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Computer-Aided Design AND APPLICATIONS

The Design of PE Course Key Score Information Analysis and Tutoring System Based on Intelligent CAD

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Abstract: With the continuous advancement of teaching information construction in colleges and universities, a large number of teaching information resources have been produced in the teaching management of physical education courses. This paper designs a score management and analysis system in order to carry on the data mining to the information data to improve the physical education teaching quality and proposes the improved decision tree algorithm in the physical education course analysis and management application. Using students' grades to get the correlation between courses helps teachers and teaching administrators to provide students with grade warning information. This paper improves the C4.5 decision tree algorithm and constructs the decision tree model and database. The test results show that the improved PE curriculum key score information analysis and management system has a good performance in terms of conversion rate and increase rate, which improves the system's data processing ability and provides a scientific basis for improving the efficiency and quality of PE curriculum management.

Keywords: Intelligent CAD; Decision Tree Algorithm; PE Curriculum; Data Mining; Grade Information Analysis; Tutoring System Design
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1 INTRODUCTION

With the continuous progress of computer technology and the continuous development of teaching normalization, colleges and universities nationwide have begun to gradually popularize various modern teaching equipment and related management systems [1]. The development and implementation of information-based teaching also produce a large amount of teaching management data, and a large amount of data not used will cause a huge waste of resources. However, the use of manual means to analyze and process will produce a large amount of time and labor costs, so it is necessary to use computers to liberate teachers from a lot of complex and repetitive work [2]. According to the attributes and requirements of different courses, it has

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become the research direction and hot spot of various course teaching management systems to extract the inevitable relations and potential relations in these data.

As an interdisciplinary discipline, data mining brings together the research results from machine learning, pattern recognition, databases, statistics, artificial intelligence, and other fields [3]. Large-scale popularization of computers produces massive data. Data mining processes and analyses massive data by integrating the technical achievements in the above fields. At present, the application of data mining in the teaching management system is in the initial stage; the related research in the field is small, so the application in physical education curriculum teaching case less, Zhang W is put forward based on ID3 decision tree business English practice teaching effectiveness evaluation scheme, the existing physical education curriculum grade management system has the function of no performance analysis, It cannot provide powerful technical support for improving the efficiency and quality of physical education teaching [4]. Logical regression, classification of decision trees, and analysis of association rules in data mining technology have also been widely used in the research of teaching management in colleges and universities [5]. Fiarni C et al. uses data mining to conduct in-depth analysis and research on a large number of data related to students' learning behaviors and finally evaluate students' learning effects. In this respect, he has made great contributions to the field of education [6]. Song Y Y et al. used decision tree technology to study the factors related to the recovery rate of the questionnaire and achieved good results [7]. The association rule algorithm proposed by Jin M et al. includes three algorithms for parallel mining: frequency distribution algorithm, candidate set distribution algorithm, and data distribution pattern algorithm [8]. Huang Q et al. used the K-means clustering algorithm to classify the grades of college students, constructed the decision tree with the R-C4.5 algorithm, extracted the classification rules, and then analyzed the relationship between the grades of each course and the overall evaluation of students [9].

The transformation of higher education from elite to popular makes the scale of colleges and universities expand year by year. All colleges and universities pay attention to the improvement of teaching quality and then cultivate technical talents with high levels and strong ability to meet the needs of society. Each university uses computer and database technology to establish the corresponding information system; however, along with the university enrollment, student numbers will increase, and the information in the information system will also gradually increase. Teaching tasks occupy a dominant position; the quality of teaching will directly determine the comprehensive strength of a university. Students' grades directly reflect the quality of teaching. In the performance management and analysis system, the function of the performance early warning is to prevent the occurrence of problems as far as possible. Teachers or teaching administrators can also find problems in time and adjust the management methods and teaching methods so as to help the students who have difficulties in learning. With the increasing enrolment of higher vocational colleges, improving the teaching quality more effectively and cultivating excellent skilled talents for society have become more and more of a concern for colleges and universities.

2 IMPROVED DECISION TREE ALGORITHM

With the continuous progress of information technology, the requirements for data processing in various fields are increasingly high, and the deep analysis of data is often impossible for the traditional data management system. Because the general database management system only provides some simple processing functions of the data, if you want to find the inherent connection between the data or find its rules, it is extremely difficult to deal with the massive data. Since data is becoming more and more important in decision making, we especially want to find a way to assist in processing a large amount of complex data, and then discover the valuable information hidden behind it, and finally serve for decision making, and at the same time reduce the burden of labor.

