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Sentiment Analysis using Machine Learning (The Sorting Hat)

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Abstract: *Sarcasm and Hate Speech is impacting societal harmony and peace. Considering the magnitude of this harmonious impact, there is a need to find a solution to curb the online spread of Hate Speech and Sarcasm. Detection of hate speech and sarcasm is being tackled with various approaches like manual checks, deep learning techniques in recent times, and statistical-based classification algorithms. These methods are unreliable due to the non-binary(true or false) nature of the tweets. Categorizing tweets requires deeper investigation such as classification on entirely positive or entirely negative rather than binary classification. In this paper - a snippet - The Sorting Hat, to detect sarcasm, hate-speech, and sentiments in the tweets using SVM (Support Vector Machine) and LSTM (Long short term memory) is proposed. The Sorting Hat classifies a given tweet into one of the six degrees of classification - "Positive", "Negative", "Neutral", "Sarcasm", "Non-sarcasm", "Hate-speech". The basic meaning of sarcasm which comes into our mind is a positive statement or sentiment attached to a negative situation or vice versa.The current system works on the outside which has been assigned to a particular topic. Current systems also do not determine the impact rating, the results are limited to whether they can be included in the particular processing field and do not allow retrieval of data based on user-generated query meaning that it has been selected.. Whereas the Sorting Hat will collect the tweets from the users manually. Collected tweets will be considered for further processing. We will then apply the supervised algorithm on the stored data. The supervised algorithm used in the our system is Support Vector Machine (SVM). The results of the algorithms i.e. emotions will be represented in a graphical way (bar charts). The proposed system works better compared to the existing one. This is because we will be able to obtain calculated figures from representation of result can have any impact in the field of a particular. The overall product experience using The Sorting Hat largely intervenes the impulsive behavior of posting tweets, and thereby provides the solution to curb rampant spread of Hate Speech and better understanding of sarcastic tweets.*

Key Words*: Sentiment Analysis; Opinion Mining; Sarcasm; Hate Speech; Sorting Hat*

Introduction: A Sentiment is an attitude, a thought, or a judgment based on emotion. Sentiment analysis, or opinion mining, studies people's emotions on specific topics. The Internet is a place of great information. From a user's perspective, people are able to post their content through various social media platforms, such as forums, micro-blogs, or social networking sites. For instance, Twitter is an open, social media platform where people express their opinion about various topics. People may express their opinion about a certain topic in a positive, negative or neutral way. They may also use sarcasm in their tweets, as well as use hate speech. From the researcher's point of view, many social

networking sites develop their own programming interface (APIs), which enables data collection and analysis by researchers and developers.However, those types of internet have several errors that prevent the analysis of process of emotions. The first flaw is that since people can freely post its content, the quality of their orients is not guaranteed. For example, instead of sharing topic-related opinions, online spammers post spam on forums. Some spams were inexhaustible, while others lacked opinions incomparable to those of opinions. Second flaw is that the ground truth of this online is not always available, which acts as an indication of the opinion whether it is positive, negative or neutral.

• The main objective of Sentiment Analysis is to sort the tweets in their sentimental order.

- Detects Positive/Negative tweets.
- Detects Sarcasm- Type of sentiment in which people suppresses their negative emotions using positive or reinforced words in the text.
- Detects Hate Speech- a type of sentiment where people expresses their anger in the form of words with only intention to hurt others.
- Use of Machine Learning Algorithms to detect these sentiments.

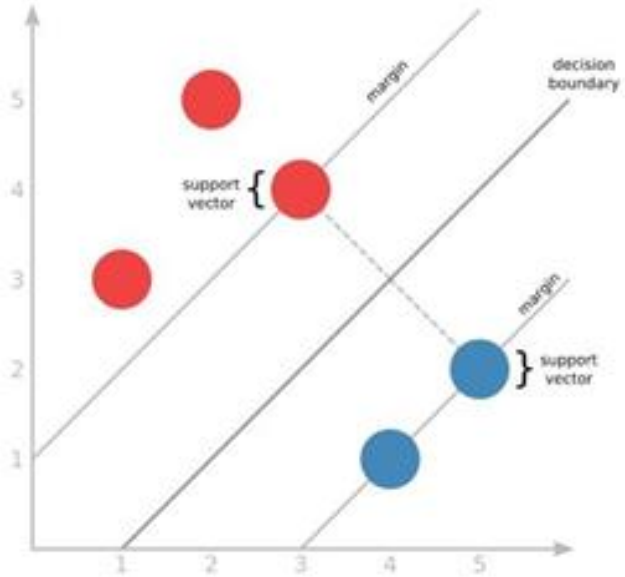
I. Material And Methods

Classification Algorithm and Evaluation:

