Research on the application of personalized teaching mode based on big data in Computer teaching

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Abstract. In order to improve the efficiency of teaching and learning, it has become an inevitable trend to explore a new teaching mode based on the analysis technology of big data in view of the disadvantages of learners' passive acceptance of knowledge under the traditional teaching mode. For mining online learning behavior, In order to learn the optimal strategy behavior better, a new strategy based on reinforcement learning is proposed based on focused crawler. Using Bayesian classifier, hyperlinks are classified according to the whole web page text and link text, and the importance of each link is calculated, so as to determine the access order of links. Targeted mining of learner interests to predict learner preferences and make personalized guided recommendations. Through the analysis results show that, in the same experiment platform, enhance learning algorithm to get the optimal strategy for online learning behavior training, so that teaching staff can quickly and efficiently make the decision of teaching content recommendation to learners based on learning platform.

Keywords: Big data, learning behavior analysis, reinforcement learning, Internet worm.

1. Introduction

With the advancement of technology, the rapid development of the Internet and mobile Internet, cloud computing and the arrival of the era of big data, information applications have fully penetrated into all areas of social development, and various social activities of human beings are being recorded, digitized, and Tracking, being spread, a large amount of data hides huge wealth. The Internet and mobile Internet make the collection and use of information everywhere. Internet service providers obtain information from terminals and users at all times to provide users with communications and various Internet services. For example, the life trajectory left when using telephone, credit card, e-commerce, Internet, e-mail, etc. In the following cases, the continuous growth of big data [1] has brought a certain commercial impact. When you search for flights to Beijing, the discount information of local hotels will be displayed on the website; the shops you have visited will conduct customer behavior Data mining is used to maximize profits. The algorithm predicts ticket purchase requirements, and airlines adjust prices in unpredictable ways. It is also because of the infinity technology of big data that applying it to the field of education [2] will surely become a sharp sword in teaching reform. It analyzes students' online learning behavior
and guides students' learning direction. Scholars at home and abroad have also conducted in-depth research on the practical application of massive data in the field of education [3].

In terms of academics, foreign universities and research institutions have paid close attention to the growing large-scale data, and conducted in-depth research on the application of Hadoop technology [4]. Many famous universities have joined the research of Hadoop clusters. In the middle, and many universities are also studying and analysing students' online learning activities. For example, American universities use big data [5] to predict whether students will successfully complete the course. Marist College in Poughkeepsie, New York, has partnered with commercial data analysis company Pentaho to launch an open source academic analysis program. The purpose is to predict which students will not be able to complete the course within two weeks of starting a new course. The program developed an analysis model based on Pentaho’s open source business analysis platform, and analysed student learning habits through data collection. For example, by browsing information online, bulletin board statements, etc. to predict students' academic status, timely intervention and support students in question, thereby improving the graduation rate. On the basis of research, Chinese scholars believe that big data can be applied in the field of education [6] to promote education and learning. For example, a website named "Circle Time" designed by Xiamen University Library. The website records the library memories spent during the university by collecting the reading records and number of admissions of university graduates during the university.

Big data will bring many benefits to social development and progress due to its particularity, and its value depends on the application of big data, so how to apply big data and serve the objective world has become an urgent problem for theoretical scholars and practical operators.

2. Construction of learning behaviour analysis mode

Under the big data environment, the specific realization of exploring the personalized teaching mode [7] is based on a large amount of historical data or online behaviors, studying the browsing history of learners and analyzing the needs and behaviors of learners, and discovering the learners’ interests. For example, the time spent browsing the page, the degree of interest in a class, the mastery of the overall knowledge of the class, and the degree of discussion of a problem. By establishing correlations between learners with similar behaviors and courses that are of interest to the same learner, an optimal strategy is trained, so that the teaching worker can quickly and efficiently make teaching content recommendation decisions to the learners based on the learning platform. Using learning analysis technology to analyze students and their learning environment, the purpose is to find potential problems, optimize learning, understand learning, and predict and master the learner's situation in real time. The learning analysis technology is centered on various information data generated by the learner during the learning process, and uses various mathematical modeling techniques and data processing techniques to interpret these data to explore the learning process and situation based on the result data and analysis information for optimization And improve the teaching to provide certain feedback, and continuously promote the learning of learners. The learning analysis technology takes advantage of data mining [8] and collects, stores, and analyzes a large amount of data information accumulated on the learning platform through data modeling. By using the analyzed results to evaluate and predict learners' learning behavior [9], and provide individual students with more effective education, further improve teaching quality and effect, improve teaching quality, and achieve the purpose of promoting learning. The realization of the course intelligent recommendation model is shown in Figure 1:
Sampling the data, using probabilistic mathematical statistical learning methods [10] to establish samples, and then learning the samples, and finally obtaining the sample model, this model is used as a criterion for judging other new data and new samples, and finally returns to the actual go among them.