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2.1 Decision-Making Tree

A decision tree is a tree-shaped prediction model, which is a hierarchical structure composed of nodes and directed edges. There are three types of nodes in the tree: root, inner, and leaf. The decision tree has only one root node, which is the set of all training data. An internal node in the tree represents a test on a feature property, and the corresponding branch represents the output of this feature property on a range. A leaf node holds a category, and the data set with the category label is the category to which the instance belongs. A decision tree is a directed and acyclic tree, which is composed of decision nodes, branches, and leaves. Each internal node in the tree represents a test point, a branch of the tree corresponds to a test output, and a leaf node represents a class distribution. A decision tree is a recursive division from the top down. It adopts the top-down divide-and-conquer method, and its basic algorithm is essentially a greedy algorithm [12]. For each node of the decision tree, each decision node represents a problem or decision corresponding to the attribute of the object to be classified, and each leaf represents the possible classification result. By traversing the decision tree from top to bottom, each node is tested, and the test output results on each node are formed into different branches and finally transmitted to a leaf node in a certain way. Several variables can be used in this process to determine the category. Starting from the root node, it is found that each non-" leaf node "finds an attribute in its corresponding sample set to test the sample set, and the training sample set is divided into several subsample sets according to different test results. Each subsample set forms a new "leaf" and repeats the process for the new "leaf" so that the loop continues to a specific termination condition. The key to constructing the decision tree is how to divide the sample set and the selection of test attributes.

Decision tree technology, as a common information theory method in data mining, can achieve the purpose of prediction by classifying the data through the study of this potential information and then allowing the leadership to make a decision to provide a certain basis. In the mining process, the first thing to do is to determine the object of mining, and then according to its ready to the data, use the appropriate algorithm to prepare the depth of data mining, based on the depth of mining the data for further analysis. Finally, it is concluded that the results of the analysis data for the manager's decision-making process provide valuable analysis data. Different decision tree algorithms adopt different techniques. The decision tree uses a top-down recursive method to compare and evaluate the attribute values of internal nodes of the decision tree and to judge the branches downward from this node according to different attribute values. One of the biggest advantages of a learning algorithm based on a decision tree is that it does not require users to master a lot of basic knowledge in the learning process. The decision tree construction process is divided into two steps: tree building and pruning. The first step is the tree-building stage. Firstly, some training data will be selected, and a decision tree will be built using a breadth-first recursive algorithm until each leaf node belongs to the same class. The second step is the pruning stage. It uses the remaining data to test the generated decision tree and correct errors. Finally, it prunes and adds nodes to the decision tree until a correct decision tree is established. The tree-building algorithm of the decision tree is a recursive process, and finally, a decision tree is obtained, while pruning can reduce the noise data. The classification accuracy method is a recursive process, and finally, a decision tree is obtained. The schematic diagram generated by decision tree data mining is shown in Figure 1.

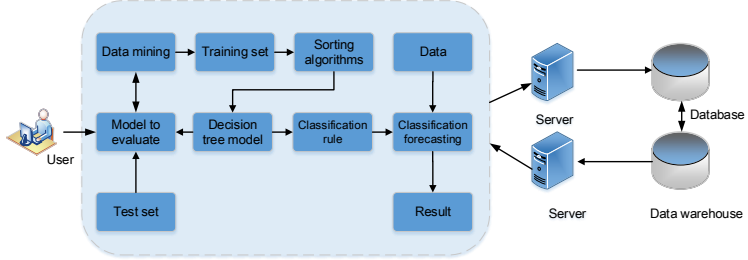

Figure 1: Decision tree data mining generates a schematic diagram.

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2.2 The Improved C4.5 Algorithm

The C4.5 algorithm is not only the successor algorithm of the algorithm but also the basis of many other algorithms. The algorithm performs well in terms of precision and speed in the whole decision tree algorithm. In addition, the processing of continuous attributes is supplemented on the basis of overcoming the defect of large information gain value of attribute selection bias in selecting attribute values [13]. The concrete method to discredit the continuous attribute value is to use the information gain rate to select the attribute and avoid using the information gain to select the attribute so as to improve the operation speed.

