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PERSONALIZED OPTIMIZATION OF SPORTS TRAINING PLANS BASED ON BIG DATA AND INTELLIGENT COMPUTING

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Abstract. In order to effectively improve the athletic performance of athletes and make their training more systematic, scientific, and standardized, the author proposes a personalized optimization study of sports training plans based on big data and intelligent computing. Based on the research on big data and intelligent computing, the author designs a human-computer interaction system using association rule mining algorithms, data fusion processing in sports training decision support systems, and improved Apriori algorithm frequent association rules. A sports training plan leveraging big data and intelligent computing was developed through experiments. The findings reveal that the author's enhanced Apriori algorithm exhibits a reduced reaction time when subjected to a minimum support threshold. Specifically, with a minimum support of 3.5, the execution time is under one second. This demonstrates that the improved Apriori algorithm can efficiently facilitate decision support for sports training regimes, offering valuable insights for athletes' physical conditioning. The research on personalized optimization of sports training programs, utilizing big data and intelligent computing, enables athletes to access real-time sports data, thereby enhancing their performance.

Key words: Big data, Intelligent computing, Sports, Training plan

1. Introduction. With the rapid progression of modern technology, the convergence of various disciplines has steadily increased. To effectively improve athletes' performance, incorporating computer technology support systems can make their training more systematic, scientific, and standardized. Presently, data mining technology is a major area of development in China and has been widely applied across many industries. By analyzing sports training methods using data mining techniques, we can develop decision-making systems that better optimize traditional sports training methods. The importance of digital physical training monitoring lies in its ability to monitor and analyze the training process in real-time and in detail. By configuring digital equipment, data such as exercise posture, muscle strength, and training energy range can be read. These data can not only help coaches and athletes provide timely feedback on speed, strength, endurance, agility, and coordination control abilities, but also enable the development of more scientific and personalized training plans based on these data [1]. Through digital technology, the training process of athletes can be monitored in real-time, problems can be identified in a timely manner, training plans can be adjusted, and training efficiency can be improved. Digital technology can monitor the training process of athletes in real-time, detect their physical condition in a timely manner, and prevent athletes from being injured due to overtraining [2].

Sports are an indispensable part of people's lives, and as future sports talents, the quality of their training is directly related to the development of the sports industry. However, traditional sports training methods have some problems, such as difficulty in evaluating training effectiveness and frequent sports injuries. Digital training monitoring utilizes modern technological methods to measure and analyze data in real-time during athletes' physical training, in order to monitor training quality and adjust the physical training process based on the data. For example, digital monitoring of strength training and resistance training, as well as other important aspects of physical fitness training, can be achieved through the intervention of big data technology to achieve digital and real-time monitoring. In high-level competitive training, "no monitoring, no training" has become a new concept and criterion. The training team will conduct data-driven monitoring, feedback, and optimization of techniques, tactics, physical fitness, condition, field, and command throughout the entire process, in order to achieve the transformation from traditional experiential training to information-based, digital, and scientific training [3]. In addition, by monitoring the training of top athletes in various sports

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around the world and monitoring the daily physical fitness of the general public, a large amount of data has been collected for analysis and comparison, and a reliable data analysis framework and system have been designed. This approach not only enhances the precision and efficiency of physical training but also aids coaches in understanding the training effects, revising training plans, and scientifically managing the training process. Sports encompass a broad range of disciplines, including humanities, sports science, and sports social science. The rapid advancements in computers and information technology, particularly in artificial intelligence theory and data mining technology, have established a strong theoretical foundation for scientific training and the implementation of advanced training methods. As training data accumulates, traditional statistical analysis techniques may fall short in effectively analyzing the data, making it challenging to identify suitable patterns to describe the correlations. Data mining, however, offers optimization methods for uncovering scientific patterns and correlations within extensive and complex training data [4].

2. Literature Review. Through digital technology, the training effectiveness of athletes can be accurately evaluated, scientific training suggestions can be provided, and training quality can be improved. Researchers, both domestically and internationally, have carried out studies on decision support systems for sports training methods. Guan, L. K. et al. examined the development process of an intelligent decision support system for college sports using big data analysis. They integrated big data and artificial intelligence technologies into the creation of university sports decision support systems, proposing a system framework and its structural components. Finally, they analyzed the relevant key technologies, offering a reference for building similar systems [5]. Huang, Y. et al. developed an intelligent sports prediction analysis system by integrating the predictive capabilities of the particle swarm optimization algorithm in edge computing with traditional sports event prediction methods. Experimental results demonstrated that this intelligent sports event prediction and analysis system achieves higher accuracy in forecasting sports events compared to conventional prediction methods and better meets the interests of sports event enthusiasts [6]. Ai, X. B. et al. introduced an algorithm for intelligently integrating traditional ethnic sports and cultural resources through big data. They initially established a comprehensive dataset by defining the time decay period of weighted samples. Mining parameters were subsequently based on accurate values to enable in-depth exploration of the insights within traditional ethnic sports and cultural resources [7].

