Study of Machine Learning and Deep Learning Model for Sentiment Analysis

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Abstract- Sentiment analysis is one of the prevalent and hotspot research areas. Sentiment analysis research has expanded laterally and has its applications in many other research areas. As the applications of sentiment analysis grew, one of the most fine-grained form in demand is Aspect level sentiment analysis, the field which identifies the product features/aspects that are talked about in the review and hence map a sentiment to each aspect. There has been active research in the field of sentiment analysis for a couple of decades where the task of aspect term extraction which identifies the product features/aspects in the review has been found more challenging. The large volume of unlabeled data definitely encourages the need for more unsupervised models to be experimented in the field. Supervised models are definitely outperforming unsupervised models but are constrained by the availability of labelled data for the fine grained task. There is a huge cost, time and effort involved in creating voluminous and qualitative labelled datasets for training data required by supervised models.

Keywords- Machine Learning, Deep Learning, Sentiment Analysis

I. INTRODUCTION

Decision making to a large extent is influenced by what others feel or say about an entity or an experience. These opinionated inputs benefit end users ranging from individuals making product purchase decisions to even companies which formulate product design strategies based on this feedback. With voluminous opinionated data available online there developed the need for automated systems that could automatically read text and extract the sentiment expressed by the speaker or the opinion holder. This led to the emergence of the field called Sentiment Analysis [1]. With the social media era paving way to data explosion, companies invest a lot in aggregating sentiment from large volumes of opinionated text available online for analyzing customer feedback. Sentiment analysis also has real time applications which aid companies to judge brand sentiment on social media and instantaneously respond to unhappy customers. The applications of sentiment analysis are thus boundless. The initial orientation of Sentiment Analysis was only towards finding the subjectivity orientation in a text review i.e. to classify a given text as one expressing a positive, negative or neutral opinion [2].

The data source of these experimentations was mostly product reviews from websites where people have shared their opinion. Various approaches which are supervised, combinations or pure lexicon approaches have been explored in this field of subjectivity classification and research has progressed a lot ahead. Building domain specific lexicons to tackle the issue of context dependencies improved sentiment classification accuracies to a large extent. With the dawn of social media, the availability of data increased exponentially leaving greater scope for experimentations but had equal challenges put forward by the informal nature and short length of opinionated texts [3]. A summarized representation of the opinionated text in terms of product features and their corresponding sentiments has been a form of fine-grained representation in high demand [4, 5]. Major challenging research areas in the previous decade has been domain adaptation transfer learning, deep learning architectures for sentiment analysis, sentiment classification for codemixed data, explorations in low resource languages and so on. The field of sentiment analysis has witnessed the emergence of multimodal dimensions that extends sentiment analysis beyond text to other modalities like visual and audio data. Fields like affective computing and sentiment analysis, which explores the power of combined analysis of sentiment and emotion has provided an interesting dimension to the field [6].

II. LITERATURE REVIEW

Cach N. Dang et al. [1], feeling examination on general assessment communicated in informal communities, for example, twitter or Facebook, has been formed into a large number of utilizations, yet there are as yet many difficulties to be tended to. Cross breed procedures have demonstrated to be possible models for decreasing feeling blunders on progressively complex preparation information. This paper means to test the unwavering quality of a few crossover strategies on different datasets of various spaces. Our examination questions are pointed toward deciding if it is feasible to create half and half models that beat single models with various spaces and sorts of datasets. Crossover profound feeling investigation learning models that join long transient memory (LSTM) organizations, convolutional brain organizations (CNN), and support vector machines (SVM) are fabricated and tried on eight printed tweets and survey datasets of various spaces. The half and half models are

analyzed against three single models, SVM, LSTM, and CNN. Both dependability and calculation time were viewed as in the assessment of every method. The mixture models expanded the exactness for feeling investigation contrasted and single models on a wide range of datasets, particularly the blend of profound learning models with SVM. The dependability of the last option was altogether higher.