Let E be a finite vector space of n dimensions, F denotes a finite set of discrete symbols, and the element E in e is called an example. Assuming that YE and NE are two example sets of E and that the sizes of positive example set yi and negative example sets ni in vector space E are y and n, respectively, then on vector space E, the probability of positive and negative examples in the classification probability E of the decision tree for any sample set is consistent.

It can be concluded from the formula that a decision tree can judge the information required by a sample set according to the correct category. Let the number of positive examples and negative examples in E be respectively yi and ni, then the calculation formula of the information required by E is:

$$I=\frac{y_i}{y_i+n_i}\lg\frac{y_i}{y_i+n_i}-\frac{y_i+n_i}{y_i} \tag{1}$$

Therefore, the information entropy of attribute A as the root node is expressed in Equation (2):

$$E(A)=\sum_{i=2}\frac{y_i+n_i}{y}I \tag{2}$$

Formula (3) can be obtained by simplification:

$$E(A)=\frac{y_i}{y_i+n_i}\sum_{i=2}\frac{y_i+n_i}{y}\lg\frac{y_i}{y_i+n_i}-\frac{y_i}{y_i+n_i}\sum_{i=2}\frac{y_i+n_i}{y_i} \tag{3}$$

Let the training set be a constant and assume that the function satisfies Equation (4).

$$E(A)=\sum_{i=2}\frac{y_i+n_i}{y}\lg\frac{y_i}{y_i+n_i}-\sum_{i=2}\frac{y_i+n_i}{y_i} \tag{4}$$

Due to the equivalent infinitesimal principle, the formulation can be simplified to Formula (5):

$$\lg\frac{y_i}{y_i+n_i}\approx\frac{y_i}{y_i+n_i} \tag{5}$$

After the information entropy formula is simplified, the information splitting formula is:

$$E(A)=\sum_{i=2}\frac{y_i}{y}-\sum_{i=2}\frac{y_i+n_i}{y_i} \tag{6}$$

Then, the splitting information is calculated according to the new formula, and the attribute with the highest information gain rate obtained by calculation is taken as the root node.

2.3 Improved Data Sample

Traditionally, when the decision tree classification algorithm is carried out, the data samples are first divided into a training set and a test set. The training set is used to generate the decision tree, and the test set is used to detect the accuracy of the decision tree conclusions. It can be

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seen that the quality of samples is very important and can affect the accuracy of decision tree classification to a large extent. Therefore, in the process of research, if the classification is only conducted once and a batch of training sets are used to generate the decision tree, it is likely to be difficult to achieve optimal classification accuracy. Therefore, this paper improves the traditional decision tree classification algorithm. In the initial state, the data set is randomly selected to obtain the training set, and the test set is the remaining sample, which is used to test the precision of the decision tree. The decision trees built each time are compared, and the samples are adjusted for errors. After many tests, the decision tree with the highest accuracy is selected as the final decision tree for use in the system. Specific algorithm steps: 1) Suppose there are N samples, and each sample contains M attributes; 2) N samples are randomly selected as the training set, and the remaining samples are the test set. 3) According to the C4.5 algorithm, the training set N is used to generate decision tree T and sample iteration counter; 4) Screening the samples in the training set N, replacing the samples in which the characteristic attributes cannot meet the requirements with the same number of samples in the test set to produce new test sets and training sets.

2.4 Data Mining Process

The data mining process of this system is mainly analyzed in accordance with the process shown in Figure 2, which belongs to a cyclic process.

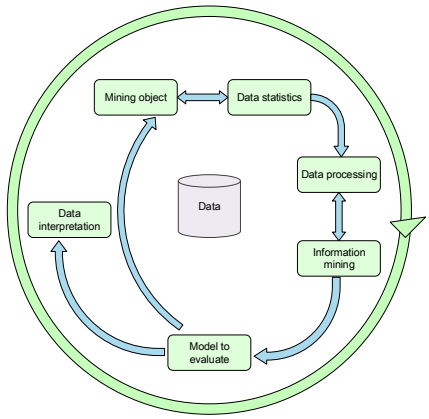

Figure 2: Schematic diagram of the data mining process.