In order to address the above issues and provide a basis for scientific sports training, the author proposes a personalized optimization study of sports training programs based on big data and intelligent computing. Intelligent computing technology is a discipline that describes problem objects through specific mathematical models, making them operable, programmable, computable, and visual. It utilizes its parallelism, adaptability, and self-learning to mine patterns and discover knowledge from massive data in disciplines such as information, neurology, biology, and chemistry. Based on the research of previous scholars, this paper explores the application of big data and intelligent computing in sports training mode decision support systems.

In order to reduce the negative impact of current laser image pattern recognition methods on image applications, a laser image pattern recognition method based on big data analysis is proposed. Firstly, briefly explain the principles of big data analysis applied in the research process, Implement image analysis and training processing on the original laser image big data, Extract the features of laser images and perform pre segmentation on them to achieve pre-processing of the original laser images, Finally, the pattern recognition of laser images is completed using the regularized least squares method. Set up a simulation experiment to verify the application effect of this method. Using 10 types of laser images and a total of 1000 images as samples, set the preset target image recognition rate, recognition error rate, and image recognition consumption time as evaluation indicators for the simulation experiment. Apply this method for image pattern recognition analysis.

3. Research Methods.

3.1. Big Data and Intelligent Computing.

3.1.1. Application of Big Data and Intelligent Computing. The advent of the intelligent era is propelled by the collaborative advancements in big data and deep learning technologies. Artificial intelligence, conceptualized over six decades ago in 1956, continues to evolve, necessitating a strong integration with the real economy to leverage existing industrial frameworks and foundations. And every enterprise or region should be pragmatic, tailored to local conditions, and have a persistent attitude, so that artificial intelligence can truly

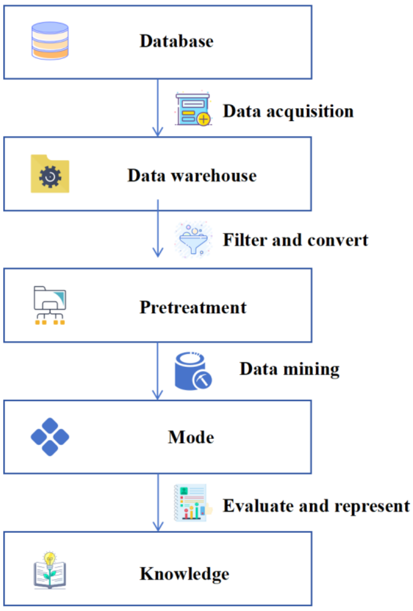

Fig. 3.1: Data Mining Process

lead social change. Artificial intelligence has played a lot of roles in various industries, and countries are also doing it. The future is an era of intelligence, where artificial intelligence technology influences various industries and fields. These fields are not independent, and they can cross integrate with each other. The upstream and downstream of the entire industry chain also influence each other. From the analysis of small data to data mining, to massive data mining, and now to big data mining, we have been exploring how to utilize the useful information hidden in data to solve problems [8]. Of course, in the process of data mining, it is necessary to deal with issues such as the distribution, volume, dimension, uncertainty of data, and differences in human cognition for the same data. The ultimate goal of using computer systems to process data is to complete human self-awareness, use computer systems to calculate, solve cognitive problems, and then solve problems. Human cognition has a habit of prioritizing large areas, seeing the big picture first and then the details in the middle. This is universal. Computer data processing ranges from fine to coarse, and multi granularity big data intelligent computing can be done using a mathematical model, which is what we call granularity problems. We classify items, and different classifications reflect different granularities; On the cloud model, connect human cognitive behavior with computer data processing behavior, create a collaborative computing model between humans and machines, and create a granular cognitive computing model. In various industries, we naturally apply this model concept to turn enterprise management into a multi granularity model and make intelligent decisions at different granularities.

