In [116]:

```python
#Data Cleansing part 1
"""
Created on Sun Dec 16 19:12:02 2018
@author: HN
"""
import codecs
import math
import re
import os
import time
#import string
import pandas as pd
import numpy as np
from collections import Counter, defaultdict
from nltk import FreqDist
from nltk.corpus import stopwords
#from spacy.lemmatizer import Lemmatizer as lemma
#from spacy.lang.en import LEMMA_INDEX, LEMMA_EXC, LEMMA_RULES
#from nltk.tokenize import word_tokenize
start = time.time();

script_dir = os.path.dirname(os.path.realpath('__file__')) #<-- absolute dir the script is in
rel_path = "02_data/" ; abs_file_path = os.path.join(script_dir, rel_path)

Files = ["wallstreet.csv", "winter.csv", "christmas.csv", "britishcricket.csv", "scubadive.csv", "brexit.csv" ];
out = ["allwallstreet.txt","allwinter.txt", "allchristmas.txt", "allbritishcricket.txt", "allscubadive.txt", "allbrexit.txt" ];
ind = -1;

cleaned_tweets = defaultdict(list); all_hashtags = defaultdict(list);
stop_words = set(stopwords.words('english'));

for file in Files:
    ind += 1
    outfile = os.path.join(abs_file_path, out[ind])
    with codecs.open(outfile, "w", "utf-8") as out_data:

        readfile = os.path.join(abs_file_path, file)
        #print(readfile)
        with open(readfile, "r", encoding = "utf8") as my_input_file:

            for line in my_input_file:
                # clean data
                line = re.sub("`|@|,|~|\n|'['|']'|'?'|<.*>|<|!|\.|\$|\*|:|%|\+|…|\\\\|\/|«|»|···|\||\•|\?|\(|\)|=|-|&|;|\_|—|~|¯
|\{|\}|\[|\]|£|€|¥|¿|–|\“|\”|\‘|\’|\"|,|'", " ", line)
                line = re.sub("http[a-zA-Z0-9]+", "", line)
                line = re.sub("pictwitter"," pictwitter", line); line = re.sub(" # "," #", line); line = re.sub("#"," #", line);
 line = re.sub("# ","", line);
                line = line.lower();

                # remove stop words
                word_list = line.split(' ');  filt_words = []
                for word in word_list:
                    if ((word not in stop_words) and (word != '' and len(word)>2) and (not word.__contains__('pictwitter'))):
                        filt_words.append(re.sub("  "," ", word));
                        if (word[0] == '#') and (len(word)> 1) : all_hashtags[ind].append(word);

                filt_tweet = ' '.join(filt_words);
                cleaned_tweets[ind].append(filt_tweet)
                out_data.write(filt_tweet+'\n')

print("Checkpoint 1 completed in ", time.time() - start);
```

```
Checkpoint 1 completed in  6.970265626907349
```

In [117]:

```python
#Data Cleansing part 2
start = time.time();
top_hashtags = []

for tag in all_hashtags.keys():
    hashtag = FreqDist(all_hashtags[tag]).most_common(1)[0][0]
    top_hashtags.append(hashtag)

selectedtweets = ["wallstreet.txt","winter.txt", "christmas.txt", "cricket.txt", "scubadive.txt", "brexit.txt" ]; ind = -1;
hashtag_file = os.path.join(abs_file_path, "classes.txt")

#Top hashtags in each catagory
with codecs.open(hashtag_file, "w", "utf-8") as hashfile:
    for tag in top_hashtags:
        hashfile.write(tag + '\n')

for file in out:
    ind += 1;

    readfile = os.path.join(abs_file_path, out[ind])
    with codecs.open(readfile, "r", "utf-8") as read_file:

        writefile = os.path.join(abs_file_path, selectedtweets[ind])
        with codecs.open(writefile, "w", "utf-8") as write_file:
            for line in read_file:
                if any(s in line for s in top_hashtags):
                    write_file.write(line)

print("Checkpoint 2 completed in ", time.time() - start);
```

```
Checkpoint 2 completed in  0.8426642417907715
```

