AmazonReviewsClassificationNaiveBayes

June 15, 2018

1 AmazonReviews Naive Bayes Assignment

```
In [1]: %matplotlib inline

        import sqlite3
        import pandas as pd #for data frames
        import numpy as np #numpy array operations
        import nltk #natural lang processing, for processing text
        import string
        import matplotlib.pyplot as plt
        import seaborn as sns #for plotting
        from sklearn.feature_extraction.text import TfidfTransformer
        from sklearn.feature_extraction.text import TfidfVectorizer
        from sklearn.feature_extraction.text import CountVectorizer
        from sklearn.metrics import roc_curve, auc
        from nltk.stem.porter import PorterStemmer
        import pickle
        import seaborn as sn

        import matplotlib.pyplot as plt
        from sklearn.cross_validation import train_test_split
        from sklearn.neighbors import KNeighborsClassifier
        from sklearn.metrics import accuracy_score
        from sklearn.cross_validation import cross_val_score
        from collections import Counter
        from sklearn.metrics import accuracy_score
        from sklearn import cross_validation

        from sklearn.metrics import average_precision_score,f1_score,precision_score,recall_sc
```

```
C:\Users\Dell\Anaconda3\lib\site-packages\sklearn\cross_validation.py:41: DeprecationWarning: 
  "This module will be removed in 0.20.", DeprecationWarning)
```

```
In [2]: pickle_in=open("cleanedData.pickle","rb")
        final = pickle.load(pickle_in)
```

```
In [3]: pickle_in = open("BOW_tfidf_avgW2V_TfidfW2V.pickle","rb")
        count_vect = pickle.load(pickle_in) #BOW
        final_counts = pickle.load(pickle_in) #BOW

        tf_idf_vect = pickle.load(pickle_in) #TFIDF
        final_tf_idf = pickle.load(pickle_in) #TFIDF
        features = pickle.load(pickle_in) #TFIDF

        w2v_model = pickle.load(pickle_in) #w2v
        words = pickle.load(pickle_in) #w2v

        sent_vectors = pickle.load(pickle_in) #avg W2V
```

```
C:\Users\Dell\Anaconda3\lib\site-packages\gensim\utils.py:1197: UserWarning: detected Windows;
  warnings.warn("detected Windows; aliasing chunkize to chunkize_serial")
```

```
In [4]: # Weighted TF_IDF W2V
        pickle_in =open("WiightedTfidfW2V.pickle","rb")
        tfidf_sent_vectors = pickle.load(pickle_in)
```

```
In [5]: final.shape
```

```
Out[5]: (364171, 11)
```

```
In [6]: scores = final['Score'].get_values()
        len(scores)
```

```
Out[6]: 364171
```

```
In [7]: li = lambda x: 1 if x=='positive'  else 0
        final_scores = []
        for i in range(0,364171):
            final_scores.append(li(scores[i]))
```

1.0.1 Getting Best Alpha Value Using Cross Validation Using Time Based Split

```
In [8]: from sklearn.model_selection import TimeSeriesSplit
        from sklearn.naive_bayes import BernoulliNB

        li_of_scoring = ['Accuracy Score','F1 Score','Precision Score',
                         'Recall Score','AUC','Log-Loss']

        def alpha_cross_validation(x_1,y_1,n_alpha,score):
            #list of alpha values
            liOfAlphas = list(range(1,n_alpha));

            #empty list to hold CV scores/accuracy
            cv_scores = []
```

```
for alph in liOfAlphas:

    tscv = TimeSeriesSplit(n_splits=5)
    acc_sum=0
    cnt=0
    for train_index, test_index in tscv.split(x_1):
        X_train, X_test = x_1[train_index], x_1[test_index]
        Y_train, Y_test = y_1[train_index], y_1[test_index]

        #alpha is used to avoide Errors, its ntg but Laplace Smoothing
        # Binarize=0 or any num indicates it converts every feature into bin value
        clf = BernoulliNB(alpha=alph, binarize=0.0, class_prior=None, fit_prior=Tru
        clf.fit(X_train,Y_train)

        pred = clf.predict(X_test)

        acc = 0

        if(score == 1):
            acc = accuracy_score(Y_test, pred, normalize=True )*float(100)

        elif(score == 2):
            acc = f1_score(Y_test, pred)*float(100)
        elif(score == 3):
            acc = precision_score(Y_test, pred)*float(100)
        elif(score == 4):
            acc = recall_score(Y_test, pred)*float(100)
        elif(score == 5):
            fpr, tpr, thresholds = roc_curve(Y_test, pred)
            acc = auc(fpr, tpr) * 100
        elif(score == 6):
            acc = log_loss(Y_test, pred,normalize=True)


        acc_sum=acc_sum+acc
        cnt=cnt+1
    cv_scores.append(acc_sum/cnt)



 # determining best Alpha
optimal_alpha = liOfAlphas[cv_scores.index(max(cv_scores))]
print('\nThe optimal value of alpha is: ',optimal_alpha,' With ',li_of_scoring[sco

plt.plot(liOfAlphas, cv_scores)
```

```
        for xy in zip(liOfAlphas, np.round(cv_scores,3)):
            plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')

        plt.xlabel('Alpha')
        plt.ylabel('Accuracy Percentage')
        plt.show()

        print("the Accuracy for each Alpha is : ", np.round(cv_scores,3))
        print('*********************************************************************')
        print("optimal Alpha is: ",optimal_alpha)
        return optimal_alpha;
```