Q. Zhang et al. [2], have plans to investigate coevolution of close to home virus and conduct for microblog feeling examination. As needs be, a profound learning engineering (signified as MSA-UITC) is proposed for the objective microblog. The coevolution of close to home virus and conduct, right off the bat, is depicted by the tie strength between microblogs, that is to say, with the spread of profound infection, client conduct, for example, profound articulation will be impacted. Then, at that point, in view of client connection and the relationship with target microblog, the Hawkes cycle is taken on to measure the tie strength between microblogs in order to fabricate the comparing weighted network. Furthermore, in the weighted organization, the Deepwalk calculation is utilized to assemble the succession portrayal of microblogs which are like the objective microblog. Then, a CNN-BiLSTM-Consideration organization (the convolutional brain organization and bidirectional long transient memory network with a multihead consideration component) is intended to break down the opinion examination of target and comparative microblogs. At long last, the trial results on two genuine Twitter datasets exhibit that the proposed MSA-UITC has progressed execution contrasted and the current cutting edge techniques.

H. Kaur et al. [3], with the ascent in instances of Coronavirus, a peculiar circumstance of tension was mounted on every country to make plans to control the populace and use the accessible assets fittingly. The quickly ascending of positive cases all around the world made frenzy, nervousness and misery among individuals. The impact of this lethal infection was viewed as straightforwardly corresponding to the physical and psychological wellness of the populace. Starting around 28 October 2020, a larger number of than 40 million individuals are tried positive and more than 1 million passings have been recorded. The most predominant instrument that upset human existence during this time is virtual entertainment. The tweets with respect to Coronavirus, whether it was various positive cases or passings, prompted a flood of dread and uneasiness among individuals living in various regions of the planet. It's not possible for anyone to deny reality that web-based entertainment is all over and everyone is associated with it straightforwardly or in a roundabout way. This offers a chance for specialists and information researchers to get to the information for scholarly and research use. The virtual entertainment information contains numerous information that connect with genuine occasions like Coronavirus. In this paper, an examination of Twitter information has been finished through the R programming language. We have gathered the Twitter information in light of hashtag catchphrases, including Coronavirus, Covid, passings, new case, recuperated. In this review, we have planned a calculation called Crossover Heterogeneous Help Vector Machine (H-SVM) and played out the feeling characterization and ordered them good, pessimistic and nonpartisan opinion scores. We have additionally analyzed the presentation of the proposed calculation on specific boundaries like accuracy, review, F1 score and exactness with Repetitive Brain Organization (RNN) and Backing Vector Machine (SVM).

N. C. Dang et al. [4], the investigation of general assessment can furnish us with important data. The examination of feeling on informal communities, like Twitter or Facebook, has turned into a strong method for finding out about the clients' viewpoints and has a large number of uses. In any case, the effectiveness and precision of opinion examination is being blocked by the difficulties experienced in normal language handling (NLP). Lately, it has been exhibited that profound learning models are a promising answer for the difficulties of NLP. This paper audits the most recent examinations that have utilized profound figuring out how to tackle feeling investigation issues, like opinion extremity. Models utilizing term recurrence reverse record recurrence (TF-IDF) and word inserting have been applied to a progression of datasets. At long last, a relative report has been led on the trial results got for the various models and information highlights.

G. Wang et al. [5], with an ever increasing number of financial backers applying their voices through network gatherings or web-based entertainment stages, the connections between online financial backer opinion and stock developments definitely stand out. In this paper, we creep stock remarks from China's most famous web-based stock gathering, East Cash (www.eastmoney.com), and afterward foster an opinion classifier utilizing the LSTM strategy. Utilizing the internet based financial backer opinion of the stock discussion, we investigate the impact of online financial backer feeling on the stock developments of CSI300. The outcomes show that web-based financial backer opinion emphatically affects both stock return and exchanging volume and stays critical in the wake of controlling book-to-advertise proportion, BETA, and market esteem. Besides, financial backer opinion decidedly affects request lopsidedness of enormous exchange, which addresses the fundamental progression of cash on the lookout. Subsequently, financial backer opinion emphatically affects the significant asset streams on the lookout. As such, an expansion in financial backer feeling can help the significant cash streams in the market somewhat. According to a pragmatic perspective, financial backer feeling can help financial backers to settle on speculation choices and assist the public authority with controlling the securities exchange.

