

ProjectStartUp1_NeuralNetwork-M3

December 12, 2020

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[1]: from scipy.io import loadmat
import numpy as np

#SETUP
X = loadmat("RawData.mat")['X']
y = loadmat("RawData.mat")['y']
Xones = np.ones((len(X),1))

#Single threshold for classification
thresh = 1500
for i in range(len(X)):
    if(y[i] <= thresh):
        y[i] = 0
    if(y[i] > thresh):
        y[i] = 1

#print(np.mean(y))

#Optional: Eliminate high values
#for i in range(110):
#    X = np.delete(X, np.argmax(y), 0)
#    y = np.delete(y, np.argmax(y), 0)
#    X = np.delete(X, np.argmin(y), 0)
#    y = np.delete(y, np.argmin(y), 0)

TwoNormCol = np.zeros((len(X.T),1))

#Remove keyword columns (poorly treated data)
X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)
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X = np.delete(X, 17, 1)
X = np.delete(X, 17, 1)

#Normalize columns to 2-norm
for i in range(len(X.T)):
    TwoNormCol[i] = np.sqrt(X[i,:]*X[i,:])
    X[i,:] = X[i,:]/TwoNormCol[i]
#print(TwoNormCol)
#print(X[0,:])
#print(y)

#Form subsets (indices, first group is full X)
Xsubs = np.
    ↳array([[0,49],[0,5],[5,7],[7,9],[9,11],[11,17],[17,20],[20,26],[28,33],[33,37],[37,45],[45,

#Create and run over 11 sets of 3604 entries from X and y,
#using 1 as a primary test set (when needed for lambda)
setArr = np.array([[0,int(len(X)/11)],[int(len(X)/11),int(2*len(X)/
    ↳11)],[int(2*len(X)/11),int(3*len(X)/11)],\
        [int(3*len(X)/11),int(4*len(X)/11)],[int(4*len(X)/
    ↳11),int(5*len(X)/11)],\
        [int(5*len(X)/11),int(6*len(X)/11)],[int(6*len(X)/
    ↳11),int(7*len(X)/11)],\
        [int(7*len(X)/11),int(8*len(X)/11)],[int(8*len(X)/
    ↳11),int(9*len(X)/11)],\
        [int(9*len(X)/11),int(10*len(X)/11)],[int(10*len(X)/
    ↳11),int(len(X))]])
#print(setArr)

#Set up network node count
networkCount = 3
networkTest = np.linspace(2, 6, networkCount)
#print(networkCount)

#Error tally storage
errorOrig = np.zeros((110,1))

#####

#Only looping over full X matrix
Xset = 0

M = 3

errorOrig = np.zeros((12,1))

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errorNew = np.zeros((12,1))

for Xset in range(len(Xsubs)):
    for i in range(11):
        print("X subset = ",Xset," i = ",i)
        testTally = 0
        #Set up Training and testing sets
        for k in range(11):
            if i == k:
                XTest1 = X[setArr[i,0]:setArr[i,1],Xsubs[Xset,0]:Xsubs[Xset,1]]
                #print(XTest1)
                yTest1 = y[setArr[i,0]:setArr[i,1]]
                #print(yTest1)
            if k != i:
                if testTally == 0:
                    XTrain = X[setArr[k,0]:setArr[k,1],Xsubs[Xset,0]:
↪Xsubs[Xset,1]]
                    yTrain = y[setArr[k,0]:setArr[k,1]]
                    testTally = 1
                else:
                    XTrain = np.concatenate((XTrain, X[setArr[k,0]:
↪setArr[k,1],Xsubs[Xset,0]:Xsubs[Xset,1]]),\
                                            axis=0)
                    yTrain = np.concatenate((yTrain, y[setArr[k,0]:
↪setArr[k,1]]), axis=0)

        XTest1 = np.hstack((np.ones((len(XTest1),1)), XTest1))
        XTrain = np.hstack((np.ones((len(XTrain),1)), XTrain))

