STUDY ON BOOK QUALITY EVALUATION BASED ON NEURAL NETWORK AND DATA VISUALIZATION

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Abstract: In order to improve the quality of library books evaluation, neural network visualization and feature model technology were used to establish a feature model for the quality evaluation system. Model processing of neural network in the paper was applied to the book information of library, and various information indicators related to the quality of book evaluation were used as neurons. The convergence speed was improved by optimizing global optimization of neural network weights, and the relationship between the meta-nodes nerves were more accurately displayed, and the data analysis function with visual effects was provided, thus, an objective and vivid display of the book quality of library was shown. Finally, the neural network structure algorithm designed in this paper directly represented the mapping relationship between various indicators and evaluation scores, which was a reasonable and feasible method for library book quality evaluation.

1. Introduction
As information technology develops faster and faster, the library's information resources will also carry out data-centric information construction. Readers are increasingly demanding the efficiency of electronic resources, the quality of services and the user experience. The evaluation of library books belongs to the important content of library service work, and the quality of its evaluation determines the direct effect of library collection on readers' recommendation. The main content of the paper is to design the data center established by the information technology conditions of library, to use the neural network theory to model the data of book information, and to use the visual processing effect to optimize the quality of books after the process of model optimization algorithm, so as to more objectively verify the book quality evaluation effect.

2. The Composition of Library Information Data Based on Neural Network

2.1 book information data of library
The library book information data was mainly collected according to various books information of the library. The collected data was organized into information related to the analysis of the collected book data. Which the main process was as follows: first, removing the secondary information unrelated to the data analysis, and second, retaining important information about data analysis, such as: "book time", "classification", "book number", "total number of books", etc.; third, counting the number of each type of book, for example: a total of 2,280 volumes of T-industrial technology class, a total of 2,280 volumes of TB-general industrial technology classes, a total of 13,137 volumes of TD-mining projects, and a total of 48,300 volumes of TE-oil and gas industries. Finally, these data are input into
Excel spreadsheets, and data mining models are used to analyze their data and extract important information.

We build an intuitive model to import the data into the "Excel" node of the "source" of the Clementine software; then connected the "Table" node of the "Output" to output the data to see if the data enters "Excel" node of the "Source"; and attached the "Type" node of "Field Options"; and set the variable "total number of books" to the "output" state in order to prepare for the neural network building model; the remaining variables, such as, "book time", "classification", "phone number", were set to the "input" state and connected to the "neural network" model node; then, the "histogram" node was connected on the "neural network" node; according to the graph, the library's future collection could be visually seen. An intuitive model of the "neural network" was build, which was as shown in Figure 1.

![Figure 1. Book information clustering neural network topology](image)

However, the library used the data characteristics to model according to the model rules. The data space formed by the feature model would be very large, adding more data features, which required more accurate and effective calculations using the neural network nodes as the unit.

2.2 Optimization of neural network node algorithm

The neural network model in the paper was applied to evaluate the book quality of library, which was necessary to consider the number of hidden nodes in the hidden layer. The hidden layer node mainly extracted and stored the inherent regular pattern from the sample. The design of the number of hidden layer nodes was very important. Too much would lead to excessive noise, which reduced the generalization ability and increase the training time; too little would lead to the network's ability to obtain information from the sample. Therefore, the empirical formula in the paper was selected, which was as follows.

\[ m = a + b + c \]

Where, \( m \) represents the number of hidden layer nodes; \( a \) represents the number of input layer nodes; \( b \) represents the number of output layer nodes; \( c \) is a constant between 1 and 10; according to the above, the number of hidden layer nodes can be 4 to 11.

(1) Design of initial values

The initialization of the network weight was critical to the training time of the network because it determined where the training of the network starts from the error surface. According to the current
research situation, the initial values were mostly determined by empirical methods, and there was no clear standard. The initial value in the paper was set according to this method. The hidden layer weight was determined so that the initial value was small enough, and the initial weight of the output layer was determined so that the initial value of +1 and -1 had the same number of weights.

(2) Design of activation function

The activation function was also called the transfer function. The activation function on the hidden layer unit selected the hyperbolic tangent function. The activation function of the output layer opted the unipolar Sigmoid function. The function form was \( f(x) = \frac{1}{1 + e^{-x}} \).

(3) Performance evaluation steps of tacit knowledge ability of university librarians based on BP neural network model

According to the evaluation index of tacit knowledge ability of university librarians and BP neural network model, the specific process of BP neural network performance evaluation was described as follows:

Step1. Set the variables and parameters. The input layer neurons are evaluation index of the librarian's tacit knowledge ability. The input vector is \( X = (x_1, x_2, ..., x_i, ..., x_n)^T \), where \( n \) is the number of training samples; the hidden layer output vector is \( Y = (y_1, y_2, ..., y_j, ..., y_m)^T \), where \( m \) is the number of hidden layer nodes; the output layer neurons are the tacit knowledge ability of the librarian, and the output vector is \( O = (o_1, o_2, ..., o_k, ..., o_l)^T \), where \( l \) is the number of output neurons; the expected output is \( d = (d_1, d_2, ..., d_k, ..., d_j)^T \), the weight matrix between the input layer and the hidden layer is \( V = (v_1, v_2, ..., v_j, ..., v_m)^T \), where \( v_j \) represents the vector corresponding to the \( j \)-th neuron of the hidden layer; the weight matrix between the hidden layer and the output layer is \( W = (w_1, w_2, ..., w_k, ..., w_j)^T \), where \( w_k \) represents the weight vector corresponding to the \( k \)-th neuron of the output layer.

