

Application Analysis of NLP Technology in Understanding Psychological Intervention for College Students

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Abstract. Given that the majority of university students are interested in mental health problems within their academic and social lives, how to apply state-of-the-art technologies for timely detection and response to the mental risks is becoming an active research area. NLP is the field that aims to understand texts, recognize sentiments in them, and perform deep semantics understanding. The present paper will discuss about the history and general technical structure of NLP which shows how much relevant is NLP for Psychological Health Intervention at College level. Moreover, this paper discusses the practical use of emotion analysis, monitoring of the public opinion, intelligent question answering systems, and automatic warning systems. By using the method of studying the campus wall data, this paper examines what can be inferred of the text content posted by students that reveals some possible emotional tendencies and mental issues. With these results, this paper also assesses the existing academic trends and their main challenges including the protection of data privacy and model accuracy, and envisions the further development opportunities. To sum up, the present research is intended to form a strong theoretical basis and give a useful technical perspective on enhancing the mental health education and optimizing the intervention plans in universities

1 Introduction

College students nowadays live under the era of data and they post on social media and online forum to show what they feel and value or document their everyday life. The content is full of emotional indicators and psychological clues which can be helpful when it comes to studying about their mental health. Campus walls are a platform built for the campus community, providing a semi enclosed space where college students can post info on it. Such an environment will help in understanding the student's mood status along with psychological needs. Natural Language processing (NLP) is an area of Artificial Intelligence which deals with textual data and interprets meaning, it can even be used while developing automatic psychological wellbeing monitoring tools for detecting psychological status and risks. Recently, deep learning methods (especially with pre training) has pushed further the state of art on sentiment analysis or meaning understanding tasks in NLP.

Over the past few years, the development of deep learning techniques, particularly those involving the use of pretrained deep learning techniques, has allowed greater advancements in sentiment analysis and meaning comprehension in NLP. In recent times, many papers are reporting success stories about applying deep learning techniques for finding out the sub-space of affective features from text data aiming at predicting the class of psychological state present within the text data like the Bidirectional Encoder Representations from

Transformers (BERT) model that improves effectiveness to a large number of tasks NLP, which is widely applied to identify emotions and detect mental illness. Built on top of such work is the RoBERTa model introduced by Liu et al., which enhanced text representation even further, through a modification to the initial way in which the neural networks are trained [1]. Within mental health analysis, N Han et al. built a model to detect language used in social media to predict mental health [2]. Also, J Sawalha et al. developed methods for the automated detection of depression and post-traumatic stress disorder (PTSD) using text analytic methods on Twitter data. These are some to the more prominent analysis methods in NLP developed in the past few years [3].

Domestic Research Progress in China is also steady. Some researchers have established Chinese corpora on Weibo, studied emotional vocabulary combined with deep learning to identify college students' emotions related to anxiety and stress. Some psychology combines the attention mechanism and multiple feature fusion methods to extract important text information and improves the accuracy of psychological state classification. Besides, more and more researches try their best to apply NLP technique in a certain situation (like school forum, "campus walls") in order to gather the information which will cause psychological risk alarms and capture student's real voice with greater accuracy. Overall, while the above works have demonstrated advances on both models and applications, they also suffer from a few limitations, such as targeted

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population studies, lack of corpus resources, and model's lack of interpretability.

Therefore, a systematic review and evaluation of the application of NLP technology in psychological intervention for college students is crucial, which involves compiling existing research and attempting to fill existing gaps, while exploring the possibility of campus walls detecting psychological states and warning risks based on their specific language features. This article aims to summarize the development level, key technologies, and applications of NLP technology in student mental health assistance. In addition, it also describes potential research areas and provides valuable suggestions and guidance for future research work.

2 Development of NLP

2.1 Background of NLPs

NLP plays an important role in many fields such as information retrieval, sentiment analysis or question answering with smart answers. At first, natural language processing which used hand crafted systems and huge inflexible rule based manuals to process the language. Processing the language in such a manner was rigid and inefficient when scaling up with more data to be processed. With an increasing volume of data available for use, NLP transitioned into using data-driven techniques which used statistics such as Naive Bayes and Support Vector Machine (SVM). Within the discipline of ML, these approaches handled huge volume of data and enhanced the precision in classification and sentiment analysis.

Also, the emergence of such technology as DL, has also paved way to NLP. World self repairing mechanism gave new prospect to natural language processing with new options for semantic features having a new possibility of being extracted at multiple layers. Not just by overcoming difficulties while upgrading conventional methods, but not only for better sentiment analysis. Recognition of emotional states based on text processing allowed analyzing mental health. This novel domain has been important in many fields, including mental health research.