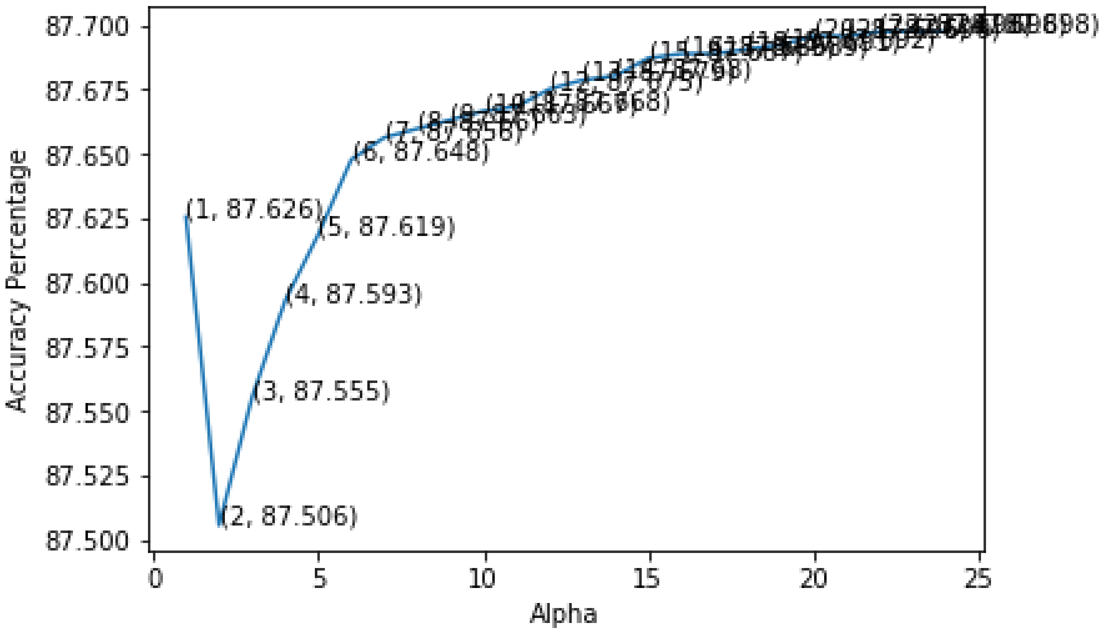
1.0.2 Util Functions: Get Optimal Alpha, Predict Class Label and get Accuracy Using Diff Scoring Techniques

In [9]:
```
def convToNpArray(arr):
        if(type(arr) == list):
            arr = np.array(arr)
            return arr
        else:
            return arr;
    def getAlpha_and_Show_Accuracy(x,y,noOfAlphas):
        x_1, x_test, y_1, y_test = cross_validation.train_test_split(x,y, test_size=0.3, ra

        x_1 = convToNpArray(x_1)
        x_test = convToNpArray(x_test)
        y_1 = convToNpArray(y_1)
        y_test = convToNpArray(y_test)


        optim_alpha = 0;
        for i in range(0,len(li_of_scoring)):
            optim_alpha = alpha_cross_validation(x_1,y_1,n_alpha=noOfAlphas,score=i+1)


        print("#################################################################")
        print("With Optimal Alpha-----------------------------------------------")


        NB_Optimal = BernoulliNB(alpha=optim_alpha, binarize=0.0, class_prior=None, fit_pri

        NB_Optimal.fit(x_1,y_1)

        pred = NB_Optimal.predict(x_test)

        #acc = accuracy_score(y_test,pred) * 100
```

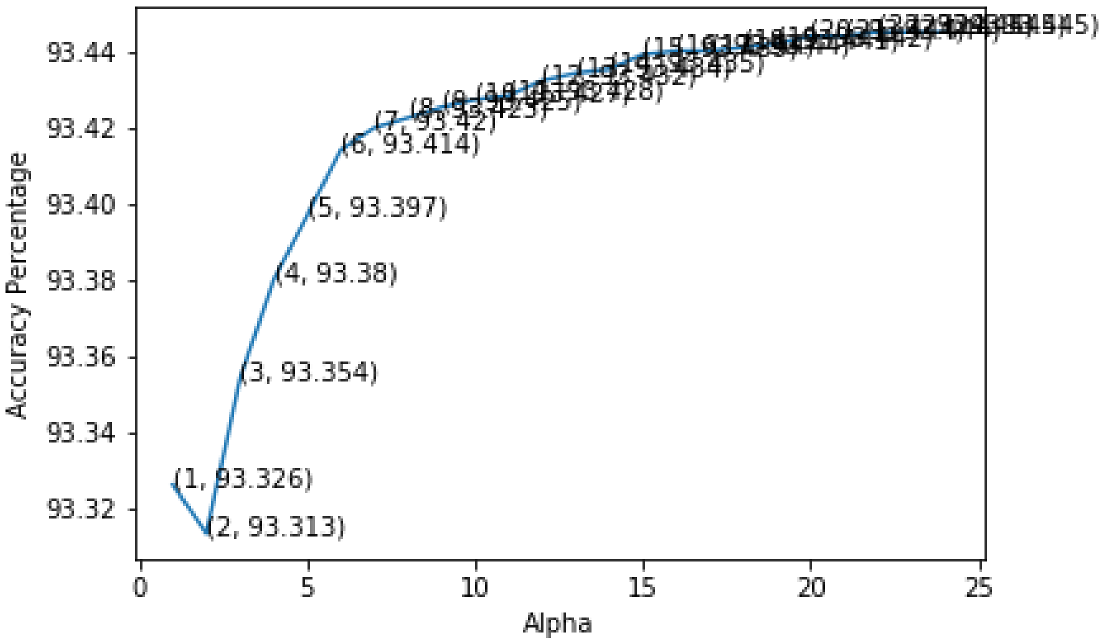
```
        print("Accuracy Of NB Classifier using Accuracy Score: ",accuracy_score(y_test,prec

        print("Accuracy Of NB Classifier using F1 Score: ",f1_score(y_test,pred) * 100)

        print("Accuracy Of NB Classifier Precision Score: ",precision_score(y_test,pred) *

        print("Accuracy Of NB Classifier using Recall Sscore: ",recall_score(y_test,pred)


        fpr, tpr, thresholds = roc_curve(y_test,pred)
        acc = auc(fpr, tpr)
        print("Area Under The Curve is : ",acc)

        print("Log Loss val can be 0 to infinity, 0 is best Our LogLoss is:",log_loss(y_tes


        print("############# Confusion Matrix ###############")

        tn, fp, fn, tp = confusion_matrix(y_test, pred).ravel()
        tpr = tp/(fn+tp)
        tnr = tn/(tn+fp)
        fnr = fn/(fn+tp)
        fpr = fp/(tn+fp)

        print("TPR :%f,TNR : %f,FNR : %f,FPR: %f"%(tpr,tnr,fnr,fpr))
```

