



An Introduction to Key Technology in Artificial Intelligence and big Data Driven e-Learning and e-Education

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1 Editorial

Age of artificial intelligence and big data comes rapidly with fast increment of computer and communication technology, and the new technology improvements bring new educational age [1]. Mobile education and fragmentation of education become new trends. Moreover, artificial intelligence and mobile network technology in education is also becoming a hot research domain [2]. Long distance education is changing the traditional education and has much benefit. However, here are many remaining scientific and engineering problems in it. The problem in education based information technology with mobile networks is a key issue to solve. Besides, the new generation of mobile networks and IT in education is also an important research domain now. Meanwhile, the engineering application of AI and big data driven long distance learning and education exist lots of problems [3, 4]. All these need scholars to put much energy into this area.

In this way, this issue “Key Technology in AI and Big Data Driven Long-Distance Learning and Education” aims to provide an opportunity for educators and scholars to publish their gifted theoretical and technological studies in this area, as well as the novel real applications of industrial researchers within this domain.

This issue received 19 submissions and accepted 8 out of them with at least 2 rounds of strict reviews, with acceptance ratio 42.11%. This editorial is divided into two sections, which aims to the intelligent algorithms for online education

in the first section, as well as models of intelligent learning in the second section.

2 Intelligent algorithms for online education

The first section of this issue includes four papers, which focuses on the intelligent algorithms for online education, including fuzzy system, man-machine cooperation, index update, and edge computing [5–8].

The multi-dimensional characteristics of public opinion in online education lead to the difficulty of data cross-dimensional mining. To solve this problem, the first article, “Cross-Dimension Mining Model of Public Opinion Data in Online Education based on Fuzzy Association Rules”, authored by Jerry Chun-Wei Lin from the Department of Computer Science, Electrical Engineering and Mathematical Sciences, Western Norway University of Applied Sciences, Norway, designs a cross-dimensional data mining model of public opinion in online education based on fuzzy association rules. Their method uses Yaahp software to calculate the influence factor weight of public opinion in online education, and clarifies the relationship between the dimensions of various public opinion data. By introducing the fuzzy set theory into the database, the data is preprocessed with feature selection and text vectorization. The simulation results show that the model has the advantages of wide range, fast speed, and high accuracy, and can provide data support for online education reform.

The rapid development of information technology accelerates the modernization of distance education. In order to realize the unified organization and management of learning resources as well as improve the utilization rate of resources, the second article, “The Design of Mobile Distance Online Education Resource Sharing from the Perspective of Man-Machine Cooperation”, authored by Norbert Herencsar from the Department of Telecommunications, Brno University of Technology, Czech Republic, proposes the design of a mobile online education resource sharing system from the perspective of man-machine cooperation. This method analyzes the main body and

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scope of collaboration, constructs a resource sharing model with large-scale man-machine cooperation as the main model. The role access control mechanism is used to manage user rights, and the settlement incentive algorithm is introduced to protect the intellectual property rights of distance education resources. The experimental results show that this system promotes the development of distance education information, improves the efficiency of resource sharing, and enhances the enthusiasm of users to contribute online educational resources.

When using current index update methods of educational resources, there is no analysis of the hierarchical association structure between educational resources, which bring some problems such as too long index construction time, high query time and low query accuracy. Therefore, the third article, “Research on Adaptive Updating Method of Education Resource Index based on Mobile Computing”, authored by Arun Kumar Sangaiah from the School of Computing Science and Engineering, Vellore Institute of Technology, India, introduces mobile computing to study the adaptive updating method of education resource index. Their method analyzes the structure of the index system of educational resources. The initial query is expanded by selecting extension words by local co-occurrence method, and the weight of the extended query is allocated by genetic algorithm to realize the adaptive updating of the index of educational resources. The experimental results show that the average index redundancy rate is only 0.22%, indicating that the resource index update performance of the proposed method is suited for online education application.

In response to the demand for high-quality electronic information talents in the mobile network industry, in the situation of artificial intelligence (AI) to promote technological innovation, the fourth article, “Application and Exploration of Artificial Intelligence and Edge Computing in Long-distance Education on Mobile Network”, authored by Yun Lin from the College of Information and Communication Engineering, Harbin Engineering University, China, conducts an overall design in the target system, curriculum system, teaching platform, teaching mode and teaching case. The practice education mode of teaching, engineering, innovation, and enterprise, which aims to improve students’ ability to solve complex engineering problems, is constructed. The modal breaks geographical boundaries between schools and enterprises to build the through-through experimental teaching course system based on artificial intelligence and edge computing. At the same time, the hardware portability of the edge computing platform provides good conditions for long-distance education. This method is a beneficial attempt to online education.

3 Models of intelligent learning

The second section of this issue includes four papers, which focuses on the models of intelligent learning, including

service and movie recommendation, evaluation of teaching quality, and semantic classification [9–12].

In view of the problem that the traditional learning service recommendation does not fully consider the distinct differences between individuals, it is easy to lead to the contradiction between unchanging learning resources and learners’ personalized learning requirements that are constantly improving. In this way, the fifth article, “Improvement of Adaptive Learning Service Recommendation Algorithm based on Big Data”, authored by Marcin Woźniak from Faculty of Applied Mathematics, Silesian University of Technology, Poland, proposes an improved adaptive learning service recommendation algorithm based on big data. Their method builds a student demand model by considering the individual differences, making students as the center, and collecting students’ personalized learning demand. Then, with data mining on clustering recommendation service resources in learning, an adaptive recommendation model is constructed according to students’ individual needs. Experimental results show that the proposed recommendation algorithm has high recommendation accuracy, coverage rate and recall rate, which is of great significance in the actual learning service recommendation.

