

# ProjectStartUp1\_NeuralNetwork-M4

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 = 4

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: 0.4555771365149833

Mean error with test set: 0.5038845726970034

X subset = 0 , i = 1

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Mean error with orig set: 0.5225582685904551

Mean error with test set: 0.47807991120976695

X subset = 0 , i = 2

0

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Mean error with orig set: 0.4643729189789123
Mean error with test set: 0.40316315205327413
X subset = 0 , i = 3
0
1
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9
Mean error with orig set: 0.5349611542730299
Mean error with test set: 0.5857380688124306
X subset = 0 , i = 4
0
1
2
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4
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9
Mean error with orig set: 0.4578801331853496
Mean error with test set: 0.46642619311875694
X subset = 0 , i = 5
0
1
2
3
4
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9
Mean error with orig set: 0.5222530521642619
Mean error with test set: 0.47780244173140957
X subset = 0 , i = 6
0
1

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Mean error with orig set: 0.4551054384017758
Mean error with test set: 0.4961154273029967
X subset = 0 , i = 7
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5403718091009989
Mean error with test set: 0.5355160932297447
X subset = 0 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5174250832408435
Mean error with test set: 0.5277469478357381
X subset = 0 , i = 9
0
1
2
3
4
5
6
7
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9
Mean error with orig set: 0.5341287458379578

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Mean error with test set: 0.5957269700332963
X subset = 0 , i = 10
0
1
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Mean error with orig set: 0.4658157602663707
Mean error with test set: 0.39039955604883464
X subset = 1 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45474472807991123
Mean error with test set: 0.5033296337402886
X subset = 1 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.548196448390677
Mean error with test set: 0.45366259711431745
X subset = 1 , i = 2
0
1
2
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4
5
6

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9
Mean error with orig set: 0.46440066592674806
Mean error with test set: 0.40316315205327413
X subset = 1 , i = 3
0
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9
Mean error with orig set: 0.5349889012208657
Mean error with test set: 0.5857380688124306
X subset = 1 , i = 4
0
1
2
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6
7
8
9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 1 , i = 5
0
1
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Mean error with orig set: 0.4554661487236404
Mean error with test set: 0.5061043285238623
X subset = 1 , i = 6
0
1
2

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Mean error with orig set: 0.45507769145394006
Mean error with test set: 0.4961154273029967
X subset = 1 , i = 7
0
1
2
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5
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9
Mean error with orig set: 0.45829633740288567
Mean error with test set: 0.46420643729189787
X subset = 1 , i = 8
0
1
2
3
4
5
6
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9
Mean error with orig set: 0.4602108768035516
Mean error with test set: 0.4450610432852386
X subset = 1 , i = 9
0
1
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5
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8
9
Mean error with orig set: 0.4656492785793563
Mean error with test set: 0.40427302996670367

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X subset = 1 , i = 10
0
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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
3
4
5
6
7
8
9
Mean error with orig set: 0.45549389567147613
Mean error with test set: 0.503607103218646
X subset = 2 , i = 1
0
1
2
3
4
5
6
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8
9
Mean error with orig set: 0.45138734739178693
Mean error with test set: 0.5446725860155383
X subset = 2 , i = 2
0
1
2
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9
Mean error with orig set: 0.4654550499445061
Mean error with test set: 0.40427302996670367
X subset = 2 , i = 3
0
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9
Mean error with orig set: 0.4646503884572697
Mean error with test set: 0.4142619311875694
X subset = 2 , i = 4
0
1
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9
Mean error with orig set: 0.5240288568257492
Mean error with test set: 0.5321864594894562
X subset = 2 , i = 5
0
1
2
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4
5
6
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8
9
Mean error with orig set: 0.4554661487236404
Mean error with test set: 0.5061043285238623
X subset = 2 , i = 6
0
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3

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9
Mean error with orig set: 0.4561043285238624
Mean error with test set: 0.49528301886792453
X subset = 2 , i = 7
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9
Mean error with orig set: 0.4591287458379578
Mean error with test set: 0.4672586015538291
X subset = 2 , i = 8
0
1
2
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4
5
6
7
8
9
Mean error with orig set: 0.5219478357380688
Mean error with test set: 0.5027746947835738
X subset = 2 , i = 9
0
1
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Mean error with orig set: 0.4653718091009989
Mean error with test set: 0.40482796892341844
X subset = 2 , i = 10

