Research on Design and Application of Computer Database Quality Evaluation Model

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Abstract

Computer data quality evaluation is the key problem of computer database level optimization. In the process of evaluating its quality, using the traditional quality evaluation method has certain limitations, and it can only satisfy the quality evaluation of small-scale computer database. Although the traditional way is more accurate, if the object of quality evaluation is a computer database with a certain scale, there will be a huge amount of information data to be processed, which can not only result in a large amount of computation, but also easily result in the error of quality evaluation results, with relatively poor effect. Therefore, it is necessary to carry out innovation of the traditional computer database quality evaluation model, and select the large cloud computing computer database security level optimization and evaluation method based on the fuzzy multi-level analysis algorithm, so as to achieve the core purpose of accurately analyzing its quality evaluation grade. So, by analysis of the characteristics of the large cloud computing computer database in this study, the analytic hierarchy process model for computer database is put forward in a targeted manner, the quality evaluation index weights of computer database are calculated, and the judgment matrix of evaluation index is established. After normalization of the results, the maximum eigenvalue vector of computer database quality evaluation indexes will be obtained. Based on the fuzzy multi-level analysis principle, the comprehensive evaluation is carried out to evaluation objectives, and the final object is obtained from the results, namely the computer database quality evaluation results.

Keywords: Computer, Computer Database, Quality Evaluation.

1. RESEARCH OVERVIEW

1.1 Research background

With the constant development of information technology, information data has been widely applied to various fields of the society, which has played an important role in promoting the development of traditional fields. Computer database serves as an important means to store, manage and share various data, and its quality is becoming more and more important to users. Computer database quality evaluation can directly evaluate the construction level of computer database, and can provide important reference basis for the optimization construction and development of computer database, which has become the focus of research in this field. At present, a variety of computer database quality evaluation models have been developed, mainly including the support vector machine algorithm based computer database quality evaluation model, the binary tree algorithm based computer database quality evaluation model and the multi-source heterogeneous algorithm based computer database quality evaluation model. Among them, the support vector machine based computer database quality evaluation model is the most widely used. The computer database quality evaluation model can accurately put forward the construction level of computer database, not only can effectively meet the users' use demands, but also can carry out the corresponding optimization and adjustment of computer database based on the deficiency produced in the results, which is of great significance to promote the development of computer database.

1.2 Literature review

The computer database quality evaluation model is a key problem in the research of computer database, which has always attracted the attention of experts and users and has broad development prospect. At present, a variety of computer database quality evaluation models based on multiple algorithms have been developed, and the evaluation results are relatively accurate. However, the traditional method may only apply to small and
medium-sized computer database, while for large computer database, because of the need to process huge amounts of information data, it may greatly reduce the evaluation accuracy of the computer database quality evaluation model, resulting in a big error (Mo and Ma, 2013). As the traditional algorithm itself has limitations and deficiencies, when it is applied to the computer database quality evaluation model, the evaluation results will produce big error in the face of large computer database. But the computer database quality evaluation model based on the fuzzy multi-level analysis algorithm can effectively solve the various problems arising from the traditional algorithm. In addition, based on the relevant experiments, the computer database quality evaluation model based on the fuzzy multi-level analysis algorithm can effectively promote the accuracy of evaluation on quality of large computer database, which meets the actual demands of experts and users, and has certain advantages (Son, 2013). For the computer database quality evaluation model based on the fuzzy multi-level analysis algorithm, its general steps are as follows: build the analytic hierarchy process model for computer database according to the characteristics of large computer database, analyze the weight values of computer database quality evaluation indexes, and build the corresponding judgment matrix. After normalization of the results obtained from calculation, the maximum eigenvector of computer database quality evaluation indexes will be obtained. Based on the fuzzy multi-level analysis algorithm, the comprehensive evaluation will be carried out to computer database quality evaluation indexes, and the results will be classified according to certain rules, so as to obtain the several biggest influence factors, and obtain the computer database quality evaluation results (Liu, 2014).