1.1 BOW

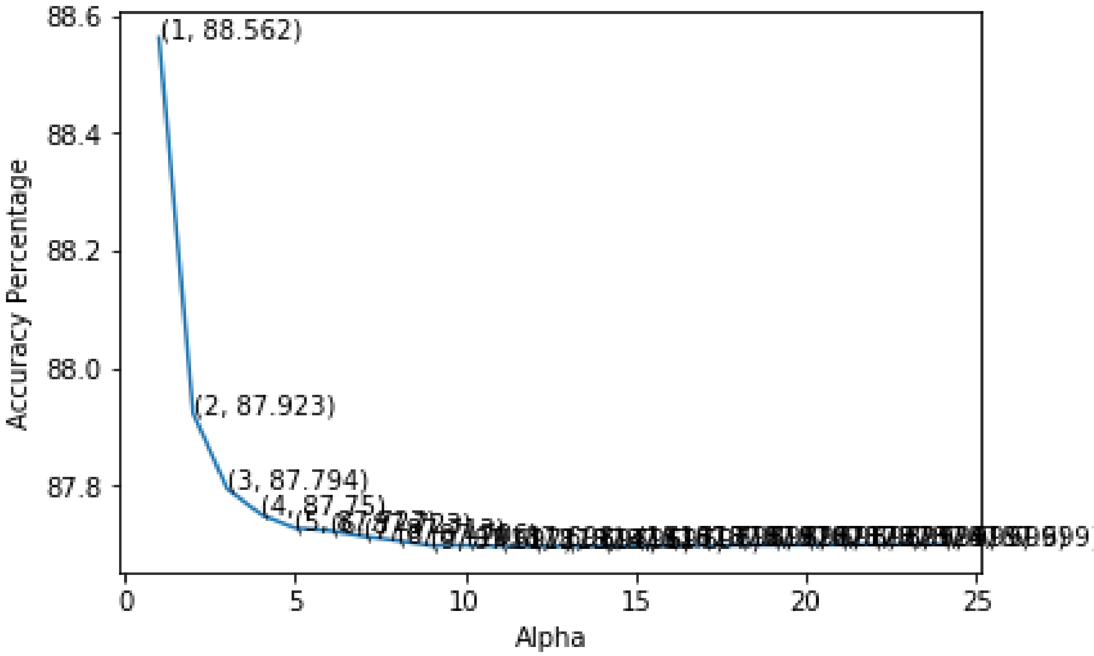
```
In [14]: final_counts.shape

Out[14]: (364171, 115281)

In [15]: # Total data frame

         x = final_counts[0:100000]


         # this is only Score/rating  of data

         y = final_scores[0:100000]

In [290]: getAlpha_and_Show_Accuracy(x,y,30)


The optimal value of alpha is:  22  With  Accuracy Score
```



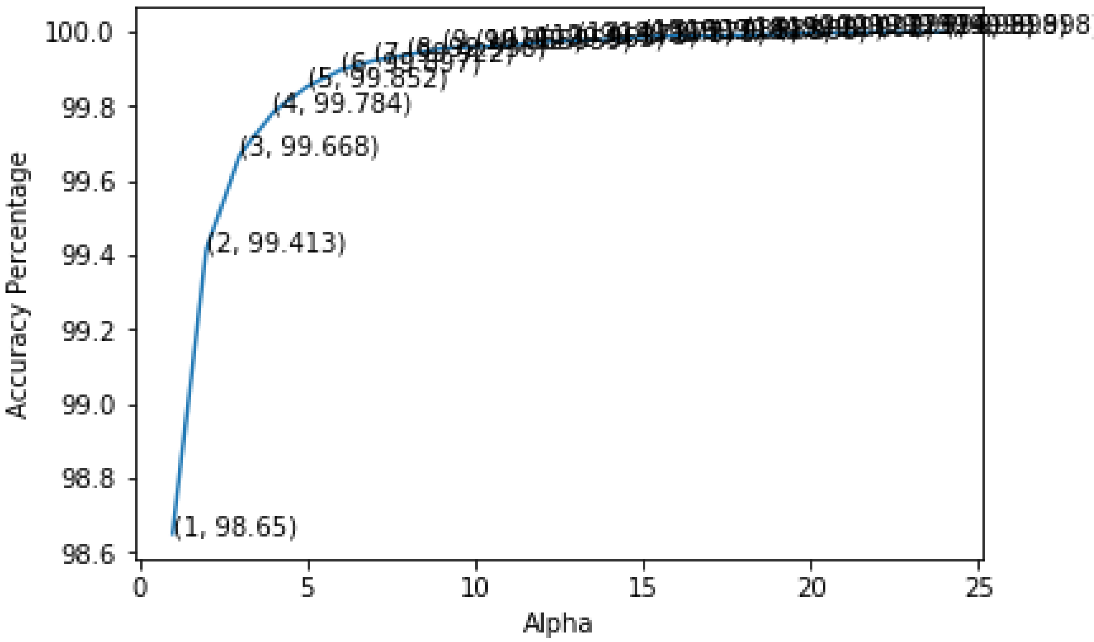

```
the Accuracy for each Alpha is :  [87.626 87.506 87.555 87.593 87.619 87.648 87.656 87.66  87.6
 87.668 87.675 87.679 87.68  87.687 87.689 87.689 87.691 87.692 87.696
 87.696 87.698 87.698 87.698]
*********************************************************************
optimal Alpha is:  22

The optimal value of alpha is:  22  With  F1 Score
```



