

Deep Learning Based Twitter Sentiment Analysis

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Abstract:

To summarize reviews of a product, an extensively used approach is Aspect-based text mining which is applied on tweets or review data. With the help of Twitter sentiment detectors (TSDs) we can obtain a finer answer to assess a product in terms of quality and service. Social media has become a necessary means of communication in our daily lives. If we consider Twitter, most of the tweets are usually unstructured, non-formal, and it lacks labeled data like ratings, emojis, different categories, images, hashtags, videos etc. which makes it laborious for product opinion mining. The term "Twitter Sentiment Analysis" implies the usage of futuristic opinion mining techniques to analyze the - sentiment of the tweet within the sort of positive, negative, and neutral. Deep learning techniques utilize various models to extract data from unstructured input, such as tweets or text data, and symbolize it in particular kinds of algorithms. These algorithmic models are employed to draw conclusions regarding fresh datasets that have not yet been modeled. The "Universal Language Model Fine-Tuning" (ULMFiT) and Support Vector Machine (SVM) are combined to provide a new, highly accurate technique of sentiment analysis utilizing deep learning architectures. We show that analyzing opinions based on aspects of a large number of tweets produces useful product viewpoints. When used with the Twitter US Airlines dataset, the accuracy performance is above 90%.

Keywords: Opinion mining, sentiment analysis, Twitter product review, emojis , SVM, ULMFiT.

Introduction:

An important deciding factor when choosing a product can frequently be found in customer reviews. Although these reviews are publicly accessible online, their volume makes it difficult to read them all. As a result, many automated algorithms have been developed to look through the reviews and generate a better palatable synopsis for the user. For electronic products like camera , for instance, the characteristics might be "image pixel calibre," "portability," and so on. To identify the attributes using soft clustering, topic models are frequently utilized. Successful topic modeling applications have been made to review data retrieved from review websites like Epinions.com, Trip Advisor, etc. One of the most popular micro-blogging platforms, Twitter serves as a mesmerizing arena for more than 0.5 billion tweets every day over 1.64 billion users. Due to the user's privacy concerns that differs from various social networking websites, a message on Twitter by a list of characters limited to 280 characters, is posted openly or by dedicated followers. Transfer learning method seeks to apply insight learned from one work to others that are similar. ULMFiT, a technique for natural language processing, was created in 2018.



Fig1: ULMFiT Flow

As a transfer learning method for information extraction solutions, ULMFiT is employed. To train the model using this method, only a modest amount of data is needed. Additionally, ULMFiT is said to be universal because it may be utilized with any dataset of various sizes or any document using a single architecture like AWD-LSTM. This method also has the wonderful benefit of being adaptable to any activity without the need for designing a special feature. The fundamental principle of SVM is to split information into categories and use a hyperplane to maximize the space between them. A theoretical framework for machine learning that incorporates statistics and functional analysis is called Statistical Learning Theory (SLT). Learning classification methods based on SLT commonly use SLT. SLT has been effectively used in a number of fields, including bioengineering, computer vision, and voice recognition. SVM is commonly used in problem classification because of its outstanding performance and high classification accuracy.

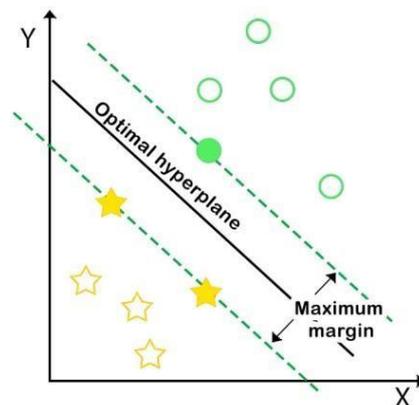


Fig2: SVM

Literature Survey:

In 2019, Saad and Yang [22] sought to provide a comprehensive ordinal regression-based machine learning algorithmic analysis of tweet sentiment. Pre-processing was a component of the model. An efficient feature was developed using tweets as a starting point and the feature extraction approach. Techniques for categorizing sentiment analysis SVR, RF, DTs, and Multinomial Logistic Regression (SoftMax) are employed. In order to address the problems, Fang et al. [25] proposed multi-strategical sentiment analysis algorithm that make use of semantic fuzziness in 2018. The results showed that the suggested model had achieved great efficiency.

