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tokenization is over we move to the next step of preprocessing.

```
tokenized_tweet = combi['tidy_tweet'].apply(lambda x: x.split())
tokenized_tweet.head()

0          [when, father, dysfunctional, selfish, drags, kids,
1  [thanks, #lyft, credit, cause, they, offer, wheelchair, vans, #d
2
3          [#model,
4          [factsguid
Name: tidy_tweet, dtype: object
```

3. Removal of non-English words

Twitter generally supports more than 60 languages. But our project mainly involves English tweets; hence we remove the non-English words.

id	label	tweet
0	1	@user when a father is dysfunctional and is so selfish he drags his kids into his dysfunction. #run
1	2	@user @user thanks for #lyft credit i can't use cause they don't offer wheelchair vans in pdx. #disapointed #getthankd
2	3	bihday your majesty
3	4	#model i love u take with u all the time in urð!!!! ð!!!! ðð!!!! ðð!!!!
4	5	factsguide: society now #motivation

4. Emoticon replacements Emoticons are very important in determining the sentiment. So the emoticons are replaced by their polarity by seeing the emoticon dictionary.

```
0          [when, father, dysfunct, selfish, drag, kid,
1  [thank, #lyft, credit, caus, they, offer, wheelchair, van,
2
3          [#model,
4          [facts
Name: tidy_tweet, dtype: object
```

2.3 FEATURE EXTRACTIONS

election of useful words from the tweet is called as feature extraction. In the feature extraction method, we extract the aspects from the pre-processed twitter dataset.

1. There are three different types of features namely unigram, bigram, n-gram features.
2. Parts Of Speech Tags such as like adjectives, adverbs, verbs and nouns are good indicators of subjectivity and sentiment.
3. Negation is another important but difficult feature to interpret. The presence of a negation usually changes the polarity of the sentiment.

2.4 FEATURE SELECTION

Correct feature selection techniques are used in sentiment analysis that has got a significant role for identifying relevant attributes and increasing classification (machine learning) accuracy. They are categorized into 4 main types namely, 1. Natural language processing 2. Statistical

2.5 ADVANTAGES OF NEURAL NETWORKS

The main advantage is that they are data driven self-adaptive methods where, they can adjust themselves to the data without any explicit specifications of functional or distributional form. They can approximate any function with arbitrary accuracy since they are universal functional approximates.

III. EXECUTION AND RESULT

Step 1: Open the source code in the Pycharm platform

```
1 import numpy as np
2 import pandas as pd
3 import os
4 print(os.listdir("../input"))
5 train = pd.read_csv("../input/train_E6aV3IV.csv")
6 test = pd.read_csv("../input/test_tweets_8nuFYb8")
7 train.head()
8 test.head()
9 train['label'] = train['label'].astype('category')
10 train.info()
11 from nltk.stem import WordNetLemmatizer
12 from nltk import tokenize
13 from sklearn.feature_extraction.text import TfidfVectorizer
14 import re
15 train['text_lem'] = [' '.join([WordNetLemmatizer().lemmatize(w) for w in tokenize(text)]) for text in train['text']]
16 test['text_lem'] = [' '.join([WordNetLemmatizer().lemmatize(w) for w in tokenize(text)]) for text in test['text']]
17 model_selection import train_test_split
18 X_train,X_test,y_train,y_test = train_test_split(train['text_lem'], train['label'],
```

Step 2: Tokenization

```
Tweet Tokenization
0 [when, father, dysfunctional, selfish, drags, '...
1 [thanks, #lyft, credit, can't, cause, they, do...
2 [bihday, your, majesty]
3 [#model, love, take, with, time, urð!!!!, ð!!!!, ðð
```

Step 3: Run Code

A. Understanding the common words used in the tweets

Now I want to see how well the given sentiments are distributed across the train dataset. One way to accomplish this task is by understanding the common words by plotting wordclouds.

A wordcloud is a visualization wherein the most frequent words appear in large size and the less frequent words appear in smaller sizes.