Following are the Classification models we used for our topic:

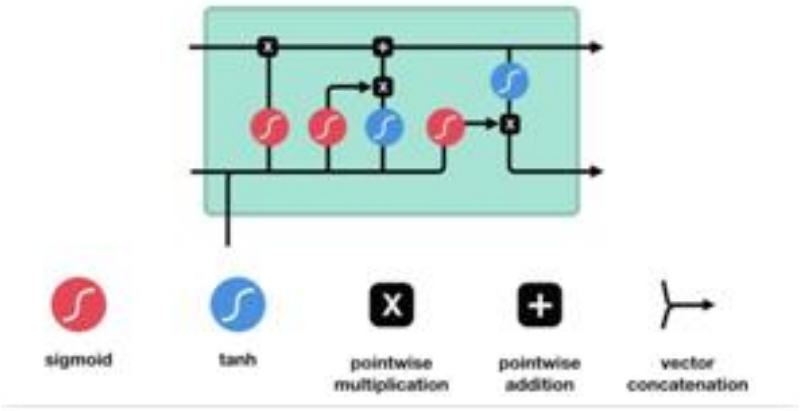
➢ **Support Vector Machine (SVM) Linear kernel [7]**:

SVM is a supervised learning algorithm that can be used both for classification and regression. Here we will use it for classification. SVM is known for its simplicity and effectiveness in binary classification.SVMs have been given the opportunity to find the best hyperplane that is separated between the two classes. Support vectors are data points close to hyperplane. Points of a data are set that, when renewed, they can change the position of the separating hyperplane. Hence this, can be considered as the critical elements of a data set. Whatever side of the hyperplane it lands will decide the class that we assign to it.



➢ **LSTM Network [4]**

LSTM networks are extended recurrent neural networks (RNNs). It is useful that the current input is fully monitored for the previous output (feedback) and the release of its memory for a short period of time (short-term memory). Drawback to this RNN is that it fails to store information for a longer period of time.



LSTM has a chain structure consisting of forums, neural networks and various memory blocks called cells. Information is maintained by cells and memory manipulations are done by gates. There are three gates –

Forget Gate: Data no longer valid on the cell state is extracted by forget gate.

Input gate: Addition of useful information to the cell state is done by input gate.

Output gate: The task of extracting useful information from the current cell state to be presented as an output is done by output gate.

II. Procedure Methodology

➢ **Datasets**

For our paper, specific keywords were required. We have collected 5 different datasets for namely positive words, negative words, hate words, sarcastic tweets and non-sarcastic (factualized) tweets. These keywords from the datasets were used for testing and training splitting as 30% and 70% respectively.

Positive Dataset: This dataset includes keywords affiliated with Positive opinions. We downloaded this dataset from Github.com[5] . The dataset contains 2006 keywords.

Negative Dataset: This dataset includes keywords affiliated with Negative opinions. We downloaded this dataset from Github.com[5] . The dataset contains 4783 keywords.

Hate-speech Dataset: This dataset includes keywords affiliated with Hate opinions or Hate Speech. We downloaded this dataset from Github.com[6] . The dataset contains 451 keywords.

➢ **Evaluation of SVM Algorithm**

We have used the SVM algorithm for sentiment analysis including positive, negative sentiment score as well as Sarcasm detection. The Sklearn library was used in training. The best performance was seen when C (cost of classification or penalty parameter of error) value was given as 0.1.

To evaluate the performance of the algorithm for the given feature set the metrics used are Precision, Recall, F-score and Accuracy. In the next section, we can see the values of the above metrics for each of the different feature sets and the combination.