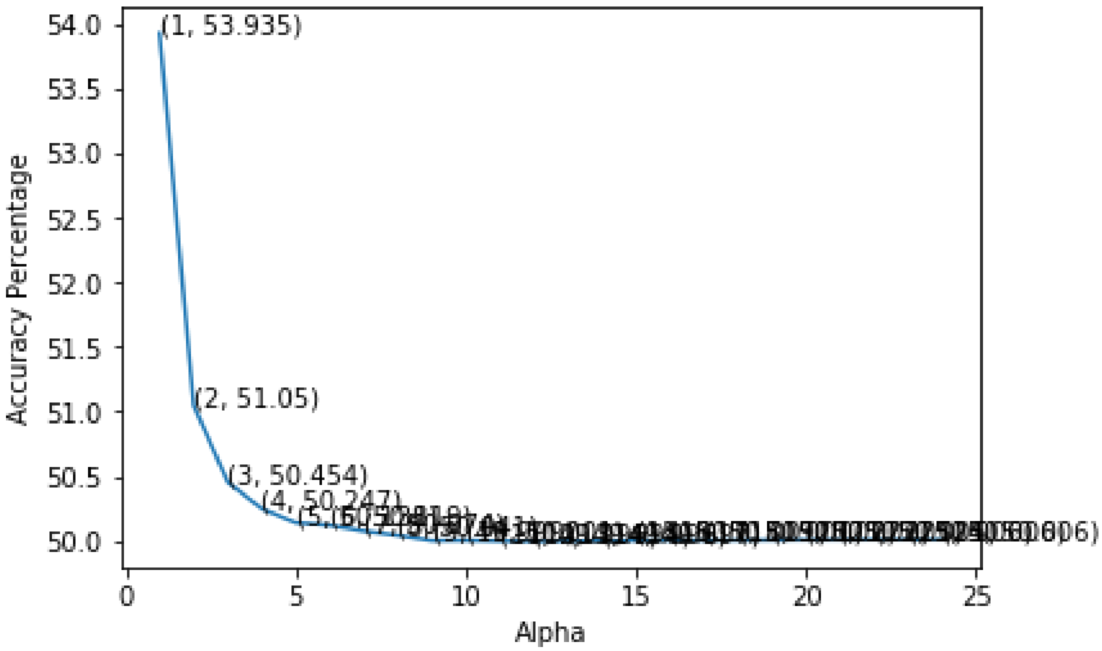

```
the Accuracy for each Alpha is :  [93.326 93.313 93.354 93.38  93.397 93.414 93.42  93.423 93.4
 93.428 93.432 93.434 93.435 93.439 93.44  93.44  93.441 93.442 93.444
 93.444 93.445 93.445 93.445]
*********************************************************************
optimal Alpha is:  22

The optimal value of alpha is:  1  With  Precision Score
```