2.2 The process of developing emotional analysis

One of the important areas of NLP involves analyzing emotions. The beginnings of emotional analysis can be linked to early analytics which were based on rules and sentiment vocabulary. In earlier studies, researchers relied on manually created sentiment lexicons and ruled based methods to identify the sentiment of a text. The methods that fell under the category of calculating sentiment tendency based on point mutual information (PMI) [4], laid the preliminary work for developing automatic sentiment analysis methods, but these methods are insufficient to account for the semantics of the context and complicated emotional expressions.

Sentiment analysis gradually transitioned to statistical learning with development of machine

learning. Researchers began to employ bag of words model, and n-grams to form feature representation. In addition, they began to combine statistical learning methods such as support vector machine and naive bayes to determine the polarity of text [5]. The work of Pang and Lee provided significant boost for sentiment analysis to be adopted in text mining and provided a compendium of the empirical achievements of sentiment analysis.

During the early 2010s, a lot of progress in sentiment analysis were as a result of deep learning methods. A lot of the work in deep learning for sentiment analysis shifted the dependence of manual feature engineering, with technology such as Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) which automated emotional feature learning through end to end training. One of the CNN based architecture of kim was able to perform Sentiment analysis of text with better results relative to the other deep learning methods that were developed for sentiment analysis [6].

Large pretrained models and methods such as BERT have enabled large scale sentiment analysis by bi-directional context encoding to understand the fine-grained contextual information better which benefits various down-stream tasks (e.g., sentiment analysis) [7]. Large sophisticated pre-trained models enable more profound mining of latent feelings and complex semantics and long texts and emotion expressions. This will help, especially when it comes to text mental health analysis.

During the psychology studies of college students, campus walls are frequently used as anonymous messaging systems. The text that people leave on the campus walls can be highly emotional. There have been many studies that have tried to do sentiment analysis on campus wall text. The most popular methodology for providing a data based psychological snapshot of a student group and supporting the psychological alert systems of the university is the analysis of the student group psychology and counting the changes in expressions of negative emotions.

3 Core Technologies of NLP

3.1 Semantic comprehension

Semantic reasoning forms the basis behind the prevalent NLP task for extracting deeper semantic information in a given text. Particularly, it is crucial to understand affective changes and possible effects of cognitive, psychological contents of writing documents for intervention psychology over college students. Not all the body expressions were said by new and hard feelings, where the former is manifest in a more direct manner, while for the latter it appears indirectly. For example, the sentence 'I feel a little tired', could be benign yet might indicate underlying depression and/or anxiety disposition that needs to be accurately recognized by performing extensive context-aware processing over NLP tools.

3.2 Sentiment analysis and sentiment extraction

A primary application of NLP for mental health research are sentiments analyses (estimation of affective tendencies or states from text). Recently, deep learning-based methods for sentiment analysis including CNN [7], LSTM [8], have achieved good classification performance. All these advances are not only limited to simple polarity detection but also identify nuanced emotion classes, for example fear, sadness or irritation. The emotion mining could help us to find possible crisis in college student's mental health monitoring, for instance, students that might have lingering symptoms of anxiety may require more comprehensive psychological care [9]. Such nuanced examination on emotional intelligence could help counsellors craft specific strategies for individual student or family's need.

3.3 Information extraction and text classification

For instance, through adapting information extraction technology to extract simple events, characters, and emotional triggers from non-structural text; this technology can help the system obtain some key information that is conducive to judging the mental state of college students' psychological intervention. For example, it is able to recognize emotion provoking factors like academic pressure, emotional issues etc., through the analysis of the forum discussions in the student community, and offer important clues to psychological treatment.

Text classification - The task is to assign texts to pre-defined classes. For example, people use the classification model to classify the psychological state of college students into "normal", "low level of anxiety", "high risk", so that it can give the mental health teachers an evidence based method to deal with these students. Deep learning combined with a pre trained language model makes text classification approach have good performance on this task.

4 Application Fields of NLP

4.1 Online public opinion monitoring and psychological early warning

College students' emotion expression on the digital communication scene could be understood by the campus forum, campus walls [6], and social media [7]. The texts contain immediacy and authenticity that is important to be used as a source of data in providing information on the mental health. By using NLP, emotional expression is recognized and the risk of mental illness is classified, it will be possible to predict mental illness risks system.

Research shows that the language style and the psychological situation of the individual are correlated. For example, in social media, the vocabulary and emotional expressions can also be used to find the

individuals that are in the depressive side. In university, the use of negative expressions on campus wall posts can reduce the risk level of the community, and excite the system to provide psychological support to the users. The goal of this model is to enhance the efficiency of psychological problem identification and reduce the cost of the mental health community monitoring.

