Analysis of Educational Big Data Mining Based on Deep Learning Technology

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ABSTRACT

Behavioral data comes from a large database that collects data on students' use of their campus smart cards. The main work of this paper includes: (1) firstly, this paper summarizes the research status of student behavior analysis and educational data mining technology at home and abroad, and further briefly introduces the basic algorithms and common classification algorithms of information education. By exploring the problems and importance of current student achievement prediction model modeling, this paper analyzes the related research and application of deep learning and sequence modeling. The subjectivity and difference of students' behavior characteristics are described by statistical analysis method, which can not only understand the structure of data, but also better extract features and find out the potential practical value in behavior data. (2) Specifically, this paper uses the characteristics of campus behavior data to describe students' learning behavior, life behavior and consumption behavior, and strive to establish a more comprehensive understanding of students' traditional behavior mode, in order to improve the effect of performance prediction. In the use of the algorithm, it is not limited to a single algorithm, but selects a variety of algorithms to model students' behavior on the basis of fully considering the data language characteristics, tests the advantages of different algorithms, and looks for the best multi classification prediction model..

Keywords: Deep learning; Big data of education; Teaching assistance; data mining

1   INTRODUCTION

With the progress of society and the development of science and technology, people's life is becoming more and more networked and digital. Information management system has replaced the traditional text recording method, followed by the linear n growth of the data recording the trajectory of human daily behavior. In education, especially in schools, students' behavior data has increasingly become the most significant indicator of teaching improvement. Educational data mining (EDM), as a technology for mining potential information from massive user learning behavior data, has been widely used in scientific research, business finance and other fields. In 2012, the blue book "promoting teaching and learning through educational data mining and learning analysis" released by the U.S. Department of education marked that EDM has attracted extensive attention. In 2018, NSFC applied for a new project of educational information science, with a separate secondary code[1]. With the continuous deepening of information construction in Colleges and universities, colleges and universities have a higher demand for using the student behavior data gathered and accumulated

by information. At the same time, education information itself has become a necessary measure and means of education management in Colleges and universities. The application of China's University Park cartoon system has penetrated into the all-round aspects of students' learning dynamics and life trajectory, These digital information are completely recorded in the form of text, which has a certain practical significance for education managers to analyze the traces of students' activities. The most important of big data analysis in the field of education is to improve students' academic performance and promote their all-round development. Each student is an independent individual with different behavior characteristics and motivation. For example, students who want to get a high grade point average (GPA) may have a very regular life, so they need to work hard to overcome the courses they take. By exploring students' behavior data, we can study whether they intend to invest more in learning. Students' behavior is intuitive, we can judge the results more directly and quickly, and don't take action when students' learning and life problems are not found in the semester. On this basis, this paper studies the prediction methods of students' performance from students' campus behavior[2]. These methods can pay more attention to and identify students

with poor academic performance. At the same time, educators can get early feedback and take timely intervention measures in order to improve students' performance.

2   RELATED WORK

In recent years, deep learning technology has been widely used in practical problems, and its value has been recognized by researchers in different fields. However, there are differences in the definition of deep learning between the field of artificial intelligence and the field of education. Firstly, this paper discusses the relationship between the concept of deep learning in the field of artificial intelligence and education, and briefly analyzes the typical deep learning model in the field of artificial intelligence in data mining.

2.1   Concept of deep learning

"Depth" is mainly aimed at the previous shallow neural network learning. In the past, due to the lack of computing power, the training of multi-layer neural network was not feasible in calculation and easy to converge to the local optimal solution, so the neural network was limited to several layers. The number of layers and neurons per layer is increasing, so the learning process is called "depth"
The word "learning" is to let the computer know what characteristics these samples have. Traditional feature extraction methods can not avoid manual intervention. Even if some optimization methods seem reasonable, the actual effect is not very ideal. Experience shows that effective models are often unexplained at present. The model can explain that the effect is often not very good[3]. Deep learning is to extract data features from original data by using neural network. These incomprehensible features often make the classification effect better.
With the booming global data, Internet plus education is being developed. ˆ With the vigorous promotion of, massive education big data came into being with the emergence of many education management systems. As one of the most popular application technologies, data mining has gone deep into the development of finance, e-commerce, medical and other industries. However, the application time of data mining and machine learning technology in the field of education is relatively short, and the relevant algorithms are still being explored. Most studies focus on simple statistical analysis rather than improvement. Performance prediction is one of the important research contents of education big data. It is to predict students' future learning performance through

existing data, such as performance, ranking, etc. The main goal of higher education institutions is to provide students with high-quality education and improve the quality of management decision-making. Finding useful knowledge from educational behavior data and studying the main attributes that may affect students' performance can provide support for the monitoring of students' behavior and academic performance and improve the teaching effect[4]. Next, the research status of educational data mining and student behavior analysis is introduced in detail.

2.2   Three classic models of deep learning

(1) Self encoder model
For a group of samples, the self encoder model does not need to know the sample label (the category of each sample), and directly extract the characteristics of each sample.
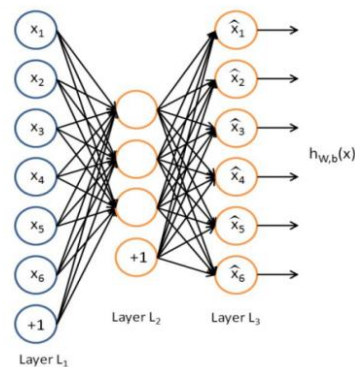

Fig. 1. Self encoder model diagram

As shown in Figure 1, the first layer is the input, which is weighted and biased in the way of full connection and enters the second layer (hidden layer). After sigmoid function operation, the result is input to the third layer. After weighted and biased and sigmoid function operation, the network output is obtained. The ultimate goal is to make the output and input as equal as possible. In this way, the value of the middle hidden layer can be taken as the feature of the original value.
(2) Restricted Boltzmann machine (RBM)
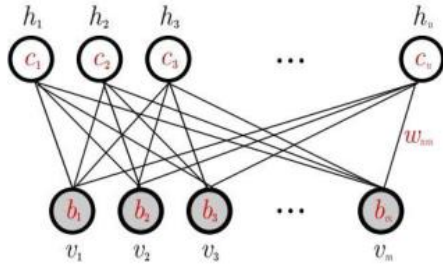The RBM model is shown in Figure 2

Fig. 2. RBM model

Each node in the graph represents a random variable. The lower layer is visible node, that is, the input sample, whose random vector is represented by V, and the upper layer is hidden node, whose random vector is represented by H. These are all 0-1 variables. Its purpose is to calculate the weight by estimating the sample distribution. According to its connection mode, it can be proved that it is a Markov random fields, so its joint distribution has the following form:

$$P(V, H) = \frac{1}{Z} e^{-E(V,H)} \tag{1}$$

where $Z = \sum_{V,H} e^{-E(V,H)}$, $E(V, H)$ is the energy function.

(3) CNN convolutional neural network

CNN model is mainly composed of two steps: convolution and pooling, and its processing object is mainly image. The most classic CNN model is shown in Figure 3.
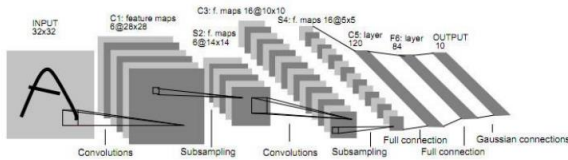

Fig. 3. RBM model

CNN's main feature is to put training and classification together. The training algorithm is similar to the traditional BP algorithm.

3 DATA ANALYSIS

3.1 Characteristics of big data mining in Education

Research status of educational data mining in the field of education, with the increasing popularity of digital and scientific e-learning systems with different terminal devices, it is natural that the behavior data recorded in

the database system has the characteristics of diversity and magnanimity, which makes the application value of educational big data increasingly prominent. Educational data mining is committed to exploring unique educational technology methods from the educational environment, and using these methods to better understand students and their learning environment. A non-governmental research institution concluded in a report: "Big data will bring significant changes to the field of education, because the introduction of big data makes it possible to dynamically obtain students' daily performance and learning status information, instead of passing some tests at a fixed time as before; Through big data analysis, educators can grasp the dynamics of students in real time and guide students in time. In recent years, driven by the applications of educational informatization, distance education, intelligent education and flipped classroom, the field of educational data mining has attracted extensive researchers' interest and attention[5]. The main disciplines involved in educational data mining technology include the interactive technology of several disciplines, such as technical pedagogy, statistics, computer science, psychometrics and information visualization, to deal with the actual needs in teaching practice and conduct in-depth thinking and research.

$$\|\Delta x_{k+1}(t)\| \leq k_f \int_0^t \|\Delta x_{k+1}(t)\| \, d\tau +$$

$$m_1 \int_0^t \|\Delta u_k(\tau)\| \, d\tau + m_2 \|x_d(t)\| + m_3 \|x_{k-1}(t)\| =$$

$$\int_0^t (k_f \|\Delta x_{k+1}(t)\| + m_1 \|\Delta u_k(\tau)\|) d\tau + m_2 \|x_d(t)\| +$$

$$m_3 \|x_{k-1}(t)\| \leq m_1 \int_0^t e^{k_f(t-\tau)} \|\Delta u_k(\tau)\| d\tau +$$

$$m_2 \|x_d(t)\| + m_3 \|x_{k-1}(t)\| \tag{2}$$

Sequence modeling based on deep learning aims to learn from sequence items (for example, words or deep recursive features have been widely studied in many hot fields such as natural language processing and recommendation systems. For example, ⊔ et al. Proposed a hybrid cyclic neural network model, which uses the attention mechanism to capture the continuous preference of users and the main purpose of the current session to complete the session based recommendation task. Lu et al. 57 proposed an attention based recommendation task In previous studies, Chung et al. Used a sequence to sequence learning framework to learn the audio segment representation of variable length acoustic feature sequences, and proved that this model can obtain better retrieval performance than other related work. Zhu et al A new LSTM variant is proposed to model the continuous behavior of users, in which the time interval between user behaviors is of great significance to capture the relationship between user behaviors[6]. Another

study introduces a neural network structure, which processes input sequences and target questions, forms situational memory, and generates relevant answers.prediction, text mining and the deep learning neural network discussed in this paper.

$$\begin{cases} E(t)\dot{x}_k(t) = f\big(t, x_k(t)\big) + B(t)u_k(t) \\ \qquad\qquad y_k(t) = C(t)x_k(t) \end{cases}$$

(3)

Sequence based performance classifier (SPC) predicts students' current performance by classifying students' recent sequence behaviors (such as going in and out of the library and fetching water to the canteen). The method of mining students' potential behavior characteristics and predicting their academic performance proposed in this paper is based on deep learning and data mining algorithms. Specifically. Decoding (expressed as TC) is implemented when fed together to the sequence feature generator (i.e. the output of the hidden state). Note that students' main purpose or behavioral intention may be hidden behind their series. For example, reading in the library, but she also buys some food or shower. Her main purpose is hidden behind her behavior. In order to learn from students' current.

3.2 Educational big data mining process based on deep learning technology

One of the characteristics of educational big data is complexity and diversity, that is, it can be obtained from the activities of different objects in various educational environments. In order to better extract effective and valuable information from the characterization data, the workflow of educational big data mining based on deep learning technology is divided into three levels: Educational big data acquisition and preprocessing, the processing of educational big data by deep learning model and the application of educational big data mining.

In the acquisition and preprocessing of education big data, according to the characteristics of data, the difficulty of acquisition and preprocessing is also gradually increasing. The data expressed as quantitative results (such as student achievement data) is usually stored in a two-dimensional table and can be called directly; The collection methods of complex unstructured data (such as student behavior data) are more diversified, etc. According to the different application purposes of different service objects in educational big data mining, the original data needs to be preprocessed. For the purpose of data generation and classification, it is necessary to use labeled educational data for supervised learning, that is, by dividing educational data into training set and verification set, the model is adjusted and optimized to improve the accuracy. For the purpose of clustering and

anomaly detection, unsupervised learning can be used to identify the model law, and semi supervised learning can also be used in most cases to reduce the cost and improve the accuracy[7]. After preprocessing the education big data, it is necessary to convert the variables of the education big data set as the input of the deep learning model, that is, image data, text data and voice data into input vectors. Image data is mainly processed by some software and tools, such as using imread function to convert the image into matrix vector, so as to form a feature map as the input of deep learning model. Text data can be vectorized by TF word frequency method, TF-IDF word frequency inverse document frequency one hot and word2vec. Generally, the characteristic graph of one-dimensional vector is used as input. The deep learning processing process shown in Figure 3 is a general deep neural network model. In the specific use process, the deep learning model should be selected according to the purpose and service object of educational big data mining.

4 EXAMPLE ANALYSIS

4.1 The purpose of educational big data mining based on deep learning technology

With the development of computer hardware technology, the application of data mining technology in education is a new interdisciplinary research field. The basic of educational data mining is to show students' academic performance and evaluate learners. Therefore, how to screen I and extract students' information features from massive educational behavior data, and analyze the mode and relationship between behavior features and academic performance has become one of the popular and urgent problems to be solved. This paper presents a data mining system, which can predict the possibility of students' learning success according to their behavior on campus. Behavioral data comes from a huge database that collects data on students' use of their campus smart cards[8]. The main work of this paper includes (1) firstly, this paper summarizes the research status of student behavior analysis and educational data mining technology at home and abroad, and briefly introduces the basic algorithms and common classification algorithms in the field of information education. By exploring the problems and importance of current student achievement prediction model modeling, this paper analyzes the related research and application of deep learning and sequence modeling. Using statistical analysis method to describe the subjectivity and difference of students' behavior characteristics, we can not only understand the structure of data, but also more accurately extract fea-

tures to find out the potential practical value in behavior data. 2) Specifically, this paper uses the characteristics of campus behavior data to describe students' learning behavior, life behavior and consumption behavior, and strive to establish a more comprehensive understanding of students' traditional behavior mode, in order to improve the effect of performance prediction. The use of algorithms is not limited to a single algorithm, but to select a variety of algorithms to model students' behavior on the basis of full consideration of data language characteristics, test the advantages of different algorithms, and find the best classification prediction model (3) in this work, the problems of students' behavior and academic performance are studied, Taking the student's achievement prediction task as a short-term sequence modeling problem, a two-stage classifier SPC is proposed. Specifically, the sequence based performance classifier consists of a hybrid cyclic neural network based on attention mechanism and a classical support vector machine classification method. Among them, the basic sequence encoder can effectively integrate the input sequence behavior information, while the attention-based sequence encoder can adaptively capture the main intention of students. In order to extend the method in this paper to real-time scenes, the campus card data is analyzed and applied to complete this work. Compared with the benchmark algorithm, it is proved that the depth information of student behavior is more representative than the traditional behavior features, and the effectiveness of the classifier is also provedsupport for correctly leading the development direction of Education [9].
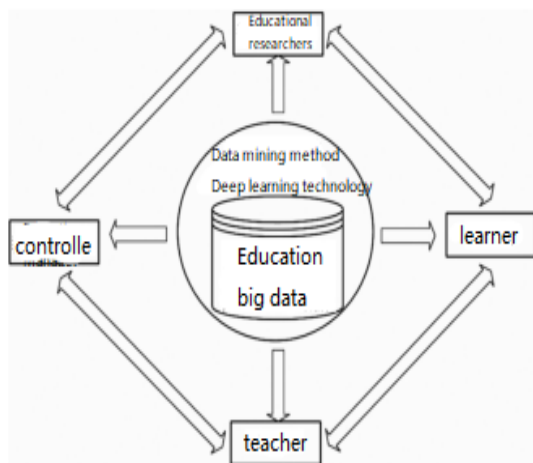

Fig. 4. Relationship between service objects of education big data mining

4.2 Analysis and application of educational big data mining based on deep learning technology

The amount of mouse clicks recorded in the learning process can also be used to study the trajectory of students' activities Find out how different students react to different knowledge points? How long did it take? What knowledge points need to be repeated or emphasized, and which presentation or learning tool is the most effective. Big data can also help teachers make a comprehensive and correct evaluation of students. In the past, the evaluation of students often relied on feeling, intuition and examination. But there are blind spots in people's feelings, intuition is not complete, and examinations are limited. Big data can objectively display the complete image of a student by virtue of daily bit by bit information collection and strict and detailed logical reasoning; Separate databases in the cloud are used for multi-dimensional online analysis. In this way, it will present us a grand educational scene. Each student can be examined and seen in the educational scene. Using the data analysis results of EDM and a, teachers can better understand students, understand and observe students' learning process, and find the most appropriate teaching method and teaching order; It can also adopt different teaching methods and strategies for students with different characteristics, and can find problems in time. Carry out effective intervention and make comprehensive and correct evaluation, so as to significantly improve the quality and quality of teaching.

Xiao et al. Analyzed the experience texts published by college students on microblog through in-depth belief network to understand students' physical and mental development and interests; Liao Peng and others extract the target features in students' classroom video through convolution neural network model, accurately identify students' abnormal classroom behavior, and enable teachers to find students' problems in time: Zeng Zhi digs the relationship between Big Five personality traits and face traits through deep confidence network, effectively judges students' traits, and then helps teachers tap students' potential]10].

5 CONCLUSION

The connotation of learning analysis technology a is to use the existing model to understand and understand the new learning behavior and process. Siemens defines LA as the measurement, collection, analysis, summary and presentation of data about learners and their learning environment. The purpose of La is to understand and optimize learning and learning situations. According to Siemens, the main application of La is to monitor and

predict students' academic performance, find potential problems in time, and intervene accordingly to prevent students from generating wind in the study of a subject. F should pay attention to and answer questions about A. according to the description of the report of the U.S. Department of Education on "big data education application", it should involve the following five aspects: (1) When can students move on to the next topic? ② 2) when are students likely to fall behind in a course? (3) When may a student be at risk of not completing a course? (4) If there were no intervention and remedial measures, what grades would students be likely to get? (5) What is the best course for a particular student? Do you need special help? How can EDM and La help improve teaching? As some scholars have pointed out, in the context of big data, EDM, La and other technologies can help teachers effectively improve teaching. For example, teachers can check the time they stay on a picture, judge whether they review after answering a wrong question, count the number of online questions and discussions, and then carry out their learning behavior on this basis.

REFERENCES

[1] Liao Peng, Liu Chenming, Su Hang, et al. An abnormal behavior detection and analysis system for students based on deep learning [J]. Electronic world, 2018 (8): 97-98.

[2] Han Jiawei, kamber Micheline. Data mining: concepts and technologies. China Machine Press. 20122

[3] Mao Guojun, Duan Lijuan. Data mining principles and algorithms. Tsinghua University Press, 20073

[4] Weiss, Feng Shunxi. Data structure and algorithm. China Machine Press. 2009

[5] Zhou Yan. Research on Lie Detection Based on speech sparse representation [D]. Suzhou: Suzhou University, 2017

[6] Wang Bingqian. Research on speech quality evaluation method based on deep learning [D]. Dalian: Dalian University of technology, 2015

[7] Li Xiang. Research on speech recognition based on deep learning in noisy environment [D]. Wuhan: Wuhan University of engineering, 2017

[8] Wu Jiawei. Research on entity relationship extraction of electronic medical records [D]. Harbin: Harbin Institute of technology, 2014

[9] Liang Jun, Chai Yumei, Yuan Huibin, et al. Emotion analysis of microblog based on deep learning [J]. Chinese Journal of information technology, 2014,28 (5): 155-161

[10] Cao Yuhui. Research on text emotion analysis based on deep learning [D]. Harbin: Harbin Institute of technology, 2016