

Interpretable sentiment analysis and detection of cognitive distortions for Chinese language

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Abstract. In this paper, we explored the performance of sentiment analysis models of different combinations for the Chinese text in social media. We made experiment to study how performance varies with the change of combination of different segmentation strategies and Lexicon. We found that with some good combination of segmentation strategies and Lexicon, the result can be improved and overtake the performance of ordinary sentiment analysis model of Chinese language. This way we show the importance of selection of segmentation strategies and Lexicon for the sentiment analysis of Chinese text.

Keywords: Social Media, Cognitive Distortion, Chinese Text, Interpretable Artificial intelligence, Nature Language Processing, Sentiment Analysis

1. Introduction

Social media is nowadays a critical component of life. It provides a convenient communication platform for people to stay in touch with friends, family and colleagues, and also provides people with channels to obtain news, current affairs, learning materials and other information. People are used to get information and generate information in the social media. Text information that people generate in the Internet, which usually in the form of comments in social media platform, contribute to the formation of public opinion, and contains very impressive possibility of getting more important potential information through data analysis.

Bilibili, a video platform with Chinese young people as its main user group, provides a powerful video community, in which users can add comments to videos and interact with other users. Those comments under video can provide information that reveal the thought of people who clicked and watched this video regarding a certain trend, news, product, etc.

Sentiment analysis is an active research field in natural language processing. Its

development history can be traced back to the 1950s. Early research mainly focused on the construction of emotional dictionaries and the design of emotion classification algorithms. With the rise of social media, the application scenarios of sentiment analysis are becoming more and more widespread, such as product reviews, online news, blogs, social media, etc. As an application of nature language processing, Sentiment analysis can be helpful in the issues such as prediction and feature discovery. With text data gathered in the social media, people are able to make to prediction with the information those text contain and make a good association between the sentiment in the text and the fluctuations in other field like market price. And we are intending to take the “N-grams” segmentation strategy from Aigents and its corresponding Lexicon, which show a great performance in sentiment analysis to the text data in English and Russian language, to Chinese language and make a comparison of it with those popular sentiment analysis model that focusing on Chinese text sentiment analysis.

2. Literature Review

Works focusing on the review of sentiment analysis were conducted in previous years. In this work of review on sentiment analysis, a technical summary of common modern frameworks, the taxonomy of its parent fields, and a brief analysis of related research dating back to the early 1990s were provided ^[1]. In the work on sentiment analysis techniques, a review of sentiment analysis techniques, particularly those related to social media platforms and an exploration of how natural language processing extracts attitudes and emotions from human expressions were done ^[2]. Except from the technical summary of modern frameworks, early research of sentiment analysis and techniques of sentiment analysis, the work focusing on related tasks, approaches, and levels of analysis in the field of sentiment analysis was also conducted ^[3]. And for sentiment analysis of social media, there is also a review of sentiment analysis using Twitter datasets within the subfield of natural language processing ^[4].

Works focusing on model usability of sentiment analysis were conducted. In the work focusing on BERT-Based model, the comparison of different strategies for analyzing sentiment using BERT-based models was carried out ^[5]. And improvements over existing tools for sentiment analysis were indicated by experimental results. Usability of large language model

for sentiment analysis was also been studied, comparison of performance of sentiment analysis in the context of large language models and interpretable multimodal sentiment analysis using large-scale language models had been conducted in related works ^[6,7]. Work on overview of recommender system and sentiment analysis and comparison of various libraries used in sentiment analysis and classification algorithms were also conducted ^[8,9].

Works focusing on the sentiment analysis of Chinese text in previous years had been conducted. In this review of sentiment analysis research, the author explored past, present, and future aspects of Chinese sentiment analysis from both monolingual and multilingual perspectives ^[10]. And covered the construction of sentiment corpora and lexica, monolingual sentiment classification frameworks, and introduces sentiment classification based on multilingual approaches. In the paper of reviewing on sentiment analysis model for social media text, the complexity of sentiment analysis in unstructured Chinese social media content, including data preprocessing, word segmentation, and feature extraction were discussed ^[11]. Comprehensive overview of sentiment analysis, including its application to Chinese and other special texts and literature, including relevant research in the field were done in the work of review of Chinese sentiment analysis ^[12,13].

