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15BCE0517

L7+L8

**ADABOOST ALGORITHM**

Here the input class (0/1) from original data set is converted to (-1,1) representation for easy evaluation.Initially all weights are set as 1/N.

AdaBoost algorithm

Given a data set containing n points, where

https://cdn-images-1.medium.com/max/800/1*2fp-O3KfXqrdYEGU_RjY0w.jpeg

Here -1 denotes the negative class while 1 represents the positive one.

Initialize the weight for each data point as:

https://cdn-images-1.medium.com/max/800/1*IMHTVrXPKc2mVqDDK40k9w.jpeg

For iteration m=1,…,M:

(1) Fit weak classifiers to the data set and select the one with the lowest weighted classification error:

https://cdn-images-1.medium.com/max/800/1*C8-yNia8Oh44X-t0UxUCUA.jpeg

(2) Calculate the weight for the m\_th weak classifier:

https://cdn-images-1.medium.com/max/800/1*jFpUGuxpGZuzpG6FlDAASw.jpeg

For any classifier with accuracy higher than 50%, the weight is positive. The more accurate the classifier, the larger the weight. While for the classifer with less than 50% accuracy, the weight is negative. It means that we combine its prediction by flipping the sign. For example, we can turn a classifier with 40% accuracy into 60% accuracy by flipping the sign of the prediction. Thus even the classifier performs worse than random guessing, it still contributes to the final prediction. We only don’t want any classifier with exact 50% accuracy, which doesn’t add any information and thus contributes nothing to the final prediction.

(3) Update the weight for each data point as:

https://cdn-images-1.medium.com/max/800/1*mqLcX8yookiPVZoAe6iwqA.jpeg

where Z\_m is a normalization factor that ensures the sum of all instance weights is equal to 1.

If a misclassified case is from a positive weighted classifier, the “exp” term in the numerator would be always larger than 1 (y\*f is always -1, theta\_m is positive). Thus misclassified cases would be updated with larger weights after an iteration. The same logic applies to the negative weighted classifiers. The only difference is that the original correct classifications would become misclassifications after flipping the sign.

After M iteration we can get the final prediction by summing up the weighted prediction of each classifier.

Here since the classes are complementary (-1,1) if the sign of the predicted output is +ve then it means it belongs to class 1 .If –ve then it belongs to class -1.

Here simple rules for binary tree are used .It is done for simplicity.

The evaluate function evaluates whether the output from dataset matches with predicted output.

**DATASET**:

|  |  |
| --- | --- |
| |  | | --- | | **Blood Transfusion Service Center Data Set** | |

Given is the variable name, variable type, the measurement unit and a brief description. The "Blood Transfusion Service Center" is a classification problem. The order of this listing corresponds to the order of numerals along the rows of the database.   
  
R (Recency - months since last donation),   
F (Frequency - total number of donation),   
M (Monetary - total blood donated in c.c.),   
T (Time - months since first donation), and   
a binary variable representing whether he/she donated blood in March 2007 (1 stand for donating blood; 0 stands for not donating blood).

**CODE:**

from \_\_future\_\_ import division

from numpy import \*

import pandas as pd

import numpy

class AdaBoost:

def \_\_init\_\_(self, training\_set):

self.training\_set = training\_set

self.N = len(self.training\_set)

self.weights = ones(self.N)/self.N

self.RULES = []

self.ALPHA = []

def set\_rule(self, func, test=False):

errors = array([t[1]!=func(t[0]) for t in self.training\_set])

e = (errors\*self.weights).sum()

if test: return e

alpha = 0.5 \* log((1-e)/e)

print ('e=%.2f a=%.2f'%(e, alpha))

w = zeros(self.N)

for i in range(self.N):

if errors[i] == 1: w[i] = self.weights[i] \* exp(alpha)

else: w[i] = self.weights[i] \* exp(-alpha)

self.weights = w / w.sum()

self.RULES.append(func)

self.ALPHA.append(alpha)

def evaluate(self):

