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Design of Course Analysis and Management System based on Decision Tree Algorithm

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ABSTRACT

With the development of technology, significant progress has been made in the informatization of higher education, and the management of games has greatly benefited from this progress. To better use this information, we propose a decision tree algorithm that can effectively analyze and manage games to improve the quality of physical education teaching. First, we delve into our data mining method - the C4.5 decision tree algorithm- and propose a complete course analysis, management system framework, and the corresponding database design. Then, we use ASP.NET as the development language, and with the support of SQL Server 2008 and Visual Studio 2010, we implement the system's functionalities. After testing, we find that the proposed games analysis and management system performs excellently in terms of runtime and accuracy, providing strong support for improving the efficiency and quality of game management.

Keywords: Decision Tree, Data Mining, Games Management, ASPNET, Management System, Course Analysis

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1. Introduction

In recent years, due to the rapid development of computer technology and the vigorous promotion of educational informatization, many large, medium and small schools are actively adopting advanced games, such as Blue Ink Cloud Classes, MOOCs, Smart Classrooms, Online Q&A, Online Classes, etc. With the development of IT, the discovery and application in the field of education have led to a surge of massive education management data. However, relying solely on traditional methods cannot effectively process the data, and the costs and resources required are considerable. Therefore, we should fully utilize the advantages of technology to free teach

-ers from tedious and inefficient work. Studying the characteristics of multiple courses and their impacts on each other, as well as exploring their inherent relationships and potential opportunities, is an important focus of R&D in education[1]. With the widespread application of technology, more and more information is being discovered, which is now referred to as data information discovery. It is a cross-disciplinary new field that crystallizes the latest developments in machine learning pattern recognition, databases, statistics, artificial intelligence, and other fields[2], and uses these crystallizations to process and analyze complex information. With the advancement of technology, data mining has been widely applied to all aspects of the teaching management system, especially in the reform of games. Zheng and others proposed a Business English practice teaching achievement evaluation scheme based on the ID3 decision tree, which provided important technical support for improving the effect and quality of games[3]. By applying the decision tree algorithm, this paper aims to deeply explore the data features of games and their relationships, compare them with students' grades, to obtain more accurate and complete personalized student information, and provide valuable data support for the teaching and management of games, thereby greatly improving the quality of teaching and management efficiency.

2. Related Work

With the advancement of technology, information excavation has been widely applied to various industries, thereby helping us better understand, identify, evaluate, interpret, infer, manage, and so on, and better serve multiple dimensions such as society, economy, and politics. Accompanied by the increasingly intense wave of educational digitization, how to use the latest digital technology to improve education quality has become increasingly urgent. Looking at the massive achievements of international learners, various methods can be used for in-depth exploration and research, such as aggregation, association rule discovery, neural networks, genetic algorithms, nearest neighbor methods, classification rule discovery, and decision trees [4], to meet the needs of today's society. Research shows that compared with traditional analysis tools, decision tree data mining has more straightforward advantages because it uses a tree-like structure like a tree model, which can effectively test and evaluate the values represented by attributes. Chen C and others believe that through the use of decision trees, the assessment scores of university graduates can be effectively predicted[5]. This not only can effectively improve the employment situation after university graduation, but also help companies implement effective management strategies more effectively, and make more effective use of large-scale human resources to achieve better educational benefits. By deeply analyzing potential, vague, and visible information, students' behavior can be more accurately and comprehensively grasped, so that teachers can make timely feedback on classroom content, teaching methods, curriculum settings, etc. according to the actual situation, thereby improving students' academic level. Rizvi and others use decision tree algorithms to collect information about children's English comprehensive ability, academic fields, teachers, females, age, parental history, occupation, religion, etc., starting from the academic performance of children from two universities, and use the second year's academic performance to infer the overall trend of the third year's academic performance [6]. The second case study re-examined the learning situation of the Asian Institute of Technology (AIT), by analyzing factors such as students' college history, GPA scores, marital status, national income and expenditure, age, females, TOEFL scores, etc., as well as individual differences in students, they finally figured out their future development trends. An important project of ChenC uses decision tree technology to analyze large amounts of data from a macro perspective, thereby more accurately assessing the comprehensive quality of university graduates and providing strong support for their future career development [5]. Through the research Zhang proposed a novel learning model based on decision tree learning, which can effectively predict the learning situation of some universities in Ethiopia[7]. The model uses the C4.5 decision tree learning algorithm and constructs five classification rules to identify learners' learning performance better

and help them complete their studies [8]. Diao uses educational data mining technology to establish a reliable classification model for accurately evaluating students in universities and society, especially those at a lower level [9], thereby providing an effective reference for management in universities and society and better guiding management in universities and society, promoting the development of universities and society. Through decision tree technology, we can combine students' final assessment results with their daily activities, assessment content, assessment expectations, assessment results, and expected assessment results to evaluate the final assessment results more accurately. Through the research and analysis of domestic and foreign-related papers, using data mining-related technology as a guide for educational work can help to improve the effectiveness of vocational colleges' education and teaching work and the quality of related course teaching [10]. Therefore, integrating data mining technology with education and teaching will inevitably become a future trend in education.