A multi-domain NB approach was introduced by Xu et al. [24] in 2020, and an extensive E-commerce platform that classifies products based on reviews sentiment. The parameter evaluation approach was therefore expanded for ongoing learning in NB style. Afterward, for optimizing the distribution that was learned using three different sorts of assumptions, numerous methods for achieving the greatest performance were introduced. The outcomes have demonstrated the remarkable accuracy of the suggested model in Amazon based on Sentiment analysis of movie and product reviews. Smadi et al. [14] proposed current models in 2018 based on the faults using supervised machine learning algorithms. He mainly focused on Arabic hotel review feature-based sentiment analysis. In order to ameliorate the functionality of International Journal of Advanced Science and Technology, Araque et al. [19] suggested a deep learning model in 2017. This model combines the existing surface models with deep learning models that depend on user-derived features. Word implanting and linear ML methods were utilized

in the development of a deep learning-based sentiment classifier. Here, the effectiveness of the recommended approach was tested using 7 datasets. When compared to conventional procedures, the findings have shown that the proposed strategy was successful. We examined current TSA methods that make use of machine learning classifiers.

The research in [8] provided a method to automatically identify emotions in tweets by examining the tweet's attributes and the tweeter's emotion using an SVM LibLinear model. Raw data was gathered from 520K tweets in total. To extract features, the TweetToSparseFeatureVector filter from the Weka Affective Tweets package was implemented. Based on the weights calculated using the retrieved attributes, each tweet present in the dataset is labeled along with the appropriate emotion. The findings indicated that the SVM classifier had a 98% accuracy rate. R is employed to do text data sentiment analysis making use of TF-IDF approach. Out of the total number of words, the positive word and negative word frequencies range from (26% - 31% and 57% - 61%, respectively), according to the analysis of the positive and negative word frequencies from the eight countries. Jayanag Bayana and Dharmavarapu Durga The proposed methodology uses Sentiment Analysis, Naive Bayes classification, and AdaBoost algorithms to detect sarcasm on Twitter. Using the Naive Bayes method, the tweets can be separated into sarcastic and non-sarcastic categories. Nadkarni, Prof. Neepa Shah, and Kushal Ajmera, Being a part of the most prevailing social networking services is Twitter. Many users now view Twitter as a platform that can be used for all types of communication-news, distributing articles, and interacting with people worldwide. As a result, there is the potential for using a huge capacity, extreme speed spike of Tweet data originated every second for important analytical and interpretative applications. Our paper's major goal is to illustrate Tweet- Analyzer, a simple and direct method. Nadkarni, Prof. Neepa Shah, and Kushal Ajmera Many users now view Twitter as a platform that can be used for all types of communication-news, distributing articles, and interacting with people worldwide We provide a method to collect data from Twitter in real- time and display active users and popular hashtags on a bar graph. When presenting the tweets on a globe map, Tweet-Analyzer additionally uses the user's current location to calculate the coordinates. The proposed system is simply configurable and suitable for a range of practical purposes, including job search, news updates, and corporate information.

Afzaal et al. [15] aspect-based sentiment classification method, which they advocated in 2019, detected the characteristics precisely and achieved the highest classification accuracy. In Ontology Reasoning Towards Sentimental Product Recommendations Explanations[23], Vidya kamma, Teja Santosh Dandibhotla, Sridevi Gutta proposed an opinion mining model for product review sentiment analysis. In "Content-based video recommendation system (CBVRS): a novel approach to predict videos using multilayer feed forward neural network and Monte Carlo sampling method", [4] Baburao Markapudi, Kavitha Chaduvula, D.N.V.S.L.S. Indira & Meduri V. N. S. S. R.K. Sai Somayajulu, presented a neural network based recommendation system based on user's choice.