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Mean error with orig set: 0.5343507214206438
Mean error with test set: 0.5957269700332963
X subset = 3 , i = 0
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9
Mean error with orig set: 0.4317147613762486
Mean error with test set: 0.48473917869034405
X subset = 3 , i = 1
0
1
2
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9
Mean error with orig set: 0.4514428412874584
Mean error with test set: 0.5463374028856826
X subset = 3 , i = 2
0
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9
Mean error with orig set: 0.4463096559378468
Mean error with test set: 0.40482796892341844
X subset = 3 , i = 3
0
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9
Mean error with orig set: 0.43809655937846836
Mean error with test set: 0.4306326304106548
X subset = 3 , i = 4
0
1
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3
4
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9
Mean error with orig set: 0.43496115427302995
Mean error with test set: 0.448945615982242
X subset = 3 , i = 5
0
1
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Mean error with orig set: 0.43784683684794673
Mean error with test set: 0.44200887902330743
X subset = 3 , i = 6
0
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Mean error with orig set: 0.4562430632630411
Mean error with test set: 0.4983351831298557
X subset = 3 , i = 7
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9
Mean error with orig set: 0.4620976692563818
Mean error with test set: 0.4655937846836848
X subset = 3 , i = 8
0
1
2
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9
Mean error with orig set: 0.46689789123196446
Mean error with test set: 0.45172031076581576
X subset = 3 , i = 9
0
1
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9
Mean error with orig set: 0.4656492785793563
Mean error with test set: 0.40427302996670367
X subset = 3 , i = 10
0

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Mean error with orig set: 0.4399556048834628
Mean error with test set: 0.41287458379578246
X subset = 4 , i = 0
0
1
2
3
4
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9
Mean error with orig set: 0.4860432852386238
Mean error with test set: 0.48224195338512765
X subset = 4 , i = 1
0
1
2
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4
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8
9
Mean error with orig set: 0.4514983351831299
Mean error with test set: 0.5463374028856826
X subset = 4 , i = 2
0
1
2
3
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6
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8
9

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Mean error with orig set: 0.46440066592674806
Mean error with test set: 0.40316315205327413
X subset = 4 , i = 3
0
1
2
3
4
5
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7
8
9
Mean error with orig set: 0.534433962264151
Mean error with test set: 0.5851831298557159
X subset = 4 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4580743618201998
Mean error with test set: 0.46614872364039955
X subset = 4 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45513318534961156
Mean error with test set: 0.5077691453940066
X subset = 4 , i = 6
0
1
2
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9
Mean error with orig set: 0.4549667036625971
Mean error with test set: 0.4961154273029967
X subset = 4 , i = 7
0
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8
9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 4 , i = 8
0
1
2
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5
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7
8
9
Mean error with orig set: 0.4609322974472808
Mean error with test set: 0.4514428412874584
X subset = 4 , i = 9
0
1
2
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6
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9
Mean error with orig set: 0.4656492785793563
Mean error with test set: 0.40427302996670367
X subset = 4 , i = 10
0
1

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8
9
Mean error with orig set: 0.4656492785793563
Mean error with test set: 0.40427302996670367
X subset = 5 , i = 0
0
1
2
3
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5
6
7
8
9
Mean error with orig set: 0.3882630410654828
Mean error with test set: 0.42036625971143177
X subset = 5 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.40865704772475026
Mean error with test set: 0.4814095449500555
X subset = 5 , i = 2
0
1
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4
5
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9
Mean error with orig set: 0.4009433962264151

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Mean error with test set: 0.468645948945616
X subset = 5 , i = 3
0
1
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Mean error with orig set: 0.3891509433962264
Mean error with test set: 0.41148723640399554
X subset = 5 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.39384017758046613
Mean error with test set: 0.4095449500554939
X subset = 5 , i = 5
0
1
2
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5
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7
8
9
Mean error with orig set: 0.3929800221975583
Mean error with test set: 0.4181465038845727
X subset = 5 , i = 6
0
1
2
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4
5
6