NR = len(self.RULES)

for (x,l) in self.training\_set:

hx = [self.ALPHA[i]\*self.RULES[i](x) for i in range(NR)]

print (x, sign(l) == sign(sum(hx)))

if \_\_name\_\_ == '\_\_main\_\_':

balance\_data = pd.read\_csv('https://archive.ics.uci.edu/ml/machine-learning-databases/blood-transfusion/transfusion.data',sep= ',', header = 0 )

mllab = []

balance\_data=balance\_data.astype(numpy.float)

#print(balance\_data)

for i in range(0,balance\_data.shape[0]):

a=balance\_data.values[i,4];

if (a==0.0):

a=-1.0

mllab.append((tuple(balance\_data.values[i,0:4].tolist()),a))

#print(mllab)

m = AdaBoost(mllab)

m.set\_rule(lambda x: 2\*(float(x[0]) < 10)-1)

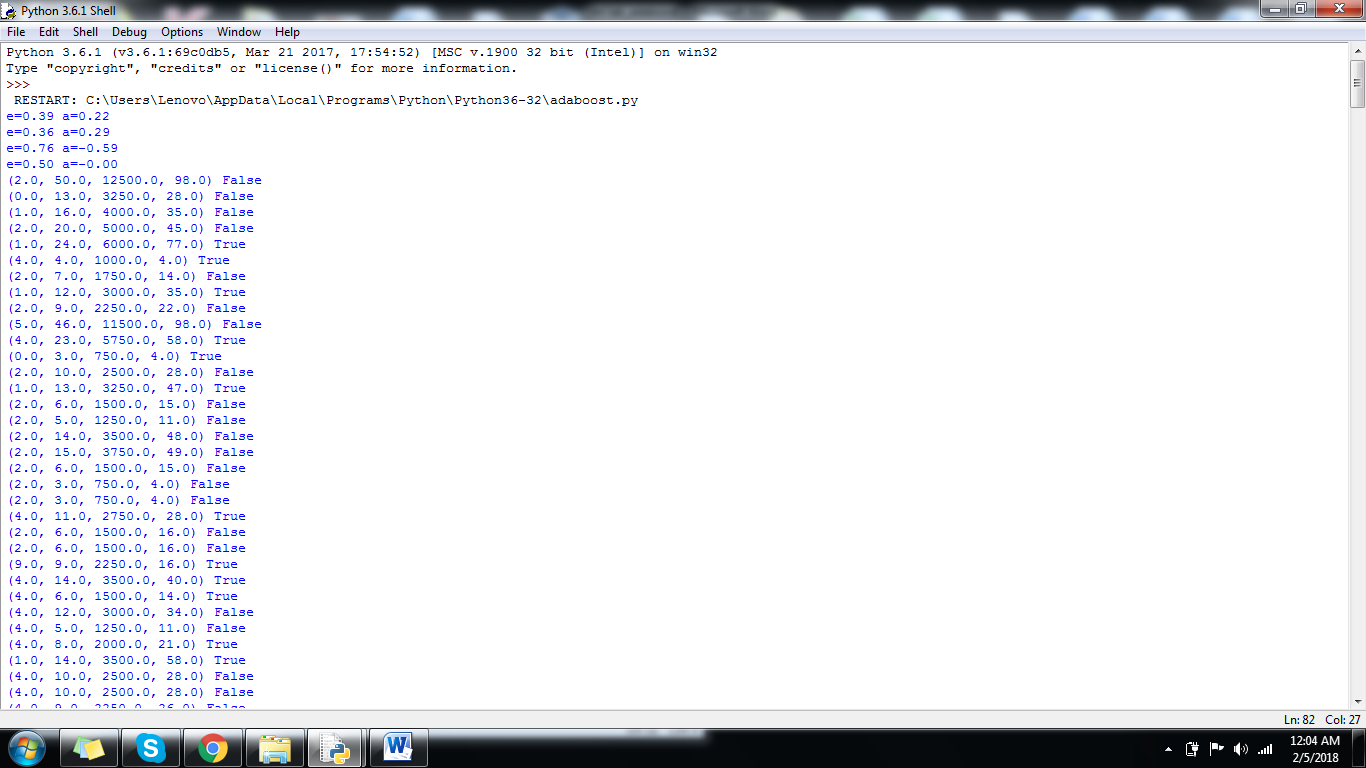
m.set\_rule(lambda x: 2\*(float(x[1]) > 5)-1)