Research Methodology

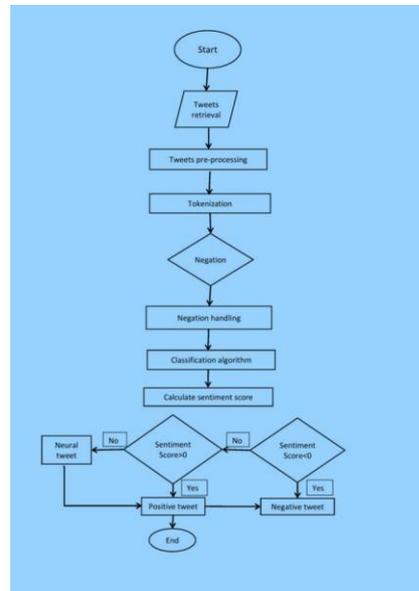


Fig 3: Methodology chart for sentiment analysis

Data set is a structured group of data. As we are all aware, data is a grouping of information that has been gathered by observations, measurements, research, or analysis. Facts, figures, names, and even simple descriptions of objects could be included in it.

Amazon cell phone reviews

verified	title	body	helpful/votes
Valid Customer	Review Title	Review Content	Helpful Feedbacks
true 612k 90% false 6761 10%	Five Stars 9% Four Stars 2% Other (60778) 89%	59815 unique values	1 990
false	Def not best, but not worst	I had the Samsung A68 for awhile which is absolute doo doo. You can read my review on it and detect...	1
false	Text Messaging Doesn't Work	Due to a software issue between Nokia and Sprint this phone's text messaging capabilities don't work...	17
false	Love This Phone	This is a great, reliable phone. I also purchased this phone after my	5

Fig4: A sample image of Amazon cell phone reviews

We searched for tweets about mobile phones that belong to various companies using the Amazon cell phone reviews dataset. Then, using langid.py [21], we eliminate non-English tweets. Additionally, since the majority of spam tweets include a link, we take a cautious technique for removing junk by excluding tweets with URLs.

The resulting collection, which we refer to as the electronic product dataset, has around 9 million tweets as shown above.

US Air lines

We explored for tweets about reviews of people about US Airlines that belong to various airlines using the Twitter US Airline Sentiment dataset. Then, using langid.py [21], we eliminate non-English tweets. Additionally, we remove junk by excluding tweets with URLs, hashtags, etc. As shown, The resulting collection has around 7 thousand unique tweets.



Fig5: A sample image of US Air lines

IMDB

We looked for tweets about different opinions of people about various movies that belong to IMDB Dataset of 50K Movie Reviews dataset. We remove unnecessary entries such as emojis, emoticons, etc. This dataset has around 50 thousand unique tweets as shown in below.



Fig6: A sample image of IMDB

GOP

We seeked for tweets that belong to First GOP Debate Twitter Sentiment dataset. This dataset has around 13.2 thousand unique tweets as in below.

id	candidate	candidate_confidence	relevant_yn	relevant_yn_confidence	sentiment	sentiment_confidence	subject_matter	subject
1	No candidate mentioned	1.0000	yes	1	Neutral	0.6578	None of the above	1.000
2	Scott Walker	1.0000	yes	1	Positive	0.6333	None of the above	1.000
3	No candidate mentioned	1.0000	yes	1	Neutral	0.6629	None of the above	0.662

Fig7: A sample image of GOP

Data Pre-Processing

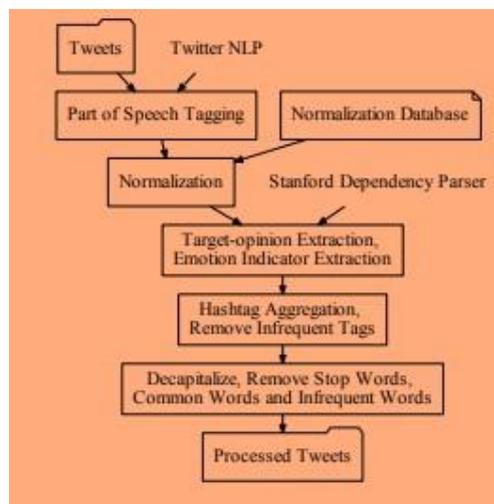


Fig8: Preprocessing channel

Results Analysis and Discussion:

We used testing data to evaluate the performance of the suggested model in three classes, and we compared the results with those of other approaches that utilized the same Kaggle datasets to demonstrate the value of our proposed approach. Table2 shows that our proposed models accuracis higher than that of competing models, proving that it is more effective than those models.