3. Decision Tree Techniques and Methods

3.1 Data Mining Techniques

With data mining techniques, we can understand vast amounts of information, enabling the implementation of our business strategies. This approach generally involves the collection, organization, and classification of large-scale information to predict future trends more effectively. Furthermore, this information technology supports rapid, accurate prediction and evaluation of complex information, providing critical support for the development and growth of a business [11,12]. Practical data mining can be achieved Through classification, aggregation, regression, relationships, and sequential patterns. The basic architecture of these models can be described with reference to Figure 1.

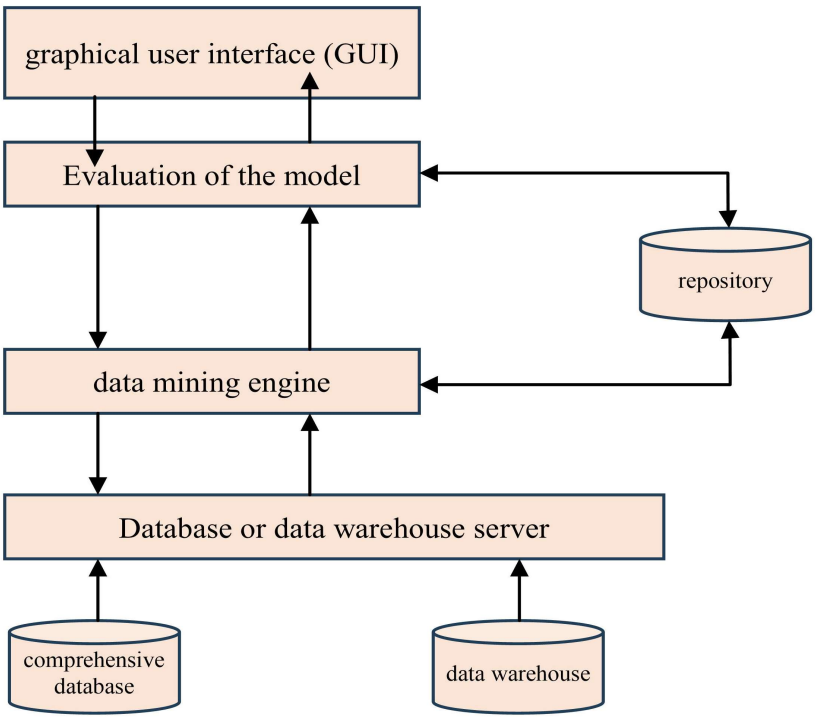

Figure 1. Data Mining System Architecture

3.2 C4.5 Decision Tree Data Mining Technique

$$(S) = -\sum_{j=1}^{m} \frac{|S_j|}{|S|} \log_2 \frac{|S_j|}{|S|} \quad (1)$$

In this context, S represents a set of training data, m represents a set of subsets, $|j|$ denotes the number of samples in the *jth* subset, and $|S|$ signifies the total number of samples in the subset when partitioned. By partitioning through attribute A, we can represent the information gain of the sample set as:

$$(S, A) = E(S) - E_A(S) \quad (2)$$

In this formula, $E(s)$ represents the entropy of the information, and $Ea(s)$ represents the entropy of information classified according to attribute A. By partitioning through the attribute A, we can describe the gain ratio of the sample set in the following way:

$$(S, A) = \frac{InfoGain(S, A)}{SplitInfo_A(S)} \quad (3)$$

In the execution phase of the C4.5 algorithm, a top-down PEP (Pessimistic Error Pruning) pruning method is adopted, namely l10l. Its pruning requirement is: *ErrorMean+ErrorSTD e"ErrorMean* must be greater than or equal to *ErrorMean*. In this formula, *ErrorMean* represents the square root of the error rate of each leaf node of each subtree, and *ErrorSTD* refers to the square root of the error rate.