2. PRINCIPLE OF COMPUTER DATABASE QUALITY EVALUATION MODEL

For optimization method of computer database quality evaluation model, the multi-level analysis method is mainly adopted in this study. This method has the advantage of combining qualitative indexes and quantitative indexes, which can form a recursive hierarchy through decomposition of a complicated problem, and then compares each of the two factors, so as to obtain the corresponding judgment matrix (Wang, 2014). After calculation of eigenvector of the matrix by normalization, the weights of computer database quality evaluation indexes can be obtained, so as to obtain the importance of different factors. Its principle is shown as follows:

First of all, the computer database quality evaluation system should be built. The influence factors of quality evaluation are divided into n levels according to the importance and the subordinate relationship, as shown in Figure 1:

![Diagram](image)

**Figure 1. Multi-level Architecture**

Assuming that the set of influence factors of quality evaluation is \( U=\{u_1, u_2, ..., u_n\} \), then object set will be \( B=\{b_1, b_2, ..., b_0\} \). Among them, object set B is mainly the calculation of evaluation results. If weight set is \( W=\{w_1, w_2, ..., w_n\} \) and \( w_i \geq 0 (i=1,2,...,n) \), it can be used to describe the computer database quality evaluation weights \( \sum_{i=1}^{n} w_i = 1 \). Assuming that comment set is \( S=\{s_1, s_2, ..., s_r\} \), a certain weight differences exist between every two comments (Luo et al., 2014).

Then, to obtain the computer database quality evaluation results by calculation, it is necessary to build an evaluation matrix \( R \in F(U,B) \). From \( R(u_i, b_j)=r_{ij} \), the matrix can be obtained as follows:

\[
R = \begin{bmatrix}
    r_{11} & r_{12} & ... & r_{1n} \\
    r_{21} & r_{22} & ... & r_{2n} \\
    ... & ... & ... & ... \\
    r_{m1} & r_{m2} & ... & r_{mn}
\end{bmatrix}
\]  

(1)

The calculation formula for the computer database quality evaluation results is shown as follows:
\[ Y = WR \]  

(2)

Next, the correlation calculation should be carried out between the level of matrix \( R \) and the results of calculation, and its formula is as follows:

\[
Z = \frac{\sum_{i=1}^{m} y_n}{\sum_{j=1}^{n} \sum_{i=1}^{m} y_{ij}}
\]

(3)

Through the operation of the above steps, the final computer database quality evaluation results can be obtained (Chen and Ye, 2014).

3. LARGE CLOUD COMPUTING COMPUTER DATABASE QUALITY EVALUATION MODEL

In traditional computer database quality evaluation algorithm, the quality evaluation to small and medium-sized computer database can only be realized, and the results are relatively accurate. But for some large computer database, the traditional computer database quality evaluation algorithm may inevitably produce the decline of accuracy due to being faced with huge amounts of information data (He et al., 2015). Therefore, it is necessary to use the principle of multi-level analysis method to construct the quality evaluation model for large cloud computing computer database, thus to effectively improve the quality evaluation level of computer database.

3.1 Analytic hierarchy process model for quality level of large cloud computing computer database

For computer database, its quality is mainly affected by three factors: First, it is the richness of data resources. Second, it is the convenience of data retrieval. Third, it is the security of data resources. Therefore, the analytic hierarchy process model for quality level of large cloud computing computer database also sets about from these three aspects, which can judge the optimal indexes, and carry out the evaluation respectively, thus to obtain the main factors with the biggest influence (Wang et al., 2015). The steps are as follows:

Firstly, reference index and comparison index are constructed for each index, which are respectively expressed with \( P_0, P_i \), obtaining:

\[
P_0 = \{P_0(1), P_0(2), ..., P_0(10)\}
\]

(4)

\[
P_i = \{P_i(j)|P_i = 1, 2, ..., 10\} (i = 1, 2, ..., n)
\]

(5)

Secondly, the obtained indexes should be normalized to ensure that each index can play a practical role, and then to finally obtain the standard value:

\[
C_{ij} = \frac{P_{ij}-P_{imin}}{P_{imax}-P_{imin}}, \ i = 1, 2, ..., n, j = 1, 2, ..., n
\]

(6)

In the above formula, \( C_{ij} \) mainly represents the standard value of the \( j \)-th index of the \( i \)-th objective to be evaluated. Among them, \( P_{imax} \) represents the maximum value of the \( i \)-th index, and \( P_{imin} \) represents the minimum value of the \( i \)-th index (Luo, 2015).