➢ **Evaluation of LSTM Algorithm**

We have used the LSTM network for Hate-speech detection in the tweets.[5] LSTM algorithm, having it's short-term memory drawback, works in favour of our problem. As soon as the network detects a 'hate word' in the tweet, it goes to the next 'hate word' if present. If found, the network forgets the previous word and uses the new one as a classifier. Hence, if 'hate word' is found, the algorithm will give the result accordingly. This results in saving of memory space as the network doesn't have to remember all the 'hate words' present.

➢ **Feature Extraction:**

Feature extraction is one of the most important part of sarcasm detection. Four different approaches for feature extraction were used:

N-grams feature: N-grams refers to the sequence of tokens within a statement whereas N refers to the number of words in sequence. To use N-grams in the classifier the tweet is tokenized, lemmatized, uncapitalized and stored as a binary feature. NLTK library was used to generate the bigrams.

Sentiment and Subjective feature: One of the common structures in sarcastic statements is the presence of contrast in sentiments. In the sense that it may have positive sentiment in a negative activity or other way around. We have used three variations to get a feature set based on the sentiments using a python library TextBlob which has a built-in sentiment score function. The sentiment score of the whole tweet is taken as a feature. TextBlob also provides the subjectivity score. So, subjectivity scores of the tweets are also taken as a feature.

POS-Tags feature: Parts of the tweet speech are numbered and included in features. Here we have used 4 tags - Noun, Verb, Adjective and Adverb.

Punctuation and special symbols feature: It is thought that punctuation has a profound effect on the textual category especially in the area of sentiment analysis. We have looked at three ways to remove a feature on typos and special characters.

1) Capitals: If the number of capitals is greater than 4 then we make this feature 1 else 0.

2) Exclamation count: The number of exclamations in the statement is taken as another feature.

3) Emoticons count: The number of emoji used in the tweet is considered.

III. Result & Discussion

- **Support Vector Machine (SVM) Linear kernel**

Using the above-mentioned methods, the data from twitter was gathered and preprocessed. Features were extracted from this data to form the feature set. This was shuffled up and divided into a 70-30 ratio (training - test) and 70% of the data was fed to the SVM classifier for training. Other 30% of the data was used as a test set and the performance of each item is calculated, the table shows the average performance of the test data.

Method	Presion	Recall	F-score	Accuracy
Sentiment	57%	59%	52%	59%
Ngrams	72%	73%	73%	73%
N-grams + sentiments	75%	74%	74%	75%
N-grams + sentiments + POS Tags	77%	77%	77%	77%
N-grams + sentiments + POS Tags + Punctuations	76%	76%	76%	76%

N-grams- This feature provides a major chunk of accuracy, which can be improved if we use a larger dataset.

Sentiment- Sentiment feature has relative low performance due to inconsistency of tweets and possibility of background information on the topic.

POS tags- This feature provided some improvement in the accuracy and hence can be considered as an important feature.

Punctuation- Surprisingly, the Punctuation and special characters' features give out bad performance. Having a larger dataset might improve accuracy.

- **Example Results:**

1) sentence = "Messi is the best footballer in the world"
Score = -70
2) sentence = "Oh how I love being ignored"
Score = 67

- **LSTM(Long Short Term Memory)**

In this paper we have collected a sample of tweets on Twitter. We built a machine-learning model to divide tweets into two categories, hate speech and neutral. We used this algorithm with 'Hate word dataset' in processed tweets. These tweets have been modified and used as a 30-70% standard test and training sequence. We calculated values for accuracy, precision, recall and F1 score for the model. The values calculated are:

Model	Accuracy	Precision	Recall	F1 Score
LSTM	97.85%	95.98%	99.86%	97.85%

Conclusion

In this paper, we have proposed a Twitter sentiment analysis system by creating a dataset with almost incalculabledata (can be added accordingly) from Twitter. The data set includes positive, negative, sarcastic, and hate speech-related direct data. Hence the scope is limited to the words stored within it at the particular point in time but new words can be added preferably. Thus, the project helps in analyzing people's sentiments and opinion mining.

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