Q1

import numpy as np;

import matplotlib.pyplot as plt;

def OLS(XT,y):

    temp=np.matmul(XT,XT.T);

    temp=np.linalg.inv(temp);

    temp=np.matmul(temp,XT);

    temp=np.matmul(temp,y);

    print("coefficient is: ");

    print(temp);

    return temp;

def render(x1,y,Coefficient):

    plt.scatter(x1,y);

    plotx= np.linspace(0, 10, 100);

    ploty = np.polyval(Coefficient, plotx)

    plt.plot(plotx,ploty);

    plt.show();

def test(testx,testy,CoefficientInReverse):

    predictArray=np.zeros(sample\_size,dtype=float);

    multiple=np.ones(sample\_size,dtype=float);

    for coefficient in CoefficientInReverse:

        predictArray+=coefficient\*multiple;

        multiple\*=testx;

    print("predict is: ");

    print(predictArray)

    predictArray=predictArray-testy;

    predictArray=predictArray\*predictArray;

    error=predictArray.sum();

    print("error is: ");

    print(error);

sample\_size=10;

x1 = np.array([5.86,1.34,3.65,4.69,4.13,5.87,7.91,5.57,7.3,7.89]);

y = np.array([0.74,1.18,0.51,-0.48,-0.07,0.37,1.35,0.3,1.64,1.75]);

x2= x1\*x1;

x3=x2\*x1;

x4=x3\*x1;

XT=np.vstack(([1,1,1,1,1,1,1,1,1,1],x1,x2,x3,x4));

print(XT);

render(x1,y,OLS(XT,y)[::-1])

testx=([5.8,0.57,4.3,6.55,0.82,3.72,5.8,3.26,6.75,4.77]);

testy=([0.93,1.87,-0.06,1.6,1.22,0.9,0.93,1.53,1.73,-0.51]);

test(testx,testy,OLS(XT,y));

Q3

import numpy as np

import math

import matplotlib.pyplot as plt;

def sig(X):

    return 1/ (1+  math.e\*\*(-X));

def df(theta,trainX,trainY):

    total=np.zeros(dim);

    for X, Y in zip(trainX,trainY):

        temp=sig((np.dot(X,theta)))-Y;

        total+=temp\*X;

    print("df: ");

    print(total);

    return total;

def test(theta,testX,testY):

    print("Beginning Testing: ")

    TP=0;TN=0;FP=0;FN=0;

    testResult=sig((np.dot(testX,theta)));

    testResult=np.where(testResult>=0.5,1,0);

    print(testResult);

    for X, Y in zip(testResult,testY):

        if X==1 and Y==1:

            TP=TP+1;

        if X==0 and Y==0:

            TN=TN+1;

        if X==1 and Y==0:

            FP=FP+1;

        if X==0 and Y==1:

            FN=FN+1;

    print("TP %d TN %d FP %d FN %d"%(TP,TN,FP,FN))

dim=3;

theta=np.array([-1,1.5,0.5]);

trainX=np.array([[1,0.346,0.78],[1,0.303,0.439],[1,0.358,0.729],[1,0.602,0.863],[1,0.790,0.753],[1,0.611,0.965]]);

trainY=np.array([0,0,0,1,1,1]);

theta=theta-0.1\*df(theta,trainX,trainY);

testX=np.array([[1,0.959,0.382],[1,0.75,0.306],[1,0.395,0.76],[1,0.823,0.764],[1,0.761,0.874],[1,0.844,0.435]])

testY=np.array([0,0,0,1,1,1]);

test(theta,testX,testY);