In [118]:

```python
#Data segregation
start = time.time();

tweets = selectedtweets; hashtags = top_hashtags;

# Dict = {Hashtag: Tweets} and bag of words
HT = dict.fromkeys(hashtags,'');
trainHT = defaultdict(list);  testHT = defaultdict(list);
ind = -1; bow = set(); #hashtweets = defaultdict(list);

for file in tweets:

    ind += 1
    infile = os.path.join(abs_file_path, file)
    with codecs.open(infile, "r", "utf-8") as in_data:
        for line in in_data:

            for tag in hashtags:
                if tag in line:
                    flag = np.random.choice([0, 1], 1, p=[0.75, 0.25])
                    if flag == 1:
                        #Test data: Dict = {Hashtag: Tweets}
                        line = " ".join(filter(lambda x:x[0]!='#', line.split()))
                        testHT[tag].append(line)
                    else:
                        # Train set: Dict = {Hashtag: Tweets}
                        trainHT[tag].append(re.sub('#' , '', line)) # {Hashtag: [T1, T2, T3]}
                        HT[tag] += re.sub('#' , '', line) # {Hashtag: ['T1 T2 T3']}

print("Checkpoint 3 completed in ", time.time() - start);
```

```
Checkpoint 3 completed in  86.5642876625061
```

In [154]:

```python
#TF-IDF Section
start = time.time();

#Bag of words
#1 creation
for txt in HT.values():
    bow = set(bow).union(set(txt.split(' ')))
#2 Bag of words initialization
bowDict = {}
for h in HT.keys():
    bowDict[h] = dict.fromkeys(bow, 0)
    #3 Bow updation for each class(hashtag)
    for w in HT[h].split(' ') :
        bowDict[h][w] += 1

#Compute Term-Frequency
def computeTF(bowDict, tweet):
    tfDict = {}
    tweetlen = len(tweet.split(' '))
    for word, count in bowDict.items():
        tfDict[word] = count/float(tweetlen)
    return tfDict

tf = {}
for h, t in HT.items():
    tf[h] = computeTF(bowDict[h], t)

#Compute Inverse document frequency
def computeIDF(docList):
    idfDict = {}
    N = len(docList)
    idfDict = HT.fromkeys(docList[0].keys(), 0)
    for doc in docList: #Each class(hashtag)
        for word, val in doc.items():
            if val > 0:
                if word not in idfDict.keys():
                    idfDict[word] = 1
                else :
                    idfDict[word] += 1

    for word, val in idfDict.items():
        idfDict[word] = math.log10(N / float(val))

    return idfDict

idfs = computeIDF([bowDict[h] for h in bowDict.keys()])

#Compute TF-IDF
def computeTFIDF(tfhashtxt, idfs):
    tfidf = {}
    for word, val in tfhashtxt.items():
        tfidf[word] = val*idfs[word]
    return tfidf

tfidfBow = {}; topfivewords = {}
for hashtag in HT.keys():
    tfidfBow[hashtag] = computeTFIDF(tf[hashtag], idfs)
    topfivewords[hashtag] = dict(Counter(tfidfBow[hashtag]).most_common(100))

tfidf = {}
for hashtag, rankwords in topfivewords.items():
    tfidf[hashtag] = rankwords.keys()


print("Checkpoint 4 completed in ", time.time() - start);
```

```
Checkpoint 4 completed in  1.6940264701843262
```

