ISSN: 1813-4890

Deep learning algorithm based on artificial neural network of applications in education

Rui Kang

School of Information Technology Engineering, Tianjin University of Technology and Education, Tianjin 300222, China.

1223353279@qq.com

Abstract

Mining students' learning behavior characteristics based on big data technology can provide an important basis for improving the learning process and optimizing learning evaluation. However, existing research has problems such as single analysis data type, low real-time performance, low accuracy of results, and lack of interpretability. The deep learning algorithm based on artificial upgrading network provides a new paradigm for using multi-modal big data to mine learner behavioral characteristics in the field of educational technology. This article briefly describes artificial neural networks and deep learning, and analyzes existing literature to identify hot research areas to help understand related applications. It then introduces the four main ways of applying deep learning in education, and discusses each of them. Briefly describe the relevant literature on the method and state the existing research results. Finally, the prospects for the application of deep learning in education are prospected.

Keywords

Artificial neural network, deep learning.

1. Introduction

1.1. Artificial neural networks

artificial neural network (ANN for short) is a complex network computing system composed of a large number of simple, highly interconnected processing elements (neurons). It is a physical structure simulation of the human brain, that is, using computer simulation methods to simulate the physical structure of the human brain so that the system has certain intelligence of the human brain. ANN is essentially a computational model consisting of a large number of neuron nodes connected to each other. Each node can be regarded as a neuron. The node contains an activation function and its output is determined based on its input. Nodes in adjacent layers are connected in pairs, and their relationship is called weight, which is equivalent to the memory process of the human brain. The output of the network is the operation result, which may be a regression result or a classification result (probability value). Generally speaking, artificial neural networks are usually an approximation of a certain algorithm or function, or an expression of a certain logical strategy [1].

1.2. deep learning

Deep learning is an algorithm for learning data representation. It can learn the hidden characteristics of data from irregular and abstract observation values, that is, input values [1]. Deep learning is a new field in machine learning research. Its motivation is to establish and simulate the neural network of the human brain for analysis and learning. It imitates the mechanism of the human brain to interpret data. Its basic model framework is based on ANN, such as a perceptron with multiple hidden layers. It can obtain more abstract hidden features

ISSN: 1813-4890

by learning the underlying features of the data, thereby understanding the distribution patterns of the data, and then predicting or classifying the data. The advantage of deep learning is that it uses efficient feature extraction algorithms to replace the original manual method of obtaining features.

2. Status quo at home and abroad

2.1. Current status of artificial neural networks

ANN application research: 1. Simulation of ANN-based software models, architecture of ANN-based hardware systems, etc.; 2. At present, the main application research fields of ANN include: knowledge engineering, pattern recognition, optimization combination, robot control, signal processing, expert systems, etc.

In practical applications, the selection of artificial neural networks usually includes appropriate neural network models, reasonable network structures and fast and effective network parameter training algorithms. For a specific network model, the research of A NN mainly focuses on the process of structural adjustment of weights and thresholds between nodes. Its learning can be divided into three categories, namely supervised learning, unsupervised learning and reinforcement learning.

Although people's current understanding of the brain's neural network structure, operating mechanism, and even the working principles of individual nerve cells is still superficial, phenomena such as distributed storage, parallel processing, and adaptive learning based on biological nervous systems have already constructed certain Artificial neural networks for primary intelligence. Of course, this kind of artificial neural network is only a rough and simple simulation of the brain, and it is still far behind the brain in terms of scale and function. But we have reason to believe that with the continuous development and advancement of mathematical statistics theory and neural network-related theories, as well as the continuous innovation and breakthroughs of related key technologies, ANN-based applications will surely penetrate into all aspects of society.