After the students' scores required for the systematic analysis were exported from the educational administration department, we found that the data structure and the form of data expression were very simple. The data could be used directly without processing, and it could complete the sorting of single index data, average value, and other preliminary statistics and queries [14]. However, if we want to analyze the specific reasons for its influence on the level of students' examination results, we need to carry out a deep analysis. The data processing process for student's test scores is as follows: (1) To determine the mining object and obtain the relevant information of students, the first step is to clarify the purpose of data mining and determine the corresponding mining object; (2) Due to the collection and acquisition of students' grades and relevant information, we found that their forms and associated data presented complex structural features, and the file format was not uniform; (3) After data reprocessing is completed and high-quality data sets are obtained, data mining can be carried out. Data mining is the core of knowledge and information mining; data mining type, according to the system, should eventually determine the function, and on this basis, to choose the appropriate algorithm, a specific algorithm will get the data set after purification treatment on iterative search, then a set of specific data or pattern. The application of performance mining technology can effectively and scientifically excavate the valuable knowledge

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hidden behind the performance data [15-16]; (4) Explain and evaluate the various patterns discovered after data mining or the data set obtained from mining. After filtering out the redundant or irrelevant pattern data, the information to be presented to the user is finally obtained. If the discovered pattern does not support the actual needs of the users, the current discovery process can be dismantled, and the mining and filtering can be carried out again at the previous stage. It can be seen that the steps of data mining are connected in series with each other by multiple sub-steps and go through a cyclic process of repeated human-computer interaction.

3 PHYSICAL EDUCATION CURRICULUM ANALYSIS AND MANAGEMENT SYSTEM DESIGN

3.1 System Design Objectives

The performance information data mining system aims to provide decision support for the management of key performance information. The design goal of the system is to carry out data mining on the large amount of data accumulated in the database, and the management staff needs to conduct basic data analysis and data management on the student performance data information through the system [17-18]. Students use the performance information system for analysis and visual display in order to grasp the student information in time. In order to adapt to the current information management system in colleges and universities and take into account the advantages of system development, the system adopts the hybrid mode for system design, as shown in Figure 3.

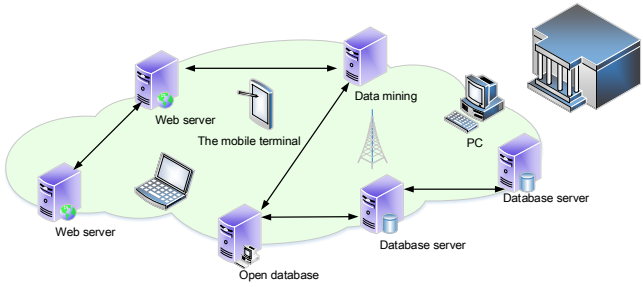

Figure 3: Mixed mode network diagram.

3.2 System Overall Framework Design

In view of the problems often encountered in the process of school physical education teaching management, this paper analyzes its functional requirements and data sets and combines them with advanced data mining methods; it can intelligently statistics and analyze a large number of physical education curriculum-related data, so as to complete the query and analysis of students' physical education curriculum results. Using this kind of system can not only quickly and accurately carry out the statistics and analysis of the course results but also, according to the students' different sports results, reasonably plan the sports course activity table so as to fit the student's interests and hobbies and actual physical quality, so as to strengthen the enthusiasm of students to participate in the sports course activities. Finally, the organic combination of basic teaching and personalized education is realized [19]. Based on the five modules of the system structure framework design and the corresponding program implementation mainly includes system information management, basic data management function, performance data management function, performance mining and analysis function, and database, into the realization of a complete performance management and analysis system. The overall framework of the physical education curriculum analysis and management system is shown in Figure 4.

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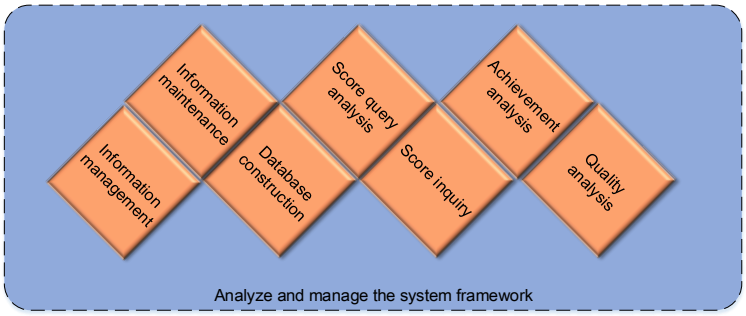

Figure 4: System framework structure diagram.