Step2. Initialize the weight. A small random non-zero value within one of each interval (-1, 1) of \( V \) and \( W \) is given.

Step3. The training samples of input are \( X = (x_1, x_2, ..., x_i, ..., x_n)^T \), where \( n = 14 \); and expected output is \( d = (d_1, d_2, ..., d_k, ..., d_j)^T \).

Step4. For the input sample \( X \), the output of the hidden layer unit is calculated.

\[
net_j = \sum_{i=0}^{n} v_{ij}x_i \quad j = 1, 2, ..., m \tag{1}
\]

\[
y_j = f(net_j) \quad j = 1, 2, ..., m \tag{2}
\]

Step5. The output \( y_i \) and the connection weight \( W \) are used to calculate the output \( O_k \) of each unit of the output layer.

\[
net_k = \sum_{j=0}^{m} w_{jk}y_j \quad k = 1, 2, ..., l \tag{3}
\]

\[
O_k = f(net_k) \quad k = 1, 2, ..., l \tag{4}
\]

Where, in equations (2) and (4), the transfer function is: \( f(x) = \frac{1}{1 + e^{-x}} \). (5)

Step6. The error \( E \) is calculated from the expected output value \( d \) and the actual output value \( O_k \) obtained in the previous step, and it is judged whether it satisfies the requirement. If it is satisfied, the process directly proceeds to step 8, and if it is not satisfied, the process proceeds to step 7.
\[ E = \frac{1}{2} (d - o)^2 \]
\[ = \frac{1}{2} \sum_{k=1}^{l} (d_k - o_k) \]  \hspace{1cm} (6)
\[ = \frac{1}{2} \sum_{k=1}^{l} \left\{ d_k - f \left[ \sum_{j=0}^{m} w_{jk} y_j f \left( \sum_{i=0}^{n} v_{ji} x_i \right) \right] \right\}^2 \]

Step7. The modified connection weights \( u_i \) and \( w_{jk} \) are calculated as follows, and then go to step 4.
\[ \Delta w_{jk} = \eta \delta_k^o y_j \quad j = 1, 2, \ldots, m; \quad k = 1, 2, \ldots, l \]  \hspace{1cm} (7)
\[ \Delta u = \eta \delta_j^h y_i \quad i = 1, 2, \ldots, n; \quad j = 1, 2, \ldots, m \]  \hspace{1cm} (8)

The constant \( \eta \) in equations (7) and (8) represents the proportional coefficient, which reflects the training rate. The \( \delta_k^o \) in equation (7) represents the error of the output of the \( k \)-th output neuron in the BP model of book quality evaluation for library. For the output neurons, which are \( \delta_k^o = (d_k - o_k) o_k (1 - o_k) \); the \( \delta_j^h \) in equation (8) represents the output error of the \( j \)-th hidden layer neuron; and for the hidden layer neurons, which are \( \delta_j^h = \left( \sum_{k=1}^{l} \delta_k^o w_{jk} \right) y_j (1 - y_j) \), where \( w_{jk} \) indicates that the book quality evaluation with BP model implicit neurons are connected to the output weight of the output neurons.

Step8. The model will determine whether all training samples have been learned, and if so, the end, otherwise go to step 3.

In the process of book quality evaluation mapping, a frequently used feature mapping structure was from one-dimensional input to two-dimensional mapping output. Therefore, the above process ensured that the mapping neural network could autonomously implement the correct topology mapping of related knowledge attributes, which was as shown in Figure 2.

![Figure 2. Relationship structure of neurons in neural network model](image_url)

After the above calculation, the prediction of the quality evaluation of the book was consistent with the expert score. The root mean square error of the output data test sample was 0.011 that satisfied the accuracy requirement, which proved that the evaluation system was effective and could reflect the library books well. The mapping relationship between the indicators of the quality evaluation service and the evaluation results was a reasonable and feasible method for evaluating the quality of library books.
2.3 Validation of evaluation system

Based on the above analysis, the data visualization effects of the book quality evaluation data in the paper established by the neural network was analyzed and compared. According to the complete data analysis of the book information data index system and the neural network to cluster the information neural node sampling observation, the system apply the neural network to randomly selected the sample point design execution simulation, which obtained neural network fitting result model. The quality evaluation made by the book system was obviously higher than the theme recommendation and the expert recommendation effect. The book recommendation fit was as high as the intelligent learning ability after the time accumulation in the neural network, and the book quality evaluation effect was gradually improved with the time of the journey, which was as shown in Figure 3.

![Figure 3. Recommendation effect verification of book quality evaluation](image)

The relative error data between the sample real value and the predicted value of the neural network could be analyzed. The book quality evaluation model showed good network training ability, which could successfully generate the basic change trend of the demo data, and then tapped the regular pattern of variation of the quality of the library; the accuracy and general analysis ability of the model were kept at a relatively appropriate level, and the accuracy of the model was verified. This method could be applied to the processing of other book quality evaluation.

3. Summary Results

Quality evaluation of the library was a multi-factor, multi-index, fuzzy nonlinear process. The evaluation indicators should be set to accurately reflect the actual situation. When evaluating the model selection, the error of the evaluation result and the accuracy of the actual situation reflection should be considered. The library quality evaluation index system designed in the paper evaluated the library quality by using the neural network model technology with fast learning speed and easy convergence. The design idea and implementation process of the neural network evaluation model were expounded. The rationality and effectiveness of the proposed method were verified by an example sample analysis.

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