In [155]:

```python
#Vectors set
start = time.time();

"""To transform train and test dataset into input and output vectors
for the multiclass-logistic regression."""

rank = tfidfpd;
trainXY = pd.DataFrame.from_dict(trainHT, orient='index')
testXY = pd.DataFrame.from_dict(testHT, orient='index')

bow = set()
for i in range(0, len(rank)):
    rankwords = rank.iloc[i]
    bow = set(bow).union(set(rankwords))

#Train data X Y
start_time = time.time()
X = list(bow); Y = list(rank.index.get_values());
r, c = trainXY.shape;
train = {}; train[tuple([0]*len(X))] = 0;

start_time = time.time()
for i in range(r):
    outY = i

    for j in range(c):
        if trainXY.iloc[i, j] != None :
            inX = [0]*len(X)

            for feature in X:
                if feature in trainXY.iloc[i, j]:
                    inX[X.index(feature)] = 1
                    if tuple(inX) not in train:
                        train[tuple(inX)] = outY
        else :
            break

trainpd = pd.DataFrame.from_dict(train, orient='index')

elapsed_time = time.time() - start_time
print('Train data created',elapsed_time)

#Test data X Y
X = list(bow); Y = list(rank.index.get_values());
r, c = testXY.shape;
test = {}; test[tuple([0]*len(X))] = 0;

start_time = time.time()
for i in range(r):
    outY = i

    for j in range(c):
        if testXY.iloc[i, j] != None :
            inX = [0]*len(X)

            for feature in X:
                if feature in testXY.iloc[i, j]:
                    inX[X.index(feature)] = 1
                    if tuple(inX) not in test:
                        test[tuple(inX)] = outY
        else :
            break

testpd = pd.DataFrame.from_dict(test, orient='index')

elapsed_time = time.time() - start_time
print('Test data created',elapsed_time)

print("Checkpoint 5 completed in ", time.time() - start); print("Vector set created --> Success!!!");
```

```
Train data created 112.39547657966614
Test data created 37.8052933216095
Checkpoint 5 completed in  151.3086199760437
Vector set created --> Success!!!
```

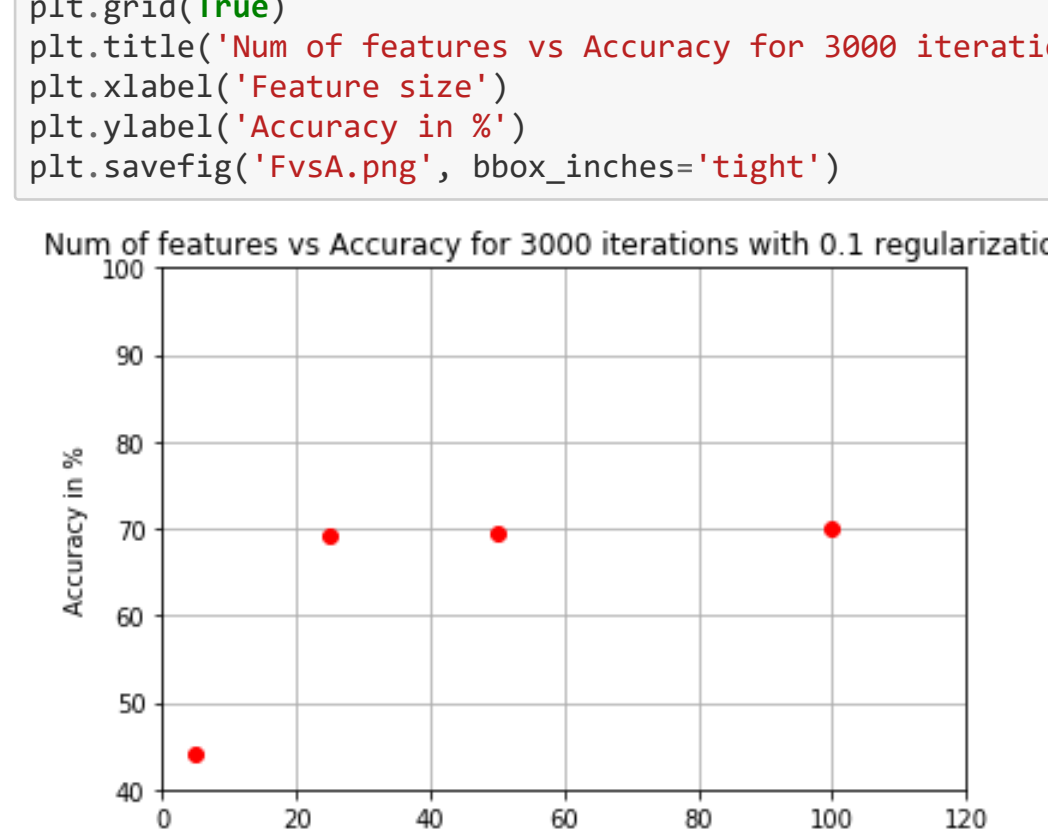
In [156]:

```python
import numpy as np
import pickle
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.metrics import precision_recall_fscore_support as score

#Logistic regression
start = time.time();

#Train data
train = trainpd;
trainX = np.array(list(train.index.get_values()))
trainY = []
for j in range(len(train)):
    trainY.append(list(train.iloc[j])[0])
trainY = np.array(trainY)

#Test data
test = testpd;
testX = np.array(list(test.index.get_values()))
testY = []
for j in range(len(test)):
    testY.append(list(test.iloc[j])[0])
testY = np.array(testY)

#Logistic regression.
logreg = LogisticRegression( C=1e1, solver='lbfgs', multi_class='multinomial', max_iter = 3000)

# Create an instance of Logistic Regression Classifier and fit the data.
logreg.fit(trainX, trainY)
PredY = logreg.predict(testX)

accuracy = accuracy_score(testY, PredY)
print('Accuracy: ', accuracy)

#print(confusion_matrix(testY, PredY))
#precision, recall, fscore, support = score(testY, PredY)
#print('precision: {}'.format(precision))
#print('recall: {}'.format(recall))
#print('fscore: {}'.format(fscore))
#print('support: {}'.format(support))

print("Checkpoint 6 completed in ", time.time() - start);  print("Task complete -- > Success!!!");
```

```
[[401 150  41  25   2  16]
 [  7 113  13   6   1   0]
 [  0  18  62   2   2   0]
 [  8 114  12 554  14   4]
 [  1  15   8   5 105   0]
 [ 27 143  60   3   3 392]]
Accuracy:  0.6991834980661796
precision: [0.90315315 0.20433996 0.31632653 0.93109244 0.82677165 0.95145631]
recall: [0.63149606 0.80714286 0.73809524 0.78470255 0.78358209 0.62420382]
fscore: [0.74328082 0.32611833 0.44285714 0.85165257 0.8045977  0.75384615]
support: [635 140  84 706 134 628]
Checkpoint 6 completed in  10.545912265777588
Task complete -- > Success!!!
```