3.1.2. Overview of Association Rule Mining Algorithms. Data mining technology, particularly the association rule algorithm like the Apriori algorithm, plays a pivotal role in analyzing complex datasets. Association rules are commonly classified based on the dimensions of data types they encompass. This classification typically divides rules into single-dimensional and multi-dimensional categories. In sports training for athletes, where numerous influencing factors are at play, the data collected often exceeds three dimensions. Therefore, when developing a decision support system for designing sports training modes using data mining techniques, it becomes crucial to consider multi-dimensional association rules. These rules are more intricate than single-dimensional ones, involving processes such as data preprocessing, mining, and pattern evaluation, as illustrated in Figure 3.1.

The preprocessing stage in the data mining process mainly involves collecting, processing, and transforming data, which takes the longest time throughout the entire data mining process; The data mining stage mainly analyzes the data in the preprocessing stage through selected association rules, neural network techniques, etc; In the pattern evaluation stage, the focus lies on presenting the insights derived from data mining to users. This can involve creating visual programs that allow for real-time viewing and analysis of the information obtained. When evaluating sports training modes with big data mining technology, it's crucial to seamlessly integrate relevant data into the sports evaluation decision support system. The author mainly uses neural network models to classify the extracted data features [9,11].

3.2. Data Fusion Processing of Sports Training Decision Support System.

3.2.1. Fusion clustering of decision information. The data feature identification function of the sports evaluation decision support system is defined by formula 3.1:

$$P_c = \sum_{i=1}^{n} \sum_{j=0}^{n} \alpha(i,j) P(i,j) \tag{3.1}$$

Formula 3.2 expresses the model relationship between sports training evaluation decision data and the distribution of cluster centers.

$$p_r = \frac{P_t}{(4\pi)^2 (\frac{d}{\lambda})^\gamma} [1 + \alpha^2 + 2\epsilon \cos(\frac{4\pi h^2}{d\lambda})] \tag{3.2}$$

Formula 3.3 represents the attribute categories of association criteria within the sports decision support system, guiding the feature recognition process based on various types of acquired data:

$$R_\beta X = U\{E \in U/R | c(E,X) \leqslant \beta\} \tag{3.3}$$

$$R_\beta X = U\{E \in U/R | c(E,X) \leqslant 1 - \beta\} \tag{3.4}$$

By mining the data of the sports training mode decision support system and extracting its association rules, the establishment of the system database model is achieved, and corresponding system design is carried out in combination with software development [12].

3.2.2. Design of human-computer interaction system. Improve the Apriori algorithm for frequent association rules in the design of human-computer interaction systems [13]. Its primary functions include: 1) Facilitating a user-friendly computer interaction system for decision-makers in sports training. This system enables checking each athlete's physical fitness indicators through front-end display settings and utilizes computers for efficient tracking and processing. 2) Visually display the operational status of the decision support system, allowing users to fully understand the data changes during the system's operation and make timely adjustments [14]. 3) Based on the output results of the system, targeted adjustments can be made to the training plan, and the simulation can be calculated to form the optimal training plan. 4) The human-computer interaction system also includes capabilities to rectify incorrect information and conduct initial verification and assessment of input data.

The training process mainly includes 5 stages, including student state diagnosis, training objectives, training plan, training plan, and goal completion evaluation, as shown in Figure 3.2. Among them, training analysis is a key link in sports training.

3.2.3. Decision Tree Based Data Mining Model. The rough set algorithm evaluates knowledge by approximating descriptions based on existing knowledge bases, aiming to eliminate redundant data during processing and achieve more precise decision outcomes. Traditional rough sets focus on evaluating and processing classified resource data, but additional data processing often necessitates discretization, which may result in information loss and data reduction [15,16]. Decision trees can classify data through a series of rules, and the classification rules represented by decision trees can be inferred from a set of irregular elements. In general, decision trees follow a recursive top-down approach where attribute values at internal nodes are compared to