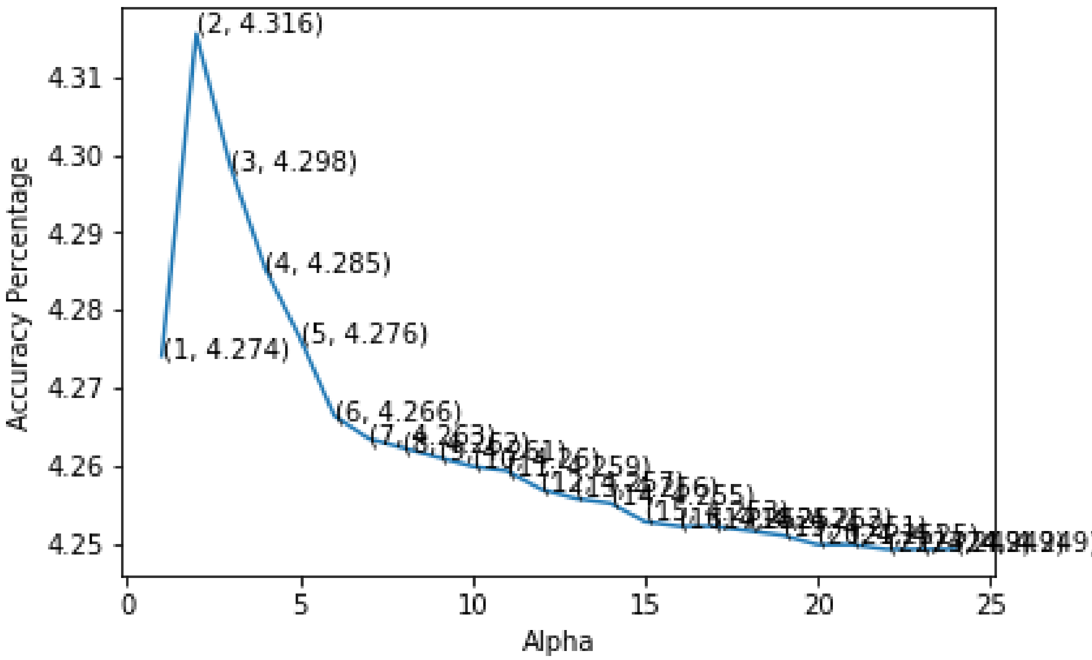

```
the Accuracy for each Alpha is :  [88.562 87.923 87.794 87.75  87.727 87.723 87.713 87.706 87.6
 87.697 87.696 87.697 87.697 87.698 87.698 87.698 87.698 87.698 87.699
 87.699 87.699 87.699 87.699]
*********************************************************************
optimal Alpha is:  1

The optimal value of alpha is:  22  With  Recall Score
```




```
the Accuracy for each Alpha is :  [98.65  99.413 99.668 99.784 99.852 99.897 99.922 99.938 99.9
 99.963 99.973 99.977 99.979 99.986 99.988 99.988 99.99  99.992 99.996
 99.996 99.998 99.998 99.998]
*********************************************************************
optimal Alpha is:  22

The optimal value of alpha is:  1  With  AUC
```




```
the Accuracy for each Alpha is :  [53.935 51.05  50.454 50.247 50.138 50.119 50.074 50.041 49.9
 49.996 49.994 49.996 49.997 50.    50.001 50.001 50.002 50.003 50.005
 50.005 50.006 50.006 50.006]
*********************************************************************
optimal Alpha is:  1

The optimal value of alpha is:  2  With  Log-Loss
```




```
the Accuracy for each Alpha is :  [4.274 4.316 4.298 4.285 4.276 4.266 4.263 4.262 4.261 4.26
 4.256 4.255 4.253 4.252 4.252 4.252 4.251 4.25  4.25  4.249 4.249 4.249]
**********************************************************************
optimal Alpha is:  2
##################################################################
With Optimal Alpha------------------------------------------------
Accuracy Of NB Classifier using Accuracy Score:  87.63666666666666
Accuracy Of NB Classifier using F1 Score:  93.33045620470769
Accuracy Of NB Classifier Precision Score:  88.64257412214783
Accuracy Of NB Classifier using Recall Sscore:  98.54186443895956
Area Under The Curve is :  0.5390940425222194
Log Loss val can be 0 to infinity, 0 is best Our LogLoss is: 4.270232677005971
############# Confusion Matrix ###############
TPR :0.985419,TNR : 0.092769,FNR : 0.014581,FPR: 0.907231
```

1.2 TF_IDF

```
In [293]: final_tf_idf.shape
```

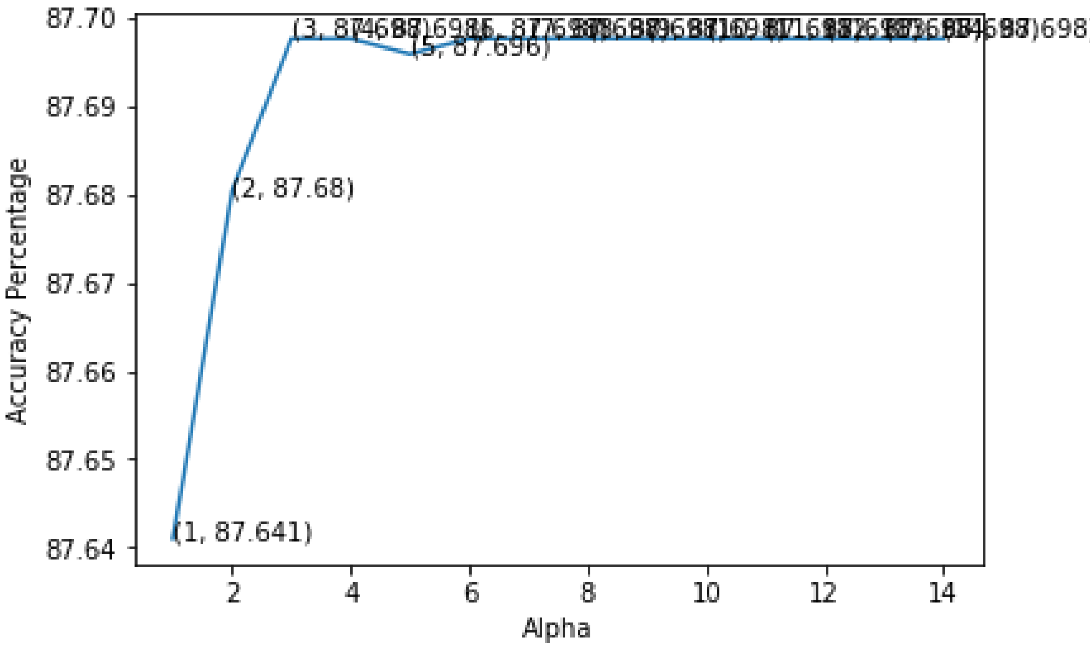
```
Out[293]: (364171, 2910192)
```

```
In [294]: # Total data frame
          x = final_tf_idf[0:100000]
```

