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NEURAL NETWORK ALGORITHMS FOR INTELLIGENT PROCESSING OF STUDENTS' REVIEWS

Abstract

This article is devoted to the problem of using neural network algorithms for automated analysis of student reviews. In the modern conditions of multidisciplinary educational institutions and online learning platforms, student performance becomes an important indicator of the quality of the educational process and serves as a basis for further adjustments. Classical approaches, such as manual processing and descriptive statistics, are not always able to answer the question of how deeply students' opinions can be understood and analyzed. Neural network algorithms, in comparison with traditional text processing methods, include Recurrent Neural Networks (RNN), BERT and transformers, which have a larger volume of text information and can use more effective logical approaches to the study of hidden patterns. The article considers approaches to processing and analyzing reviews, stages of developing neural network algorithms and their possible impact on education. The potential of more advanced neural network methods is discussed, including a method of learning on a large amount of data, contextual understanding, as well as a smaller number of data units. The study of the neural network approach also indicates that it is important to pay attention to ethics and explanation. The article, in subsequent parts, came to the conclusion that the use of neural network algorithms helps to optimize the management of educational courses and increase the level of their demand among students and raises the question of further research on this topic.

Keywords: neural network algorithms, feedback processing, educational platforms, recurrent neural networks (RNN), BERT models, model interpretability.

Introduction

In modern educational areas, interaction with students has become an important tool along with others for diagnosing the quality of educational services and planning work to improve them. In recent years, there has been an increasing number of educational platforms and programs. In this regard, it is especially important to conduct systemic analyses of student opinions and feedback. Feedback will not only allow tracking the level of student satisfaction, but also for administrators and teachers who seek to improve them as a result of increasing the effectiveness of teaching.

General systemic thinking allows you to highlight both positive and negative aspects in the educational process, revealed through focus groups. Studying students' opinions about the course, teaching methods and a full set of educational materials can both adapt and improve the quality of educational services. In the context of increasing competition between educational institutions, the speed of response to output data and changes made begins where systems are accustomed to being built in.

However, the use of renewable resources for optimizing feedback analysis based on manual processing and elementary statistics most often does not achieve the set results in a comparative understanding among students. To help with this, neural network algorithms are capable of processing large volumes of text information with the ability to identify patterns in the data environment. This article will focus on the development of suitable algorithms for automating the process of analyzing reviews, thus being at a point where the level of the educational process can rise.

The purpose of this article is to consider in detail the creation of synergetic algorithms capable of processing student reviews of an educational course. We want to highlight the ways in which modern technologies can be integrated into the educational system to improve its functioning and quality.

Objectives of the article:

- Review of review analysis methods. Study of classical opinion analysis techniques and identification of their shortcomings.
- Description of algorithms based on neural networks. Providing some details on how neural networks work and their role in text processing.
- Algorithm design processes. Refinement of the design processes, including data collection, text preprocessing, model training and model testing.
- Possible implications for the educational system. Assessing the impact of neural network algorithms on feedback analysis, program quality and student satisfaction.
- Prospects for further research. Research into promising areas in the study and development of feedback analysis based on neural network technologies.

In recent years, text data analysis, particularly review data, has become an important area of research. There are several categories of methods and approaches to text processing and review analysis, including:

1) Traditional text mining methods.

- Rule-based methods. They require significant effort and may be ineffective [2];
- Statistical methods. They are applicable when analyzing quantitative data, but may be difficult given the specific context of the text being processed [3].

2) Machine learning methods. These methods are more advanced and include the following options:

- Vector classification, which uses vector representations of words. This method takes into account word frequency and context [4];
- Random forest or decision tree. Classify text based on various features [5].

3) Neural network approaches. Relatively recent and widely used approaches:

- Recurrent neural networks (RNN). Applicable to sequential data [6];
- Transformers. Applicable to natural language processing and deep text understanding [7].

Institutional review analysis is an important area of research because it can provide important information about the value of learning and student satisfaction. Many studies have been conducted in recent years

1. Review analysis methods. Some studies also focus on review analysis methods. For example, Mahesh Batta's study used machine learning algorithms to classify student reviews of courses and lecturers to identify factors that affect student satisfaction [8].
2. Thematic analysis. In other studies, thematic analysis has been applied to identify the main themes of reviews. Researchers conducted an analysis of reviews of higher education institutions [9]. The main categories of reviews were found to be about teaching, infrastructure, and student support.
3. Impact on reputation. Some studies also discuss the impact of reviews on the reputation of institutions. For example, a study by Magdalena Garvanova showed that positive reviews significantly improve the reputation of higher education institutions, while negative reviews can significantly worsen their image [10].

Materials and methods

The methodology includes the following steps:

1. Data collection. The first and most important step in developing feedback analysis algorithms is collecting the necessary data. To do this, specialists can use various methods, such as:

- student surveys. Developing questionnaires and conducting questionnaires among students to obtain their own opinions on the quality of education. Surveys can be anonymous or identified depending on the objectives of the study;
- collecting feedback from educational platforms. The method allows collecting student feedback from university websites, educational forums and social networks, where they share their opinions on courses and teachers.

2. Data processing. Just like in the first case, the collected feedback must be processed. To do this, pre-processing includes the following steps:

- cleaning. Removing HTML tags, special characters, extra spaces, etc. Only the text is left;
- normalization. Converting the text into a single format, converting all characters to lowercase and correcting typos;
- tokenization. Dividing the text into words, which facilitates the analysis of the review content.

3. Selecting metrics for assessing the quality of reviews. For further assessment of the quality of the collected reviews, the following key metrics are selected:

- mood. In this context, we are talking about the emotional coloring of reviews: positive, negative and neutral. The mood is determined using sentiment analysis methods;
- key topics and categories. The main topics of the subcategories mentioned in the review are determined using topic modeling and other text analysis methods.

These steps provide a solid foundation for the development of review analysis algorithms and their application in education.

Results and discussions

Neural networks have become a popular tool for text analysis and natural language processing, including learning feedback. There are several key reasons why neural networks work best for this task [11].

1. They can handle large amounts of data. Deep neural networks can effectively analyze information from large amounts of text. This allows them to find seemingly invisible patterns and dependencies that may not be obvious using traditional methods.

2. They can use context. The current generation of neural networks, which take into account the context of example words like BERT and GPT, are able to understand the context of words in the same sentence. This allows them to find the tone and meaning of the text much better.

3. They are adaptive. Many models can be used for both text classification and text generation. This allows scientists to customize the models for the needs of the review study.

4. They perform better. Numerous studies have shown that neural network algorithms are better than Naive Bayes or SVM at processing text. When creating a neural network algorithm for learning feedback analysis, it is necessary to consider some of the existing ones on modern architectures. Table 1 below summarizes the key features of these researched architectures.

Each architecture supports unique capabilities and advantages, making them effective in learning feedback analysis. To evaluate the effectiveness of the architectures in the field of learning feedback analysis, a comparative analysis of their performance on several critical tasks was performed on the solutions. These tasks included sentiment classification, information extraction, and topic modeling.

Table 1 – Main characteristics and features of architectures [12–14]

Architecture	Description	Characteristic	Application
LSTM (Long Short-Term Memory)	A type of recurrent neural network, helps to solve the vanishing gradient problem.	- Long-term memory; - Ability to store and forget information to better adapt to context; - Includes input, output, and forget gates aimed at efficient information management.	- Sentiment analysis. - Text generation. - Processing of serial data.
BERT (Bidirectional Encoder Representations from Transformers)	The Transformer model was developed to understand the context of words in the same sentence.	- Ability to process text in both directions; - Pre-training on large amounts of data and re-training on specific tasks; - Ability to consider each word in the context of a sentence.	- Sentiment analysis. - Information extraction. - Text classification. - Answering questions.
Transformer	The paper “Attention is All You Need” shows the developed architecture, which has become the basis for many modern NLP models.	- Focus on different parts of the text; - Text processing occurs in parallel; - Adapted for text classification and generation.	- Text classification. - Text generation. - Translation. - Processing large amounts of data.

Table 2 – Results of the comparative analysis

Neural network architecture	Advantages	Disadvantages	Results
Tonality classification			
LSTM	Works well with sequential data and can take into account the context of words in a sentence. Effective in tasks where it is important to match the order of words.	May have long-term dependency issues and require significant computational power to train on large datasets.	On average, it achieves around 80-85% accuracy on common datasets like IMDb.
BERT	Uses bidirectional attention for better understanding of context. Training is carried out on a large amount of data, so the trained model generalizes information better.	Requires more computational power and time to train than LSTM.	Achieves over 90% accuracy on the same datasets, ranking among the best sentiment classification solutions.
Transformer	The ability to process data in parallel during training, due to which training is fast.	Can be difficult to tune and resource-intensive.	Accuracy metrics are similar to BERT, reaching 90% or higher, especially on tasks that require contextual understanding.
Extracting information			
LSTM	When extracting information from text, it is able to identify sequential dependencies.	Lacks ability to handle large amounts of data.	Competitively efficient, but often lags behind modern architectures.

Continuation of Table 2

BERT	Using contextual representation of words when searching for information.	High resource requirements.	Excels exceptionally well on information extraction tasks, often outperforming LSTM and traditional approaches.
Transformer	High speed and the ability to process data in parallel.	Difficult to tune.	Extraction speed is comparable to BERT, but can be implementation-dependent.
Topic modeling			
LSTM	Used to identify topics when working with sequential data.	Inefficient for large amounts of text.	Fair, but may still have low accuracy.
BERT	Using the context of a word allows you to identify a complex topic.	High computational cost.	Generally performs better in topic modeling than LSTM
Transformer	Efficient when working with large amounts of data.	Difficult to tune and train.	Comparable performance to BERT in tasks that require fine-grained text understanding.

In most cases, BERT and Transformer show significantly better results than LSTM in review analysis, especially in sentiment recognition and information extraction. At the same time, the choice of architecture is still a matter of means and ends, in relation to a specific task, available resources and data volumes. Neural networks have gained popularity and application in tasks such as review analysis, natural language processing and others. Here are some examples where the achievements of neural networks are much more effective in the real world:

1. Product Review Analysis

Agbonifo O., Olutayo V. and Oluyede O. conducted a study where they used machine learning algorithms such as LSTM and BERT to analyze product comments on marketplaces [15]. The results showed that BERT-based models significantly improved the accuracy of sentiment classification in reviews, which in turn helps companies better adapt their strategies and track customer opinions.

2. Course Feedback Analysis

In the study the BERT model was used to analyze courses from a university that students study [16]. The model identified the main reasons that affect the level of student satisfaction, which enabled administrators to improve the educational services provided.

3. Social Media Review Processing

The study analyzed how the BERT model is applicable to analyzing company comments on social networks [17]. The model showed good results in the distribution of emotions in reviews, which allows companies to quickly respond to negative comments and thereby improve their reputation.

4. Movie Review Analysis

In the analysis of movie reviews, a study used a recurrent neural network (RNN) [18]. The model was able to create a highly accurate sentiment detection for reviews, which allowed the development of a recommendation system.

Despite the advances in language processing and sentiment analysis, there are still issues associated with artificial neural network approaches that systematically affect their performance and interpretability [19]. Most of the main issues and limitations of these algorithms are shown in Figure 1 for the use of neural networks in review analysis.

Figure 1 – Problems and limitations

While exploring the main challenges and limitations of neural network-based approaches in review data analysis, one should also consider the ethical issues that may arise when working with the data. These issues include privacy concerns, model bias, and impact on users. The main ethical issues that need to be considered when designing and implementing neural network algorithms in the educational process are summarized in Figure 2 [20].

There are many promising avenues for advancing research in the field of neural network-based review analysis. One such gap involves developing more efficient models that can work with smaller amounts of data while maintaining the quality of the analysis. This may involve the use of active learning methods, where the model is trained on a small initial dataset and then actively queries additional data to improve its performance.

Another significant gap is related to improving the explainability of neural network models. Research can be aimed at developing explanations that allow us to understand the reasons behind the models' decisions, which is especially important in review analysis, as the results can affect the reputation of educational institutions.

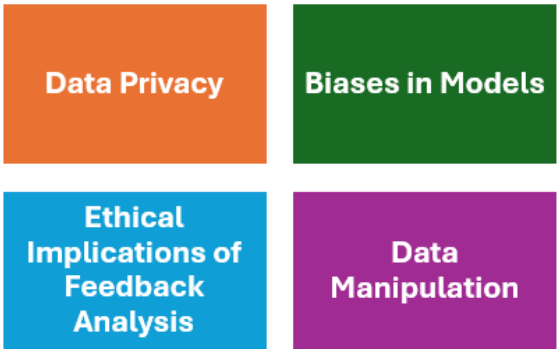

Figure 2 – Ethical aspects

There is also a need to combine neural network-based methods with other analytical techniques, such as sentiment analysis and topic modeling, to create advanced review analysis systems. This can improve the detection of not only sentiment, but also the main topics and issues discussed in reviews.

For educational institutions that plan to implement neural network algorithms in review analysis, the authors offer several practical recommendations:

- Identifying the best models. It is not recommended to use complex models like BERT right away. You can use simpler but already mastered LSTM at first. It is necessary to remember the specifics of the data and the task in order to choose the most appropriate architecture.
- Data collection and preprocessing. The best review analysis starts with a prepared and high-quality collected data set. Educational institutions should develop a data collection policy, including anonymous surveys, as well as data from social networks.
- Training and testing models. One of the most expensive resources are the most powerful and highly loaded computing resources. To train the model and test it, it is necessary to allocate them in portions, and also conduct experimental selections by performance on real data.
- Interpretation and ethics. It is necessary to consider the ways of interpretability of the model and take into account ethical aspects when collecting data. The educational institution must justify the results of the analysis and ensure the privacy of students.
- Improvement. It is necessary to regularly update the models and analysis methods based on updated data to ensure their relevance and effectiveness.

Thus, neural network algorithms are powerful tools for feedback analysis. Educational institutions with their help get the opportunity to know the opinions of students and significantly more effectively adapt their programs. Despite existing problems and limitations, such as the need for large amounts of data and computing resources, as well as ethical issues related to bias and privacy, the potential for using these technologies to improve the quality of education is significant. For pedagogical research, the practical recommended research methodologies will help in further development of neural network approaches, which in turn will facilitate feedback analysis and educational processes.

Conclusions

This article shows the importance of analyzing student feedback on the educational process and the role of neural network algorithms in this process.

Student feedback provides important data necessary for educational institutions to evaluate the quality of the services they provide. In order to further improve them. Understanding student sentiment, educational institutions can adapt educational programs and will be able to improve their effectiveness in a timely manner.

Some neural networks: LSTM, BERT transformers have a significant advantage over traditional methods of working with texts, analysis and feedback, they take into account the context, associated factors and complex interactions between parameters.

Performing such tasks as data collection, text cleaning, data preparation, model creation, debugging minor problems and subsequent testing forms the entire process of algorithm development. Achieving neural network methods requires attention at each stage to achieve the required highest quality of feedback.

Implementation of neural network algorithms in feedback analysis can improve the quality of educational programs and increase student satisfaction. This, in turn, increases the competitive advantages of educational institutions. There are many areas for exploration, such as developing more efficient models, increasing the interpretability of neural network approaches, and combining different data analysis methods. These studies can lead to more sophisticated feedback systems that offer deeper insights into students' perceptions and their impact on educational processes. Thus, a neural network-based feedback analysis system can fundamentally improve educational services and satisfaction levels among students. It is imperative to continue developing and refining these technologies to fully realize their potential in education.

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СТУДЕНТТЕРДІҢ ПІКІРЛЕРІН ЗИЯТКЕРЛІК ӨҢДЕУГЕ АРНАЛҒАН НЕЙРОЖЕЛІ АЛГОРИТМДЕРІ

Аңдатпа

Бұл мақала студенттердің пікірлерін автоматтандырылған түрде талдау үшін нейрондық желі алгоритмдерін қолдану мәселесіне арналған. Көпсалалы білім беру мекемелері мен онлайн оқыту платформаларының қазіргі жағдайында студенттердің үлгерімі білім беру үдерісінің сапасының маңызды көрсеткішіне айналып, оны әрі қарай жетілдіру үшін негіз бола алады. Қолмен өңдеу және сипаттамалық статистика сияқты дәстүрлі тәсілдер студенттердің пікірлерін қаншалықты терең түсініп, тиімді талдауға болатынына әрдайым толық жауап бере алмайды. Нейрондық желі алгоритмдері мәтінді өңдеудің дәстүрлі әдістерімен салыстырғанда қайталанатын нейрондық желілерді (RNN), BERT модельдерін және мәтіндік ақпараттың үлкен көлемін өңдеп, жасырын заңдылықтарды үйренуде тиімді трансформаторлық тәсілдерді қолдана алады. Мақалада шолуларды өңдеу және талдау әдістері, нейрондық желі алгоритмдерін әзірлеу кезеңдері және олардың білім беру үдерісіне ықтимал әсері қарастырылады. Жетілдірілген нейрондық желі әдістерінің әлеуеті, соның ішінде үлкен деректерді үйрету, контексті түсіну және шағын деректер бірліктерімен жұмыс істеу мәселелері талқыланады. Нейрондық желі әдістерін зерттеу кезінде этикалық мәселелер мен нәтижелерді түсіндірудің маңыздылығы да атап өтіледі. Мақаланың келесі бөлімдерінде нейрондық желі алгоритмдерін пайдалану білім беру курстарын басқаруды оңтайландыруға, сондай-ақ студенттер арасында бұл курстардың сұранысын арттыруға ықпал ететіні жөнінде қорытынды жасалады. Сонымен қатар, осы тақырыпты одан әрі зерттеу қажеттілігі туралы мәселе көтеріледі.

Тірек сөздер: нейрондық желі алгоритмдері, кері байланысты өңдеу, білім беру платформалары, қайталанатын нейрондық желілер (RNN), BERT модельдері, модельді интерпретациялау.

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НЕЙРОСЕТЕВЫЕ АЛГОРИТМЫ ДЛЯ ИНТЕЛЛЕКТУАЛЬНОЙ ОБРАБОТКИ ОТЗЫВОВ СТУДЕНТОВ

Аннотация

Данная статья посвящена проблеме использования нейросетевых алгоритмов для автоматизированного анализа отзывов студентов. В современных условиях многопрофильных учебных заведений и платформ онлайн-обучения успеваемость студентов становится важным показателем качества образовательного процесса и служит основой для дальнейших корректировок. Классические подходы, такие как ручная обработка и описательная статистика, не всегда способны ответить на вопрос, насколько глубоко можно понять и проанализировать мнения студентов. К нейросетевым алгоритмам, в сравнении с традиционными методами обработки текста, относятся рекуррентные нейронные сети (RNN), BERT и трансформаторы, которые имеют больший объем текстовой информации и могут использовать более эффективные логические подходы к изучению скрытых закономерностей. В статье рассматриваются подходы к обработке и анализу отзывов, этапы разработки нейросетевых алгоритмов и их возможное влияние на образование. Обсуждается потенциал более продвинутых нейросетевых методов, включая метод обучения на большом объеме данных, контекстное понимание, а также меньшее количество единиц данных. Исследование нейросетевого подхода также свидетельствует о том, что важно уделять внимание этике и объяснению. В статье в последующих частях сделан вывод о том, что использование нейросетевых алгоритмов способствует оптимизации управления образовательными курсами и повышению уровня их востребованности среди студентов, а также ставится вопрос о дальнейших исследованиях данной темы.

Ключевые слова: нейросетевые алгоритмы, обработка отзывов, образовательные платформы, рекуррентные нейронные сети (RNN), модели BERT, интерпретируемость моделей.

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