Sentiment analysis researches with Aigents model are also what we care about. In this research of sentiment analysis with Aigents model, the author explored the usability of different natural language processing models, including Aigents sentiment analysis model for the sentiment analysis of social media ^[14]. The experiment was carried out based on the financial data and social media comment to analyze potential causal connections between the different sentiment metrics and the price movements. This way the author confirmed that interpretable artificial intelligence and natural language processing methods might be more valuable practically than non-explainable and non-interpretable ones. And in the paper studying of the relation between the time series of different natures in context and movement of financial market, an experiment with Aigents model was carried out ^[15]. With the data involves various financial metrics computable from raw market data as well as metrics determined upon social media news streams, the author pointed out the possibility to discriminate causal connections between different sorts of real field market data.

3. Methodology

This study can be generally divided into four steps. The first step is conducting a literature survey on all popular public sentiment analysis models that dealing with Chinese texts. We took a look at some popular models for both sentiment analysis and text segmentation, with which we could conduct some good comparisons with Aigents segmentation and sentiment analysis performance. In the second step we gathered some specific comment data from an online platform which is popular among the young people in China, in which way we can gather some texts that are expressed in a quite normal and formal way but instead, full of art of contradiction and abstraction. And then in the third step, we performed data processing using all the gathered sentiment analysis models and make some combination with the text segmentation model and do a comparison with the performance of model from Aigents. To make the evaluation of the performance of every model aligned, we made the result of the sentiment analysis binarized. This way for this specific sample of sentiment analysis, we can find the model with best performance. And in the last step, to check the effect of the Lexicon selection in the performance of sentiment analysis mission for Chinese texts, we made comparison for Aigents model with its own Lexicon and with Lexicon of SnowNLP. And also carried out a parallel performance comparison of sentiment analysis for Jieba segmentation strategy and distinct word strategy with these two different Lexicon to check how the performance varied causing by different Lexicon varied between model under different segmentation strategy.

4. Model Evaluation Experiments

Using the same data of comments collected from social media and 4 sentiment analysis models with 4 type of segmentation strategies and 2 Lexicon, which in total combined into 8 combinations, we conducted our experiment by checking and evaluating the performances of every combination, which are presented in Figure.1. All of the models evaluated in this experiment are public accessible.

4.1 Data

We gathered 150 comments data from video platform Bilibili, where we collected the comments under a consistent topic regarding to the attitude of a new releasing domestic graphic card. Those comments gathered from the platform were manually marked by 3 independent reviewers who classified marked those comments with a score from 0 to 1. And this way we classified these comments into “Positive” and “Negative” after a binarization of the average score computed with the scores marked by those reviewers.

4.2 Models

We checked and evaluated the performance of 4 sentiment analysis models, which in total contain 4 segmentation strategies and 2 Lexicon. For Chinese version of Aigents Lexicon, we took the English version Lexicon of Aigents and translated it with Google Translator.

4.2.1 SnowNLP

SnowNLP is a class library written in python, which can easily process Chinese text content with its own trained Lexicon. It was inspired by TextBlob. Since most of the natural language processing libraries now are basically for English, this library was created to facilitate the processing of Chinese text.

4.2.2 Jieba

Jieba is a Python-based natural language processing library, mainly used for Chinese text processing. Word segmentation is the core function of the jieba library, which can improve word segmentation accuracy by adding a custom dictionary. And also provides keyword extraction function based on TextRank algorithm.

4.2.3 Aigents

Aigents is an “interpretable” sentiment analysis model based on its own “N-grams” segmentation strategy. It is written in Java and available as part of <https://github.com/aigents/aigents-java> distribution. It has a Lexicon which was built based on the frequencies of occurrences of the reference n-grams in the text along with independent positive and negative sentiment metrics and contains over 8,200 negative and over 3,800 positive n-grams to works for “N-grams” segmentation strategy. The segmentation of N-grams followed the principle of “priority on order”. For a n-gram search with higher “n”, when a n-gram is matched, all the component words of this n-gram will be disregarded in the search of n-gram with lower “n”.