3.3 Building a Decision Tree Model

Building a decision tree model is the focus of this study. To this end, we used Python's data analysis tools and Jupyter and other related decision tools and algorithms to construct a Cart decision tree. The main reasons for this are as follows: We study the construction of decision trees using Jupyter software and Graphviz software on the Python platform [13,14]. Jupyter (JupyterNotebook) aims to provide an easy-to-use tool that can quickly generate, write, maintain, update, manage, and compare with other software to meet our needs better. Jupyter has multiple language features, such as syntax highlighting, indentation, and tab completion, making it easier to access. It also provides a fast, efficient interface for quick access and use. Another important resource, Graphviz, comes from AT&T Labs and is specifically responsible for creating DOT language charts. We put them into Jupyter to better implement decision tree visualization. We can effectively construct decision tree models by using multiple algorithms such as Pandas, Sklearn, Pydotplus, and Graphviz. In particular, the combination of Pydotplus and Graphviz makes the visualization of decision trees more efficient, and they can also achieve a more intuitive representation of decision trees through the Python interface. After an in-depth comparison, we finally decided to use the decision tree as our data mining method. Decision trees have many advantages, such as being easy to master, observe, and abstract various classification methods, and their computational efficiency is very high, suitable for dealing with various incomplete data. Therefore, we consider the decision tree to be the best data mining method [15]. The construction of a decision tree model is not only limited to the ID3, C4.5, C5.0, and CART four algorithms, and the C5.0 algorithm pays more attention to the optimization of multi-branch trees. It selects the nodes and separation points of the decision tree with the optimization of data gain as the standard, and utilizes the advantages of the "reduce-error" and "reduce-loss" methods to effectively prune the decision tree, thereby further improving the accuracy, capacity, and expansion of the model. The CART algorithm has an essential difference from traditional classification algorithms. The CART algorithm is based on a binary tree structure. It uses the principle of the Gini gain index to determine the nodes and splitting points. Its

pruning algorithm mainly has the "minimum cost-complexity" and "loss matrix" methods. Therefore, the CART algorithm can effectively deal with complex data sets; whether it is analysis or prediction, it can play its advantages. After in-depth analysis, we used the CART decision tree algorithm to simulate the various factors affecting basketball learning effectiveness.

4. Experimental Design and Results Analysis

4.1 Design of the Basketball Course Analysis and Management System

In response to some difficulties often encountered in campus sports teaching management work, by using advanced information technology tools and appropriate data mining methods, we can intelligently count and analyze a large amount of information related to basketball sports and then realize the query and analysis of students' basketball performance. Utilizing this system, we can not only quickly and accurately carry out statistical analysis of course scores, such as score ranking and retrieval, etc., but also plan basketball course activities reasonably according to the students' various sports scores to suit their interests and actual physical fitness, thereby enhancing students' enthusiasm for participating in basketball courses, and finally achieving the perfect combination of basic education and individualized education. Using SQLServer 2008 as the foundation, our system database can effectively collect, integrate, manage, display, feedback, evaluate, report, and other forms of information to better meet the needs of basketball classrooms. The development team of this article used the Microsoft Windows 7 operating system to complete this project. It used the Simplified Chinese Enterprise Edition of Microsoft SQL Server 2008 to handle all data. ASP.NET was used as the programming language, and the BS framework was used for programming.

4.2 System Test Score Analysis

Through data mining analysis of the basketball course scores of students in 20 classes, we found a training set of data for 735 students, including Figure 2. This data can serve as the basis for further research and help us better understand these students' performance.

