HW3

November 13, 2018

In [61]:
```
import gzip
import random
import matplotlib.pyplot as plt
import string
from sklearn import svm
from collections import defaultdict
```

0.0.1 Question 1

In [62]:
```
def readGz(f):
  for l in gzip.open(f):
    yield eval(l)
```

In [63]:
```
train = []
for l in readGz("train.json.gz"):
    train.append(l)
```

In [64]:
```
notPurchased = []
for i in range(0, 100000):
    user = random.randint(0, 99999)
    product = random.randint(0, 99999)
    v = {'reviewerID' : 0,
        'itemID' : 0}
    v['reviewerID'] = train[user]['reviewerID']
    v['itemID'] = train[product]['itemID']
    notPurchased.append(v)
```

In [65]:
```
validation = train[100000:]
train = train[:100000]
```

In [66]:
```
validation = validation + notPurchased
```

In [67]:
```
### Would-purchase baseline: just rank which businesses are popular and which are not,

businessCount = defaultdict(int)
totalPurchases = 0

for l in train:
  user,business = l['reviewerID'],l['itemID']
```

```
    businessCount[business] += 1
    totalPurchases += 1
```

In [68]:
```
mostPopular = [(businessCount[x], x) for x in businessCount]
mostPopular.sort()
mostPopular.reverse()

return1 = set()
count = 0
for ic, i in mostPopular:
  count += ic
  return1.add(i)
  if count > totalPurchases/2: break
```

In [69]:
```
validationResult = []
expectedResult = []
i = 0
for v in validation:
    if v['itemID'] in return1:
        validationResult.append(1)
    else:
        validationResult.append(0)
    if i < 100000:
        expectedResult.append(1)
    else:
        expectedResult.append(0)
    i = i+1
```

In [70]:
```
comparison = list(zip(validationResult, expectedResult))
accuracyV = [v[0] == v[1] for v in comparison]
accuracy = sum(accuracyV)/len(accuracyV)
```

In [71]:
```
accuracy
```

Out[71]:
```
0.471355
```

0.0.2 Question 2

In [72]:
```
### Would-purchase baseline: just rank which businesses are popular and which are not,

def predict(X, percentile):
    return1 = set()
    count = 0
    for ic, i in mostPopular:
      count += ic
      return1.add(i)
      if count > totalPurchases*percentile: break

    validationResult = []
```

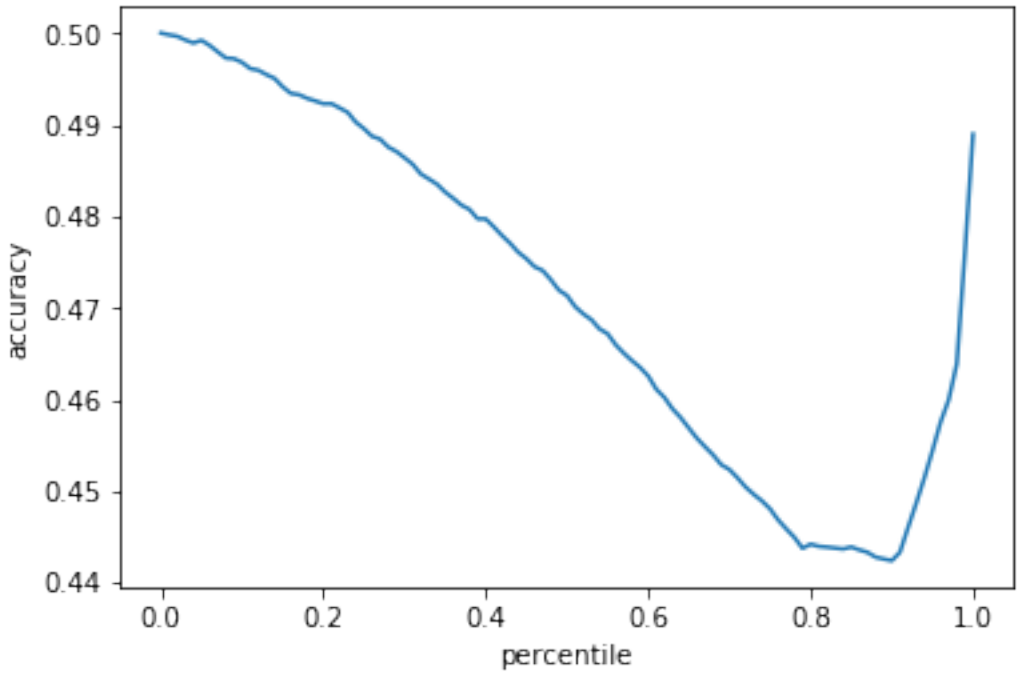
```
            for v in X:
                if v['itemID'] in return1:
                    validationResult.append(1)
                else:
                    validationResult.append(0)

            return validationResult

        def modelAccuracy(y, real_y):
            comparison = list(zip(y, real_y))
            accuracyV = [v[0] == v[1] for v in comparison]
            return sum(accuracyV)/len(accuracyV)
```