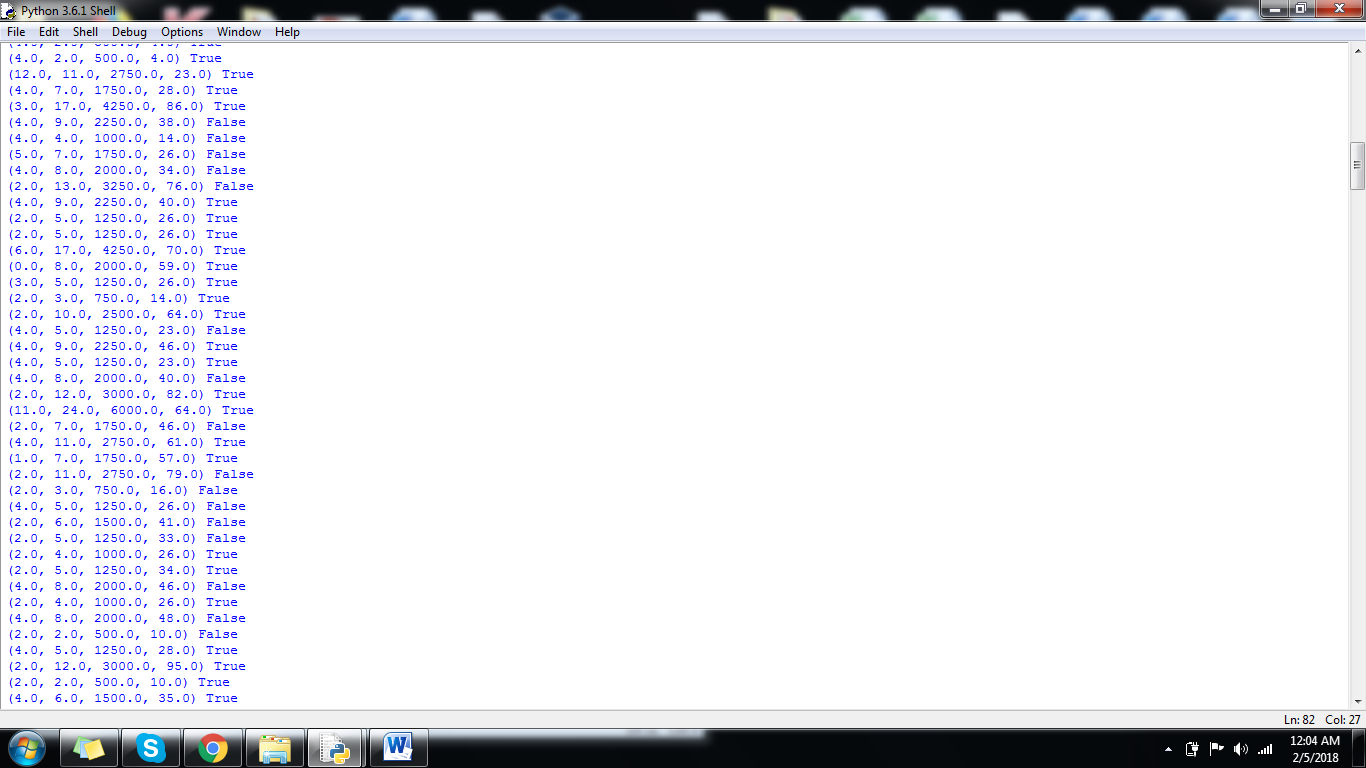
m.set\_rule(lambda x: 2\*(float(x[2]) > 20)-1)

m.set\_rule(lambda x: 2\*(float(x[3]) < 400)-1)

m.evaluate()