In order to enhance the hybrid teaching of physical education online and offline, a quality evaluation method for online and offline hybrid teaching based on mobile edge computing is proposed in the sixth article, “Evaluation Method of Online and Offline Hybrid Teaching Quality of Physical Education based on Mobile Edge Computing”, authored by Ping Yu from the College of Computer Science and Technology, Jilin University, China. Through the evaluation target, index, weight of index and evaluation standard, their method constructs a quality evaluation index system of hybrid physical education online and offline. Index items are simplified by analyzing factor and cluster on the importance evaluation grade data of each index, and the quality evaluation of hybrid physical education is realized effectively by using the fuzzy comprehensive evaluation model. The simulation results show that the proposed method can effectively reduce the cost and error of quality evaluation for online-offline hybrid teaching, improve the evaluation efficiency, and enhance the quality of online and offline hybrid teaching.

With rich resources, movies have been applied as instructional media in the domain of education, such as fields of Second/Foreign Language Learning, Communication, and Media Art. Factorization machine (FM) can effectively simulate common matrix factorization models by changing the form of real-value vector, which can be utilized in movies recommendation under the context of education. In this way, the seventh article, “Movie Recommendation System for Educational Purposes Based on Field-aware Factorization Machine”, authored by Suxia Zhu from the Research Center of Information Security and Intelligent Technology, Harbin University of Science and Technology, China, applies the field-aware factorization machine (FFM) to solve movie rating prediction and help users to select appropriate movies for

learning purposes. In order to further enhance the availability of the model, clustering algorithm is also integrated in FFM for adding new fields. The experimental results demonstrate the effectiveness of the proposed methods in reducing the Root Mean Square Error (RMSE).

Scholarly articles are a great source of knowledge. Learning from them like E-learning requires automatic approaches to build concept-maps, learning paths, etc., as these sources are monotonically increasing and are big too. These sources have multi-domain, variety, huge volumes, which are, in fact, Big Data's characteristics. Thus data from different domains have to be handled together, especially in the E-learning systems. Therefore, the eighth article, "Fuzzy Semantic Classification of Multi-Domain E-Learning concept", authored by Omar Almutiry from the College of Applied Computer Science, King Saud University (Almuzahmiah Campus), Saudi Arabia, presents a new approach for concept extraction and semantically clustering and classification of these e-learning concepts using fuzzy membership values. A test on BBC datasets with 100 documents and 650 documents is achieved for testing their fuzzy-based semantic system by extending the maximum accuracy up to current 94% to 96% for all data sets. In clustering, by using K-Means, their method gets precision up to 93%. The system can be used to generate adaptive learning paths, concept map extraction, and big data based e-learning portals.

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References

1. Liu S, Wang S, Liu X, Lin CT, Lv Z (2020) Fuzzy detection aided real-time and robust visual tracking under complex environments. *IEEE Trans Fuzzy Syst*:1. <https://doi.org/10.1109/TFUZZ.2020.3006520>
2. Liu S, Guo C, Fadi A et al (2020) Reliability of response region: a novel mechanism in visual tracking by edge computing for IIoT environments. *Mech Syst Signal Process* 138:106537
3. Ke Q, Zhang J, Wozniak M, Wei W (2019) The phase and shift-invariant feature by adaptive independent subspace analysis for cortical complex cells. *Information Technology And Control* 48: 58–70
4. Lin Y, Li Y, Yin X, Dou Z (2018) Multisensor fault diagnosis modeling based on the evidence theory. *IEEE Trans Reliab* 67(2): 513–521

5. Li-Xuan L, Huo Y, Lin JC (2021) Cross-Dimension Mining Model of Public Opinion Data in Online Education based on Fuzzy Association Rules. *Mobile Networks and Applications*
6. Li C, Zhao Q, Herencsar N, et al. The Design of Mobile Distance Online Education Resource Sharing from the Perspective of Man-Machine Cooperation
7. Liu J, Sangaiah AK (2021) Research on Adaptive Updating Method of Education Resource Index based on Mobile Computing. *Mobile Networks and Applications*
8. Hou C, Hua L, Lin Y, et al (2021) Application and Exploration of Artificial Intelligence and Edge Computing in Long-distance Education on Mobile Network. *Mobile Networks and Applications*
9. Yang Y, Zhong Y, Woźniak M (2021) Improvement of Adaptive Learning Service Recommendation Algorithm based on Big Data. *Mobile Networks and Applications*
10. Bao L, Yu P (2021) Evaluation Method of Online and Offline Hybrid Teaching Quality of Physical Education based on Mobile Edge Computing. *Mobile Networks and Applications*
11. Lang F, Liang L, Huang K, et al (2021) Movie Recommendation System for Educational Purposes Based on Field-aware Factorization Machine. *Mobile Networks and Applications*
12. Ahmed R, Ahmad T, Almutairi FM, et al (2021) Fuzzy semantic classification of multi-domain E-learning concept. *Mobile Networks and Applications*

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area contains big data processing, computer vision, and information