In [73]:
```
percent = []
res = []
for i in range(0, 101):
    percentile = i/100
    percent.append(percentile)
    result = predict(validation, percentile)
    acc = modelAccuracy(result, expectedResult)
    res.append(acc)
```

In [74]:
```
plt.plot(percent, res)
plt.xlabel('percentile')
plt.ylabel('accuracy')
plt.show()
```



```
In [75]: percent[res.index(max(res))]

Out[75]: 0.0

In [76]: max(res)

Out[76]: 0.50003
```

The best performance is achieved when predicting all pairs with False.

0.0.3 Question 3

```
In [25]: predictions = open("predictions_Purchase.txt", 'w')
         for l in open("pairs_Purchase.txt"):
             if l.startswith("reviewerID"):
                 #header
                 predictions.write(l)
                 continue
             u,i = l.strip().split('-')

             userCategories = list(set([v['categoryID'] for v in train if v['reviewerID'] == u])
             itemCat = list(set([v['categoryID'] for v in train if v['itemID'] == i]))
             if itemCat != []:
                 itemCat = itemCat[0]

             if itemCat != [] and itemCat in userCategories:
                 predictions.write(u + '-' + i + ",1\n")
             else:
                 predictions.write(u + '-' + i + ",0\n")

         predictions.close()
```

0.0.4 Question 4

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Team Name: Pedro Meireles

0.0.5 Question 5

```
In [23]: train = []
         for l in readGz("train.json.gz"):
             train.append(l)

In [24]: subSet = []
         for i in range(0, 20000):
             index = random.randint(0, 19999)
             subSet.append(train[index])

In [25]: validation = subSet[len(subSet)//2:]
         train = subSet[:len(subSet)//2]
```

```
In [12]: usersCats = defaultdict(list)
         for v in train:
             user = v['reviewerID']
             usersCats[user] = [0,0,0,0,0]

         mostCommonCat = [0,0,0,0,0]
         for v in train:
             user = v['reviewerID']
             index = v['categoryID']
             usersCats[user][index] = usersCats[user][index] + 1
             mostCommonCat[index] = mostCommonCat[index] + 1

In [13]: for v in usersCats:
             maxIndices = [i for i, x in enumerate(usersCats[v]) if x == max(usersCats[v])]
             catID = [mostCommonCat[i] for i in maxIndices]
             catID = maxIndices[catID.index(max(catID))]
             usersCats[v] = catID

In [8]: predictions = []
        actualValue = []
        for l in validation:
            user = l['reviewerID']
            if user in usersCats:
                predictions.append(usersCats[user])
            else:
                predictions.append(0)
            actualValue.append(l['categoryID'])

In [9]: comparison = list(zip(predictions, actualValue))
        accuracy = [v[0] == v[1] for v in comparison]
        accuracy = sum(accuracy)/len(accuracy)
        accuracy

Out[9]: 0.8187

In [14]: predictions = open("predictions_Category.txt", 'w')
         for l in open("pairs_Category.txt"):
             if l.startswith("reviewerID"):
                 #header
                 predictions.write(l)
                 continue
             u,i = l.strip().split('-')

             if u in usersCats:
                 predictions.write(u + '-' + i + "," + str(usersCats[u]) + "\n")
             else:
                 predictions.write(u + '-' + i + ",0\n")

         predictions.close()
```