4.2.4 Generative AI

Baidu Wenxin Yiyan is an intelligent language generation tool based on a large language model launched by Baidu, which can interact with people in conversations, answer questions, and assist in creation especially in Chinese language. WenXin YiYan has cross-modal and cross-language in-depth semantic understanding and generation capabilities. It has extensive applications in search question and answer, content creation and generation, smart office and other fields.

5. Experimental Results

The evaluation of the performance of different model were performed based on the F1-score result which we gained from the confusion matrix “ground truth”(discussed in section 4).

Three segmentation strategies were compared in this experiment, we implemented the SnowNLP sentiment analysis model with its own segmentation strategy on 150 comments to make a comparison with “groud truth”, which were binarily divided into “Positive” and “Negative” to check the confusion matrix of it and then make a comparison of SnowNLP sentiment analysis model with segmentation strategy provided by library Jieba, whose experiment was performed also in the same way, to check the difference of the influence of these two segmentation strategies on the SnowNLP sentiment analysis model. We can find from Figure.1 that mixing the segmentation strategy from Jieba library with SnowNLP sentiment analysis model didn’t help much on improving the performance of the sentiment analysis. SnowNLP with its own segmentation strategy held a better performance in the sentiment analysis on these 150 comments text.

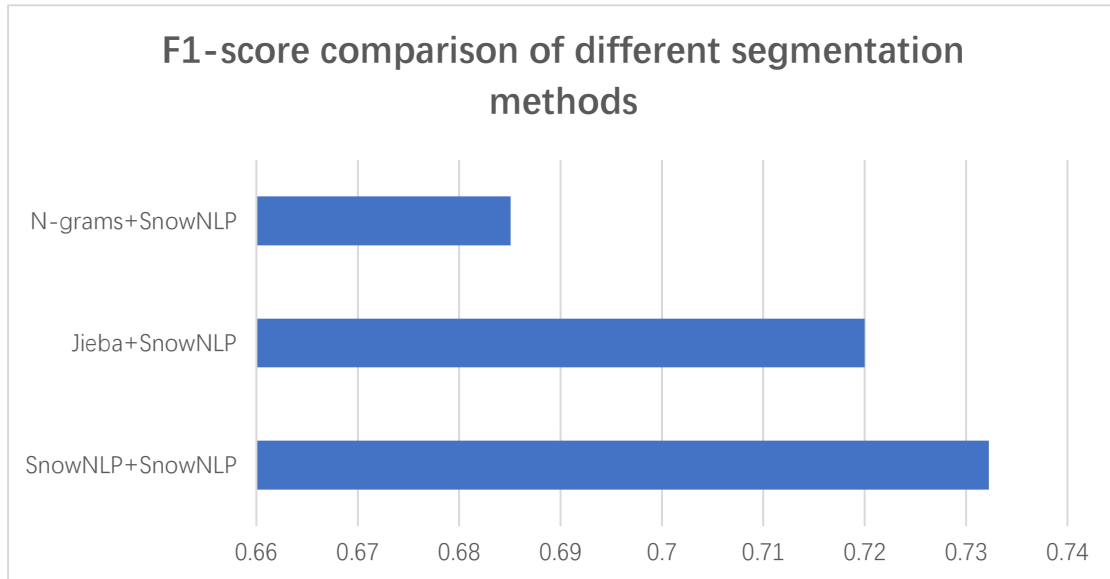


Figure.1 F1-score comparison of different segmentation methods

After that we added the N-grams segmentation strategy from Aigents into the experiment, which was also performed in the same way as the previous two strategies, to make the comparison of three strategies. In Figure.1, we can find that for sentiment analysis of Chinese text, the combination of N-grams strategy and SnowNLP also didn't get a better performance just like the combination of segmentation strategy from Jieba and SnowNLP, and also doesn't seem to be more competitive than the combination of SnowNLP and its own segmentation strategy.

