Construction of Civil Engineering Teaching System Based on Data Mining Algorithm and Big Data Technology

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Abstract. Under the big data (BD) technology, colleges and universities pay more and more attention to educational technology, so as to follow up with modern information, digitization, and visualization. The courses of civil engineering teaching with traditional teaching methods and single knowledge of students are profit-only, applying data mining (DM) technology and BD technology to realize positive thinking mode. This article first gives a brief overview of DM technology and BD technology, and then discusses the strategy of applying BD technology in teaching of civil engineering professional courses, and finally applies BD DM technology to the construction of civil engineering teaching system, to realize the intelligent teaching mode. Based on DM technology and BD technology, this paper comprehensively studies the construction of two technologies in the civil engineering teaching system of colleges and universities. This article combines the new concept of constructing attention to teaching, expounds the advantages of DM algorithm in the construction of civil engineering teaching system, and briefly analyzes the composition and development of the networked civil engineering teaching system platform. At the same time, this article also in-depth research in the classification algorithm of the DM algorithm, the k-nearest algorithm is discussed, and for the efficiency of their construction in the civil engineering teaching system, the visualization research is carried out from the operation efficiency of the algorithm steps and other aspects and the organization of the data set. Based on the above research, the optimization schemes of particle swarm algorithm and ant colony algorithm are designed, and a parallelized early warning system model is realized using GPU based on CUDA platform. In the above research, the two algorithms were compared and tested, and the efficiency of the algorithm in the construction of civil engineering teaching system was verified. Experimental research results show that the cosine correlation analysis based on DM algorithms and the hybrid particle swarm algorithm can effectively integrate BD technology to construct a civil engineering teaching system and improve the operating efficiency of the system.

Key words: DM technology, BD technology, Hybrid particle swarm algorithm, Civil engineering teaching system

1. Introduction
With the development of education informatization in China and the development of information teaching technology, information teaching increasingly meets teaching needs. Information teaching is an important choice for school education in the information age [1]. Schools must increase their efforts to create conditions, and teachers must improve their ability to teach information. The civil engineering model is based on DM technology and the parameter model using BD technology to integrate the relevant information of each project, sharing and transmitting data in the planning and operation and maintenance of the project, the purpose is to facilitate teachers to correctly analyze each item Students’ learning data and effects [2-3]. Its teaching system can effectively integrate DM technology and BD technology into the existing teaching system and teaching system, and can make full use of the characteristics of DM technology and BD technology in visualization, coordination, simulation, and optimization, and stimulate Students are interested in learning the profession [4].

The professionalism and practicability of the civil engineering teaching system has been taught by many teachers and students, but many professional teachers still use the traditional teaching model for course teaching, but in the traditional and practical teaching model, the internal and the external connection is often not close, so the traditional teaching methods cannot connect the curriculum knowledge with the practical process [5]. But in order to be able to solve the poor teaching quality of civil engineering courses and the imprecise teaching system, in the process of system upgrade and transformation, I think that BD technology and DM algorithms are used to update and upgrade the traditional algorithms in the teaching system. A shared building information model platform, and the platform can cover three models of civil engineering science courses [6-7]. On the one hand, we can know that it can help students understand the relevant theoretical knowledge of the professional course, and on the other hand, it can strengthen the connection between teachers and students to achieve the desired effect of the school. The application of DM algorithms and BD technology in the professional course teaching system is very helpful to the cultivation of students’ own practical skills [8].

This course takes concrete structure design as an example, and mainly studies the performance of reinforced concrete materials[9]. Teachers can intuitively construct concrete models of concrete structures to construct concrete models. In addition, the platform can also use related software to derive models. With the help of the internal force of the limit structure of the model, the basic structure and construction conditions of the beam can be directly displayed. Teachers and students can display the learning content at any time, and can provide a platform for mutual exchange and learning between teachers and students, meet their own requirements in daily learning, and allow students to learn freely anytime and anywhere [10].