        # Storage for current iteration
        #WNET = np.zeros((len(X.T),networkCount))

        # Loop through different counts
        #for index in range(networkCount):
            #M = networkTest[index]

        V = np.random.randn(M+1, 1);
        W = np.random.randn(len(XTrain.T), M);

        #Step and epoch count
        alpha = 0.5
        L = 10

        def logsig(_x):
            return 1/(1+np.exp(-_x))

        for epoch in range(L):

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ind = np.random.permutation(len(XTrain))
for iii in ind:
    # Forward propagation
    H = logsig(np.hstack((np.ones((1,1)), XTrain[[iii],:]@W)))
    #print(np.hstack((np.ones((1,1)), XTrain[[iii],:]@W)))
    Yhat = logsig(H@V)

    # Back propagation
    delta = (Yhat-yTrain[[iii]])*Yhat*(1-Yhat)
    Vnew = V-alpha*H.T@delta
    gamma = delta@V[1:,:].T*H[:,1:]*(1-H[:,1:])
    Wnew = W - alpha*XTrain[[iii],:].T@gamma
    #print(alpha*XTrain[[iii],:].T@gamma)
    V = Vnew
    W = Wnew
print(epoch)

H = logsig(np.hstack((np.ones((len(XTrain),1)), XTrain@W)))
y_net1 = logsig(H@V)

errorOrigTemp = 0
for index in range(len(XTrain)):
    if (yTrain[index] > 0.5 and y_net1[index] < 0.5) or (yTrain[index]
↪ < 0.5 and y_net1[index] > 0.5):
        errorOrigTemp = errorOrigTemp + 1
errorOrigTemp = errorOrigTemp/len(XTrain)
print("Mean error with orig set: ",errorOrigTemp)

H = logsig(np.hstack((np.ones((len(XTest1),1)), XTest1@W)))
y_net1 = logsig(H@V)

errorOrig[Xset] = errorOrig[Xset] + errorOrigTemp

errorOrigTemp = 0
for index in range(len(XTest1)):
    if (yTest1[index] > 0.5 and y_net1[index] < 0.5) or (yTest1[index]
↪ < 0.5 and y_net1[index] > 0.5):
        errorOrigTemp = errorOrigTemp + 1
errorOrigTemp = errorOrigTemp/len(yTest1)
print("Mean error with test set: ",errorOrigTemp)

errorNew[Xset] = errorNew[Xset] + errorOrigTemp

GlobalMeanOrigError = np.zeros((11,1))

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GlobalMeanNewError = np.zeros((11,1))
for index in range(11):
    GlobalMeanOrigError[index] = errorOrig[index]/11
    GlobalMeanNewError[index] = errorNew[index]/11
    print("Mean Error for training set, X subset ",(index+1)," =␣
↪",GlobalMeanOrigError[index])
    print("Mean Error for test set, X subset ",(index+1)," =␣
↪",GlobalMeanNewError[index])

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X subset = 0 , i = 0

/opt/conda/lib/python3.7/site-packages/ipykernel_launcher.py:117:

RuntimeWarning: overflow encountered in exp

0

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Mean error with orig set: 0.4556881243063263

Mean error with test set: 0.5038845726970034

X subset = 0 , i = 1

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Mean error with orig set: 0.45083240843507216

Mean error with test set: 0.5460599334073252

X subset = 0 , i = 2

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Mean error with orig set: 0.465788013318535
Mean error with test set: 0.40288568257491675
X subset = 0 , i = 3
0
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Mean error with orig set: 0.5353218645948946
Mean error with test set: 0.5857380688124306
X subset = 0 , i = 4
0
1
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9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 0 , i = 5
0
1
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3
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Mean error with orig set: 0.4541620421753607
Mean error with test set: 0.5055493895671476
X subset = 0 , i = 6
0
1

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Mean error with orig set: 0.45507769145394006
Mean error with test set: 0.4961154273029967
X subset = 0 , i = 7
0
1
2
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4
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6
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9
Mean error with orig set: 0.5411487236403996
Mean error with test set: 0.5344062153163152
X subset = 0 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5390122086570477
Mean error with test set: 0.5485571587125416
X subset = 0 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4655937846836848