The purpose of course intelligent recommendation is to achieve knowledge recommendation. Learners do not need to provide clear requirements. Instead, they analyse the learners’ historical behaviors and actively recommend the learners information that meets their needs and interests, which breaks the traditional learning. Model to achieve independent and independent learning. First use data mining technology [11] to analyse the data, process the data and construct a data model, which is established when constructing the data model. Based on the reinforcement learning algorithm, the distance between the learners is calculated by using the historical behaviour data of the learners to predict the target learners' preference for a specific course, and the system recommends the learners corresponding content according to such preference behaviors. A focused crawler strategy algorithm based on reinforcement learning is proposed. Its purpose is to conduct personalized course recommendation analysis and correlation analysis with learning effect. The improved algorithm can more accurately obtain users' search satisfaction and recommend personalized courses.

Personality mining and tutoring recommendation adopts the three-stage learning content recommendation method of "interest and implicit feature discovery + personality portrayal + adaptive collaborative process" to achieve interactive personalized tutoring based on relevant, satisfying learners in different learning scenarios Recommended for your learning path. The recommended mode to overcome the "Cognitive Trek" problem under massive resources. In order to achieve targeted push learning courses and content, build an adaptive learning environment, and give application effects and inspiration based on the analysis results. At the same time, you can better understand the student's learning situation.

3. Algorithm analysis

3.1. Reinforcement learning algorithm
With the development of distributed computing technology and networks, many real systems are very complex and huge, and have distributed characteristics, so that a single agent is unable to reach due to the limitations of individual computing resources and knowledge. Therefore, multi-agent [12] It has gradually become a hot topic in the field of artificial intelligence. Its main characteristics are autonomy, collaboration and reaction. Autonomy is to control one's internal state and behavior by continuing to exercise without human intervention; the response is to perceive the environment and take appropriate
measures to change the environment; Collaboration is a complex task in a multi-agent environment. It can resolve conflicts and achieve some mutually beneficial solutions that cannot be found independently. That is, multi-agent systems do not require the integrity of environmental knowledge when they are executed, and have the ability to repair themselves.

Multi-agent system (MAS) is a system composed of multiple agents. As an effective method to solve complex systems, parallel distributed processing technology and modular design concepts can be used to split the complex system into independent agent subsystems and solve complex problems through cooperation and competition among Agents.

The basic elements of reinforcement learning algorithm [13] are mainly composed of state, action and reward value. The improvement of the accuracy of the reinforcement learning algorithm in the big data scenario is mainly analysed from these three aspects.

One is the state. The second is behavior. The third is the reward value. Reinforcement learning is ultimately to learn the reward value corresponding to each behavior, and use the reward value to determine whether a certain behavior is "good" or "bad" in the future. In order to help decision-makers make the most favourable decision-making plan for the teaching model. The learning and behavior of reward values are inseparable. The more historical data information that the enhanced learning algorithm learns in the big data scenario, the more complete the behavior of learning, and the more reward value learned is more suitable for the learning state of the learner.

In reinforcement learning, the learning of input/output mapping is done through interaction with the environment, and the goal is to minimize a scalar performance indicator. In order to adapt to the learning in the case of delayed reinforcement, the block diagram of the reinforcement learning system is designed, as shown in Figure 2. This learning system is based on an evaluation. The evaluation is to receive an initial enhancement signal from the surrounding environment and transform it into a high-standard enhancement signal called enlightenment enhancement signal.

![Figure 2. Block diagram of reinforcement learning](image)

The purpose of reinforcement learning is to minimize the cost-to-go function to a minimum. This function is defined as the cumulative expected value of the cost after adopting a series of step behaviors, rather than a pure direct cost. The results prove that the behavior that occurred earlier in the time series is actually the best decision in the entire system. The purpose of the learning system is to discover these behaviors and give them back to the environment.

3.2. Link priority analysis

Sergey Brin and Lawrence Page, PhD students at the School of Computer Science at Stanford University, proposed a new algorithm based on network link analysis-PageRank algorithm in 1998. The core idea of the algorithm is: if a webpage uses hyperlinks to point to another page, multi-step browsing through the link, the frequency of viewing this link determines the value of this page. The description of PageRank algorithm [14] is: Suppose a web page is defined as i, I (i) is a group of pages pointed to by page i, out (j) represents the outgoing degree of page j, that is, the page pointed to by page j number. Then the traditional calculation formula for PageRank of webpage i is:
To calculate the PR value of a webpage, you can browse the webpage by clicking the link, or access it by directly entering the URL. The normalization factor d [15] is introduced (d generally takes a value of 0.85). That is, the user accesses the page linked from the current page with probability d at any time, selects the page with a probability of 1-d from the entire page and accesses it. Therefore, the iterative calculation formula of RageRank of webpage i is:

\[
PR(i) = (1 - d) + d \sum_{j \inout(i)} \frac{PR(j)}{\text{out}(j)}
\]  

(1)

PageRank algorithm is a static algorithm, not related to search results, which can effectively reduce the amount of calculations during online search. However, it is because of the irrelevance of the PageRank algorithm and the retrieval results that it ignores the relevance of the retrieved content [16], which has the disadvantage that the relevance of the retrieved content and the result is not very high. Aiming at the problems of this algorithm, an improved algorithm based on content-related PageRank is proposed. To better describe the improved algorithm, the following definitions are made:

Definition 1 Link (i, j) hyperlink: represents a hyperlink from webpage i link to webpage j.

