In [1]:

```
import nltk
```

In [2]:

```
#nltk.download_shell()
```

In [3]:

```
messages=[line.rstrip() for line in open('SMSSpamCollection')]
```

In [4]:

```
print(len(messages))
```

```
5574
```

In [5]:

```
messages[50]
```

Out[5]:

```
'ham\tWhat you thinked about me. First time you saw me in class.'
```

In [6]:

```
for mess_no,message in enumerate(messages[:10]):
    print(mess_no,message)
    print('\n')
```

```
0 ham   Go until jurong point, crazy.. Available only in bugis n great wor
ld la e buffet... Cine there got amore wat...


1 ham   Ok lar... Joking wif u oni...


2 spam  Free entry in 2 a wkly comp to win FA Cup final tkts 21st May 200
5. Text FA to 87121 to receive entry question(std txt rate)T&C's apply 084
52810075over18's


3 ham   U dun say so early hor... U c already then say...


4 ham   Nah I don't think he goes to usf, he lives around here though


5 spam  FreeMsg Hey there darling it's been 3 week's now and no word back!
I'd like some fun you up for it still? Tb ok! XxX std chgs to send, Â£1.50
to rcv


6 ham   Even my brother is not like to speak with me. They treat me like a
ids patent.


7 ham   As per your request 'Melle Melle (Oru Minnaminunginte Nurungu Vett
am)' has been set as your callertune for all Callers. Press *9 to copy you
r friends Callertune


8 spam  WINNER!! As a valued network customer you have been selected to re
ceivea Â£900 prize reward! To claim call 09061701461. Claim code KL341. Va
lid 12 hours only.


9 spam  Had your mobile 11 months or more? U R entitled to Update to the l
atest colour mobiles with camera for Free! Call The Mobile Update Co FREE
on 08002986030
```

In [7]:

```
#We want to figure out which text messages are spam and which are ham
```

In [8]:

```
messages[0]  #We get that this has a tab separation
```

Out[8]:

```
'ham\tGo until jurong point, crazy.. Available only in bugis n great world
la e buffet... Cine there got amore wat...'
```

In [9]:

```
import pandas as pd
```

In [10]:

```
messages=pd.read_csv('SMSSpamCollection',sep='\t',names=['label','message'])
```

In [11]:

```
messages.head()
```

Out[11]:

	label	message
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

In [12]:

```
messages.describe()
```

Out[12]:

	label	message
count	5572	5572
unique	2	5169
top	ham	Sorry, I'll call later
freq	4825	30

In [13]:

```
messages.groupby('label').describe()
```

Out[13]:

	message			
	count	unique	top	freq
label				
ham	4825	4516	Sorry, I'll call later	30
spam	747	653	Please call our customer service representativ...	4

In [14]:

```
#Better the domain knowledge on the data , better it is for feature engineering
```

In [15]:

```
messages['length']=messages['message'].apply(len)
```

In [16]:

```
messages.head()
```

Out[16]:

	label	message	length
0	ham	Go until jurong point, crazy.. Available only ...	111
1	ham	Ok lar... Joking wif u oni...	29
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155
3	ham	U dun say so early hor... U c already then say...	49
4	ham	Nah I don't think he goes to usf, he lives aro...	61

In [17]:

```
import matplotlib.pyplot as plt
#matplotlib inline
```

In [18]:

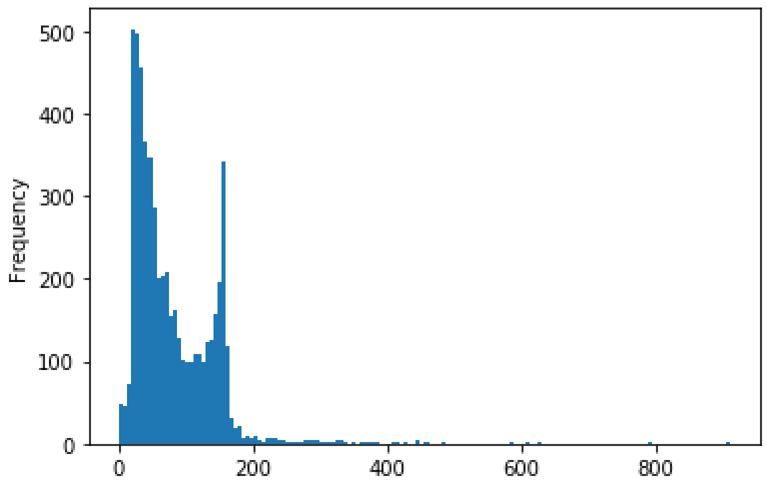
```
import seaborn as sns
```

In [19]:

```
messages['length'].plot.hist(bins=150)
```

Out[19]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x15a86ae8288>
```



In [20]:

```
#Kinda looks like bimodal behavior
```

In [21]:

```
messages[messages['length']>600]
```

Out[21]:

	label	message	length
1085	ham	For me the love should start with attraction.i...	910
1579	ham	How to Make a girl Happy? It's not at all diff...	611
1863	ham	The last thing i ever wanted to do was hurt yo...	790
2434	ham	Indians r poor but India is not a poor country...	629

In [22]:

```
messages['length'].describe()
```

Out[22]:

```
count    5572.000000
mean       80.489950
std        59.942907
min         2.000000
25%        36.000000
50%        62.000000
75%       122.000000
max       910.000000
Name: length, dtype: float64
```

In [23]:

```
messages[messages['length']==910]['message'].iloc[0]
```

Out[23]:

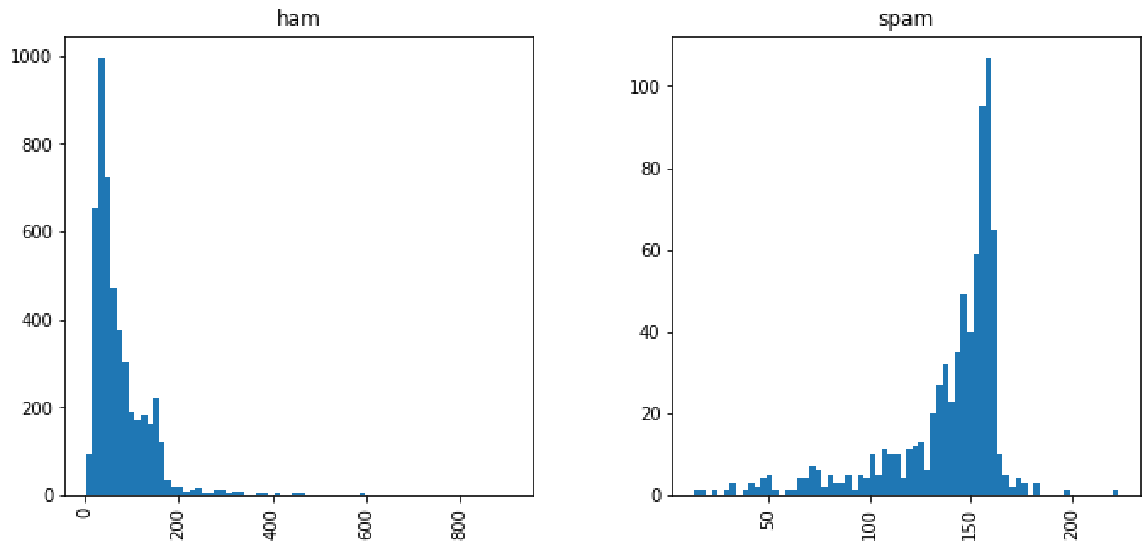
```
"For me the love should start with attraction.i should feel that I need he
r every time around me.she should be the first thing which comes in my tho
ughts.I would start the day and end it with her.she should be there every
time I dream.love will be then when my every breath has her name.my life s
hould happen around her.my life will be named to her.I would cry for her.w
ill give all my happiness and take all her sorrows.I will be ready to figh
t with anyone for her.I will be in love when I will be doing the craziest
things for her.love will be when I don't have to proove anyone that my gir
l is the most beautiful lady on the whole planet.I will always be singing
praises for her.love will be when I start up making chicken curry and end
up makiing sambar.life will be the most beautiful then.will get every morn
ing and thank god for the day because she is with me.I would like to say a
lot..will tell later.."
```

In [24]:

```
messages.hist(column='length',by='label',bins=70,figsize=(11,5))
```

Out[24]:

```
array([<matplotlib.axes._subplots.AxesSubplot object at 0x0000015A873E2C48
>,
       <matplotlib.axes._subplots.AxesSubplot object at 0x0000015A8743F3C8
>],
      dtype=object)
```



In [25]:

```
#Lets move forward to text preprocessing
#For the classification algorithms we need some kind of numerical feature vector in ord
er
#to perform the classification
#one of the most common ways of doing that is bag of words
#lets move forward to convert the raw messages , a sequence of characters to a sequence
of
#numbers i.e vectors
```

In [26]:

```
import string
```

In [27]:

```
#The first thing we wanna do is remove punctuation
```

In [28]:

```
mes='Here is a Sample!! It has a colon: and a question mark ?.'
```

In [29]:

```
string.punctuation
```

Out[29]:

```
'!"#$%&\'()*+,-./:;<=>?@[\\]^_`{|}~'
```

In [30]:

```
#Lets use string comprehension to check whether it is present in the string or not
```

In [31]:

```
w_o_punc=[s for s in mes if s not in string.punctuation]
```

In [32]:

```
#w_o_punc  #No more punctuatuation
```

In [33]:

```
from nltk.corpus import stopwords  #we downloaded stopwords package, has words like "a
 , the " etc
```

In [34]:

```
stopwords.words('english')   #Common words that dont tell us any distinguishing feature
s
```

Out[34]:

```
['i',
 'me',
 'my',
 'myself',
 'we',
 'our',
 'ours',
 'ourselves',
 'you',
 "you're",
 "you've",
 "you'll",
 "you'd",
 'your',
 'yours',
 'yourself',
 'yourselves',
 'he',
 'him',
 'his',
 'himself',
 'she',
 "she's",
 'her',
 'hers',
 'herself',
 'it',
 "it's",
 'its',
 'itself',
 'they',
 'them',
 'their',
 'theirs',
 'themselves',
 'what',
 'which',
 'who',
 'whom',
 'this',
 'that',
 "that'll",
 'these',
 'those',
 'am',
 'is',
 'are',
 'was',
 'were',
 'be',
 'been',
 'being',
 'have',
 'has',
 'had',
 'having',
 'do',
 'does',
 'did',
    'doing',
    'a',
    'an',
    'the',
    'and',
    'but',
    'if',
    'or',
    'because',
    'as',
    'until',
    'while',
    'of',
    'at',
    'by',
    'for',
    'with',
    'about',
    'against',
    'between',
    'into',
    'through',
    'during',
    'before',
    'after',
    'above',
    'below',
    'to',
    'from',
    'up',
    'down',
    'in',
    'out',
    'on',
    'off',
    'over',
    'under',
    'again',
    'further',
    'then',
    'once',
    'here',
    'there',
    'when',
    'where',
    'why',
    'how',
    'all',
    'any',
    'both',
    'each',
    'few',
    'more',
    'most',
    'other',
    'some',
    'such',
    'no',
    'nor',
    'not',
    'only',
    'own',
    'same',
    'so',
    'than',
    'too',
    'very',
    's',
    't',
    'can',
    'will',
    'just',
    'don',
    "don't",
    'should',
    "should've",
    'now',
    'd',
    'll',
    'm',
    'o',
    're',
    've',
    'y',
    'ain',
    'aren',
    "aren't",
    'couldn',
    "couldn't",
    'didn',
    "didn't",
    'doesn',
    "doesn't",
    'hadn',
    "hadn't",
    'hasn',
    "hasn't",
    'haven',
    "haven't",
    'isn',
    "isn't",
    'ma',
    'mightn',
    "mightn't",
    'mustn',
    "mustn't",
    'needn',
    "needn't",
    'shan',
    "shan't",
    'shouldn',
    "shouldn't",
    'wasn',
    "wasn't",
    'weren',
    "weren't",
    'won',
    "won't",
    'wouldn',
    "wouldn't"]
```

In [35]:

```
w_o_punc=''.join(w_o_punc)  #It is a list of letters, so we join over ''. We can join o
ver anything actually
```

In [36]:

```
w_o_punc
```

Out[36]:

```
'Here is a Sample It has a colon and a question mark '
```

In [ ]:

```

```

In [37]:

```
w_o_punc.split()
```

Out[37]:

```
['Here',
 'is',
 'a',
 'Sample',
 'It',
 'has',
 'a',
 'colon',
 'and',
 'a',
 'question',
 'mark']
```

In [38]:

```
clean_mes=[word for word in w_o_punc.split() if word.lower() not in stopwords.words('en
glish')]
```

In [39]:

```
clean_mes  #Removal of stop words
```

Out[39]:

```
['Sample', 'colon', 'question', 'mark']
```

In [40]:

```
#Lets do this on actual messages data-set/frame
#For that i will create a function
```

In [41]:

```
#1.Remove punctuation
#2.Remove Stopwords
#3.Return list of text words
def text_process(mes):
    no_punc=[char for char in mes if char not in string.punctuation]
    no_punc=''.join(no_punc)
    mes_now=[word for word in no_punc.split() if word.lower() not in stopwords.words('e
nglish')]
    return mes_now
```

In [42]:

```
messages.head()
```

Out[42]:

	label	message	length
0	ham	Go until jurong point, crazy.. Available only ...	111
1	ham	Ok lar... Joking wif u oni...	29
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155
3	ham	U dun say so early hor... U c already then say...	49
4	ham	Nah I don't think he goes to usf, he lives aro...	61

In [43]:

```
#lets see what our function does
```

In [44]:

```
messages['message'].head(5).apply(text_process)
#Therefore the stop words and punctuation is removed and a list of useful words is retu
rned
```

Out[44]:

```
0    [Go, jurong, point, crazy, Available, bugis, n...
1                        [Ok, lar, Joking, wif, u, oni]
2    [Free, entry, 2, wkly, comp, win, FA, Cup, fin...
3        [U, dun, say, early, hor, U, c, already, say]
4    [Nah, dont, think, goes, usf, lives, around, t...
Name: message, dtype: object
```

In [45]:

```
#this is very simple method of text normalisation
#for more check nltk documentation
```

In [46]:

```
#Now aftern tokenisation of the raw stream of words , we have to focus on vectorising
#it so we can feed it into a machine learning model
```

In [47]:

```
#VECTORISATION
#CountVectoriser estimator object
#Each vector will have as many dimensions as there are unique words in the SMS corpus.
#We will first use SciKit Learn's CountVectorizer.
#This model will convert a collection of text documents to a matrix of token counts.
#We can imagine this as a 2-Dimensional matrix.
#Where the 1-dimension is the entire vocabulary (1 row per word) and the other dimensio
n are the actual documents,
#in this case a column per text message.
```

In [48]:

```
from sklearn.feature_extraction.text import CountVectorizer
```

In [49]:

```
#There are a lot of arguments and parameters that can be passed to the CountVectorizer.
#In this case we will just specify the analyzer to be our own previously defined functi
on:
```

In [50]:

```
bgow_transformer=CountVectorizer(analyzer=text_process).fit(messages['message'])
```

In [51]:

```
print(len(bgow_transformer.vocabulary_)) #Looks like 11425 words in our vocabulary
```