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9
Mean error with orig set: 0.3924250832408435
Mean error with test set: 0.3787458379578246
X subset = 5 , i = 7
0
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5
6
7
8
9
Mean error with orig set: 0.39367369589345175
Mean error with test set: 0.3662597114317425
X subset = 5 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.3935072142064373
Mean error with test set: 0.36792452830188677
X subset = 5 , i = 9
0
1
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5
6
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9
Mean error with orig set: 0.39442286348501665
Mean error with test set: 0.3587680355160932
X subset = 5 , i = 10
0
1
2

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3
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9
Mean error with orig set: 0.3949778024417314
Mean error with test set: 0.35321864594894564
X subset = 6 , i = 0
0
1
2
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5
6
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8
9
Mean error with orig set: 0.4556881243063263
Mean error with test set: 0.505826859045505
X subset = 6 , i = 1
0
1
2
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6
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9
Mean error with orig set: 0.5233629300776914
Mean error with test set: 0.4794672586015538
X subset = 6 , i = 2
0
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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
0
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Mean error with orig set: 0.5353496115427303
Mean error with test set: 0.5857380688124306
X subset = 6 , 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 = 6 , i = 5
0
1
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5
6
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8
9
Mean error with orig set: 0.4554661487236404
Mean error with test set: 0.5061043285238623
X subset = 6 , i = 6
0
1
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```



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9
Mean error with orig set: 0.5437569367369589
Mean error with test set: 0.5016648168701443
X subset = 6 , i = 7
0
1
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5
6
7
8
9
Mean error with orig set: 0.4596281908990011
Mean error with test set: 0.46448390677025525
X subset = 6 , i = 8
0
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8
9
Mean error with orig set: 0.4609322974472808
Mean error with test set: 0.4514428412874584
X subset = 6 , i = 9
0
1
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3
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5
6
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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

```

```

4
5
6
7
8
9
Mean error with orig set: 0.5134295227524972
Mean error with test set: 0.5785238623751388
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: 0.5342119866814651
Mean error with test set: 0.5971143174250833
X subset = 7 , i = 3

```

```

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: 0.47999445061043283
Mean error with test set: 0.48473917869034405
X subset = 7 , i = 6
0
1
2
3
4
5
6
7
8

```

```

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: 0.43668146503884575
Mean error with test set: 0.41759156492785793
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: 0.42852386237513873
Mean error with test set: 0.3912319644839068
X subset = 7 , i = 10
0
1
2
3
4

```

```

5
6
7
8
9
Mean error with orig set: 0.43776359600443954
Mean error with test set: 0.40677025527192007
X subset = 8 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.425
Mean error with test set: 0.470865704772475
X subset = 8 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4184239733629301
Mean error with test set: 0.45172031076581576
X subset = 8 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4298834628190899
Mean error with test set: 0.4938956714761376
X subset = 8 , i = 3
0

```

```

1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4187291897891232
Mean error with test set: 0.468645948945616
X subset = 8 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4530521642619312
Mean error with test set: 0.4553274139844617
X subset = 8 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.42161487236403994
Mean error with test set: 0.4342397336293008
X subset = 8 , i = 6
0
1
2
3
4
5
6
7
8
9

```

```

Mean error with orig set: 0.42716426193118756
Mean error with test set: 0.3973362930077691
X subset = 8 , i = 7
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.44375693673695893
Mean error with test set: 0.42924528301886794
X subset = 8 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4609322974472808
Mean error with test set: 0.4514428412874584
X subset = 8 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.42702552719200887
Mean error with test set: 0.3806881243063263
X subset = 8 , 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 = 9 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4455882352941177
Mean error with test set: 0.4900110987791343
X subset = 9 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4434239733629301
Mean error with test set: 0.5124861265260822
X subset = 9 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.465788013318535
Mean error with test set: 0.40288568257491675
X subset = 9 , i = 3
0
1

```



```

2
3
4
5
6
7
8
9
Mean error with orig set: 0.4505826859045505
Mean error with test set: 0.4408990011098779
X subset = 9 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.44916759156492786
Mean error with test set: 0.4542175360710322
X subset = 9 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4535793562708102
Mean error with test set: 0.45643729189789123
X subset = 9 , i = 6
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4682019977802442

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Mean error with test set: 0.42563817980022195