2.2. Current status of deep learning

In 2011, Microsoft speech recognition used deep learning technology to reduce the speech recognition error rate by 20 %-30% , which was the biggest breakthrough development in this field in more than ten years; in 2012 , deep learning was applied to the famous biopharmaceutical company silently. Gram's molecular drug prediction problem, learning from various types of molecules to find those molecules that may become drugs to achieve the best results in the world; Google's Google B rain project uses a server cluster of 16,000 processors to build a set of more than 1 billion the node's neural network with autonomous learning capabilities can automatically summarize a conceptual system from a large amount of input data. Image search, driverless cars and Google Glass will all benefit from it; in June of the same year, Google's deep learning system was The accuracy of identifying objects has doubled compared to the previous generation system, and the error rate of the Android system's speech recognition system has been significantly reduced; in January and February , Microsoft Research Asia demonstrated a Chinese-English real-time interpretation system, with an error rate of only 7 % , and the pronunciation is very smooth . In 2017, the DeepMind team launched AlphaGo based on deep learning and strategy search methods, defeating Go world champion Lee Sedol. In 2018, the OpenAI team launched OpenAI Five based on multi-agent DRL (MADRL), which defeated human players in the 5v5 mode of the Dota2 game, and after a period of training, defeated the Dota2 world champion OG team. In 2019,AlphaStar launched by the DeepMind team based on MADRL reached the human master level in the StarCraft II game and surpassed 99.8% of human players in the official StarCraft II ranking.

ISSN: 1813-4890

Generally speaking,in foreign countries, computer giants such as IBM, Google, and Facebook or Internet giants are making every effort to develop deep learning or artificial intelligence, especially DNN algorithm research in the field of speech recognition, and the progress is gratifying. Domestically, Internet companies such as Baidu, Alibaba, and Tencent, as well as research institutions such as the Institute of Automation of the Chinese Academy of Sciences, have also followed the pace of world artificial intelligence research and invested heavily in the fields of artificial intelligence and deep learning.

3. Research trend analysis

3.1. Data Sources

This study selected journal articles in the China National Knowledge Infrastructure Database (CNKI) as data samples to ensure the integrity and reliability of the data. Select "Advanced Search" on the CNKI search page, the search keywords are " deep learning algorithm " & " education ", the search time period is "January 1, 2014 - December 31, 2023" , and 89 documents were obtained .

3.2. Publish annual trend analysis

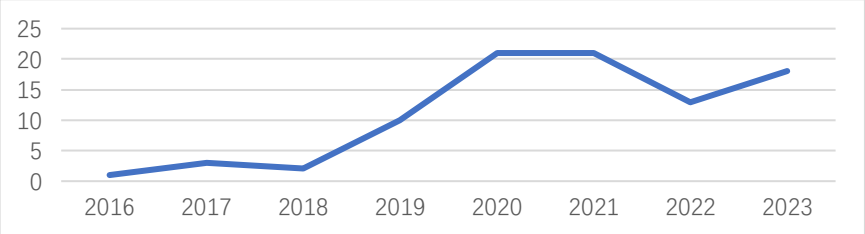

Fig.1Annual publication trends from 2016 to 2023

A visual analysis was conducted on 89 documents to obtain the publication annual trend from 2016 to 2023 (Fig. 1) . As can be seen from the figure, the relevant literature has shown a substantial growth trend since 2018. This is because in 2016, AlphaGo , developed by Google based on deep learning, defeated the top international Go players with a score of 4: 1 , and deep learning became as popular as ever. In 2017, deep learning-related algorithms achieved remarkable results in many fields such as medical care, finance, art, and driverless driving. This was the year in which deep learning and even artificial intelligence developed by leaps and bounds. These achievements have made deep learning algorithms also receive attention in the field of education. From 2020 to 2021, the number of papers published has changed slowly. The author speculates that some research has stagnated due to the impact of the epidemic shutdown and production shutdown. In 2022, the number of relevant papers will show a downward trend, which may be due to the impact of the post-epidemic that has led to the temporary shelving of scientific research projects. After the opening up across the country in 2023, the economy gradually recovered and scientific research projects were restarted. At this time, related research grew again.