Lets visualize all the words our data using the wordcloud plot.



Fig. Understanding the common words used in the tweets

We can see most of the words are positive or neutral. With happy and love being the most frequent ones. It doesn't give us any idea about the words associated with the racist/sexist tweets. Hence, we will plot separate wordclouds for both the classes (racist/sexist or not) in our train data.

B. Words in non racist/sexist tweets



Fig 4.2.5 racist/sexist tweets

We can see most of the words are positive or neutral. With happy, smile, and love being the most frequent ones. Hence, most of the frequent words are compatible with the sentiment which is non racist/sexists tweets. Similarly, we will plot the word cloud for the other sentiment. Expect to see negative, racist, and sexist terms.

C. Racist/Sexist Tweets



Fig 4.2.4 words in non racist/sexist tweets

As we can clearly see, most of the words have negative connotations. So, it seems we have a pretty good text data to work on. Next we will the hashtags/trends in our twitter data.

D. Non-Racist/Sexist Tweets

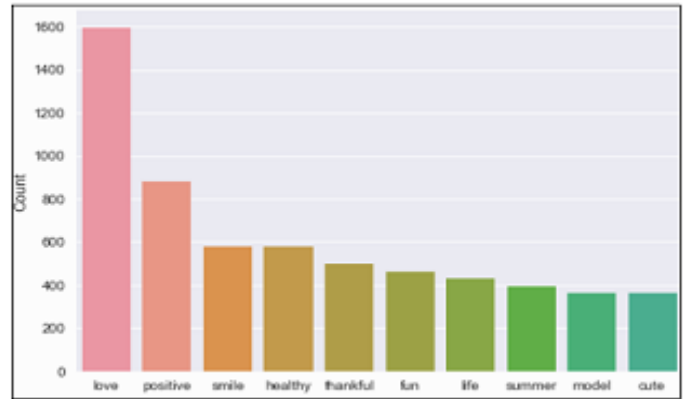


Fig 4.2.6 hashtags appearing in the non racist/sexist tweets.

All these hashtags are positive and it makes sense. I am expecting negative terms in the plot of the second list. Let's check the most frequent hashtags appearing in the racist/sexist tweets.

E. Racist/Sexist Tweets

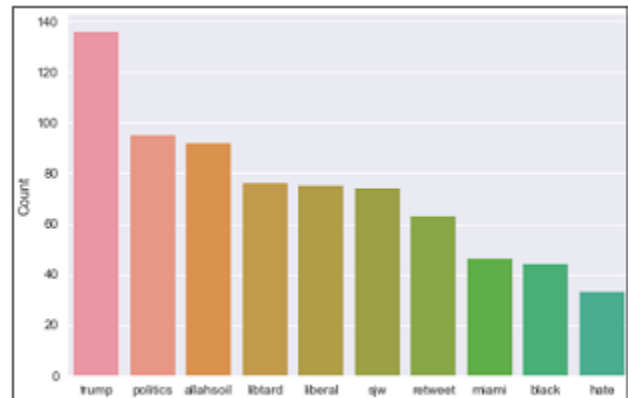


Fig 4.2.7 Negative Racist/Sexist Tweets

As expected, most of the terms are negative with a few neutral terms as well. So, it's not a bad idea to keep these hashtags in our data as they contain useful information. Next, we will try to extract features from the tokenized tweets.

IV. CONCLUSION

In this paper, the aim was to detect hate speech using a Natural Language Processing technique. To enable successful execution of the research it was first necessary to understand what hate speech is. To accomplish this, an overview of this topic has been conducted. Here it can be



concluded that hate speech has several definitions, all coming from different platforms. Hate speech detection is a classification-related task, and that's why further literature was reviewed to understand the idea behind Natural Language Processing and the application of various techniques. Previous work showed that deep learning models improve the state-of-art approaches within hate speech classification tasks. Therefore, a deep learning method, namely a Convolutional Neural Network (CNN), has been applied on a Twitter dataset. This data contains tweets annotated with three labels: hate, offensive language and neither.

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