OUTPUT:





e=0.39 a=0.22

e=0.36 a=0.29

e=0.76 a=-0.59

e=0.50 a=-0.00

(2.0, 50.0, 12500.0, 98.0) False

(0.0, 13.0, 3250.0, 28.0) False

(1.0, 16.0, 4000.0, 35.0) False

(2.0, 20.0, 5000.0, 45.0) False

(1.0, 24.0, 6000.0, 77.0) True

(4.0, 4.0, 1000.0, 4.0) True

(2.0, 7.0, 1750.0, 14.0) False

(1.0, 12.0, 3000.0, 35.0) True

(2.0, 9.0, 2250.0, 22.0) False

(5.0, 46.0, 11500.0, 98.0) False

(4.0, 23.0, 5750.0, 58.0) True

(0.0, 3.0, 750.0, 4.0) True

(2.0, 10.0, 2500.0, 28.0) False

(1.0, 13.0, 3250.0, 47.0) True

(2.0, 6.0, 1500.0, 15.0) False

(2.0, 5.0, 1250.0, 11.0) False

(2.0, 14.0, 3500.0, 48.0) False

(2.0, 15.0, 3750.0, 49.0) False

(2.0, 6.0, 1500.0, 15.0) False

(2.0, 3.0, 750.0, 4.0) False

(2.0, 3.0, 750.0, 4.0) False

(4.0, 11.0, 2750.0, 28.0) True

(2.0, 6.0, 1500.0, 16.0) False

(2.0, 6.0, 1500.0, 16.0) False

(9.0, 9.0, 2250.0, 16.0) True

(4.0, 14.0, 3500.0, 40.0) True

(4.0, 6.0, 1500.0, 14.0) True

(4.0, 12.0, 3000.0, 34.0) False

(4.0, 5.0, 1250.0, 11.0) False

(4.0, 8.0, 2000.0, 21.0) True

(1.0, 14.0, 3500.0, 58.0) True

(4.0, 10.0, 2500.0, 28.0) False

(4.0, 10.0, 2500.0, 28.0) False

(4.0, 9.0, 2250.0, 26.0) False

(2.0, 16.0, 4000.0, 64.0) True

(2.0, 8.0, 2000.0, 28.0) False

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(4.0, 6.0, 1500.0, 16.0) False

(2.0, 14.0, 3500.0, 57.0) False

(4.0, 7.0, 1750.0, 22.0) False

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(2.0, 5.0, 1250.0, 16.0) True

(2.0, 5.0, 1250.0, 16.0) False

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(4.0, 20.0, 5000.0, 69.0) False

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(4.0, 3.0, 750.0, 25.0) False

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(4.0, 5.0, 1250.0, 74.0) True

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(16.0, 4.0, 1000.0, 23.0) True

(16.0, 3.0, 750.0, 19.0) True

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(14.0, 2.0, 500.0, 35.0) False

(16.0, 6.0, 1500.0, 81.0) True

(16.0, 4.0, 1000.0, 58.0) True

(16.0, 5.0, 1250.0, 71.0) True

(21.0, 2.0, 500.0, 26.0) True

(21.0, 3.0, 750.0, 35.0) True

(21.0, 3.0, 750.0, 35.0) True

(23.0, 8.0, 2000.0, 69.0) True

(21.0, 3.0, 750.0, 38.0) True

(23.0, 3.0, 750.0, 35.0) True

(21.0, 3.0, 750.0, 40.0) True

(23.0, 2.0, 500.0, 28.0) True

(21.0, 1.0, 250.0, 21.0) True

(21.0, 1.0, 250.0, 21.0) True

(25.0, 6.0, 1500.0, 50.0) True

(21.0, 1.0, 250.0, 21.0) True

(21.0, 1.0, 250.0, 21.0) True

(23.0, 3.0, 750.0, 39.0) True

(21.0, 2.0, 500.0, 33.0) True

(14.0, 3.0, 750.0, 79.0) True

(23.0, 1.0, 250.0, 23.0) False

(23.0, 1.0, 250.0, 23.0) True

(23.0, 1.0, 250.0, 23.0) True

(23.0, 1.0, 250.0, 23.0) True

(23.0, 1.0, 250.0, 23.0) True

(23.0, 1.0, 250.0, 23.0) True

(23.0, 1.0, 250.0, 23.0) True

(23.0, 4.0, 1000.0, 52.0) True

(23.0, 1.0, 250.0, 23.0) True

(23.0, 7.0, 1750.0, 88.0) True

(16.0, 3.0, 750.0, 86.0) True

(23.0, 2.0, 500.0, 38.0) True

(21.0, 2.0, 500.0, 52.0) True

(23.0, 3.0, 750.0, 62.0) True

(39.0, 1.0, 250.0, 39.0) True

(72.0, 1.0, 250.0, 72.0) True