3.3. Main topic distribution analysis

After counting the main topics of all the retrieved documents and classifying similar topics, it was found that the frequency of the main topics from high to low is: recommendation algorithm, knowledge tracking, identification algorithm, and online learning.Based on these main topics, it can be inferred that the main methods of deep learning algorithms in the field of education include recommendation algorithms (recommendation systems) and image recognition, because these two keywords appear most frequently in related articles; relatively speaking, prediction algorithms, recognition The frequency of intellectual diagnosis and academic warning appears less, indicating that there are less relevant studies.

ISSN: 1813-4890

The application forms of deep learning algorithms in image recognition can be divided into image classification, target detection, semantic segmentation, and image generation. The main application forms of image recognition in the field of education are image classification and target detection. Image classification is to identify students' expressions during the learning process, and analyze and predict students' behaviors based on these; target detection is mainly to identify students' body movements to improve teaching effects. The application form of deep learning algorithm in recommendation algorithm is mainly the intelligent push of learning resources. By extracting students' learning characteristics and behavioral habits, it can predict students' learning needs and recommend appropriate learning resources to students to achieve personalized services. Target.

4. Applications in education

4.1. Image Identification

4.1.1. Image classification - expression recognition

proposed by Zhou Nan [2] et al. can quickly and accurately identify learners' learning behavior and evaluate teaching effects. The LBREM method mainly relies on visual behavior and uses CNN to carry out expression recognition, and expressions can well express human emotional activities, so students' learning behavior can be analyzed through their expression recognition. Ng et al. [3] used LSTM to model videos. LSTM connected the output of the underlying CNN as the input of the next moment, and achieved a recognition rate of 82.6% on the UCF101 database. Donahue et al. [4] proposed the Long term recurrent convolutional network (LRCN). This network combines CNN and LSTM to extract features from video data. The image information of a single frame is obtained through CNN. Characterize, and then pass the output of the CNN through the LSTM in time order, so that the video data is finally characterized in the spatial and temporal dimensions , and an average recognition rate of 82.92% is obtained on the UCF101 database . Zheng Yang [5] et al. used transfer learning to recognize teenagers' facial expressions and further perceived students' mastery of each knowledge point. Compared with other classic models, they found that this model has the highest accuracy, reaching 74.8% , which improves the robustness of the model. sex and flexibility. Yu Zhengtao [6] first constructed a classroom emotion data set based on student face emotion recognition in a classroom teaching environment, then designed an attention feature convolutional neural network, and then assigned weights to training images through the attention mechanism network. Finally, the designed loss function is added to improve the accuracy of facial emotion recognition under occlusion. Zhou Nan [7] et al. proposed a deep learning-based LBREM method for analyzing student learning behavior and teaching effect evaluation in interactive classrooms. It can quickly and accurately identify learner learning behaviors and carry out teaching effect evaluation. In smart classrooms and distance learning, mobile learning, MOOC and other intelligent education teaching evaluation and personalized recommendations have important reference significance.

4.1.2. Target detection - student body movement recognition

Liu Meizhen [8] designed and implemented a teaching management system based on artificial intelligence. This system can dynamically monitor and accurately evaluate movements in limb disciplines, identify people, and improve analysis of limb movement technology. It provides a platform for limb movement disciplines. Informationization and precise teaching provide quantifiable basis and management means. Ai Xinyan [9] developed a Taekwondo intelligent education system based on human posture detection technology. The system's main goal is to identify whether Taekwondo actions meet the standards, provide comprehensive evaluation and improvement suggestions for the quality of action completion, and get rid of the coach and the venue. constraints, realizing automated and intelligent auxiliary teaching.

ISSN: 1813-4890

4.2. Natural language processing - text processing

Liang Bin [10] and others proposed a specific target emotion classification method that combines multiple attention mechanisms and convolutional neural networks. This model greatly reduces the training time of the attention mechanism-based network model, and effectively improves the specific target emotion classification method by adding a part-of-speech attention mechanism. The classification accuracy of target sentiment analysis; He Yanxiang et al. [11] used deep learning methods such as Weibo text and unsupervised learning to automatically learn the semantic information of words, and performed well in the sentiment classification of Weibo text; Yu Chuanming [12] used a text emotional cause analysis method based on multi-task deep learning to improve the performance of the emotional cause recognition model . She Yanyun [13] constructed an Internet trajectory matrix that can identify 75% of students with mental health problems.

Although many models have shown their effectiveness in text classification, there are still many directions for improvement worth exploring. For example, some small noise samples may cause substantial changes in decision confidence, or even lead to decision reversal. Currently, it is impossible to instruct the model to "understand" text from the semantic level like humans do. The robustness and semantic representation capabilities of the model need to be verified in practice. In addition, research on transmission strategies for context-free word vectors is still relatively preliminary.

4.3. Personalized service

Tan Jindan [14] proposed an online learning resource course recommendation algorithm based on an autoencoder neural network that combines a self-attention mechanism encoder and a course correlation decoder, which not only models learner preferences, but also combines course attribute characteristics , generate a recommendation score ranking list and provide personalized recommendation services. Tang Cheng [15] studied the improvement of cognitive diagnosis model and joint probability matrix decomposition model recommendation algorithm, and implemented a teaching resource management and push platform and Office function plug-in. The deep neural network recommendation model established by Hu Yue [16] and others can effectively shorten the training time of data and improve the recommendation performance of the model. Yuan Huan [17] built an online learning recommendation system based on deep learning, and verified the stability and practicality of the system through testing. Li Xin [18] built multi-dimensional student portraits based on university smart campus information data, and used ALS matrix decomposition algorithm and convolutional neural network algorithm to build models, thereby personalizing students' different learning characteristics, styles, habits, etc. Recommended learning paths and training programs. Gao Jingyu [19] and others designed an improved medical education data analysis method. The proposed algorithm has high accuracy and short computing time. Hu Qintai [20] and others used deep learning algorithms to conduct multi-modal learning analysis, and used HDRBM (deep hybrid discriminant restricted Boltzmann machine) neural network model to establish a multi-modal learning analysis model to improve the interpretability of learning behavior analysis. Sex has better results. Hu Yue [21] and others combined neural networks with collaborative recommendation algorithms to effectively shorten the training time of data and improve the recommendation performance of the model. Wen Yi [22] designed a deep learning algorithm based on the user's long and short interest difference model to solve the need to identify changes in user interests in educational scenarios.

The rapid development of Internet informatization has made it more and more convenient for us to access information. Facing the needs of a large number of users, personalized meeting the needs of different students is an important research field in smart education. Deep learning algorithms based on artificial neural networks can well help us meet this need. Although the

ISSN: 1813-4890

existing smart devices are relatively rudimentary, with the development of technology and the evolution of algorithms, I believe smart education will become possible in the near future.

4.4. Education Forecast

In the algorithm era, as various artificial intelligence algorithms continue to mature, the volume of educational data continues to grow, and computer computing capabilities continue to improve, the three major bottlenecks that restrict educational forecasting have been broken through. In order to achieve educational forecasting with scientific standards Possibility is provided. Compared with general machine learning algorithms, the core advantage of deep learning is that it is good at mining complex structures in high-dimensional data without relying on prior knowledge. It has been widely used in fields such as financial prediction [23] . The following introduces the application of deep learning algorithm prediction functions in the field of education.

Wu Nannan [24] proposed a dropout prediction model based on convolutional neural network and long short-term memory network, which can predict students' behavioral state changes at different moments , helping teachers provide timely intervention measures to improve learners' learning effects. Based on the existing early warning system, Cheng Hao [25] used LSTM neural network to improve the academic early warning system through experimental verification . The model prediction accuracy is stable at 94.21%, and can reach a maximum of 98.17%. The average accuracy is higher than the existing early warning model. Two percentage points, especially in the negative recall rate, which has been significantly improved, and in terms of data dependence and result stability, there has also been a significant improvement. Wang Xianlian [26] introduced a deep learning model to model and predict the scale of higher education, which can better give the corresponding evolution rules. Wang Zheng [27] based on campus multi-source heterogeneous data, combined with Wi-Fi positioning technology, trajectory data mining technology, social network analysis technology, machine learning and deep learning technology, constructed students' personal behavior portraits and social behavior portraits, and designed deep learning The network combines multiple factors to predict students' academic performance, and designs and implements academic warning and social analysis systems. She Yanyun [28] proposed a mental health problem identification algorithm based on multi-source data. In order to further optimize the model recognition effect, a mental health problem identification algorithm based on the Deep Psy model was proposed, which can identify 75% of students with mental health problems.

5. Summary and outlook

The next theoretical development of deep learning will focus on reinforcement learning, transfer learning and unsupervised learning. The Generative Adversarial Nets (GAN) proposed in recent years will also be a good research target, and the Capsule project proposed by Hinton will also be Leading another wave of research on deep learning and neural network structures. In the field of application development, intelligent robots will be an important practical application in the field of deep learning. Google acquired Boston Dynamic, which now has the most powerful robot body and the most intelligent robot brain. Let us look forward to Google having a real robot in the near future. of artificial intelligence is launched.

Although there are currently huge flaws in the field of artificial intelligence, especially in deep learning, we have reason to believe that with the joint efforts of relevant scholars around the world, the field of artificial intelligence, especially in the direction of deep learning, will continue to break through technical barriers and gradually be able to Applied to all aspects of real society, it brings revolutionary changes to our lives.

ISSN: 1813-4890

References

[1] Liu Junyi. Overview of deep learning algorithms based on artificial neural networks [J]. China New Communications, 2018, 20(06): 193-194.

[2] Zhou Nan, Zhou Jianshe. Student behavior analysis and teaching effect evaluation based on deep learning [J]. Modern Educational Technology, 2021, 31(08): 102-111.

[3] Ng JYH, Hausknecht M, Vijayanarasimhan S, Vinyals O, Monga R, Toderici G. Beyond short snippets: deep networks for video classification. arXiv : 1503.08909, 2015.

[4] Donahue J, Hendricks LA, Guadarrama S, Rohrbach M, Venugopalan S, Saenko K, Darrell T. Long-term recurrent convolutional networks for visual recognition and description. arXiv : 1411.4389, 2014.

[5] Zheng Yang. Facial expression recognition of adolescents based on transfer learning [D]. China University of Geosciences (Beijing), 2021.DOI:10.27493/d.cnki.gzdzy.2021.000544.

[6] Yu Zhengtao. Research on student facial emotion recognition based on classroom teaching environment [D]. University of Electronic Science and Technology of China, 2021.DOI: 10.27005/ d.cnki.gdzku.2021.004071.

[7] Zhou Nan, Zhou Jianshe. Student behavior analysis and teaching effect evaluation based on deep learning [J]. Modern Educational Technology, 2021, 31(08): 102-111.

[8] Liu Meizhen. Research on limb teaching information management system based on artificial intelligence [D]. Shaanxi Normal University, 2020.DOI:10.27292/d.cnki.gsxfu.2020.000603.

[9] Ai Xinyan. Taekwondo smart teaching algorithm and application based on deep learning [D]. Henan Normal University, 2020.DOI:10.27118/d.cnki.ghesu.2020.000821.

[10] Liang Bin, Liu Quan, Xu Jin, Zhou Qian, Zhang Peng. Target-specific sentiment analysis based on multi-attention convolutional neural network [J]. Computer Research and Development, 2017, 54(08): 1724-1735 .

[11] He Yanxiang, Sun Songtao, Niu Feifei, Li Fei. An emotional semantics enhanced deep learning model for Weibo sentiment analysis [J]. Journal of Computer Science, 2017, 40(04): 773-790.

[12] Yu Chuanming, Li Haonan, An Lu. Analysis of text emotional causes based on multi-task deep learning [J]. Journal of Guangxi Normal University (Natural Science Edition), 2019, 37(01): 50-61. DOI: 10.16088/ j.issn.1001-6600.2019.01.006.

[13] Tan Jindan. Research on personalized learning resource recommendation algorithm based on deep learning [D]. Guilin University of Electronic Science and Technology, 2021. DOI: 10.27049/d. cnki.ggldc.2021.000355.

[14] Cheng Hao. Research on academic early warning system based on improved LSTM algorithm [D]. Guilin University of Electronic Science and Technology, 2021. DOI: 10.27049/ d.cnki. ggldc.2021.000113.

[15] Tang Cheng. Research on teaching resource recommendation algorithm based on deep learning and cognitive diagnosis [D]. South China University of Technology, 2020. DOI: 10.27151/ d.cnki . ghnlu.2020.000492.

[16] Yuan Huan. Research and implementation of online learning recommendation system based on deep learning [D]. Southwest University, 2021.DOI:10.27684/d.cnki.gxndx.2021.001242.

[17] She Yanyun. Research on identification algorithm of mental health problems of college students based on campus big data [D]. Chongqing University, 2020.DOI:10. 27670/d. cnki. gcqdu. 2020.002099.

[18] Li Xin, Zhang Guihua. Research on personalized deep learning algorithm recommendation model based on student portraits [J]. Digital World, 2019(11):214.

[19] Gao Jingyu, Pan Bo. Medical education data analysis method with improved deep learning algorithm [J]. Information Technology, 2021(08):106-111.DOI:10.13274/j.cnki.hdzj.2021.08.020.

[20] Hu Qintai, Wu Wenyan, Feng Guang, Pan Tingfeng, Qiu Kaixing. Research on the interpretability analysis of multi-modal learning behaviors under the support of deep learning [J]. Audio-visual Education Research, 2021, 42(11): 77-83.DOI: 10.13811 /j.cnki.eer.2021.11.011.

[21] Hu Yue, Luo Xiaonan, Wang Bin, Zhang Wei. Research on intelligent push technology of continuing education information based on deep neural network [J]. Electronic Design Engineering, 2021, 29(14): 42-46. DOI: 10.14022/ j.issn1674-6236.2021.14.010.

[22] Wen Yi. Course video recommendation algorithm based on differences in interests of users in educational scenarios [D]. Hunan University, 2019. DOI: 10.27135/d.cnki.ghudu.2019.001846.

[23] Wan Liyong. Educational prediction and research paradigm shift in the algorithm era [J]. Journal of Distance Education, 2022, 40(03): 35-44. DOI: 10.15881/j.cnki.cn33-1304/g4. 2022.03.010.

[24] Wu Nannan. Research on MOOC dropout prediction algorithm based on deep network [D]. Northwest University, 2019.

[25] Hu Yue, Luo Xiaonan, Wang Bin, Zhang Wei. Research on intelligent push technology of continuing education information based on deep neural network [J]. Electronic Design Engineering, 2021, 29(14): 42-46. DOI: 10.14022/ j.issn1674-6236.2021.14.010.

[26] Wang Xianlian, An Fengping. Higher education scale prediction algorithm based on weight initialization-multi-layer convolutional neural network sliding window fusion [J]. Information Technology and Informatization, 2019 (10): 24-29.

[27] Wang Zheng. Design and implementation of academic warning and social analysis system based on student campus data [D]. Beijing University of Posts and Telecommunications, 2019.

[28] She Yanyun. Research on identification algorithm of mental health problems of college students based on campus big data [D]. Chongqing University, 2020.DOI:10.27670/d. cnki.gcqdu. 2020.002099.