0.0.6 Question 6

```
In [15]: wordCount = defaultdict(int)
         punctuation = set(string.punctuation)
         for v in train:
             r = ''.join([c for c in v['reviewText'].lower() if not c in punctuation])
             for w in r.split():
                 wordCount[w] += 1

In [16]: wordCount = [(wordCount[w], w) for w in wordCount]
         wordCount.sort()
         wordCount.reverse()

In [17]: totalWords = sum([v[0] for v in wordCount])

In [18]: frequency = [(v[0]/totalWords, v[1]) for v in wordCount]

In [19]: catWordCount = [defaultdict(int), defaultdict(int), defaultdict(int), defaultdict(int),
         catTotalWords = [0, 0, 0, 0, 0]
         catFrequency = []
         for i in range(0, 5):
             for v in [v for v in train if v['categoryID'] == i]:
                 r = ''.join([c for c in v['reviewText'].lower() if not c in punctuation])
                 for w in r.split():
                     catWordCount[i][w] += 1

             catWordCount[i] = [(catWordCount[i][w], w) for w in catWordCount[i]]
             catWordCount[i].sort()
             catWordCount[i].reverse()

             catTotalWords[i] = sum([v[0] for v in catWordCount[i]])
             catFrequency.append([(v[0]/catTotalWords[i], v[1]) for v in catWordCount[i]])

In [20]: for i in range(0, 5):
             print('CategoryID = ' + str(i))
             for v in catFrequency[i][:10]:
                 f = v[0] - [x[0] for x in frequency if x[1] == v[1]][0]
                 print(v[1] + ' - ' + str(f))
             print()

CategoryID = 0
the - -0.0001830118442185738
i - 0.0033639416588894383
and - 0.00013154814794518604
a - 0.00017151733026209842
it - 0.0013979045179383365
to - -5.735199828152404e-05
is - -1.8542851970240748e-05
for - -0.0006914201788361021
```

```
this - 0.0003678141018239392
in - 0.00016154547404756588

CategoryID = 1
the - 0.0007219045468786905
i - -0.00725930284502313
and - -0.000475814828130805
a - -2.874195769825283e-05
to - 0.00019532598714466776
is - -7.155610571632845e-05
it - -0.003432213312138343
for - 0.0012323506655017892
of - 0.0012031414365440852
in - -0.00028453338477869676

CategoryID = 2
the - -0.0025907973113547325
and - 0.0016222582519749493
i - -0.008940365249605942
a - -0.001840804437797234
it - 0.003825898935718528
to - 0.00037173734580276535
for - 0.0045828249158813145
is - 0.0017084864812889032
my - 0.004234039467868931
this - 0.0011560368560521832

CategoryID = 3
the - -0.0017261461279429666
and - 0.0005600184426730673
a - -0.0026411741360753346
i - -0.015680574597252032
to - -0.0004661007835804615
for - 0.005814946457524731
is - 0.0008455558323745838
it - -0.002869327476240576
my - 0.005094340821756282
they - 0.0019342949678975378

CategoryID = 4
the - -0.0021038049108826062
and - 0.0012281013563130855
i - -0.013016485752960435
a - -0.0055148783855534615
to - -0.000965385310450477
for - 0.004342980689654028
is - 0.000644616162266503
they - 0.004425295974886974
```

```
are - 0.004344480796026496
it - -0.004816703944121101
```

0.0.7 Question 7

```
In [26]: X_train = []
         y_train = []
         X_validation = []
         y_validation = []
         for v in train:
             if v['categoryID'] != 0:
                 v['categoryID'] = 1
             features = []
             for i in range(0, 500):
                 features.append(frequency[i][1] in v['reviewText'])
             y_train.append(v['categoryID'])
             X_train.append(features)


         for v in validation:
             if v['categoryID'] != 0:
                 v['categoryID'] = 1
             features = []
             for i in range(0, 500):
                 features.append(frequency[i][1] in v['reviewText'])
             y_validation.append(v['categoryID'])
             X_validation.append(features)

In [27]: test_accuracies = []
         svms = []
         for c in [0.01, 0.1, 1, 10, 100]:
             clf = svm.SVC(C=c, kernel='linear')
             clf.fit(X_train, y_train)
             test_predictions = clf.predict(X_validation)
             accuracy = []
             for i in range(0, len(test_predictions)):
                 accuracy.append(test_predictions[i] == y_validation[i])
             test_accuracies.append((c, sum(accuracy)/len(accuracy)))
             svms.append(clf)

In [28]: test_accuracies

Out[28]: [(0.01, 0.7714), (0.1, 0.7915), (1, 0.7908), (10, 0.7933), (100, 0.7918)]
```