Beside of that, an evaluation of the influence of different Lexicons on the performance of sentiment analysis was also conducted. Evaluations were performed for sentiment analysis with N-grams strategy, Jieba segmentation strategy and distinct word segmentation strategy in the Chinese text sentiment Lexicons of SnowNLP library and Chinese text sentiment Lexicon of Aigents. (The sentiment analysis for distinct word was also made just for control experiment, since we know that for Chinese text, distinct word doesn't make sense like what it does for English or Russian text). It's not hard to tell from the Figure.2 that the performance of sentiment analysis with segmentation strategies from Jieba and Aigents had both significantly increase after switch the Chinese text Lexicon for sentiment analysis from SnowNLP's to Aigents', which showed that the change of Lexicon from ordinary SnowNLP Lexicon to Aigents can do a great improvement on the analysis of sentiment.

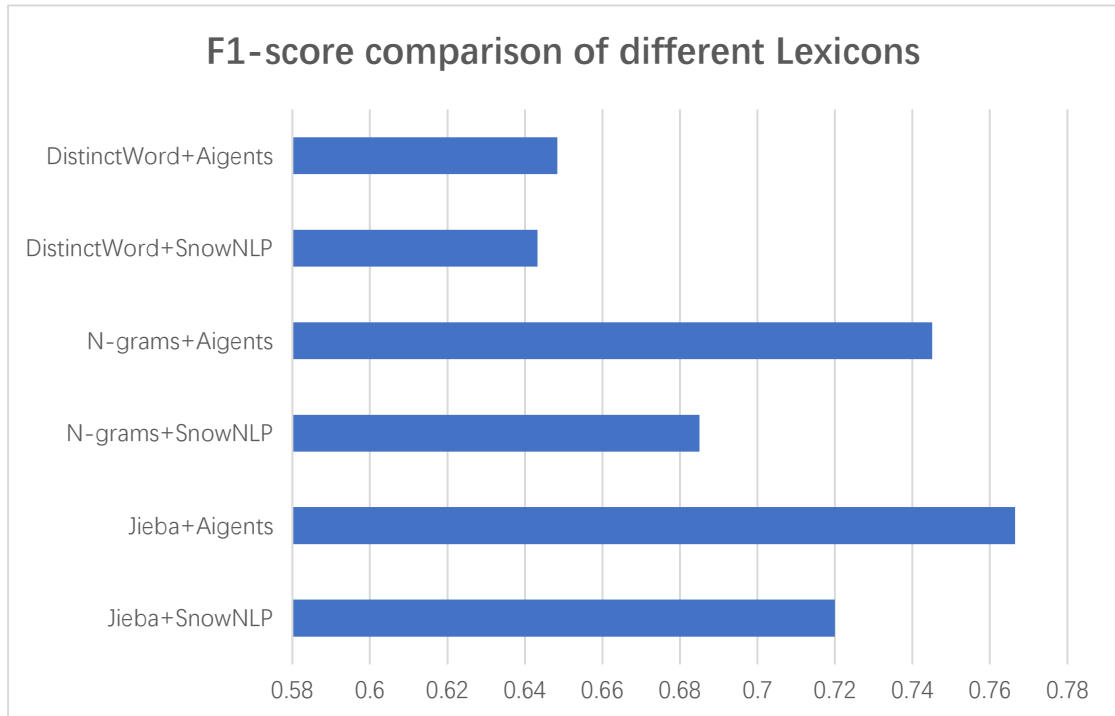


Figure.2 F1-score comparison of different Lexicons

And the performance of sentiment analysis with N-grams segmentation strategy, also, obtained a greater increase in F1-score, which showed that the Lexicon from Aigents is quite an adaptive Lexicon for the N-grams strategy.

In the overall comparison of all the segmentation strategies, Lexicon and sentiment analysis model showed in Figure.3, we can find the combination with the best performance is the combination of Jieba segmentation strategy and Aigents' Lexicon. And the Aigents' combination, which is N-grams segmentation strategy and Aigents' Lexicon, also got a competitive performance result.