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Mean error with test set: 0.40455049944506105

X subset = 0 , i = 10

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Mean error with orig set: 0.46567702552719203

Mean error with test set: 0.39039955604883464

X subset = 1 , i = 0

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Mean error with orig set: 0.45474472807991123

Mean error with test set: 0.5027746947835738

X subset = 1 , i = 1

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Mean error with orig set: 0.45030521642619314

Mean error with test set: 0.5441176470588235

X subset = 1 , i = 2

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Mean error with orig set: 0.46440066592674806
Mean error with test set: 0.40316315205327413
X subset = 1 , i = 3
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Mean error with orig set: 0.4646503884572697
Mean error with test set: 0.4142619311875694
X subset = 1 , i = 4
0
1
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9
Mean error with orig set: 0.54003884572697
Mean error with test set: 0.5355160932297447
X subset = 1 , i = 5
0
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Mean error with orig set: 0.4554661487236404
Mean error with test set: 0.5061043285238623
X subset = 1 , i = 6
0
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Mean error with orig set: 0.4562430632630411
Mean error with test set: 0.4983351831298557
X subset = 1 , i = 7
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9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 1 , i = 8
0
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9
Mean error with orig set: 0.4609322974472808
Mean error with test set: 0.4514428412874584
X subset = 1 , i = 9
0
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Mean error with orig set: 0.5341287458379578
Mean error with test set: 0.5957269700332963

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X subset = 1 , i = 10
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Mean error with orig set: 0.4656492785793563
Mean error with test set: 0.40427302996670367
X subset = 2 , i = 0
0
1
2
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9
Mean error with orig set: 0.5084350721420644
Mean error with test set: 0.49056603773584906
X subset = 2 , i = 1
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9
Mean error with orig set: 0.5364872364039955
Mean error with test set: 0.4525527192008879
X subset = 2 , i = 2
0
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9
Mean error with orig set: 0.46534406215316315
Mean error with test set: 0.40288568257491675
X subset = 2 , i = 3
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Mean error with orig set: 0.4646503884572697
Mean error with test set: 0.4142619311875694
X subset = 2 , i = 4
0
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Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 2 , i = 5
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Mean error with orig set: 0.4980577136514983
Mean error with test set: 0.4911209766925638
X subset = 2 , i = 6
0
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9
Mean error with orig set: 0.536015538290788
Mean error with test set: 0.4983351831298557
X subset = 2 , i = 7
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Mean error with orig set: 0.45943396226415095
Mean error with test set: 0.46503884572697
X subset = 2 , i = 8
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Mean error with orig set: 0.48451720310765817
Mean error with test set: 0.46781354051054386
X subset = 2 , i = 9
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Mean error with orig set: 0.4720865704772475
Mean error with test set: 0.4525527192008879
X subset = 2 , i = 10

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Mean error with orig set: 0.46623196448390675
Mean error with test set: 0.3940066592674806
X subset = 3 , i = 0
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9
Mean error with orig set: 0.4413984461709212
Mean error with test set: 0.48224195338512765
X subset = 3 , i = 1
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1
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Mean error with orig set: 0.4295227524972253
Mean error with test set: 0.5152608213096559
X subset = 3 , i = 2
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Mean error with orig set: 0.465788013318535
Mean error with test set: 0.40288568257491675
X subset = 3 , i = 3
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9
Mean error with orig set: 0.4646503884572697
Mean error with test set: 0.4142619311875694
X subset = 3 , i = 4
0
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9
Mean error with orig set: 0.5350721420643729
Mean error with test set: 0.5260821309655938
X subset = 3 , i = 5
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Mean error with orig set: 0.43562708102108766
Mean error with test set: 0.44755826859045506
X subset = 3 , i = 6
0
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Mean error with orig set: 0.43756936736958935
Mean error with test set: 0.45615982241953384
X subset = 3 , i = 7
0
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9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 3 , i = 8
0
1
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9
Mean error with orig set: 0.44542175360710323
Mean error with test set: 0.41731409544950054
X subset = 3 , i = 9
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Mean error with orig set: 0.5343507214206438
Mean error with test set: 0.5957269700332963
X subset = 3 , i = 10
0