Thirdly, the correlative function between the objective and index should be calculated, and the formula is as follows:

\[
\varepsilon_{ij} = \frac{\min \min |c_{0j}-c_{ij}| + \rho \min \min |c_{0j}-c_{ij}|}{|c_{0j}-c_{ij}| + \rho \min \min |c_{0j}-c_{ij}|}, \ i = 1, 2, ..., n, j = 1, 2, ..., 10
\]

(7)

Finally, the final result is calculated, and the formula is as follows:

\[
E_{ki} = \sum_{j=1}^{10} W_j \times \varepsilon_{ij}, i = 1, 2, ..., n, j = 1, 2, ..., 10, k = 1, 2
\]

(8)

\[
E_{ki} = \sum_{k=1}^{2} (\sum_{j=1}^{10} W_j \times \varepsilon), i = 1, 2, ..., n, j = 1, 2, ..., 10, k = 1, 2
\]

(9)
The final result is the analytic hierarchy process model for quality level of large cloud computing computer database.

### 3.2 Calculation of index weight

The index weight can directly reflect the effect of different influence factors on the quality of large cloud computing computer database. To calculate the index weight, a judgment matrix should be constructed based on the known information and related principles. The matrix is shown as follows:

$$A = (a_{ij})_{n \times n}$$  \hspace{1cm} (10)

In the matrix, $a_{ij}$ is mainly used to describe the importance coefficient produced by comparison of the two criteria. Then, the various elements presented in the above matrix must be multiplied and conducted with the extraction operation by $n$ times, and the final geometric mean can be obtained (Shang et al., 2012), as shown below:

$$a_n = \left[ \prod_{j=1}^{n} a_{ij} \right]^{1/n}$$  \hspace{1cm} (11)

Then, the result must be normalized to obtain the eigenvector of any objective, and the formula is as follows:

$$w_n = \frac{a_n}{\sum_{i=1}^{n} a_i}$$  \hspace{1cm} (12)

Next, its maximum eigenvalue $\lambda_{max}$ must be calculated, and the formula is as follows:

$$\lambda_{max} = \frac{1}{n} \sum_{l=1}^{n} b_l/w_j$$  \hspace{1cm} (13)

$$\frac{\lambda_{max} - m}{n-1} = CI = 0$$  \hspace{1cm} (14)

If $\frac{\lambda_{max} - m}{n-1} = CI = 0$, the consistency check should be carried out, and the formula is:

$$CR = \frac{CI}{RI}$$  \hspace{1cm} (15)

Among them, the value range of RI is as shown in Table 1:

<table>
<thead>
<tr>
<th>Order number</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>RI</td>
<td>0</td>
<td>0</td>
<td>0.58</td>
<td>0.90</td>
<td>1.12</td>
<td>1.24</td>
<td>1.32</td>
<td>1.41</td>
<td>1.45</td>
</tr>
</tbody>
</table>

From the above, the final weight of each influence index can be calculated so that the main factors influencing the quality of computer database can be obtained.

### 3.3 Quality evaluation model for large cloud computing computer database based on the fuzzy evaluation method

According to the above contents, it is necessary to evaluate the quality of large cloud computing computer database based on the fuzzy multi-level analysis principle, sort the final evaluation results according to certain rules, and find the optimal solution according to the results obtained, so as to obtain the final results of evaluation on quality of computer database. The process is as follows:
First of all, a comment set for quality evaluation of large cloud computing computer database must be built (Ma et al., 2012). If 1-4 is used for substituting, respectively representing excellent, good, acceptable and poor, the higher the number is, the lower the grade will be. The expression method is as follows:

$$V=(v_1, v_2, v_3, v_4)$$

If the quality evaluation of large cloud computing computer database adopts the centesimal system, then $v_1$ is 100 points, $v_2$ is 80-100 points, $v_3$ is 60-80 points, and $v_4$ is below 60 points. Secondly, according to the above computer database quality index criteria and weights, a corresponding matrix should be built, as shown below:

$$U_i=(u_{i1}, u_{i2}, ..., u_{ik}) \quad (i=1,2,...,5)$$

Then, according to the theory of fuzzy evaluation, the various computer database quality indexes are evaluated, and its comment matrix is $R$. After that, the comprehensive evaluation are carried out to the above matrix $U_i=(u_{i1}, u_{i2}, ..., u_{ik}) \quad (i=1,2,...,5)$, and the results can be obtained as follows:

$$B_i=A_i \cdot R_i$$

Among them, $A_i$ is mainly used to describe the weight of the secondary index, and $R_i$ is mainly used to describe the weight of the comment set. After the conclusion is drawn, the final weight results of each comment can be obtained through classification and analysis, and the final quality evaluation model for large cloud computing computer database can be obtained (Sun and Guo, 2012).