Definition 2 out(i) link out: represents the total number of hyperlinked pages pointed to by webpage i.

Definition 3 In(i) link: represents the total number of pages that all hyperlinks point to page i.

Let \( F_i \) be used to represent the set of all pages pointed to by webpage i, \( F_i = \{p_1, p_2, p_3, ..., p_m\}, m=\text{out}(i) \); all web pages use the set \( B_i \) to represent the linked web pages i, \( B_i = \{q_1, q_2, q_3, ..., q_n\}, n=\text{In}(i) \). Suppose a user is browsing page i at a certain period of time, and randomly access any link j (j \( \in F_i \)) on page i at time \( u+1 \), then the probability of the user browsing the webpage j is \( \frac{1}{\text{out}(i)} \). The purpose of introducing content relevance is to better respond to the accuracy of retrieval results. Therefore, the calculation formula is:

\[
\text{similar}(P, Q) = \frac{\sum_{i=1}^{\text{out}(i)} F_i(i)}{\sqrt{\sum_{i=1}^{\text{out}(i)} (F_i(i))^2}}
\]

(3)

Similar (P, Q) is the similarity value between the document Q and the content P. The larger the value of similar (P, Q), the higher the matching degree between P and Q. \( F_i(i) \) is the number of times the retrieved content P appears in Q. At this time, the iterative calculation formula of RageRank of webpage i is converted to:

\[
PR(i) = (1 - d) + d \sum_{j \in B_i} \frac{PR(j) \cdot \text{similar}(P, j)}{\text{out}(j) \cdot \sum_i \text{similar}(P, i)}
\]

(4)

The execution steps of this improved algorithm are as follows:

(1) Capture webpage information on the MOOC platform through web crawler webpage analysis algorithms;
(2) filter the captured webpage information to eliminate noise and use it as a test sample;
(3) Extract webpage information, pick high priority links from the queue, and extract the information in the web page;
(4) calculate the content relevance by formula (4), and get the PageRank value to predict the page pointed to by the link;
(5) Search based on ranking to determine personalized recommendations;
(6) Filter the results based on the calculated values obtained by the improved algorithm, so as to effectively push the content.
4. Experiment
In the context of big data, in order to enable learners to carry out better and efficient learning, master knowledge in time and learn what they are interested in. In this paper, the algorithm before and after the improvement is empirical. The Hadoop platform is built in a virtual environment. The CPU used is the Intel Core i5-6600 quad-core processor and the memory is 4GB. Based on the MOOC teaching platform [17] as the research object, some of the learner's data are selected and divided into test sets and sample sets. The algorithms are implemented using Matlab and Java language, and combined with the learning behavior analysis model to analyze the learning behavior [18] in the learning process. For example, learners’ browsing status, watching videos, and completion of interest tasks, etc., using the MOOC platform as a research object, summarizing the actual status of learning, and finally analyzing the results and feeding back to learners, teachers, education researchers and Platform managers to provide application effects and inspiration.

The number of visits is the number of times to view the pages belonging to the platform. Including learning interface and non-learning interface. The learner's access to the learning page is to access the learning interface from mobile devices and web pages to learn resources such as videos, PPTs, and exercises. Statistics show that, the concentration of learners and the utilization rate of the platform are also very high.

The course content is to select the relevant courses of the computer under the platform, and each course online corresponds to a different activity type. Each time a learner learns a lesson, he must complete the corresponding series of activities. Figure 3 shows the summary after learning each lesson.

![Completion of interest assignments](image)

**Figure 3.** Completion of interest assignments

The experimental results prove that the number of people interested in computer-related courses completed more than 50%, the highest is 80%. In this way, it is possible to recommend the content related to the course to the students in order to achieve the purpose of extracurricular expansion.

5. Summary and outlook
In the era of big data education, learners' online learning behaviors are monitored and recorded throughout the process. Based on the monitoring and recording, the learners' behaviors are predicted and their learning preferences are analyzed, and personalized course recommendations can be made. This paper proposes a crawling strategy based on reinforcement learning by constructing a learning
behavior analysis model and based on focused crawlers, aiming to carry out analysis of related factors and prediction of preferences for online learning behavior. Through verification, the algorithm can effectively predict the learner's learning situation, provide a scientific basis for teachers to adjust the teaching content as early as possible and provide personalized guidance, and also expand the learner's extracurricular knowledge. Due to the slow development of education informatization in China, the development of online learning platforms is still immature. The direction of future research should also focus on the collection of relevant massive data and the development and design of behavior analysis systems to improve the versatility of online learning behavior analysis systems.

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