2. Algorithm establishment

2.1. Cosine correlation analysis algorithm

Assuming that a and b are two different vectors, the cosine similarity calculation formula is:

\[
\cos \theta = \frac{a \cdot b}{|a||b|} \tag{1}
\]

\[
\cos \theta = \frac{x_1x_2+y_1y_2}{\sqrt{x_1^2+y_1^2}\sqrt{x_2^2+y_2^2}} \tag{2}
\]

\[
\gamma(C_i, C_j) = \frac{c_i \cdot c_j}{|C_i||C_j|} \tag{3}
\]

\[
\gamma(C_i, C_j) = \frac{\sum_{k=1}^{k}c_{i}^{k}c_{j}^{k}}{\sqrt{\sum_{k=1}^{k}(c_{i}^{k})^2}\sqrt{\sum_{k=1}^{k}(c_{j}^{k})^2}} \tag{4}
\]

2.2. DM algorithm

The reachable distance of dynamic neighborhood radius adaptive density is defined as:

\[
R_{A} = R \frac{A_{i}}{A_{i+1}} \tag{5}
\]
2.3. Hybrid particle swarm algorithm model

Combined with the running time of the sensor, historical data, load size and other aspects of machine life evaluation, we can get more scientific image recognition time. The risk in the hybrid particle swarm optimization model is the probability of no failure at a certain time, but the probability of failure after that time is expressed as follows:

\[
h(t) = \lim_{\Delta t \to 0} \frac{p[t \leq T \leq t + \Delta t | T \geq t]}{\Delta t}
\]

\[
\lambda_0(t) = \lim_{\Delta t \to 0} \frac{P\{N(t + \Delta t) - N(t) \geq 1\}}{\Delta t}
\]

\[
h(t, z) = h_0(t) e^{\alpha z(t)}
\]

The characteristics of the model are related to machine factors:

\[
f(t) = \frac{\beta}{t_0} (1 - \varepsilon)^{\beta-1} e^{-\frac{(1-\varepsilon)^\beta}{t_0}}
\]

\[
F(t) = 1 - e^{-\frac{(1-\varepsilon)^\beta}{t_0}}
\]

\[
\lambda(t) = \frac{\beta}{t_0} (1 - \varepsilon)^{\beta-1}
\]

\[
h(t, z) = \frac{\beta}{t_0} (1 - \varepsilon)^{\beta-1} e^{r z(t)}
\]

2.4. Hybrid particle swarm algorithm

\[
U(t) = (V_1, V_2, V_3, V_4, V_5, ..., V_D)
\]

\[
V(t) = (x_1, x_2, x_3, x_4, x_5, ..., x_D)
\]

\[
V(t) = (p_{b_1}, p_{b_2}, p_{b_3}, p_{b_4}, p_{b_5}, ..., p_{b_D})
\]

In the current online learning algorithms based on BD analysis, many different algorithms have been produced. However, in terms of application scope, the application of perceptron is the most widely used one. Then, for all misclassified samples, the penalty is implemented in a summation manner, which can be specifically based on the following algorithm formula:

\[
J_p(W) = \sum_{i \in T} (-W^T X_i)
\]

\[
W(x, i) = (1 - \alpha) + \alpha \frac{p_{x,i}}{LX}
\]

\[
r(x, i) = \sum_{i \in T} W(j, l)x s i m(i, j)
\]

For the given resource, the recommendation degree calculated according to the above formula is as follows:

\[
r(x, j) = \sum_{i \in \text{t}_x} W s i m(i, j)
\]

3. Modeling method

3.1. Establish an early warning analysis model for the teaching system

By analyzing the relationship between the parameters in the early warning analysis system of the established teaching system, the indicators at the same level are compared in pairs to construct a judgment model matrix, and calculate the eigenvalues of the judgment model matrix and its eigenvectors, Perform a test after obtaining the weight vector.