System management is mainly divided into user login, user logout, system data restoration, system data backup, user information management, and system logging. In order to ensure the legitimacy of user operations, users can log in and log out of the system through this function module. System data backup and data restoration in order to ensure the security of the data in the database of the system through the execution of the set of relevant statements to achieve the function of data operation. The result data management module includes querying the system subject data, managing the test result data, exporting the test result data, and printing the test result information. The achievement management module mainly analyzes the statistics and data of the examination results data. In addition, the module can also carry out statistics and analysis of early warning data.

3.3 Database Design

The database system is a system composed of a database and its management software. It mainly includes the operating system, utilities, and database management system. The data administrator is responsible for creating, monitoring, and maintaining the entire database so that the data can be used effectively by anyone with access [20]. College performance management and analysis system after the needs of the system analysis, to determine the entity objects are: department information, class information, student information, teacher information, user information, course information, performance information, performance details of information, warning information, teaching information and other entities. The performance management and analysis system is shown in Figure 5.

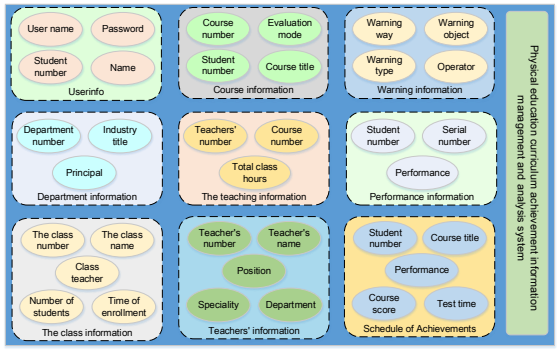

Figure 5: Database system diagram.

3.4 Entity Relational Database

In a database, an entity corresponds to a noun. Identifiable objects and entity relations mainly include three different relationships: one-to-one, one-to-many, and many-to-many [21]. Each

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entity contains a number of attributes. Attributes are properties for which things are to be stored. Entities placed in the database are derived from the activities to be performed using the database and can generally be represented by the entity relationship diagram of the database to express the entity relationship.

Usually, in an E-R diagram, the rectangle is used to represent the entity part, a diamond is used to represent the connection between entities, and then numbers or letters are used to represent the connection between entities. If the two are one-to-many, more parts should be set as the foreign keys of the fields of the other party. If it is many-to-many, the primary key of the two entities is set as the foreign key of the other party in the entity relationship. E-R diagram of the entity relational database of the system is shown in Figure 6.

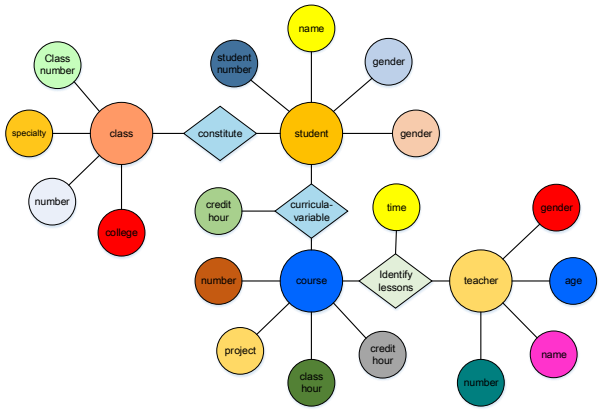

Figure 6: E-R diagram of system database.

4 SYSTEM IMPLEMENTATION AND TESTING

4.1 Improved C4.5 Algorithm Verification

In this paper, we use the IRIS dataset to verify the improvement of the C4.5 algorithm in the classification accuracy of the decision tree. IRIS data set is a kind of classical classification experimental data set. The dataset contains 210 data sets, divided into three categories, with 70 data in each category and each containing four attributes. In order to verify the experimental results of the improved algorithm, some reserved attribute values are missing. Firstly, the discrete values of the data are preprocessed by transformation. According to the formula, the information gain rate of the petalwidth attribute is the highest, so it is selected as the root node of the decision tree. Through experimental comparison, it found that the size of the improved algorithm in the decision tree and leaf node number is a great improvement over the traditional C4.5 algorithm, and then from the analysis on the instance number, the correct classification rate is also improved, improved the accuracy of the decision tree classification, experiments prove that the improved C4.5 algorithm is suitable for use in a missing attribute values more samples. The comparison figure is shown in Figure 7.