```
11425
```

In [52]:

```
#Lets check it out
mes4=messages['message'][3]
```

In [53]:

```
print(mes4)
```

```
U dun say so early hor... U c already then say...
```

In [54]:

```
bow4=bgow_transformer.transform([mes4])
```

In [55]:

```
print(bow4)
```

```
  (0, 4068)	2
  (0, 4629)	1
  (0, 5261)	1
  (0, 6204)	1
  (0, 6222)	1
  (0, 7186)	1
  (0, 9554)	2
```

In [56]:

```
print(bow4.shape)
```

```
(1, 11425)
```

In [57]:

```
bgow_transformer.get_feature_names()[9554] #Twice words
bgow_transformer.get_feature_names()[4068]
```

Out[57]:

```
'U'
```

In [58]:

```
messages_bgow=bgow_transformer.transform(messages['message'])
```

In [59]:

```
print('Shape of Sparse matrix: ',messages_bgow.shape)
```

```
Shape of Sparse matrix:  (5572, 11425)
```

In [61]:

```
messages_bgow.nnz  #Amount of non zero occurences
```

Out[61]:

```
50548
```

In [63]:

```
 sparsity = (100.0 * messages_bgow.nnz / (messages_bgow.shape[0] * messages_bgow.shape[
1]))
print('sparsity: {}'.format(round(sparsity)))
```

```
sparsity: 0
```

In [64]:

```
#Now we're done with counting, the term weights, and normalisation can be done
#with TF-IDF
#Consider a document containing 100 words wherein the word cat appears 3 times.

#The term frequency (i.e., tf) for cat is then (3 / 100) = 0.03. Now, assume we
#have 10 million documents and the word cat appears in one thousand of these.
#Then, the inverse document frequency (i.e., idf) is calculated as
#log(10,000,000 / 1,000) = 4.
#Thus, the Tf-idf weight is the product of these quantities: 0.03 * 4 = 0.12.
```

In [65]:

```
from sklearn.feature_extraction.text import TfidfTransformer
```

In [66]:

```
tfidf_transformer=TfidfTransformer().fit(messages_bgow)
```

In [67]:

```
tfidf4=tfidf_transformer.transform(bow4)
```

In [70]:

```
print(tfidf4) #heres and Tf-idf weight relationship
```

```
  (0, 9554)	0.5385626262927564
  (0, 7186)	0.4389365653379857
  (0, 6222)	0.3187216892949149
  (0, 6204)	0.29953799723697416
  (0, 5261)	0.29729957405868723
  (0, 4629)	0.26619801906087187
  (0, 4068)	0.40832589933384067
```

In [73]:

```
tfidf_transformer.idf_[bgow_transformer.vocabulary_['dog']] #Checking frequency of a ra
ndom word
```

Out[73]:

```
7.546247245889701
```

In [74]:

```
#Now lets convert the entire bag of words corpus to tfid corpus at once
```

In [76]:

```
tfidf_messages=tfidf_transformer.transform(messages_bgow)
```

In [77]:

```
#Now as we have out messages represented as nummerical vecctors , we can
#finally train our spam-ham classifier
#Now we can actually use almost any sort of classification algorithms. For a variety
#of reasons, the Naive Bayes classifier algorithm is a good choice.
```

In [79]:

```
from sklearn.naive_bayes import MultinomialNB  #Mutinomial naieve bayes theorem
```

In [80]:

```
spam_detect_model=MultinomialNB().fit(tfidf_messages,messages['label'])
```

In [82]:

```
spam_detect_model.predict(tfidf4)[0]
```

Out[82]:

```
'ham'
```

In [84]:

```
messages
```

Out[84]:

	label	message	length
0	ham	Go until jurong point, crazy.. Available only ...	111
1	ham	Ok lar... Joking wif u oni...	29
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155
3	ham	U dun say so early hor... U c already then say...	49
4	ham	Nah I don't think he goes to usf, he lives aro...	61
...	...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...	160
5568	ham	Will ü b going to esplanade fr home?	36
5569	ham	Pity, * was in mood for that. So...any other s...	57
5570	ham	The guy did some bitching but I acted like i'd...	125
5571	ham	Rofl. Its true to its name	26

5572 rows × 3 columns

In [86]:

```
messages['label'][3] #hmmm looks like we are predicting correctly
```

Out[86]:

```
'ham'
```

In [87]:

```
#now lets run this on all the messages of tfid
```

In [88]:

```
all_pred=spam_detect_model.predict(tfidf_messages)
```

In [89]:

```
 all_pred
```

Out[89]:

```
array(['ham', 'ham', 'spam', ..., 'ham', 'ham', 'ham'], dtype='<U4')
```

In [90]:

```
#NOw above we acutually trained everthing on our training data
#we should'nt be doing that , we need to split , to see the true predictive capability
 of our model
```

In [91]:

```
from sklearn.model_selection import train_test_split
```

In [92]:

```
msg_train,msg_test,label_train,label_test=train_test_split(messages['message'],messages
['label'],test_size=0.3)
```

In [93]:

```
msg_train
```

Out[93]:

```
1633    Hello my little party animal! I just thought I...
2405    Please give it 2  or i will pick it up on Tues...
3843    chile, please! It's only a  &lt;DECIMAL&gt;  h...
3740                           Did you stitch his trouser
4032    Sorry vikky, i'm Watching olave mandara movie ...
                              ...
2247    Hi ya babe x u 4goten bout me?' scammers getti...
3924    Okay lor... Will they still let us go a not ah...
5173                                                 U 2.
4395    Baaaaaaaabe! Wake up ! I miss you ! I crave yo...
5553                          Hahaha..use your brain dear
Name: message, Length: 3900, dtype: object
```

In [97]:

```
#Gotta repeat all the above steps on this training data, that's one way
#But since this is so common sklearn offers a data pipeline feature
#So we can have a entire pipeline of the word flow
```

In [98]:

```
from sklearn.pipeline import Pipeline
```

In [99]:

```
#So we don't have to repeat all the above process for all every set of data
```

In [100]:

```
pipeline=Pipeline([
    ('bgow',CountVectorizer(analyzer=text_process)),
    ('tfidf',TfidfTransformer()),
    ('classifier',MultinomialNB())

])
```

In [101]:

```
pipeline.fit(msg_train,label_train)
```

Out[101]:

```
Pipeline(memory=None,
         steps=[('bgow',
                 CountVectorizer(analyzer=<function text_process at 0x0000
015A87423048>,
                                 binary=False, decode_error='strict',
                                 dtype=<class 'numpy.int64'>, encoding='ut
f-8',
                                 input='content', lowercase=True, max_df=
1.0,
                                 max_features=None, min_df=1,
                                 ngram_range=(1, 1), preprocessor=None,
                                 stop_words=None, strip_accents=None,
                                 token_pattern='(?u)\\b\\w\\w+\\b',
                                 tokenizer=None, vocabulary=None)),
                ('tfidf',
                 TfidfTransformer(norm='l2', smooth_idf=True,
                                  sublinear_tf=False, use_idf=True)),
                ('classifier',
                 MultinomialNB(alpha=1.0, class_prior=None, fit_prior=Tru
e))],
         verbose=False)
```

In [104]:

```
pip_predictions=pipeline.predict(msg_test)
```

In [105]:

```
from sklearn.metrics import classification_report
```

In [106]:

```
print(classification_report(label_test,pip_predictions))
```

```
              precision    recall  f1-score   support

         ham       0.96      1.00      0.98      1468
        spam       1.00      0.70      0.82       204

    accuracy                           0.96      1672
   macro avg       0.98      0.85      0.90      1672
weighted avg       0.96      0.96      0.96      1672
```

In [ ]:

```

```

In [ ]:

```

```