The best performance was an accuracy of 0.7933 using C = 10

0.0.8 Question 8

In [51]:
```
newTrain = train[:10000]
newValidation = validation[:10000]
```

In [52]:
```
allPredictions = []
allSvms = []
realValidationY = [v['categoryID'] for v in newValidation]
for c in [0.01, 0.1, 1, 10, 100]:
    svms = []
    print(str(c))
    for i in range(0, 5):
        print('Category = ' + str(i))
        X_train = []
        y_train = []
        X_validation = []
        y_validation = []
        for v in newTrain:
            if v['categoryID'] != i:
                v['categoryID'] = (i+1)%5
            features = []
            for j in range(0, 500):
                features.append(frequency[j][1] in v['reviewText'])
            y_train.append(v['categoryID'])
            X_train.append(features)


        for v in newValidation:
            if v['categoryID'] != i:
                v['categoryID'] = (i+1)%5
            features = []
            for j in range(0, 500):
                features.append(frequency[j][1] in v['reviewText'])
            y_validation.append(v['categoryID'])
            X_validation.append(features)

        test_accuracies = []

        clf = svm.SVC(C=c, kernel='linear')
        clf.fit(X_train, y_train)
        print('Fit done')
        svms.append(clf)

    test_predictions = []
    print('Predicting')
    for v in X_validation:
        confidency = [svms[j].decision_function([v]) for j in range(0, 5)]
        posConf = [x for x in confidency if x > 0]
        posConf.sort()
```

```
                if posConf == []:
                    test_predictions.append(0)
                else:
                    test_predictions.append(confidency.index(posConf[0]))
            allPredictions.append([c, test_predictions])
            allSvms.append(svms)
            print('Finished')
            print()
```

```
0.01
Category = 0
Fit done
Category = 1
Fit done
Category = 2
Fit done
Category = 3
Fit done
Category = 4
Fit done
Predicting
Finished

0.1
Category = 0
Fit done
Category = 1
Fit done
Category = 2
Fit done
Category = 3
Fit done
Category = 4
Fit done
Predicting
Finished

1
Category = 0
Fit done
Category = 1
Fit done
Category = 2
Fit done
Category = 3
Fit done
Category = 4
Fit done
```

```
Predicting
Finished

10
Category = 0
Fit done
Category = 1
Fit done
Category = 2
Fit done
Category = 3
Fit done
Category = 4
Fit done
Predicting
Finished

100
Category = 0
Fit done
Category = 1
Fit done
Category = 2
Fit done
Category = 3
Fit done
Category = 4
Fit done
Predicting
Finished
```

```
In [53]: test_accuracies = []
         for v in allPredictions:
             predicted = v[1]
             accuracy = []
             for i in range(0, len(predicted)):
                 accuracy.append(predicted[i] == realValidationY[i])
             test_accuracies.append((v[0], sum(accuracy)/len(accuracy)))

In [54]: test_accuracies

Out[54]: [(0.01, 0.2286), (0.1, 0.7914), (1, 0.2089), (10, 0.7929), (100, 0.2082)]

In [55]: test = []
         for l in readGz("test_Category.json.gz"):
             test.append(l)
```

In [56]:
```
X_test=[]
for v in test:
    features = []
    for i in range(0, 500):
        features.append(frequency[i][1] in v['reviewText'])
    X_test.append(features)
```

In [60]:
```
predictions = open("predictions_Category.txt", 'w')
i = 0
for l in open("pairs_Category.txt"):
    if l.startswith("reviewerID"):
        #header
        predictions.write(l)
        continue
    u,r = l.strip().split('-')

    confidency = [allSvms[3][j].decision_function([X_test[i]]) for j in range(0, 5)]
    posConf = [x for x in confidency if x > 0]
    posConf.sort()
    if posConf == []:
        predictions.write(u + '-' + r + ',0\n')
    else:
        predictions.write(u + '-' + r + ',' + str(confidency.index(posConf[0])) + '\n')
    i += 1
predictions.close()
```