In [161]:

```python
import matplotlib.pyplot as plt
Featuresize = [5, 25, 50, 100]
Accuracy = [44.11, 69.32, 69.45, 69.91]

plt.plot(Featuresize, Accuracy, 'ro')
plt.axis([0, 120, 40, 100])
plt.grid(True)
plt.title('Num of features vs Accuracy for 3000 iterations with 0.1 regularization.')
plt.xlabel('Feature size')
plt.ylabel('Accuracy in %')
plt.savefig('FvsA.png', bbox_inches='tight')
```



In [166]:

```python
# Confusion matrix
mat = confusion_matrix(testY, PredY)
pd.DataFrame(mat, columns=["wallstreet","winter", "christmas", "cricket", "scubadive", "brexit" ], index = ["wallstreet","winte
r", "christmas", "cricket", "scubadive", "brexit" ])
```

Out[166]:

	wallstreet	winter	christmas	cricket	scubadive	brexit
wallstreet	401	150	41	25	2	16
winter	7	113	13	6	1	0
christmas	0	18	62	2	2	0
cricket	8	114	12	554	14	4
scubadive	1	15	8	5	105	0
brexit	27	143	60	3	3	392

In [192]:

```python
# Performance metric
score = [list(precision), list(recall), list(fscore), list(support)]; rows = ['precision', 'recall', 'fscore', 'support'];
pd.DataFrame(score,columns=["wallstreet","winter", "christmas", "cricket", "scubadive", "brexit"], index = ['precision', 'recal
l', 'fscore', 'support'] )
```

Out[192]:

	wallstreet	winter	christmas	cricket	scubadive	brexit
precision	0.903153	0.204340	0.316327	0.931092	0.826772	0.951456
recall	0.631496	0.807143	0.738095	0.784703	0.783582	0.624204
fscore	0.743281	0.326118	0.442857	0.851653	0.804598	0.753846
support	635.000000	140.000000	84.000000	706.000000	134.000000	628.000000

In [ ]:

```python
#TF-IDF top rank words
#print(tfidfpd) # <--uncomment
```