4.2 Failure Rate Test Results

In the test, the test scores of students from a school were selected as the data object of this experiment. There were 16 classes, and 11,585 pieces of data were collected. The test scores of students in grade 10 were selected as the data object of result verification. The system test results reflect the system function, performance, and the integrity and correctness of related business, and the actual results of the system are consistent with the requirements. Through the test, this

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study has reached the pre-design need to contain 3984 items. The statistical distribution of failing courses is shown in Figure 8, which clearly shows the proportion of failing courses.

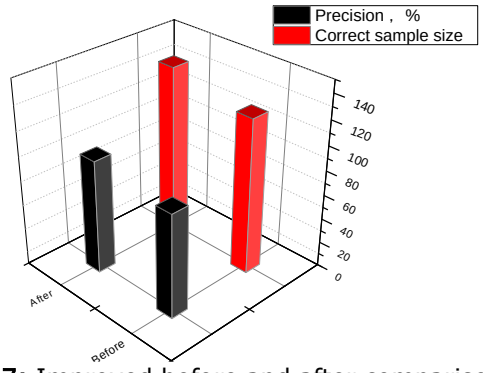

Figure 7: Improved before and after comparison.

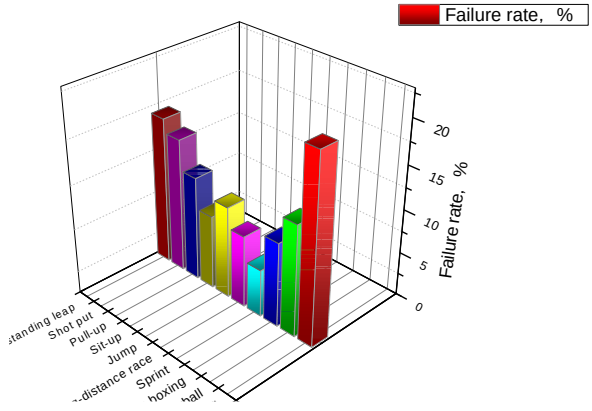

Figure 8: Failing statistics in sports.

As can be seen from the figure above, the failure rate for basketball was 21.3%; The rate of failure in volleyball was 12.7%; The failure rate of long boxing was 9.6%; The rate of failure in sprints was 5.4%; The rate of failure in long-distance running events was 8.2%; The failure rate of standing long jump was 10.5%.; For girls, the failure rate for sit-ups was 8.4%. For boys, the failure rate for pull-ups was 11.9%. The failure rate of the shot put was 15.3%. The number of failed courses is mainly concentrated in basketball sports, which is more common in this major.

4.3 The Distribution of Grades After Improvement

By analyzing the students' performance from different angles, the system can realize the statistics of the class pass rate ranking of physical education courses and compare the pass rate of each class according to the physical education course items. The C4.5 algorithm is improved to mine the professional courses that students have learned. Because the number of professional courses that students have learned is relatively large, the relationship between the performance of a course and its leading courses can be analyzed according to the establishment of a decision tree model. According to students' scores, the distribution of scores in the same semester in recent years can be statistically analyzed, as shown in Figure 9.

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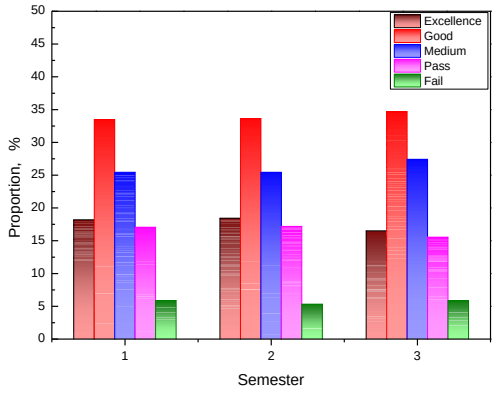

Figure 9: Performance distribution chart.

4.4 Conversion Rate and Increase Rate

In view of the warning function of the system, the results of the performance analysis are elaborated from the conversion rate of the warning students in different semesters, the changing trend of the warning students in different grades, and the status quo of the warning courses, as shown in Figure 10.