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Mean error with orig set: 0.5343507214206438
Mean error with test set: 0.5957269700332963
X subset = 4 , i = 0
0
1
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9
Mean error with orig set: 0.45474472807991123
Mean error with test set: 0.4997225305216426
X subset = 4 , i = 1
0
1
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Mean error with orig set: 0.45030521642619314
Mean error with test set: 0.5441176470588235
X subset = 4 , i = 2
0
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Mean error with orig set: 0.465788013318535
Mean error with test set: 0.40288568257491675
X subset = 4 , i = 3
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9
Mean error with orig set: 0.4629578246392897
Mean error with test set: 0.4164816870144284
X subset = 4 , i = 4
0
1
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9
Mean error with orig set: 0.5403718091009989
Mean error with test set: 0.5355160932297447
X subset = 4 , i = 5
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Mean error with orig set: 0.5243618201997781
Mean error with test set: 0.48196448390677027
X subset = 4 , i = 6
0
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Mean error with orig set: 0.45507769145394006
Mean error with test set: 0.4961154273029967
X subset = 4 , i = 7
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Mean error with orig set: 0.4950332963374029
Mean error with test set: 0.4730854605993341
X subset = 4 , i = 8
0
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Mean error with orig set: 0.4609322974472808
Mean error with test set: 0.4514428412874584
X subset = 4 , i = 9
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Mean error with orig set: 0.49131520532741396
Mean error with test set: 0.4875138734739179
X subset = 4 , i = 10
0
1

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Mean error with orig set: 0.5339900110987791
Mean error with test set: 0.5957269700332963
X subset = 5 , i = 0
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Mean error with orig set: 0.41012763596004437
Mean error with test set: 0.4667036625971143
X subset = 5 , i = 1
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9
Mean error with orig set: 0.38931742508324085
Mean error with test set: 0.4098224195338513
X subset = 5 , i = 2
0
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Mean error with orig set: 0.38903995560488347

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Mean error with test set: 0.4125971143174251
X subset = 5 , i = 3
0
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Mean error with orig set: 0.40199778024417315
Mean error with test set: 0.45810210876803553
X subset = 5 , i = 4
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Mean error with orig set: 0.3892341842397336
Mean error with test set: 0.41065482796892344
X subset = 5 , i = 5
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9
Mean error with orig set: 0.38898446170921197
Mean error with test set: 0.41315205327413984
X subset = 5 , i = 6
0
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Mean error with orig set: 0.43640399556048837
Mean error with test set: 0.470865704772475
X subset = 5 , i = 7
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Mean error with orig set: 0.39367369589345175
Mean error with test set: 0.3662597114317425
X subset = 5 , i = 8
0
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Mean error with orig set: 0.3935072142064373
Mean error with test set: 0.36792452830188677
X subset = 5 , i = 9
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Mean error with orig set: 0.41145948945615984
Mean error with test set: 0.3634850166481687
X subset = 5 , i = 10
0
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2

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Mean error with orig set: 0.44320199778024416
Mean error with test set: 0.40288568257491675
X subset = 6 , i = 0
0
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Mean error with orig set: 0.5443118756936737
Mean error with test set: 0.4961154273029967
X subset = 6 , i = 1
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9
Mean error with orig set: 0.4514428412874584
Mean error with test set: 0.5463374028856826
X subset = 6 , i = 2
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Mean error with orig set: 0.465788013318535
Mean error with test set: 0.40288568257491675