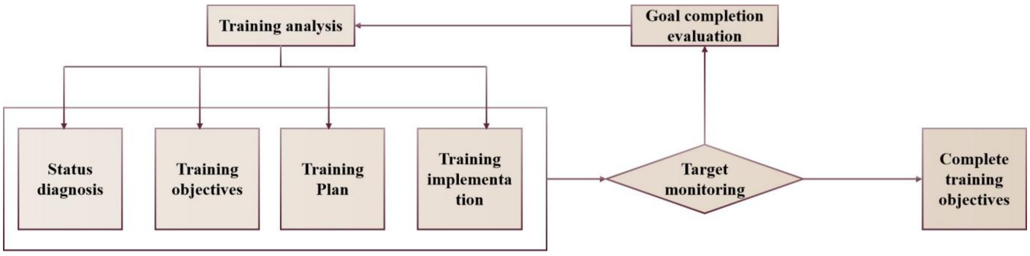

Fig. 3.2: Training Implementation Process

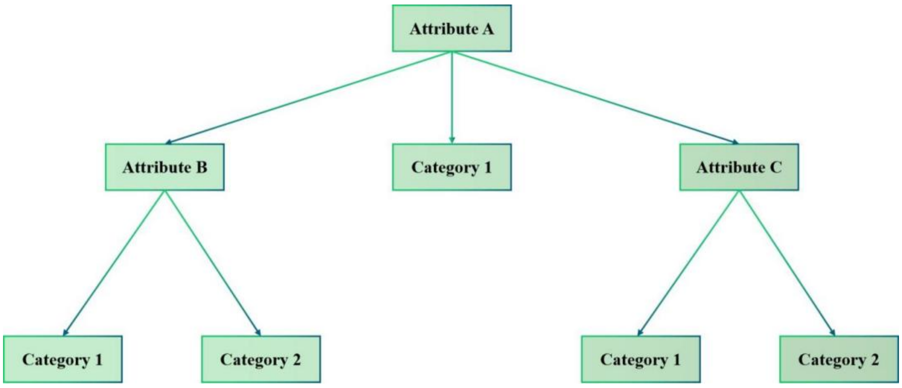

Fig. 3.3: Typical Decision Tree Composition

branch down based on different values, leading to leaf nodes that represent distinct classes. Thus, the path from the root to each leaf node forms a classification rule. Figure 3.3 illustrates a typical decision tree, comprising decision nodes, branch nodes, and leaf nodes. Each node corresponds to a non-categorical attribute, branches represent possible attribute values, and leaf nodes signify categories. Nodes in the middle of the tree are typically depicted as rectangles, while leaf nodes are shown as ellipses [17]. However, traditional decision trees are susceptible to issues like redundant branches due to noise and interference from abnormal data.

In order to address the above issues, Figure 3.4 shows the author's improved decision tree algorithm. Algorithms can be divided into two stages: learning and testing. In the learning phase, a top-down recursive approach is employed to train the parameters. Following this, the model and parameters are entered into the testing phase for validation and optimization [18]. This algorithm primarily involves two steps: first, generating the tree; and second, pruning the tree to eliminate data that may contain noise or anomalies.

3.3. Experimental research.

3.3.1. Development of data mining and training plans. The DSS of sports training model is based on the modern computer, and the computer and the programming language are used to simulate the performance of the athletes. The decision system provides a convenient way for players to access sports data in real time, and helps to guide and follow the training effectiveness. Based on the analysis of the DSS algorithms, the author integrates the DM technique into the system program, and a DSS for PE training is obtained. The main function modules of the system are the communication module, the program module, the database module and the data output module. Based on Conti-ki Bus, the data types are transferred and coordinated in DSS. In addition, the VIX integrated control technique is used to realize the overall control of the system. The DSS Data Perception component is based on a 6LoWPAN protocol stack. The WSN uses Atmel1284P as the main chip to process the whole Internet Network address assignment and management. Once the taskbar address is established, the system's human-computer interaction is facilitated through the TaskBasic interface program.