### 4. EMPIRICAL ANALYSIS

To check the practical effect of quality evaluation model for large cloud computing computer database, it is necessary to use empirical analysis for checking. Therefore, this study selects 20 large enterprises, with the internal computer database of the enterprises as the research sample, and evaluates the quality of internal computer database of the enterprises through different algorithms, so as to compare the effects of different algorithms on the quality of internal computer database of the enterprises. Its main contents are shown in Table 2:

<table>
<thead>
<tr>
<th>Quality grade</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>excellent</td>
<td>100</td>
</tr>
<tr>
<td>good</td>
<td>80</td>
</tr>
<tr>
<td>commonly</td>
<td>60</td>
</tr>
<tr>
<td>Poor</td>
<td>40</td>
</tr>
</tbody>
</table>

Among the given 20 large enterprises, there are 7 enterprises with excellent quality of internal computer database, 9 enterprises with good quality of internal computer database, 2 enterprises with acceptable quality of internal computer database, and 2 enterprises with poor quality of internal computer database. Traditional method and optimized method are respectively used to evaluate, and the conclusion drawn is shown in Table 3:

<table>
<thead>
<tr>
<th>Quality grade</th>
<th>Actual value</th>
<th>Traditional algorithm</th>
<th>Improved algorithm</th>
</tr>
</thead>
<tbody>
<tr>
<td>excellent</td>
<td>7</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>good</td>
<td>9</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>commonly</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Poor</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Through analysis of the above figure, in the traditional method, it can be judged that there are 10 enterprises with excellent quality of computer database, 5 enterprises with good quality of computer database, 4 enterprises with acceptable quality of computer database, and 1 enterprise with poor quality of computer database. While in the improved method, it can be judged that there are 8 enterprises with excellent quality of computer database, 8
enterprises with good quality of computer database, 2 enterprises with acceptable quality of computer database, and 2 enterprises with poor quality of computer database. By contrast, although the accuracy of the optimized algorithm has certain deviation, it is far higher than the traditional algorithm, and its evaluation result has a higher accuracy (Zhang et al., 2012).

![Figure 2. Evaluation Results of Different Algorithms](image)

Figure 2 is the result of accuracy obtained from both traditional algorithm and improved algorithm after 10 times' training. In the figure, the accuracy of traditional algorithm fluctuates around 60%, the highest is 62%, and the lowest has reached 50%. The accuracy of improved algorithm is around 80%, the highest is 84%, and the lowest is around 77%; its fluctuation is not obvious and has become stabilized, which shows that the accuracy of improved algorithm is much higher than that of traditional algorithm, and the accuracy will not produce great fluctuation. Through deep analysis of the above contents, it can also be seen that the difference between evaluated quality value and actual quality value is relatively small for the improved algorithm, while the traditional algorithm has a large gap with the actual quality, showing that the improved algorithm is better than the traditional algorithm. Therefore, the conclusion can be drawn that the improved algorithm, whether accuracy or adaptability, is higher than the traditional algorithm. Using the improved algorithm has better effect, especially for large computer database (Chen et al., 2011).

5. CONCLUSION

The traditional computer database quality evaluation models used in the past are mainly the quality evaluation models based on support vector machine algorithm, binary tree algorithm, and multi-source heterogeneous algorithm. These computer database quality assessment models can accurately analyze the quality level of small and medium-sized database, with certain advantages. However, under the background of continuous development of big data, with more and more large databases, this method may produce certain errors, and it is difficult to meet the requirements of large databases. Therefore, it is necessary to carry out innovation of the traditional computer database quality evaluation model, and through the analytic hierarchy process model for quality level of large cloud computing computer database based on the fuzzy multi-level analysis algorithm, the deficiencies of large computer database (Lian et al., 2012) in traditional method can be solved effectively (Lian et al., 2012). The general steps are as follows: According to the characteristics of large computer database, the analytic hierarchy process model of computer database must be constructed, and then the weights and judgment matrix of quality evaluation indexes must be analyzed. The results from calculation should be normalized to obtain the maximum eigenvector of the quality evaluation indexes. Based on fuzzy multi-level analysis algorithm, the comprehensive evaluation should be carried out to computer database quality evaluation indexes, and the results will be classified according to certain rules, so as to obtain the several biggest influence factors.
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