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X subset = 6 , i = 3
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Mean error with orig set: 0.4646503884572697
Mean error with test set: 0.4142619311875694
X subset = 6 , i = 4
0
1
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9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 6 , i = 5
0
1
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9
Mean error with orig set: 0.4554661487236404
Mean error with test set: 0.5061043285238623
X subset = 6 , i = 6
0
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8
9
Mean error with orig set: 0.4562430632630411
Mean error with test set: 0.4983351831298557
X subset = 6 , i = 7
0
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9
Mean error with orig set: 0.4596004439511654
Mean error with test set: 0.46448390677025525
X subset = 6 , i = 8
0
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6
7
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9
Mean error with orig set: 0.5387347391786903
Mean error with test set: 0.5485571587125416
X subset = 6 , i = 9
0
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3
4
5
6
7
8
9
Mean error with orig set: 0.48487791342952274
Mean error with test set: 0.43507214206437295
X subset = 6 , i = 10
0
1
2
3

```

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4
5
6
7
8
9
Mean error with orig set: 0.4656492785793563
Mean error with test set: 0.40427302996670367
X subset = 7 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4222253052164262
Mean error with test set: 0.4542175360710322
X subset = 7 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.41897891231964485
Mean error with test set: 0.48668146503884574
X subset = 7 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.42938401775804663
Mean error with test set: 0.38263041065482795
X subset = 7 , i = 3

```

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0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4271920088790233
Mean error with test set: 0.40455049944506105
X subset = 7 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4252774694783574
Mean error with test set: 0.4236958934517203
X subset = 7 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.42139289678135405
Mean error with test set: 0.4625416204217536
X subset = 7 , i = 6
0
1
2
3
4
5
6
7
8

```

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9
Mean error with orig set: 0.42333518312985574
Mean error with test set: 0.44311875693673697
X subset = 7 , i = 7
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.42602663706992233
Mean error with test set: 0.416204217536071
X subset = 7 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.42488901220865705
Mean error with test set: 0.42758046614872364
X subset = 7 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.43634850166481687
Mean error with test set: 0.4209211986681465
X subset = 7 , i = 10
0
1
2
3
4

```

```

5
6
7
8
9
Mean error with orig set: 0.42924528301886794
Mean error with test set: 0.38401775804661487
X subset = 8 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.42758046614872364
Mean error with test set: 0.4728079911209767
X subset = 8 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4201165371809101
Mean error with test set: 0.4528301886792453
X subset = 8 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4201720310765816
Mean error with test set: 0.45449500554938954
X subset = 8 , i = 3
0

```

```

1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4281908990011099
Mean error with test set: 0.48446170921198667
X subset = 8 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 8 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4279411764705882
Mean error with test set: 0.4328523862375139
X subset = 8 , i = 6
0
1
2
3
4
5
6
7
8
9

```

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Mean error with orig set: 0.4562430632630411
Mean error with test set: 0.4983351831298557
X subset = 8 , i = 7
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.434850166481687
Mean error with test set: 0.3940066592674806
X subset = 8 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4449778024417314
Mean error with test set: 0.4345172031076582
X subset = 8 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.43210321864594897
Mean error with test set: 0.38179800221975585
X subset = 8 , i = 10
0
1
2
3
4
5

```

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6
7
8
9
Mean error with orig set: 0.4263318534961154
Mean error with test set: 0.3998335183129856
X subset = 9 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4556881243063263
Mean error with test set: 0.5038845726970034
X subset = 9 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45069367369589347
Mean error with test set: 0.5269145394006659
X subset = 9 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4561320754716981
Mean error with test set: 0.4506104328523862
X subset = 9 , i = 3
0
1

```



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2
3
4
5
6
7
8
9
Mean error with orig set: 0.46331853496115427
Mean error with test set: 0.4178690344062153
X subset = 9 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5258046614872364
Mean error with test set: 0.5294117647058824
X subset = 9 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4469478357380688
Mean error with test set: 0.4692008879023307
X subset = 9 , i = 6
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4490566037735849