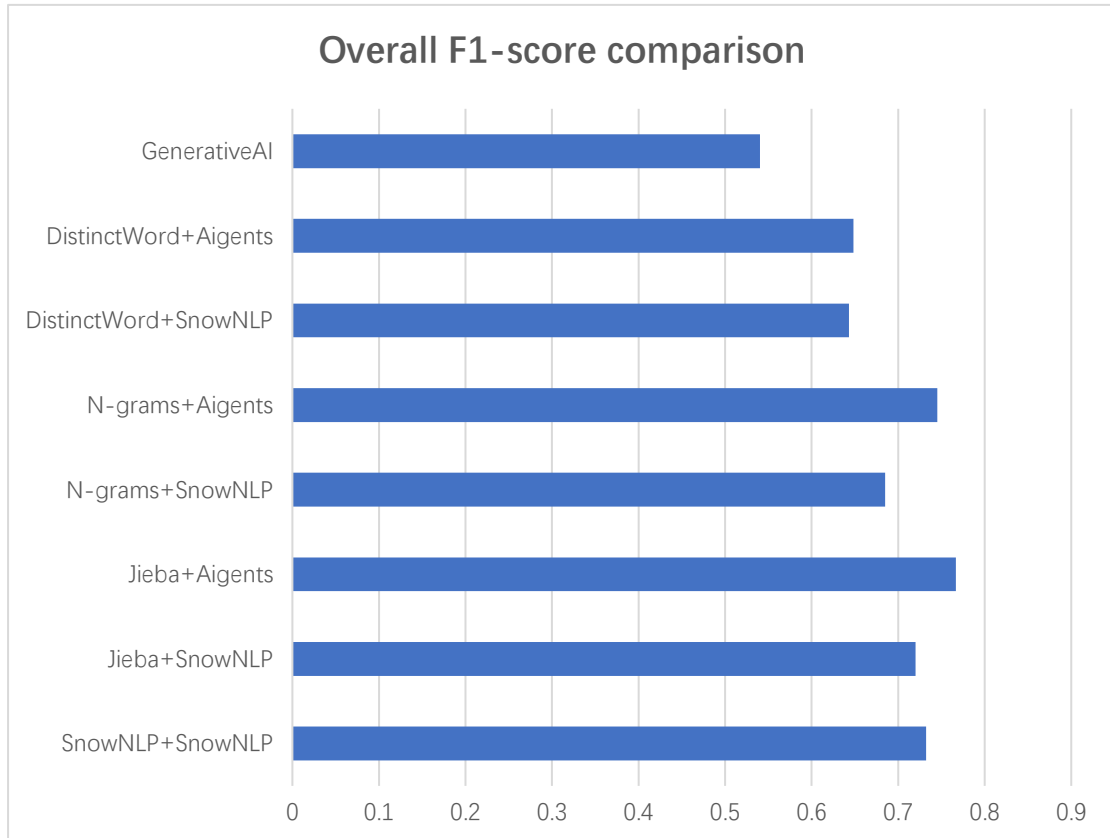


Figure.3 Overall F1-score comparison

Although SnowNLP model with its own segmentation strategy and Lexicon held a better performance in the comparison of different segmentation strategy, the performance of it was overtaken by the combinations of Jieba/N-grams segmentation strategy and Aigents' Lexicon. This indicated that performance of sentiment analysis can be improved with better selection of combination of segmentation strategies and Lexicon. With the result of experiment, we can say that the Lexicon of Aigents can do a good improve of the ultimate performance of sentiment analysis.

6. Conclusion

In this paper, we had made a comparison among the performance several sentiment analysis combination of different segmentation strategies and Lexicons and found those most combination based on our social media dataset. We checked out how those popular Chinese text sentiment analysis models and Aigents sentiment analysis models worked on the text data with abstract, contradictory, and slang-heavy styles text collected. We explored how the

varying of segmentation strategies and Lexicon choice affected the performance of Chinese text sentiment analysis.

Through the experiment we showed the importance of the selection of different segmentation strategies and selection of Lexicon in the process of sentiment analysis for Chinese text. With a good selection and combination, we can obtain a better result than the original sentiment analysis model.

We found the Aigents sentiment analysis model's performance had obviously differed from the previous studies^[14] with Aigents model dealing with English and Russian text. Further improvement of Aigents model for Chinese text analysis may be conducted with some hints of the work in this paper.

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