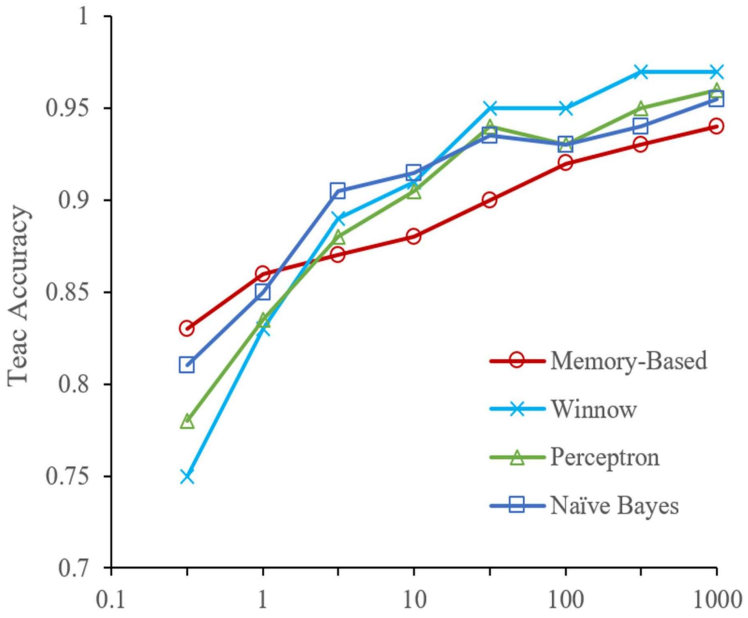

Figure 2. Training Set Data

After multiple functionality and performance testing rounds, we found that our basketball teaching analysis and management system performed excellently. It runs stably, offers an excellent user experience, and allows users to easily access more resources, such as the personal profile displayed in Figure 2. Moreover, we found that compared with the teaching results in the data analysis management system using the ID3 algorithm, our system shortened the information processing time by about 12%, and the accuracy of the data set also increased by about 8%. According to Figure 2, we found that there was no significant improvement in the students' physique and body shape after conducting experiments with the basketball teaching method. However, after the 15m x 17 times shuttle run competition, their performance slightly declined but improved in other aspects. Through in-depth communication with teachers, we found that after 8 weeks of decision tree-style teaching, the student's physical and mental health improved significantly. However, this approach also led to a decrease in their training volume, thereby damaging their stamina and leading to slight shortcomings in the 15m x 17 times shuttle run performance. Using Matlab Simulink software, we established a simulation experiment to evaluate the reliability of the college student basketball test data processing system based on the decision tree algorithm. We adopted two algorithms and tested their classification accuracy through this simulation experiment. In this study, we collected the basketball test data of 2000 college students. The capacity of this data is about 500MB, and it was collected in the first quarter of 2020. Our focus was on collecting data on various sports related to basketball; for specific details, please refer to Figure 3.

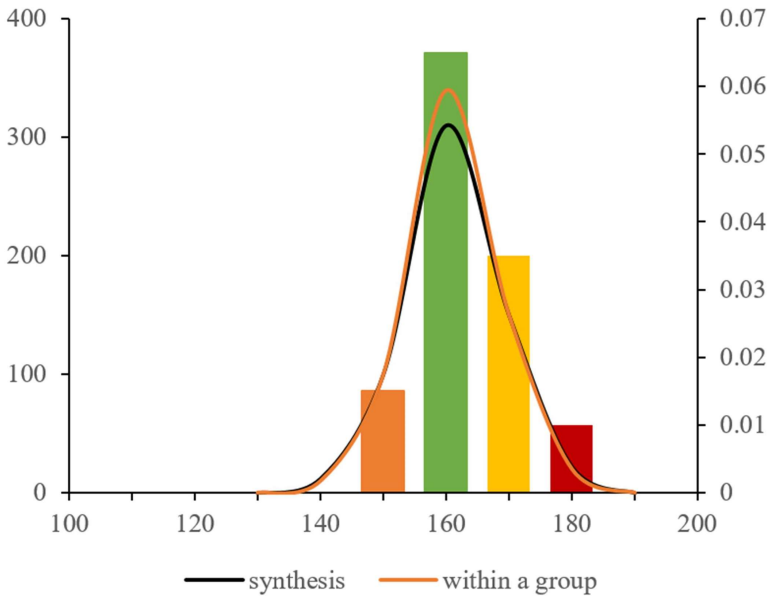

Figure 3. College Student Physical Fitness Test Data

According to the results of Figure 3, the traditional decision tree algorithm exhibits significant output changes, especially the ID3 decision tree algorithm, which has more robust output and stronger search, evaluation, and adjustment functions, thereby effectively improving the educational effect of college physical education courses. After applying the ID3 decision tree algorithm, we found a significant increase in the efficiency of processing college students' physical fitness test data, and its application prospects are extensive. Therefore, we recommend applying this algorithm in other related fields and evaluating its efficiency through actual cases. Research has found that decision-tree basketball courses can greatly enhance students' independent thinking and sports

skills compared to traditional teaching methods. In the three experiments of this study, we found that compared to the control group, the use of the decision tree basketball course yielded the best results, with an average effect of 5.738, and a p-value less than 0.01, indicating that this method is very effective in promoting students' independent thinking and movement.

5. Conclusion

This article will explore a basketball teaching method based on the decision tree algorithm. We will focus on students' learning situations and discuss how to effectively use the decision tree algorithm to help students complete their learning tasks better. We will use the C4.5 decision tree algorithm to explore students' learning situations. By using ASP.NET as a coding tool, SQL Server 2008 as a database system, and Visual Studio 2010 as a development environment, our research shows that through 8 weeks of *s & TBL* classroom activities, our students' leg and foot muscles have been strengthened, and they also control the basic actions of basketball more proficiently. Furthermore, through speed testing, we found that they can adjust body balance faster and use pivot and quick step techniques more effectively to reduce the number of turns. By using the decision tree algorithm, we can better evaluate the performance of the 5.8m x 6 times shuttle run. This method can collect a lot of data and compare it with actual performance, thus better evaluating learners' performance. This is very important for improving basketball classes' teaching quality and management level.

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