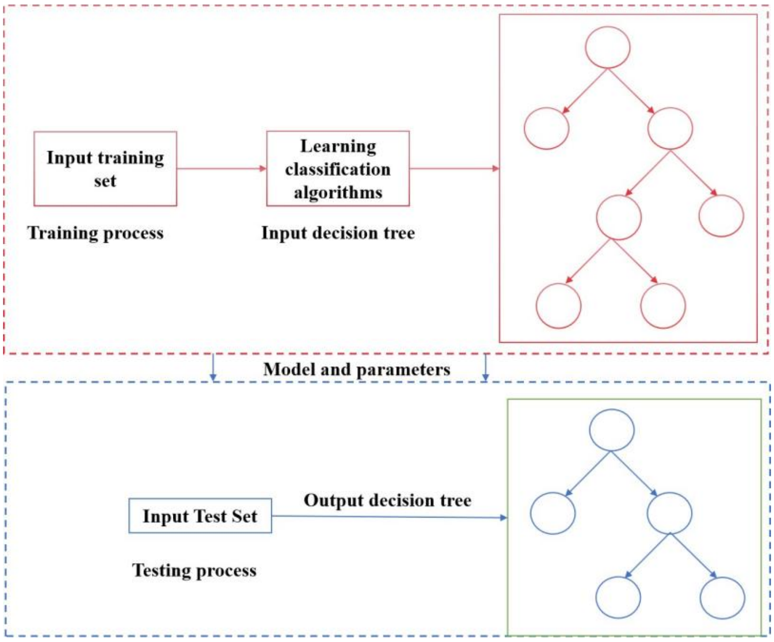

Fig. 3.4: Improved decision tree generation process

Table 4.1: Training related data of badminton teams in a certain area

types	Tid	Item	Avg
data	6511	226	47

Data quality is evaluated based on several factors, with the three most crucial being accuracy, completeness, and consistency. However, the experimental dataset contains errors, missing information, and inconsistencies, necessitating data preprocessing to enhance its quality and, consequently, the quality of data mining results. Additionally, various sports have distinct attributes for evaluation, such as time for track and field events, and attributes like score, hit rate, and duration for ball games. In order to effectively conduct data mining, the different values of each attribute can be mapped to a series of integers, and the values of attributes in that category can be replaced with integers.

4. Result analysis. In order to verify the validity of the modified Apriori algorithm, we compared the traditional Apriori algorithm, the DC Apriori algorithm and the modified Apriori algorithm. The experiments were primarily programmed using the Java language. The data set was composed of the training data of a district badminton team, as shown in Table 4.1.

In Table 4.1, Tid, Item, and Avg represent the specific training items, the total number of data items, and the average of the training sessions, respectively. Figures 4.1 and 4.2 illustrate the changes in the execution time of the system as the minimum support and the minimum confidence level increase.

Figure 4.1 demonstrates that the improved Apriori algorithm proposed by the author exhibits a shorter response time under minimum support conditions. Specifically, when the minimum support is set to 3.5, the execution time is less than one second, indicating superior algorithm performance. As shown in Figure 4.2, the improved Apriori algorithm performs better when the lowest confidence level is low. However, with the increase of the minimum confidence, the performance of the modified Apriori algorithm is reduced, and finally the same as that of the conventional Apriori algorithm. It is very important to improve the training efficiency of athletes and to optimize the support system of sports training. In this paper, the decision support of sports

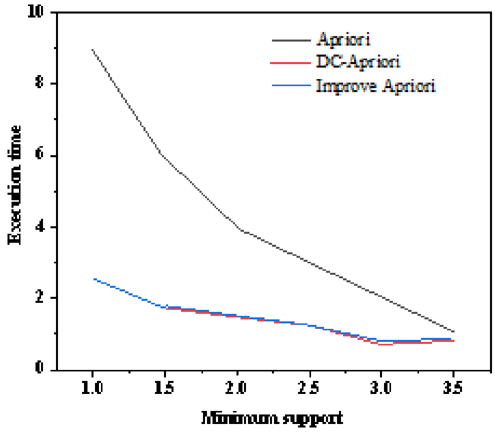

Fig. 4.1: Comparison of execution time under minimum support

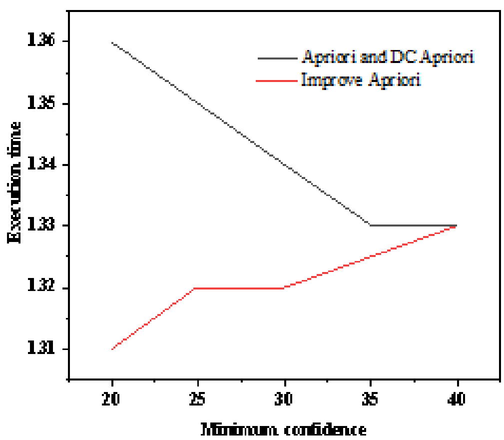

Fig. 4.2: Comparison of execution time under minimum confidence level

training model is studied by means of data mining, and an improved Apriori algorithm is put forward. This approach involves deep analysis and mining of system data to effectively extract information during athlete training, integrating sports evaluation decision data through relevant association rules. Moreover, the results of simulation and analysis on the traditional Apriori algorithm, DC Apriori algorithm and the modified Apriori algorithm prove that the improved Apriori algorithm can effectively support the decision of the sports training model.

5. Conclusion. The author addresses the need for scientific management and decision-making in the training process of sports athletes, combined with advanced big data and intelligent computing technology, and proposes an improved sports training mode decision support evaluation system. The author provides a detailed analysis of the characteristics of association rule algorithms and delves into their specific applications in data preprocessing, data mining, and pattern evaluation. Through these analyses, the system can achieve personalized optimization research on sports training programs, provide training suggestions based on scientific data for athletes, and thus improve training effectiveness and sports performance. The author not only enriches the scientific methods of sports training in theory, but also provides important references and support for athlete training in practice.

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