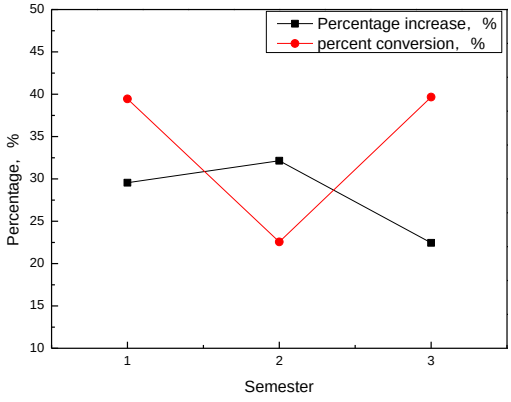

Figure 10: Performance distribution chart.

The number of early warning students will change over time, with 39.45% of them transformed from early warning students to normal students, among which 88 are still early warning students, and 29.55% are new early warning students. Generally speaking, as the school has paid more attention to the work of early warning students, the conversion rate has been improved to a certain extent. Moreover, it has been found that almost all students who cannot graduate normally are early warning students. Thus, it can be seen that the course results that affect the graduation of students can be an early warning.

The correlation relationship obtained by mining the decision tree algorithm is helpful for the performance warning of college students. The data information and total amount obtained are limited. Although the results obtained cannot draw a perfect conclusion, there is a big gap between the number of people who put forward the warning every academic year and the number of people who cannot graduate normally. However, the results of the early warning courses were consistent with those of the students who did not graduate normally. Through the test of the actual data, the conclusion of the early warning of college performance is made: through data mining, the course

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correlation relationship can be obtained, the future course performance trend of students can be predicted, and the early warning will not be normal, and the graduated students can bring the correct early warning results. That is to say, the result analysis system has a certain practical application ability.

5 CONCLUSIONS

This paper is based on a decision tree algorithm in data mining to perfect the information analysis and management system to the result, and establish the students' learning situation information, complete the analysis of student achievement to construct a decision tree model, finally, after the use of pruning techniques to complete the decision tree pruning, the formation of the decision tree is adopted the course of the relationship between the classification rules. The results show that the application of the decision tree algorithm is very effective, at least for the prediction of student achievement. This paper uses the C4.5 algorithm in the decision tree based on its own existence of complex operation shortcomings. The information gain rate is used to select the attributes, and the mathematical transformation is carried out to change the logarithmic operation into four operations. Then, the computational complexity of information entropy and information gain rate is reduced. Calculate the split information according to the new formula; the attribute with the highest information gain rate obtained by calculation is taken as the root node, and the entropy value only needs to be calculated once. Determine the order of each node and then generate the decision tree. Solve the problem of repeated calculation existing in the original algorithm. It improves the performance of system data analysis. Through the analysis of the experimental results of the system, the analysis of student performance, and then verify the feasibility of the algorithm, the analysis of students' early warning, through the change of the number of early warning students in each semester, and then compare with the actual data, and then show that the algorithm can play a role in the early warning of student performance.

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REFERENCES

[1] Chen, C.; Geng, L.; Zhou, S.: Design and implementation of bank CRM system based on decision tree algorithm, Neural Computing, and Applications, 33(14), 2021, 8237-8247. https://doi.org/10.1007/s00521-020-04959-8

[2] Moon, D.; Im, H.; Kim, I.; et al.: DTB-IDS: an intrusion detection system based on decision tree using behavior analysis for preventing APT attacks, The Journal of Supercomputing, 73(7), 2017, 2881-2895. https://doi.org/10.1007/s11227-015-1604-8

[3] Ramya, K.; Teekaraman, Y.; Kumar, K. A. R.: Fuzzy-based energy management system with decision tree algorithm for power security system, International Journal of Computational Intelligence Systems, 12(2), 2019, 1173-1178. https://doi.org/10.2991/ijcis.d.191016.001

[4] Zhang, W.: Research on English score analysis system based on improved decision tree algorithm and fuzzy set, Journal of Intelligent & Fuzzy Systems, (Preprint), 2020, 1-13. https://doi.org/10.1155/2022/8687879

[5] Hamoud, A.; Hashim. A. S.; Awadh, W. A.: Predicting student performance in higher education institutions using decision tree analysis, International Journal of Interactive Multimedia and Artificial Intelligence, 5, 2018, 26-31. https://doi.org/10.3390/app10113894