4.2 Intelligent psychological counseling system

The intelligent psychological counseling system is one of the most important directions that apply NLP techniques to mental health. The emotional support system that is built in this way can use empathy to respond to users and is able to provide students with emotional support at an early stage.

With the advances of pre trained language model, dialogue system and context understanding has been improve a lot, as well as modeling continuous dialogues. As for the psychology intervention targeted to college students, smart system could be used as an online companion, available 24 hours per day, and are able to identify high-risk statements, while referring students to professionals. Studies have shown that web-based mental health apps using NLP approaches could be marginally effective in reducing the user's negative affect, even if they are only short term [10,11].

4.3 Automatic summary and psychological profile analysis

In university psychological counseling, a large number of counseling records are stored in text form. The automatic summarization and information extraction techniques in NLP can simplify and organize long text records, allowing psychologists to easily identify students' main problems and emotional fluctuations.

These can help to detect recurrent stressors like academic workload, interpersonal conflict or job related stress. Combining time series analyses, can build up an individual history track of student's mental status, which is convenient for real-time monitoring and control. With these technological support, it will promote standardizing of mental health file and big data archiving work.

5 Current research hotspots and challenges

Recently, transformer-based language models such as BERT, are delivering impressive performances in many different fields: including sentiment analysis, and psychological state recognition. This happens because of using different general purpose corpora. Models thus learned the huge amount of language as well as context specific meaning of data. This remains useful, even if sensitive emotion expression and psychology data exist within convoluted semantics and long text. This is why they have been adopted into textual analyses and risks assessment on psychological health. Data gathering by assigned wall campus allows researchers to identify

particular psychological issues that exists within each institution.

Despite this learning in these areas, however, the discipline continues to face enormous challenges. One is that because of the sensitive nature of mental health data, private protection, and the moral dilemma of data are some of the major barriers to implementing the corresponding technologies. The second issue is obtaining labeled data with a high level of utility and quality. The cost associated may be high due to the present state of labelling inconsistencies that might encourage low quality for what should otherwise be utilised training data and on top of the immense volumes of compute required in order to run large scale models, which is another reason why it has not been implemented at many universities. Lastly, the black-box nature of DL models could be extremely detrimental in establishing psychologists' confidence in the model's mechanisms and its workflow if it is to be applied as part of psychological treatment.

6 Future development trends

In spite of present highlights and difficulties which should be treated in the NLP-based mental treatment for university understudies, the future multidirectional development of this area can predict, the first one being cross-lingual/cross-domain transfer learning, which will prove to be crucial. Thanks to a common psychological construct of a semantic representation model, researchers could perform transfer learning and fine tuning between different cultures or institutions so that people can reduce the dependency on large labelled dataset while achieving better generalisation for the model across several use case scenarios.

The second area is the enhancement of model transparency/interpretability, which is predicted to address one of the prominent gaps in research for mental health use. By the means of visualization of the attention mechanism as well as the analysis method of feature contributions, model outputs can be made less opaque to psychological educators, who can then better understand the system's decision-making rationale. This can increase safety of the human-machine collaborative intervention system and even improve the efficacy of the intervention as well [8].

Many more approaches need to be taken to tackle the ethics and fairness gaps, the major concern being algorithmic bias. To achieve the just provision of mental health services to diverse student demographics, psychological intervention systems must be able to avoid biased outcomes due to the gender, geo-cultural, and other backgrounds of the students at hand. This isn't just a difficult technological problem; it is a prominent ethical challenge on the way to integrating technology into mental health care.

Furthermore, NLP technology will further merge with big data, cloud computing, and IoT technologies, providing platform-based intelligent solutions for the management of mental health. The integration of multi-source data from the school enables continuous monitoring of the psychological state, and combined

with risk evaluation and targeted intervention feedback, this approach is expected to create a smart service platform for college students' mental health that integrates alert systems, intervention feedback, and evaluation components to provide enduring technical assistance for mental health education at colleges and universities.

7 Conclusion

The paper has explored how NLP has evolved over time in terms of technology, methodology as well as application towards mental health treatment at university level.

The constant progress and improvement in Deep Learning, specially the introduction of pretrained models have offered tremendous opportunities for NLP methods to be efficiently employed for emotion detection and psychological alert system. Nevertheless, there are yet several crucial questions which researchers leave for future work:

The lack of model transparency and limited computational capacity, along with data confidentiality and information sensitivity, pose major challenges in this field. Given the significant potential of NLP applications, addressing these issues will be crucial for future growth and broader adoption of such technologies within mental health care systems.

Incorporating ethical and privacy protected elements to provide targeted mental health support interventions have the potential to dramatically improve mental health education at colleges and universities.

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