A. Rajput et al. [6], late advances in Large Information have provoked medical services professionals to use the information accessible via online entertainment to observe opinion and feelings' appearance. Wellbeing Informatics and

Clinical Examination rely intensely upon data accumulated from different sources. Generally, a medical services professional will request that a patient finish up a survey that will shape the premise of diagnosing the ailment. In any case, clinical specialists approach many wellsprings of information remembering the patients' works for different media. Regular Language Handling (NLP) permits specialists to accumulate such information and dissect it to gather the basic significance of such compositions. The field of feeling examination — applied to numerous different spaces — relies vigorously upon strategies used by NLP. This work will investigate different pervasive hypotheses fundamental the NLP field and how they can be utilized to accumulate clients' feelings via web-based entertainment. Such feelings can be separated throughout some undefined time frame consequently limiting the blunders presented by information input and different stressors. Moreover, we check out at certain uses of opinion examination and utilization of NLP to psychological wellness. The peruser will likewise find out about the NLTK tool compartment that carries out different NLP speculations and how they can make the information searching interaction significantly more straightforward.

A. S. M. Alharbi et al. [7], opinion examination via online entertainment, for example, Twitter has turned into a vital and testing task. Because of the qualities of such information — tweet length, spelling mistakes, shortened forms, and exceptional characters — the feeling examination task in such a climate requires a forward thinking approach. Besides, online entertainment feeling investigation is a key issue with many fascinating applications. Latest web-based entertainment feeling order techniques judge the opinion extremity essentially as per printed content and disregard other data on these stages. In this paper, we propose a brain network model that likewise consolidates client conduct data inside a given record (tweet). The brain network utilized in this paper is a Convolutional Brain Organization (CNN). The framework is assessed on two datasets given by the SemEval-2016 Studio. The proposed model outflanks current pattern models (counting Credulous Bayes and Backing Vector Machines), which shows that going past the substance of a report (tweet) is helpful in opinion grouping, since it furnishes the classifier with a profound comprehension of the undertaking.

III. EXTRACTION STRATEGIES

Aspect Term Extraction/ Aspect Detection is the subtask in sentiment analysis which identifies the features/ aspects that are talked about in the review by the opinion holder. Various approaches experimented to identify the aspect terms in a review text are discussed in the section. Most of the explorations on aspect term extraction have been either heuristic approaches, supervised and unsupervised machine learning methods and hybrid approaches as depicted in Fig 1.

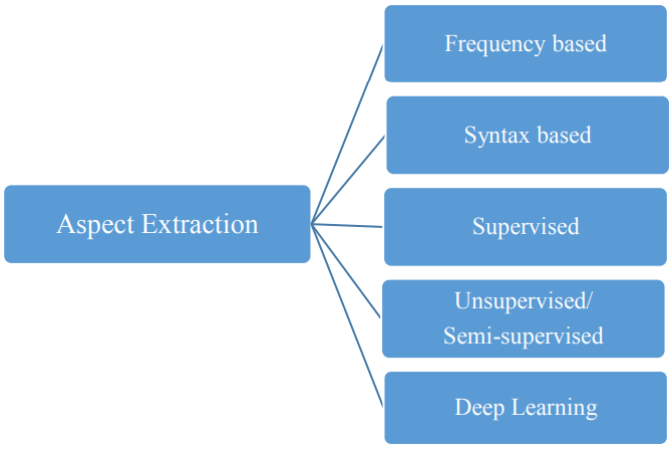

Fig. 1: Different approaches explored for Aspect Term Extraction

3.1 Frequency Based Approaches

This approach is based on the fact that the aspects/product features in a review text are mostly identifiable as nouns and noun phrases. The nouns and noun phrases are identified in the given text and a frequency based filter is appended to this approach supported by the notion that the commonly talked about tend to be features and the less talked about would be the irrelevant ones. One of the earliest works on aspect extraction from reviews, Bing Liu and team have extracted the nouns and noun phrases and later subjected them to association rule mining based on the Apriori algorithm which results in determining frequent item-sets as explicit product features. They later have applied compactness pruning to ensure that multiword item-sets do not comprise of words that appear quite far in the review sentences [8].

3.2 Syntax Based Approaches

Syntax based approaches based on the underlying syntactical dependencies have been experimented to identify aspects. For example, in Fig. 1 the adjectival modifier relationship reflected as amod between the adjective better and the noun quality helps to identify quality as an aspect. These approaches could enhance infrequent aspect coverage but more syntactic rules had to be described to ensure a good coverage. Frequency based filters, incorporating phrase dependency, similarity-based approaches based on co-occurrence statistics, similarity measures with the domain etc. are the improvisations experimented to improve the basic syntactical approach [9].