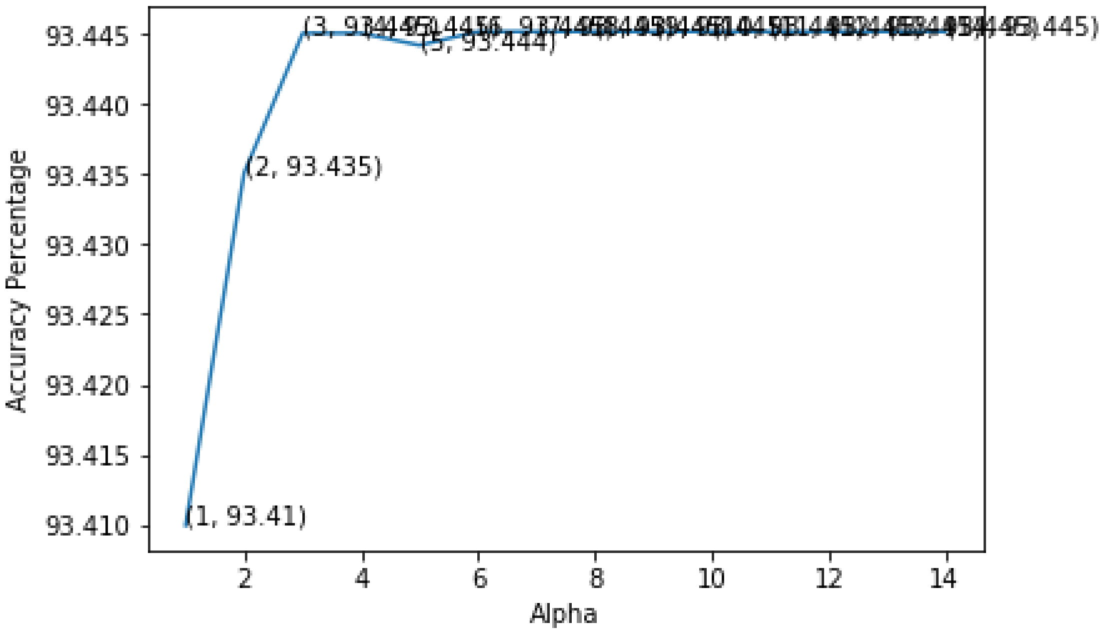
```
# this is only Score/rating  of data
y = final_scores[0:100000]
```

In [295]:
```
getAlpha_and_Show_Accuracy(x,y,15)
```

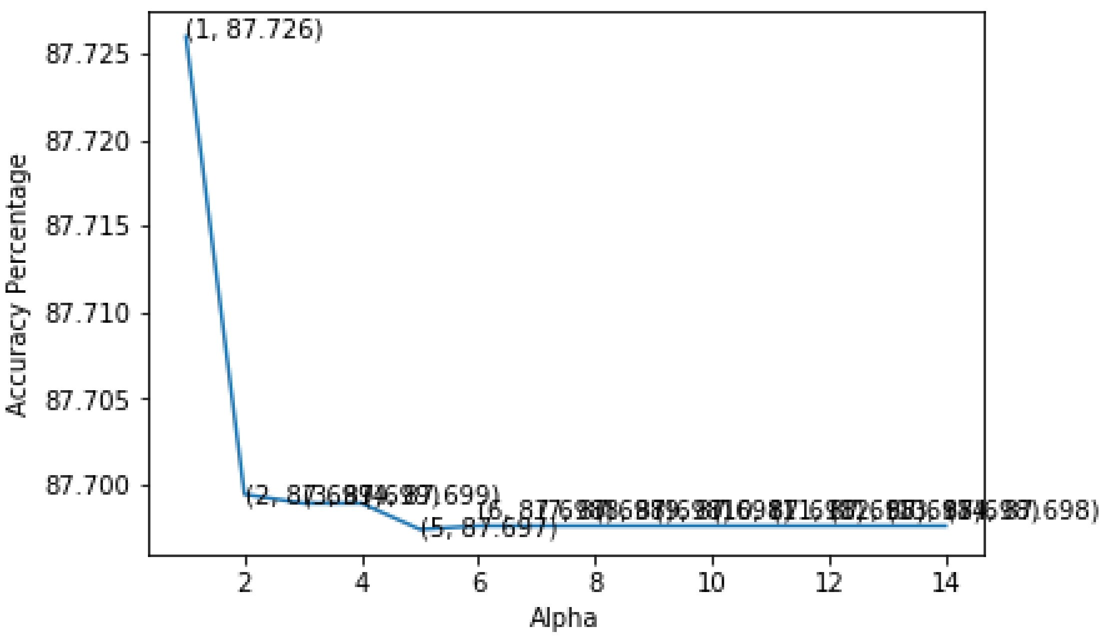
```
The optimal value of alpha is:  3  With  Accuracy Score
```



