422491 0.09958058 0.20571504 0.87455464 0.39088354 0.25358412
0.68054017 0.02762252 0.0652912 0.85858762 0.18717802 0.63684646]]

Que2.)Code in part1Que1andQue2.py
1.)For stepsize = 0.0001
MSE=0.4906158805694756 through cross-validation.
2.)For stepsize = 0.001
MSE is 0.3977520746212971 through cross-validation
3.) For stepsize = 0.01
MSE is 0.3040095038519309 through cross-validation

Que3.)Code in part1Que3.py
MSE is 0.659665822743878
with the stepsize of 0.0001.

Part 2:

Que4.) Code in part2Que1.py

Shivang Soni SID:915623718

$$f(\omega) = \frac{1}{n}\sum_{i=1}^{n} \log\left(1 + \exp\{-y\, \omega^T x_i\}\right) + \frac{1}{2}\|\omega\|^2$$

$$\frac{\delta \partial f}{\partial \omega} = \frac{1}{n}\sum_{i=1}^{n} \frac{\exp\{-y_i\, \omega^T x_i\}(-y_i x_{ij})}{1+\exp\{-y_i\, \omega^T x_i\}}$$

$$= \frac{1}{n}\sum_{i=1}^{n} \frac{(-y_i x_{ij})}{1+\exp\{-y_i\, \omega^T x_i\}} \cancel{+\omega_j} + \omega_j$$

$$X\omega = \begin{bmatrix} x_{11} & \cdots & x_{1p} \\ \vdots & & \\ x_{n1} & \cdots & x_{np} \end{bmatrix} \begin{bmatrix} \omega_1 \\ \vdots \\ \omega_p \end{bmatrix} = \begin{bmatrix} \omega^T x_1 \\ \vdots \\ \omega^T x_n \end{bmatrix}$$

$$x_{11}\omega_1 + x_{1p}\omega_p = \omega^T x_1$$

$$A = y * X\omega = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix} \underset{\text{element wise}}{*} \begin{bmatrix} \omega^T x_1 \\ \vdots \\ \omega^T x_n \end{bmatrix} = \begin{bmatrix} y_1 \omega^T x_1 \\ \vdots \\ y_n \omega^T x_n \end{bmatrix}$$

$$M = \frac{1}{1+\exp(A)} = \begin{bmatrix} \frac{1}{1+\exp\{y_1 \omega^T x_1\}} \\ \vdots \\ \frac{1}{1+\exp\{y_n \omega^T x_n\}} \end{bmatrix}$$

$$\nabla f = -\frac{1}{n}(y * X)^T M + \omega$$

Que5.) Code in part2Que2.py

The prediction accuracy is:100% as whole output test data produced is -1.