3.3 Supervised Machine Learning Approaches

A pure machine learning based supervised approach builds a model from trained labeled data. For designing aspect extraction as a supervised model, the features that are capable of discriminating a word as an aspect or non-aspect have to be identified. One of the earliest supervised approaches on movie reviews explored frequent nouns and opinion words in the domain as features for the machine learning model. The word in the review, its POS tag, context information, the head word in the phrase to which the word belongs etc. are a few striking

experimented in supervised machine learning approaches. A CRF based approach was unique in having designed aspect term extraction as an information extraction task. Word tokens, Part-Of-Speech (POS) tags, the length of the path in the dependency tree etc. have been the features considered in the supervised model. The proposers have reported an F-measure of 0.63 and 0.43 respectively and Camera and Movie reviews was the domain of choice [10, 11].

3.4 Unsupervised Machine Learning Approaches

Unlabeled data are available in large volume publicly, hence models that work with unlabeled data world be highly appreciated. The need for robust, flexible unsupervised aspect detection models is thus emphasized. Bagheri and team proposed an unsupervised framework for aspect detection starting from an initial set of seed words. An initial list referred to as the candidate list is extracted based on specific POS bigram and trigram patterns in noun phrases. A metric called A-score which is a representative measure of the frequency of an aspect word and its correlation with the aspect terms is used to filter a set of seed words based on a threshold value for the A-score. An iterative bootstrapping algorithm arrives at an optimized final output set of aspects. Subset and superset pruning methods are used to remove meaningless and redundant aspects in the finals set. The work has reported an average precision and recall of 0.84 and 0.66 on the camera review domain [12].

3.5 Semi-supervised Machine Learning Approaches

Purely unsupervised methods for aspect detection are mostly based on the observation of the co-occurrence of terms in different contexts. This unexpectedly causes the retrieval of many non-specific terms and hence being clustered. Hence rather than adapting a completely unsupervised approach if the model can be built upon some set of seed words chosen carefully from the domain that becomes a semi-supervised approach expected to perform better. One such approach uses provided minimal seed words for a few aspect categories. The model in turn clusters aspect terms into categories simultaneously. The model was experimented on hotel reviews and reported better performance than the state of art.

Deep Learning Approaches

With respect to text classification, deep learning promises a solution for the large feature vectors and the complexities involved by generating new feature representations. In recent years, deep learning models have been proposed for aspect term extraction. The majority of supervised models experimented are variations of Convolution Neural networks (CNN) architecture. Wang and team proposed a neural network model for aspect extraction which was a two-layer model with a fully connected first layer and a second layer based on a softmax distribution. The model was experimented on SemEval2015 laptop dataset and the proposers claimed to receive comparable results with the winning team of SemEval 2015 team. Dependency-tree based convolutional stacked neural network, which captures syntactic features, controlled 17 CNN for asynchronous parameter updation, enhancement using double embeddings, etc. are the variations attempted. These supervised models have reported appreciable improvement from the state of art on benchmark SemEval datasets. An extension to Recurrent Neural Network model (RNN) which enhances the richness of the target aspect by using syntactic information from both the dependency and constituent trees of the sentence has been explored. An ensemble model which uses a combination of a seven layered deep neural network model and a linguistic rule based approach was experimented on both Hu and Liu 2004 and SemEval 2014 datasets and were able to outperform the state of art in both the datasets.

IV. CONCLUSION

The deep learning model for aspect term extraction proposed by the initial set of experiments is an enhanced guided LDA model in conjunction with BERT based semantic similarity. The model experiments the strength of guiding a topic model for aspect term extraction using minimal seeds which are representative of aspect categories. The input sequences are filtered based on regular expressions, semantic and frequency filters. The approach is novel in that it has augmented semantic strength into the topic model in a unique way. The model performance has been compared with a few recent unsupervised and supervised baselines experimented on the same dataset and has reported appreciable results. The proposed work will has contributed an almost deep learning model for aspect term extraction, which is on par with the state of art.

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