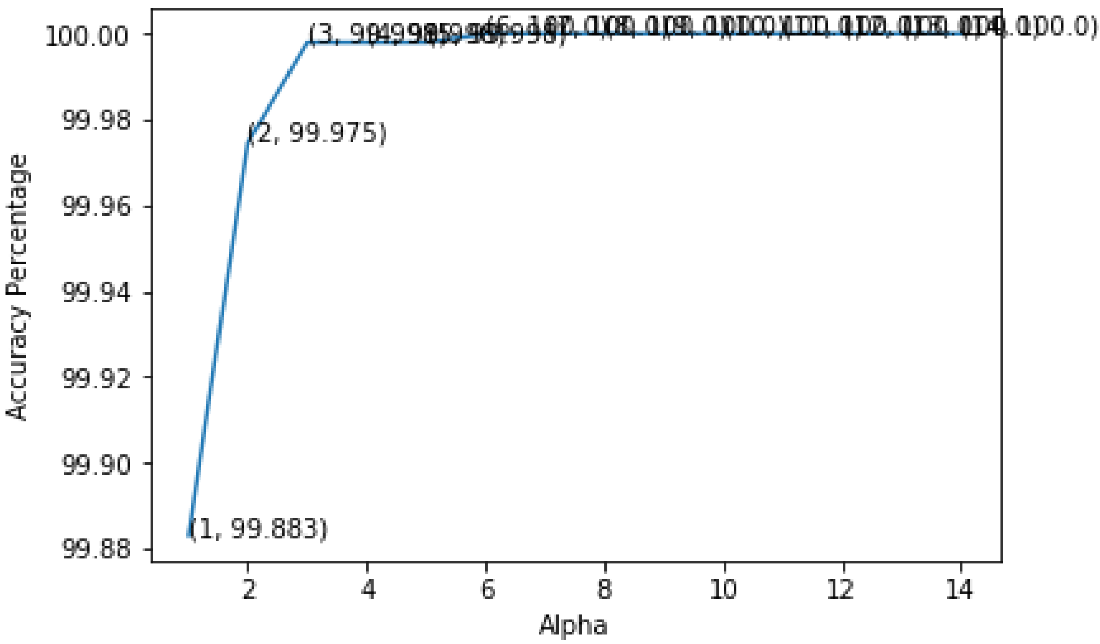

```
the Accuracy for each Alpha is :  [87.641 87.68  87.698 87.698 87.696 87.698 87.698 87.698 87.6
 87.698 87.698 87.698 87.698]
*******************************************************************
optimal Alpha is:  3

The optimal value of alpha is:  6  With  F1 Score
```



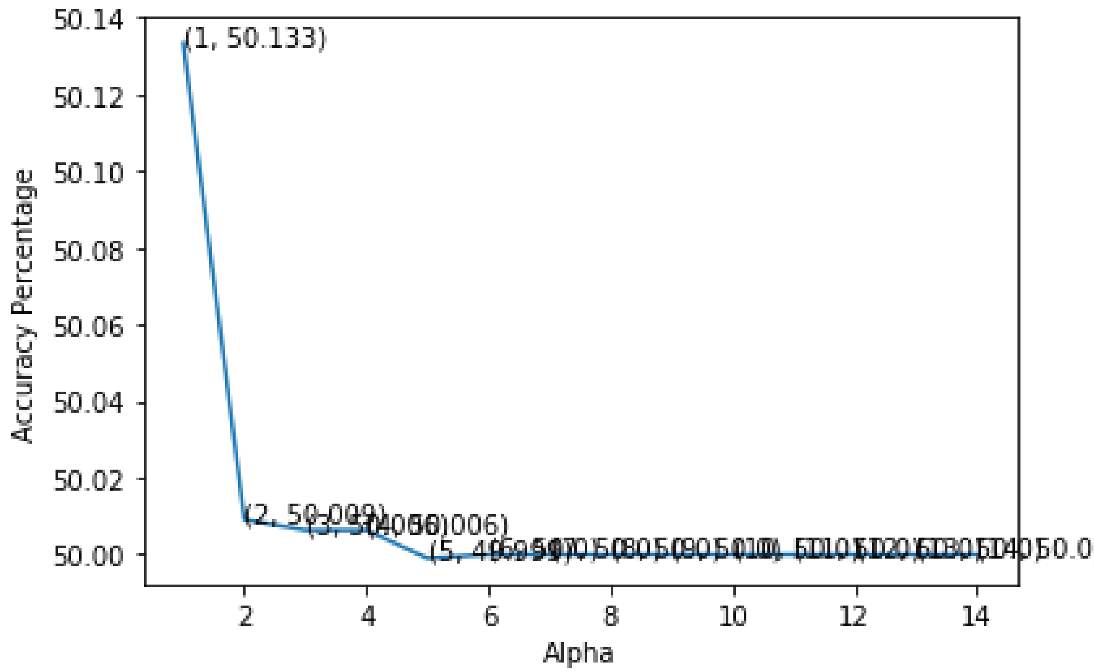

```
the Accuracy for each Alpha is :  [93.41  93.435 93.445 93.445 93.444 93.445 93.445 93.445 93.4
 93.445 93.445 93.445 93.445]
********************************************************************
optimal Alpha is:  6

The optimal value of alpha is:  1  With  Precision Score
```