[6] Fiarni, C.; Sipayung, E. M.; Tumundo, P. B. T.: Academic decision support system for choosing information systems sub majors programs using decision tree algorithm, Journal of Information Systems Engineering and Business Intelligence, 5(1), 2019, 57-66. https://doi.org/10.20473/jisebi.5.1.57-66

[7] Song, Y. Y.; Ying, L. U.: Decision tree methods: applications for classification and prediction, Shanghai Archives of Psychiatry, 27(2), 2015, 130. https://doi.org/10.11919/j.issn.1002-0829.215044

© 2025 U-turn Press LLC, http://www.cad-journal.net

[8] Jin, M.; Wang, H.; Zhang, Q.; et al.: Financial management and decision-based on decision tree algorithm, Wireless Personal Communications, 102(4), 2018,2869-2884. https://doi.org/10.1007/s11277-018-5312-6
[9] Huang, Q.; Zhang, F.; Li, X.: A new breast tumor ultrasonography CAD system based on decision tree and BI-RADS features, World Wide Web, 21(6),2018, 1491-1504. https://doi.org/10.1007/s11280-017-0522-5
[10] Rajeswari, S.; Suthendran, K.: C5. 0: Advanced Decision Tree (ADT) classification model for agricultural data analysis on cloud, Computers and Electronics in Agriculture, 156,2019, 530-539. https://doi.org/10.1016/j.compag.2018.12.013
[11] Khalili-Damghani, K.; Abdi, F.; Abolmakarem, S.: Hybrid soft computing approach based on clustering, rule mining, and decision tree analysis for customer segmentation problem: Real case of customer-centric industries, Applied Soft Computing, 73, 2018, 16-828. https://doi.org/10.1016/j.asoc.2018.09.001
[12] Mistikoglu, G.; Gerek, I. H.; Erdis, E.; et al.: Decision tree analysis of construction fall accidents involving roofers, Expert Systems with Applications, 42(4), 2015, 256-2263. https://doi.org/10.1016/j.eswa.2014.10.009
[13] Lee, J. S.; AUC4. 5: AUC-based C4. 5 decision tree algorithm for imbalanced data classification, IEEE Access, 7, 2019, 06034-106042. https://doi.org/10.1109/ACCESS.2019.2931865
[14] Wang, H.; Wang, T.; Zhou, Y.; et al.: Information classification algorithm based on decision tree optimization, Cluster Computing, 22(3), 2019, 59-7568. https://doi.org/10.1007/s10586-018-1989-2
[15] Liu, X.; Li, B.; Shen, D.; et al.: Analysis of grain storage loss based on decision tree algorithm, Procedia Computer Science, 122, 2017, 0-137. https://doi.org/10.1016/j.procs.2017.11.351
[16] Luo, X.; Xia, J.; Liu, Y.: Extraction of dynamic operation strategy for standalone solar-based multi-energy systems: A method based on decision tree algorithm, Sustainable Cities and Society, 2021, 70: 102917. https://doi.org/10.1016/j.scs.2021.102917
[17] Jia, S.; Pang, Y.: Teaching Quality Evaluation and Scheme Prediction Model Based on Improved Decision Tree Algorithm, International Journal of Emerging Technologies in Learning, 13(10), 2018, 6-157. https://doi.org/10.3991/ijet.v13i10.9460
[18] Benkercha, R.; Moulahoum, S.: Fault detection and diagnosis based on C4. 5 decision tree algorithm for grid-connected PV system, Solar Energy, 173, 2018, 10-634. https://doi.org/10.1016/j.solener.2018.07.089
[19] Hoque, M. I.; Kalam, A. A.; Tuhin, M. A. H.; et al.: University students result analysis and prediction system by decision tree algorithm, Adv Sci Technol Eng Syst J, 5(3), 2020, 115-122. https://doi.org/10.25046/aj050315
[20] Gao C.; Elzarka H.: The use of decision tree-based predictive models for improving the culvert inspection process, Advanced Engineering Informatics, 47, 2021, 101203. https://doi.org/10.1016/j.aei.2020.101203
[21] Xu H.; Wang L.; Gan W.: Application of improved decision tree method based on rough set in building smart medical analysis CRM system, Int. J. Smart Home, 10(1), 2016, 251-266. https://doi.org/10.14257/ijsh.2016.10.1.23

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