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Mean error with test set: 0.4772475027746948
X subset = 9 , i = 7
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45024972253052165
Mean error with test set: 0.4406215316315205
X subset = 9 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.46018312985571586
Mean error with test set: 0.45033296337402884
X subset = 9 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5185072142064373
Mean error with test set: 0.5430077691453941
X subset = 9 , i = 10
0
1
2
3
4
5
6

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7
8
9
Mean error with orig set: 0.47608213096559376
Mean error with test set: 0.49694783573806883
X subset = 10 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4556881243063263
Mean error with test set: 0.5038845726970034
X subset = 10 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.43998335183129855
Mean error with test set: 0.5244173140954494
X subset = 10 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.48246392896781354
Mean error with test set: 0.537180910099889
X subset = 10 , i = 3
0
1
2

```

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3
4
5
6
7
8
9
Mean error with orig set: 0.4564095449500555
Mean error with test set: 0.47863485016648166
X subset = 10 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 10 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4455049944506104
Mean error with test set: 0.4714206437291898
X subset = 10 , i = 6
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45541065482796894
Mean error with test set: 0.4961154273029967

```

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X subset = 10 , i = 7
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4596004439511654
Mean error with test set: 0.46476137624861263
X subset = 10 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4607658157602664
Mean error with test set: 0.4514428412874584
X subset = 10 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4994173140954495
Mean error with test set: 0.5124861265260822
X subset = 10 , i = 10
0
1
2
3
4
5
6
7

```

```

8
9
Mean error with orig set: 0.4656492785793563
Mean error with test set: 0.40427302996670367
X subset = 11 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.44797447280799113
Mean error with test set: 0.48446170921198667
X subset = 11 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4467258601553829
Mean error with test set: 0.5363485016648168
X subset = 11 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45715871254162044
Mean error with test set: 0.39594894561598226
X subset = 11 , i = 3
0
1
2
3

```

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4
5
6
7
8
9
Mean error with orig set: 0.45527192008879025
Mean error with test set: 0.4137069922308546
X subset = 11 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4523584905660377
Mean error with test set: 0.46198668146503885
X subset = 11 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.452219755826859
Mean error with test set: 0.5019422863485017
X subset = 11 , i = 6
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.44930632630410655
Mean error with test set: 0.49084350721420644
X subset = 11 , i = 7

```

```

0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45352386237513875
Mean error with test set: 0.4608768035516093
X subset = 11 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4533573806881243
Mean error with test set: 0.44617092119866814
X subset = 11 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4589622641509434
Mean error with test set: 0.4020532741398446
X subset = 11 , i = 10
0
1
2
3
4
5
6
7
8

```


9

```
Mean error with orig set: 0.4561043285238624
Mean error with test set: 0.41148723640399554
Mean Error for training set, X subset 1 = [0.48072092]
Mean Error for test set, X subset 1 = [0.48933004]
Mean Error for training set, X subset 2 = [0.47328978]
Mean Error for test set, X subset 2 = [0.48365453]
Mean Error for training set, X subset 3 = [0.48644435]
Mean Error for test set, X subset 3 = [0.45396529]
Mean Error for training set, X subset 4 = [0.47121633]
Mean Error for test set, X subset 4 = [0.4834275]
Mean Error for training set, X subset 5 = [0.4849889]
Mean Error for test set, X subset 5 = [0.48950661]
Mean Error for training set, X subset 6 = [0.40426799]
Mean Error for test set, X subset 6 = [0.41295026]
Mean Error for training set, X subset 7 = [0.47694481]
Mean Error for test set, X subset 7 = [0.47099183]
Mean Error for training set, X subset 8 = [0.42584502]
Mean Error for test set, X subset 8 = [0.42783271]
Mean Error for training set, X subset 9 = [0.43437595]
Mean Error for test set, X subset 9 = [0.44276561]
Mean Error for training set, X subset 10 = [0.46842397]
Mean Error for test set, X subset 10 = [0.48236808]
Mean Error for training set, X subset 11 = [0.4618656]
Mean Error for test set, X subset 11 = [0.48264555]
```

[]: