Design of Resource Matching Model for Intelligent Education System Based on Machine Learning

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Abstract

The educational revolution brought by new technology is making a robust progress. Artificial intelligence and intelligent education lead the innovation of education and teaching, so they have become an inevitable trend of the educational informationizationdevelopment. With the rise of big data in education, how to analyze a large amount of data to support accurate prediction is a new topic in the era of artificial intelligence. As an important branch of artificial intelligence, machine learning can meet the requirements for the analysis and prediction of educational big data. Therefore, based on a series of questions, such as "why to analyze, what to analyze, how to analyze, why to apply", the applicablenessof machine learning and wisdom education was discussedby analyzing the action objects, process, specific methods, and stakeholders. Through summarizing the case studies of machine learning education applications based on real data in recent years, it was found that the current application of machine learning education is mainly concentrated in student modeling, student behavior modeling, learning behavior prediction, early warning of dropout risk, learning support, as well as evaluation and resource recommendation. Then starting from the perspectiveof crossover, technology, and teaching, some suggestions were put forward for the educational application and innovation of machine learning based on the framework of intelligent education.

Keywords*: Machine Learning, Intelligence Education, Education System, Resource Matching*

I. Introduction

Education is also changing under the influence and penetration of the wave of AI research. On the one hand, a new field is formed by combining Artificial Intelligence (AI)with learning science, that is Educational Artificial Intelligence (EAI), whose core goal is "to obtain accurate and clear forms of educational, psychological and social knowledge through computation, and this knowledge is often implicit". Knowledge is presented in the form of learner model, domain knowledge model, as well as teaching model, and algorithmsare the core technology to obtain such knowledge. Currently, many educational AI systems have been applied in schools. These systems integrate educational AI and Educational Data Mining (EDM) technologies (e.g., machine learning algorithms) to track students' behavioral data and predict their learning performance, so as to support personalized learning.

As the most core and popular technology in the field of artificial intelligence, machine learning can discover rules and predict students' learning performance based on the automatic identification patterns of a large amount of data, providing possibilities to meet the needs of intelligent education and personalized learning. Currently, there is no systematic study on the educational application of machine learning both at home and abroad. Therefore, we attempt to provide a theoretical and practical basis for researchers and educators to carry out intelligent education and personalized learning by comprehensively sorting out the development status, potential, progress and challenges of the educational application of machine learning.

II. Concept summary of machine learning

(1) Definition of machine learning

Machine learning is the most important and popular algorithm in artificial intelligence and data mining. Some foreign scholars have defined machine learning. For example, Mitchell believes that machine learning is the study of computer algorithms that can be improved automatically through experience. Alpaydin holds that machine learning refers to the performance criteria optimizing computer programsby using data or past experience. Therefore, machine learning is the study that uses experience or data to improve algorithms, aiming to make machines learn rules from a large amount of historical data through algorithms, and automatically discover patterns and use them for prediction. In other words, machine learning means that a machine learns from data, and the more data it processes, the better its predictions will be.

(2) Two stages of machine learning

The development of machine learning can be divided into two stages: Shallow Learning and Deep Learning.

1) Shallow Learning

In the late 1980s, the appearance of Back Propagation algorithm (BP algorithm) used for artificial neural network[12]started the shallow learning. BP algorithm can be used to make artificial neural network model learn rules from a large number of samples and then carry out predictions. However, shallow learning models extract features of samples by relying on manual experience, which often requires developers to mine good features.

2) Deep Learning

In 2006, *Reducing the Dimensionalitg of Data withNeural Networks*[13]published by professor Hinton (professor at University of Toronto, Canada, and leading authority in the field of machine learning) and his student Salakhutdinov in *Science* opened a new chapter of deep learning. Subsequently, deep learning continuedits popularity in the academic world. Currently, many well-known universities have joined in the research on deep learning. Unlike the shallow learning model, which relies on artificial experience, the deep learning model learns more useful features by building machine learning models and massive training data, thus ultimately improving the accuracy of classification or prediction. In April 2013, deep learning technology was listed as the top ten breakthrough technologies in 2013 by MIT TechnologyReview magazine .

III. Combination of machine learning and intelligence education

As a technological intermediary, intelligent education has become a new realm and new appeal of educational informatization. The core goal of intelligent education is to enable teachers to use efficient teaching methods and learners to obtain appropriate personalized learning services and good development experiences by building a learning environment integrating technology. In the environment of intelligent education, learners' data are collected and formed into big data of education, and it is urgent to adopt intelligent means to mine these data and find potential patterns and knowledge to support the innovative development of intelligent education. Machine learning is essentially to use computers to learn rules from mass data, automatically discover patterns and use them for prediction. Therefore, it is certain that machine learning can help intelligent education to deeply understand learners'learning.

(1) Action object and environment

The action object of machine learning methods is educational data, including all the data generated by the interaction between and education system, as well as demographic, emotional, collaborative and managerial data, etc., which come from different educational environments. Romero and Ventura believe that the educational environment can be divided into the traditional educational environment and computer-based education environment. Pa-Pamitsiou and Economides think thatthe educational environment includes Virtual Learning Environment (VLE) and Learning Management System (LMS), MOOCs and social learning, Web-based education,

cognitive mentor systems, computer-based education, multimodal and mobile environments .

We believe that intelligent education environment can be divided into traditional educational environment and network education environment, as shown in Figure 1.

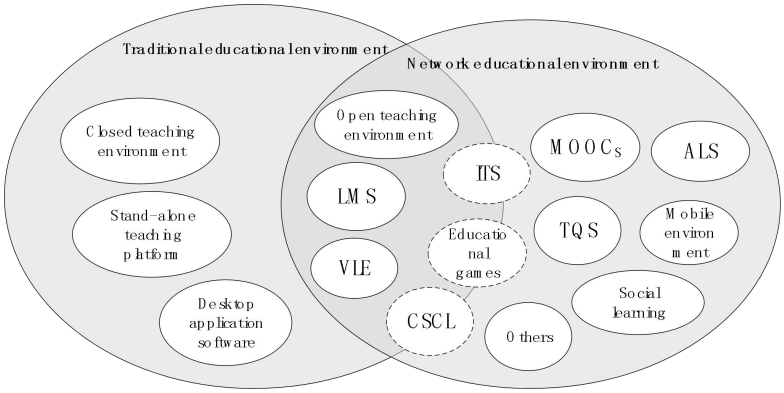

Fig 1: Composition of intelligent educational environment

The traditional educational environment is usually based on schools or classrooms. According to the differences in data storage, the traditional educational environmentcan be divided into the closed teaching environment and open teaching environment. Among them, the closed teaching environment refers to the stand-alone model, the teaching platform deployed locally or the desktop application, and the data is stored in internal storage. The open teaching environment refers to a web-based distance education platform (a controlled environment that collects learners and activity data), and the is stored in cyberspace.

The network educational environment can be divided into the open teaching environment and informal social educational environment. Among them, the informal social educational environment refers to the learning environment based on intelligent terminals (such as PC, mobile terminals, etc.) and autonomous learning, and the data is stored in cyberspace. From the perspective of data, the closed teaching environment is the small data environment of education, while the open teaching environment and network educational environment are the big data environment of education.

(2) Mechanism

Machine learning generally applies to educational data mining processes. Educational data mining involves the development, research and application of computer methods to detect patterns in a large amount of collected educational data, which is the fusion of education and data mining. Data mining technology was first applied in the field of education in 1995, which opened the curtain of education data mining research, and then gradually developed into an independent research field. The subjects involved in educational data mining mainly include pedagogy, computer science and statistics , as shown in Figure 2. Among them, machine learning, as the fusion of computer science and statistics, provides strong technical support for educational data mining.

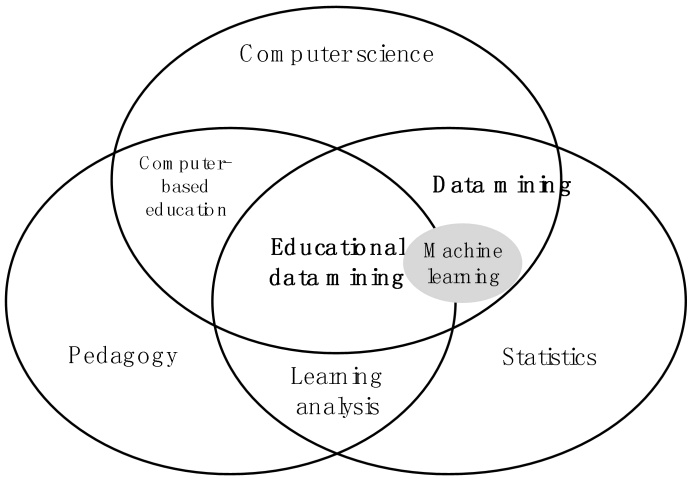

Fig 2: Integrated multi-disciplinary education data mining

In the process of educational data mining, machine learning is mainly used for data mining and interpretation, realizing functions that are lacking in traditional education or difficult to be completed artificially, and then discovering unknown new knowledge and patterns through automatic analysis of data, as shown in Figure 3.

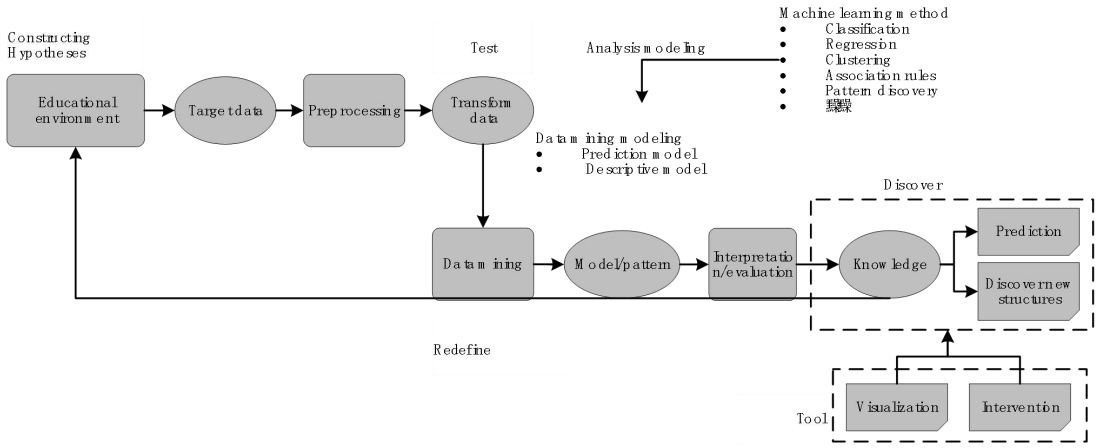

Fig 3: Educational data mining and knowledge discovery process

In the data interpretation part, the machine learning method analyzes educational data and finds patterns and knowledge by establishing a Predictive Model and DescriptiveModel. The prediction model predicts unknown data through known data, for example, students' academic performance is predicted by analyzing their grades; The descriptive model discovers new patterns or structures by analyzing data.

Knowledge is the discovery of machine learning, and it is mainly divided into principle, practice and optimization knowledge. Among them, the principle knowledge aims to verify or modify existing educational theories, for example, discovering new learning patterns; The practical knowledge aims to help teachers carry out teaching practices, for example, predicting students' performance and grades; The optimization knowledge aims to improve the effectiveness and performance of the learning system, for example, improving the adaptive ability of the system by analyzing learners' knowledge. These types of knowledge will be ultimately fed back into the education system for an iterative cycle, in order to facilitate and improve the learning.

IV. Student modeling

Student modeling is a process of creating and maintaining student model modules, which are mainly responsible for the development and maintenance of students' current knowledge state models, aiming to make assumptions about students' misunderstandings and sub-optimal performance, so that teachers can point out problems and put forward suggestions for corrections. Student modeling includes a student model, which is a data structure storing student knowledge, and a diagnostic model, which performs the diagnostic process and updates the student model. Among them, the domain model is the foundation of the student model. For example, Yudelson et al. Supported the learning of undergraduate programming language by using automated methods to extract domain models, and the student knowledge is modeled during the process ofsolving programming exercisesto support the system to recommend the next problem to be solved. The data used in this study comes from the code snapshot data of three introductory program courses in a university. The processing method is mainly based on two points: after each program is submitted, the knowledge is modeled by using the internal structure of the programming language; a set of tests are used to automatically test the correctness of the program. In this study, the Null model and the Rasch model are used for student modeling, and the AFM model combined with PC algorithm is used for students' learning modeling. It is found that the use of the PC Nalgorithm can improve the accuracy of the AFM model for filtering concept list.

As a user modeling method, Bayesian knowledge tracking is usually used in intelligent teaching systems. For example, Eagle et al. inserted students' individual parameters into the traditional Bayesian knowledge tracking model to predict the individual differenceweight oflearning and performance in the intelligent teaching system based on their activity data. The advantage of this method is that if individual difference weights can be assigned before students start to use the system, it will be easier to integrate into the intelligent teaching system. In the study, students' activity data includes reading performance data and conceptual knowledge preparation test data. Among them, the reading performance data includes reading time and revisiting text pages (related to metacognitive self-regulation skills). The conceptual knowledge pretest data includes pretest accuracy, question variation, and task completion time. The research results acquire four sets of individual difference weights for best matching and three variants of Bayesian knowledge tracking models, and it is found that the data on students' text reading is very useful for predicting learning and performance in intelligent teaching systems.

Similarly, Baker et al. adopt methods such as Bayesian knowledge tracking and linear regression to build a student model to detect the possibility of skills that have been acquired by in specific problem steps. This study is based on 232 middle school students' data of mathematics courses. The modeling is conducted mainly in two steps: the standard Bayesian knowledge tracking is used to predict students' knowledge and generate labels of possibilities by combining data and Bayesian theorem; The models are trained to predict label data by using a broader set of features.

Conclusion

Machine learning, as the core technology of artificial intelligence, is used in big data of education to help us better understand the relationship between data, information, knowledge and wisdom. It can effectively support intelligent education, and its role in educational AI and educational data mining cannot be replaced by any other technologies. With the continuous development and application of machine learning technology, its integration with the field of education will be bound to promote educational innovation.

Acknowledgements

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References

[1] Su Jinshu, Zhang Bofeng, Xu Xin. Research Progress of Text Classification Based on Machine Learning [J]. Journal of Software, 2006 (09): 1848-1859.
[2] Xu Jun, Ding Yuxin, Wang Xiaolong. Automated emotional classification of news using machine learning [J]. Chinese Journal of Information, 2007, 21(6): 95-100.
[3] Li Xie, Sun Linyan, Wang Yingluo. Prospect of Educational Model Development: From Distance Education to Intelligent Education [J]. Journal of Shaanxi Normal University (Philosophy and Social Sciences Edition), 2000 (02): 163-167.
[4] Zhang Kunying, Zhang Jianian. New Zones, Misconceptions, Blind Zones and Forbidden Zones in the Application and Research of Artificial Intelligence Education [J]. Journal of Distance Education, 2017, 35 (005): 54-63.
[5] Xu Ye. The Path from "Artificial Intelligence Education" to "Educational Artificial Intelligence"[J]. China Audio-visual Education, 2018, 383 (12): 86-92.
[6] Yin Jingyao, Yang Zhehai, Wang Hao, etc. Development of AI Educational Robot Control System [J]. Artificial Intelligence and Robot Research, 2020, 9 (4): 7.
[7] Shen Lei. The Problems and Solutions of Classroom Educational Resource Allocation in the View of Educational Equity [J]. Modern Educational Science, 2011.
[8] Zhu Hua. A Probe into the Redistribution of Educational Resources in the Information Technology Environment [C]//The 2006 Annual Meeting of Jiangsu Education Association.0.
[9] Zhu Jiefang. Utility spillover of educational products and selection of allocation mode of educational resources [J]. Monthly Educational Studies, 2010 (05): 11-13.