Construct a pairwise comparison index judgment matrix R:

\[
R = (r_{ij})_{m \times n}
\]
\[ i = 1, 2, \ldots, m \]
\[ j = 1, 2, \ldots, n \]  

Make a planning process for each item in R:

\[
r_{ij}' = r_{ij} / \sum_{m=1}^{n} r_{ij}
\]

\[
r_{ij}' = \sum_{i=1}^{n} r_{ij}
\]

\[
W_{ij} = r_{ij} / \sum_{i=1}^{n} r_{ij}'
\]

\[
A_w = \lambda_{\text{max}} \cdot W
\]

\[
\text{CI} = \frac{\lambda_{\text{max}} - n}{n-1} \quad \text{CR} = \frac{\text{CI}}{n-1}
\]  

In the process of establishing the model mentioned above, RI is an indicator of random consistency. If CR<0.1, the consistency test passes, otherwise you will continue to correct the R of the indicator judgment, merge the above models, and the earphone index evaluation weight. Obtain the scores of the comprehensive evaluation, and determine the specific corresponding seismic grade formula as follows:

\[ E = F \ast W \ast V \]  

Represents the probability of exceeding its allowable value multiplied by the weighted value of the maximum consequence and the average consequence \( \nu \) of the risk level:

\[
R_{v,t,i} = p_{v,t,i}(\propto S_{v,t,i,\text{MAX}} + p_{v,t,i,\text{AV}})
\]

\[
R_{v,t,i} = \frac{N(V_{t,i} < V_{\text{min}} | V_{t,i} > V_{\text{min}})}{N_{\text{all}}}
\]

\[
S_{v,t,i,\text{MAX}} = (V_{UP,t,i,\text{MAX}} - V_{\text{max}}) + (V_{\text{min}} - V_{\text{down},t,i,\text{MAX}})
\]

\[
S_{v,t,i,\text{AV}} = (V_{UP,t,i,\text{AV}} - V_{\text{max}}) - (V_{\text{min}} - V_{\text{down},t,i,\text{AV}})
\]

\[
R_t = \frac{1}{\text{Node}} \sum_{t=\text{Node}} \left( \eta R_{v,t,i} + \theta R_{p,t,i} \right)
\]

4. Evaluation results and research

|       | DATA-1 | DATA-2 | DATA-4 | DATA-8 | DATA-16 |
|-------|--------|--------|--------|--------|---------|
| PS-1  | 82     | 77     | 75     | 77     | 87      |
| PS-2  | 81     | 89     | 83     | 83     | 81      |
| PS-3  | 83     | 92     | 79     | 79     | 86      |
| PS-4  | 72     | 81     | 77     | 72     | 77      |
| AVERAGE | 91.75 | 84.75 | 74     | 91     | 79.8    |

The experimental results of multi-sensor image fuzzy fusion ant colony algorithm data set are shown in Table 1, which shows that the data layer is added after different convolution layers in the PSN model. For the office-51 dataset, according to the above settings, the average classification direction of the office dataset with data added is shown in Table 1. In view of the above problems and
the shortcomings of deep learning algorithm, this paper adopts sensor data fusion technology and deep learning method. Combined with deep learning processing to provide prior information, a recognition method based on multi-sensor data fusion is proposed.

Figure 1. Performance analysis of three different DM algorithms in civil engineering teaching system

As shown in Figure 1, performance analysis of three different DM algorithms in civil engineering teaching system. In order to compare the effect of different classification, experimental analysis of DM, decision tree and KNN is carried out respectively. DM, decision tree and KNN use 22, 27 and 19 features respectively. Figure 1 shows the classification performance of the three classifications. As can be seen from the figure, the performance of traditional DM classifier is the lowest, while the performance of cosine correlation analysis is the highest.

Figure 2. Analysis of the results of the alert level evaluation of the civil engineering teaching system based on DM algorithms

As shown in Figure 2, due to the analysis of the alert level evaluation results of the civil engineering teaching system based on the DM algorithm, the running time of each stage is given. The frequency change of the processor will cause the performance change, which will eventually affect the DM algorithm. The alert level evaluation results of the civil engineering teaching system analyzed the length of running time.

5. Conclusion
In summary, the use of intelligent teaching systems to introduce traditional classrooms has become the mainstream trend of intelligent teaching in higher education, and the upgrading of systems designed to design intelligent teaching technologies also includes real-time new teaching methods, including teachers level of improvement. In the teaching system of civil engineering courses, the application of DM technology and BD technology can establish a visual three-dimensional model, so that students
can combine the professional knowledge they have learned and concretize abstract knowledge into books. So as to help students understand and improve the teaching effect of the course.

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