Methods	Accuracy
Support Vector Machine	78.5%
Bag-of-words SVM	78.5%
Deep Learning Model with Dropouts in keras	77.9%
SIS-ULMFiT	84.1%
ULM-FiT-SVM	99.78%

Table1 : Shows a comparison of our ULMFiT-SVM model's accuracy to that of other models.

Using linear SVM, Daniel Langkilde categorized the sentiment in tweets concerning airlines in 2017. The accuracy result was 78%, and the author claimed that a higher score may be attained by fine-tuning or using a more sophisticated strategy . In 2019,

Wesley Liao investigated the sentiment dataset for US airlines on Twitter and made an effort to predict tweet sentiment using a language model and RNN via the ULMFiT package from Fast.ai. This model had a 77.8% accuracy rate. In 2019, Anjana Tiha used LSTM and CNN to perform sentiment analysis. The LSTM and CNN model's accuracy was 79.64%. In 2019, Carlo Lepelaars used multinomial naive bayes to forecast the Twitter US airline sentiment dataset (NB). Text mining techniques like Multinomial NB are effective at setting standards for sentiment analysis. The "MultinomialNB" class from Sklearn makes it simple to apply this strategy [22]. Table 4 and Figure 13 provide further performance benchmarks for ULMFiT-SVM depending on multiple datasets.

Evaluation Type	Accuracy Rate
Twitter US Airlines	99.78%
IMDB	99.71%
GOP Debate	95.78%

Table 2 : ULMFiT-SVM performance comparisons based on more datasets.

Additional Comparisons

Additionally, we show the superiority of our model through contrasting its detection accuracy with that attained from other classification techniques in studies of a similar kind as discussed.

Dataset	Used Model	Accuracy
Twitter US Airlines	SVM only	78%
	RNN/LSTM (ULMFiT)	77.8%
	LSTM, CNN	79.64%
	Multinomial NB	±80%
	ABCDM	±92.75%
IMDB	ULMFiT-SVM (Ours)	99.78%
	ToWE-SG	90.8%
	ULMFiT	95.4%
	BERT large fine-tune UDA	95.8%
	RCNN	84.70%
GOP Debate	ULMFiT-SVM (Ours)	99.71%
	SIS-ULMFiT	55.034%
	ULMFiT-SVM (Ours)	95.78%

Conclusion:

Sentiment analysis is still in its infancy and far from being perfected, specifically when it comes to micro blogging. Therefore, we offer a small number of concepts which we believe are pursuing in upcoming time and pave a way to better performance. Opinion and text mining incorporates Twitter sentiment analysis in its scope. It keeps an eye on examining attitudes expressed in the posts and providing that information to a ML model in order to train and then test its definiteness, allowing us to employ this model going forward in accordance with the findings. It entails actions including gathering data, text preparation, sentiment categorization, sentiment detection, model training, and testing. Over the past ten years, this study issue has progressed, with models achieving efficiencies of roughly 90%–95%. However, the dimension of data variety is still missing. Along with this, it has numerous application problems because to the abbreviated forms and slang of words utilized. The performance of a large number of

analyzers suffers as the number of classes rises. Additionally, the accuracy of the model's for topics in addition to the one under discussion has not yet been tested. Therefore, there is a very promising future for the advancement of sentiment analysis. Digging even deeper into likes, comments, and shares in the future of sentiment research is necessary to fully appreciate the value of social media interactions and what they say about the users of the platforms. This forecast also forecasts that sentiment analysis will find use in larger contexts; in addition to brands, this technology will also be used by public figures, NGOs, government agencies, schools, and many other institutions.

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