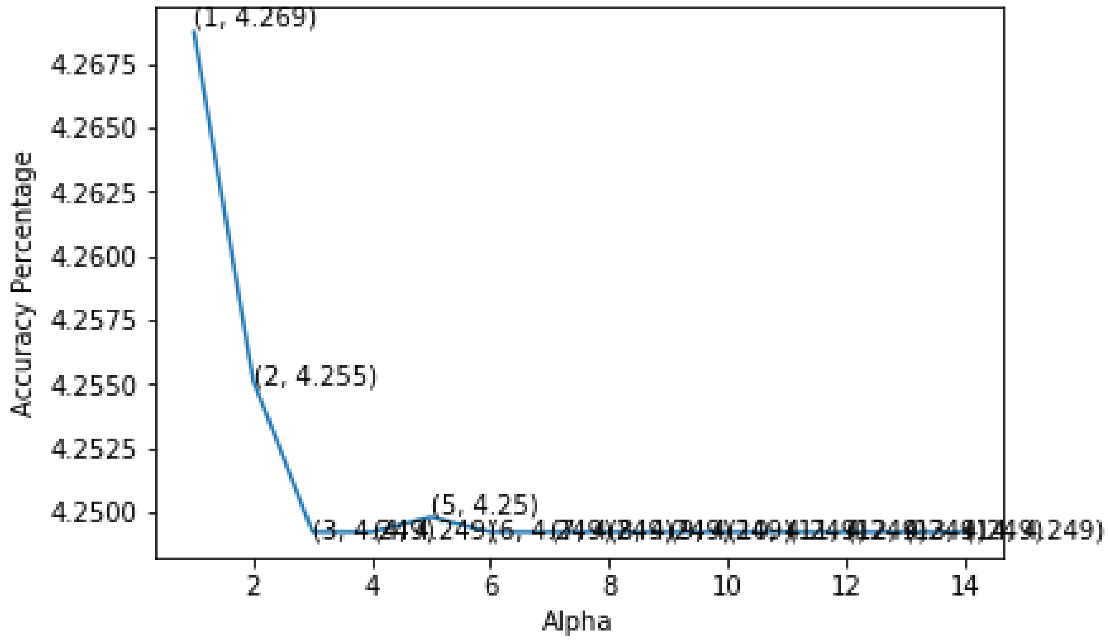
```
the Accuracy for each Alpha is :  [87.726 87.699 87.699 87.699 87.697 87.698 87.698 87.698 87.6
 87.698 87.698 87.698 87.698]
*********************************************************************
optimal Alpha is:  1

The optimal value of alpha is:  6  With  Recall Score
```




```
the Accuracy for each Alpha is :  [ 99.883  99.975  99.998  99.998  99.998 100.    100.    100
 100.    100.    100.    100.    100.   ]
*********************************************************************
optimal Alpha is:  6

The optimal value of alpha is:  1  With  AUC
```




```
the Accuracy for each Alpha is :  [50.133 50.009 50.006 50.006 49.999 50.    50.    50.    50.
 50.    50.    50.    50.   ]
*********************************************************************
optimal Alpha is:  1

The optimal value of alpha is:  1  With  Log-Loss
```




```
the Accuracy for each Alpha is :  [4.269 4.255 4.249 4.249 4.25  4.249 4.249 4.249 4.249 4.249
 4.249 4.249]
*********************************************************************
optimal Alpha is:  1
#################################################################
With Optimal Alpha-----------------------------------------------
Accuracy Of NB Classifier using Accuracy Score:  87.55
Accuracy Of NB Classifier using F1 Score:  93.35042461144047
Accuracy Of NB Classifier Precision Score:  87.87624857545083
Accuracy Of NB Classifier using Recall Sscore:  99.55192709322195
Area Under The Curve is :  0.5043080665711576
Log Loss val can be 0 to infinity, 0 is best Our LogLoss is: 4.300174065963214
############# Confusion Matrix ###############
TPR :0.995519,TNR : 0.013097,FNR : 0.004481,FPR: 0.986903
```

1.3 Feature Importance

In [12]:
```
# Total data frame
x = final_tf_idf[0:100000]

# this is only Score/rating  of data
y = final_scores[0:100000]

x_1, x_test, y_1, y_test = cross_validation.train_test_split(x,y, test_size=0.3, rand
```

```
x_1 = convToNpArray(x_1)
x_test = convToNpArray(x_test)
y_1 = convToNpArray(y_1)
y_test = convToNpArray(y_test)

NB_Optimal = BernoulliNB(alpha=2, binarize=0.0, class_prior=None, fit_prior=True)
NB_Optimal.fit(x_1,y_1)
```

Out[12]:
```
BernoulliNB(alpha=2, binarize=0.0, class_prior=None, fit_prior=True)
```

In [17]:
```
def show_most_informative_features(vectorizer, clf, n=20):
    feature_names = vectorizer.get_feature_names()
    print(len(feature_names))
    coefs_with_fns = sorted(zip(clf.coef_[0], feature_names))
    print(len(clf.coef_[0]))
    top = zip(coefs_with_fns[:n], coefs_with_fns[:-(n + 1):-1])
    print("These are the top 20 important Features Which are most widely used in Posi
    print("")
    print("\tPositive: \t\t\tNegative:")
    for (coef_1, fn_1), (coef_2, fn_2) in top:
        print("")
        print("\t%-15s\t\t\t%-15s" % (fn_2,fn_1))
```

In [18]:
```
show_most_informative_features(tf_idf_vect,NB_Optimal)
```

```
2910192
2910192
These are the top 20 important Features Which are most widely used in Positive and Negative Re

        Positive:                           Negative:

        the                                      00 00

        and                                      00 07

        to                                       00 09

        it                                       00 10

        this                                     00 11

        is                                       00 12

        of                                       00 16

        for                                      00 18

        in                                       00 20
```

my	00 20lb
with	00 24oz
that	00 27
have	00 2lb
but	00 33oz
you	00 34
are	00 40
on	00 49
not	00 50
they	00 58
so	00 60

1.3.1 Summary:

-> Here the classifier used is 'NaiveBayes' and found Optimal Alpha using Cross Validation, and used different performance measures like Accuracy, Precision, Recall, F1-Score and calculated FPR,FNR,TPR,TNR using Confusion Matrix, I have Embedded all these in two functions. -> Used 'coef_' to get the Feature Importance and Printed the top 20 Features for Positive Reviews and Negative Reviews.