X subset = 9 , i = 7

0

1

2

3

4

5

6

7

8

9

Mean error with orig set: 0.44936182019977805

Mean error with test set: 0.4470033296337403

X subset = 9 , i = 8

0

1

2

3

4

5

6

7

8

9

Mean error with orig set: 0.44877913429522753

Mean error with test set: 0.4506104328523862

X subset = 9 , i = 9

0

1

2

3

4

5

6

7

8

9

Mean error with orig set: 0.4536348501664817

Mean error with test set: 0.4034406215316315

X subset = 9 , i = 10

0

1

2

3

4

5

6

```

7
8
9
Mean error with orig set: 0.4548279689234184
Mean error with test set: 0.4078801331853496
X subset = 10 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45493895671476137
Mean error with test set: 0.5
X subset = 10 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4411764705882353
Mean error with test set: 0.5294117647058824
X subset = 10 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45923973362930076
Mean error with test set: 0.4547724750277469
X subset = 10 , i = 3
0
1
2

```

```

3
4
5
6
7
8
9
Mean error with orig set: 0.44925083240843505
Mean error with test set: 0.4286903440621532
X subset = 10 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5068534961154273
Mean error with test set: 0.5208102108768036
X subset = 10 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.455826859045505
Mean error with test set: 0.4672586015538291
X subset = 10 , i = 6
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5104328523862375
Mean error with test set: 0.4739178690344062

```

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X subset = 10 , i = 7
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.5137347391786904
Mean error with test set: 0.4961154273029967
X subset = 10 , i = 8
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4462819089900111
Mean error with test set: 0.4384017758046615
X subset = 10 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45446725860155385
Mean error with test set: 0.422031076581576
X subset = 10 , i = 10
0
1
2
3
4
5
6
7

```

```

8
9
Mean error with orig set: 0.46476137624861263
Mean error with test set: 0.4034406215316315
X subset = 11 , i = 0
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45338512763596006
Mean error with test set: 0.49916759156492785
X subset = 11 , i = 1
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4521642619311876
Mean error with test set: 0.5022197558268591
X subset = 11 , i = 2
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4582685904550499
Mean error with test set: 0.39844617092119866
X subset = 11 , i = 3
0
1
2
3

```

```

4
5
6
7
8
9
Mean error with orig set: 0.5343784683684795
Mean error with test set: 0.5843507214206437
X subset = 11 , i = 4
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45069367369589347
Mean error with test set: 0.45754716981132076
X subset = 11 , i = 5
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4491953385127636
Mean error with test set: 0.4894561598224195
X subset = 11 , i = 6
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.45588235294117646
Mean error with test set: 0.4714206437291898
X subset = 11 , i = 7

```

```

0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.4565760266370699
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: 0.4549112097669256
Mean error with test set: 0.445338512763596
X subset = 11 , i = 9
0
1
2
3
4
5
6
7
8
9
Mean error with orig set: 0.46018312985571586
Mean error with test set: 0.402330743618202
X subset = 11 , i = 10
0
1
2
3
4
5
6
7
8

```



9

```
Mean error with orig set: 0.51503884572697
Mean error with test set: 0.5566037735849056
Mean Error for training set, X subset 1 = [0.49731359]
Mean Error for test set, X subset 1 = [0.49641812]
Mean Error for training set, X subset 2 = [0.47475532]
Mean Error for test set, X subset 2 = [0.46640097]
Mean Error for training set, X subset 3 = [0.47758047]
Mean Error for test set, X subset 3 = [0.48827061]
Mean Error for training set, X subset 4 = [0.4482923]
Mean Error for test set, X subset 4 = [0.4536626]
Mean Error for training set, X subset 5 = [0.4687645]
Mean Error for test set, X subset 5 = [0.47376652]
Mean Error for training set, X subset 6 = [0.39480375]
Mean Error for test set, X subset 6 = [0.40313793]
Mean Error for training set, X subset 7 = [0.48708253]
Mean Error for test set, X subset 7 = [0.48869942]
Mean Error for training set, X subset 8 = [0.44173393]
Mean Error for test set, X subset 8 = [0.44884472]
Mean Error for training set, X subset 9 = [0.43556654]
Mean Error for test set, X subset 9 = [0.43978912]
Mean Error for training set, X subset 10 = [0.45299415]
Mean Error for test set, X subset 10 = [0.44468268]
Mean Error for training set, X subset 11 = [0.46881495]
Mean Error for test set, X subset 11 = [0.46680456]
```

[ ]: