Directors of Comprehensive Quality System of College Students in China: Based on BP Neural Network

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Abstract

Chinese college students' comprehensive quality is evaluated by using a number of indicators. The students' comprehensive quality indicators are nonlinearity and uncertainty which can not be measured accurately. The BP network model can be a good solution to this problem. For this purpose, the BP neural network integrated assessment model for students has been established to effectively judge the quality of all aspects of the university students, and evaluate the reliability of the analysis. Research on the BP network model, its function can be achieved true judgment, made out of the heavy information inquiry, summarizing work out.

Key words: BP neural network; Comprehensive evaluation; Evaluation results

INTRODUCTION

Students' Comprehensive Quality Assessment is easily affected by subjective and objective factors and the uncertainty of various factors exist as well. A scientific evaluation method on college students' comprehensive quality evaluation without a variety factors interfere of subjective and objective is very necessary. BP network is a highly complex nonlinear dynamical system to identify the model, the use of BP network overall quality of students to make the results more objective evaluation. BP neural network is based on the error back propagation algorithm multilayer feed forward neural networks. Any nonlinear can be achieved between the input and output. In this paper, the overall quality of students' evaluation system indicators as inputs, it can built BP neural network evaluation model, and the model is verified by the data evaluation that the test results are consistent with the real value.

1. THE PRINCIPLE OF COMPREHENSIVE EVALUATION BY BP NEURAL NETWORK MODEL

1.1 The Basic Structure of BP Neural Network

The research of the network is a process that uses the sample data to optimize the network parameters (weights and threshold values) in terms of some objective function. Currently BP algorithm is the most widely used and very successful algorithm.

The input signal x generates an output signal y through intermediate nodes (hidden points) acting on the output node according to the neuron action function. Each sample of network training includes input vector X and the expected output d, the deviation between network output value y and expected output d. The error of gradient direction is decreased by adjusting the weights of the input nodes and hidden layer nodes, or of the hidden layer nodes and the output nodes, and thresholds as well. According repeated training, it determines network parameters (weights and thresholds) corresponding minimum error,

then the training has been completed. At this point, the trained neural network is able to enter information on similar samples, to handle the smallest output error information through the non-linear conversion. Figure 1
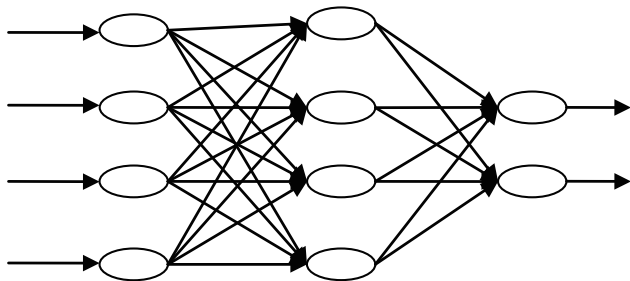
Figure 1
Topological Structure of BP Neural Network

1.2 The Basic Ideas of BP Neural Network Model

The basic idea of BP neural network model for comprehensive evaluation of students is: it takes each evaluation index attribute value as the input vector of BP network model, evaluation results as the model output. A sufficient number of samples has been taken to train the network makes it memorize each index weights, each evaluation staff experiences, and knowledge, etc.. The final results of object can be obtained by trained BP network model based on each index value evaluated of measured object.

2. THE STRUCTURAL DESIGN OF BP NEURAL NETWORK MODEL FOR COMPREHENSIVE EVALUATION

2.1 Index Structure of Design Model

According to the model structure and the evaluation principles, the comprehensive evaluation of students of BP neural network model is classified as follows:

Input layer, based on College Students' Quality Comprehensive Assessment System, it takes the lowest index number as the number of neurons in the input layer.

Hidden layer, hidden layer neurons are obtained by the formula L = (m × n) 1/2.

Output layer and output layer neurons n = 1, the output result is 0 (1 <0 <5). for college students The synthetic quality classification of college students is a process transferring qualitative to quantitative, and then through the network model make the output after qualitative into quantitative on the contrary. It uses the output result sets and comprehensive evaluation of students' quality to make a qualitative assessment and evaluation set in five levels: excellent, good, moderate, pass, and failed. The highest score is set 10 and lowest score is 1; 9 to 10 are excellent; 8 to 9 as well as the good; between 7 to 8 moderate; between 6 to 7 are pass; less than 6 to be failed.

2.2 Determine the Optimal Structure by Parameter Selection

The BP algorithm has been used while the optimal structure of BP neural network must be determined firstly. Secondly, the numbers of the input layer nodes depends on the dimension of the input feature vector. The number of output layer nodes generally is equal to the number of the model types. The output of type m uses m units, can be expressed any pattern categories by encode of output node. How to determine the number of nodes in the hidden layer, it has been no generally accepted solution and questioned many scholars. Based on a number of experimental researches, we conclude a simple and practical method to estimate directly the optimal number of nodes in the hidden layers, the method as follow:

$$N_H = \sqrt{N_I \times N_O} + N_P / 2 \qquad (1)$$

In the equation, N_H are the best hidden layer nodes, N_O are the nodes in the output layer, and N_P is the number of training samples.

Students' Comprehensive Quality Assessment is using a three-layer BP network model. Neuron input is a coordinate value of molecular dynamics data. The expected output is a series of data obtained by the data belongs to a class with a custom node data values to indicate. The type of node data belongs is determined based on neuron output value. Set h, i, j, respectively the nodes number of the input layer, hidden layer and output layer. The threshold value of hidden layer nodes and output layer node are, respectively, θ_i, θ_j. The weights of nodes of the input layer to the hidden layer and the hidden layer to output layer are namely ω_{hi}, ω_j that nodes of the input is x, and output y.

Input the sample values and calculate the values of the input and output nodes.

Set the normalized input sample and the corresponding desired output values as $\{x_k, d_k\}$, k is the sample size. Empower $\{\omega_{hi}\}$, $\{\omega_{ij}\}$ and $\{\theta_i\}$, $\{\theta_j\}$ as random values in interval (-0.1, 0.1). Set k=1, and provide the sample point to the network, and calculate input x_i and output y_i of any hidden layer node:

$$x_i = \sum_{h=1}^{h} \omega_{hi} \cdot x_k + \theta_i \qquad (2)$$

$$y_i = 1 / (1 + e^{-x_i}) \qquad (3)$$

Calculate input x_j and output y_j of each output layer node:

$$x_j = \sum_{h=1}^{i} \omega_{hi} \cdot y_i + \theta_j \qquad (4)$$

$$y_i = 1/(1 + e^{-x_j}) \qquad (5)$$

Correction of the weights and thresholds

According to the gradient descent principle, correct the weights and thresholds in terms of the following formula:

$$\Delta\omega_{ij}^{t+1} = \eta \frac{\partial E_k}{\partial x_j} y_i + \alpha\Delta\omega_{ij}^{t} \tag{6}$$

$$\Delta\omega_{hi}^{t+1} = \eta \frac{\partial E_k}{\partial x_j} x_k + \alpha\Delta\omega_{hi}^{t} \tag{7}$$

$$\Delta\theta_{j}^{t+1} = \eta \frac{\partial E_k}{\partial x_j} + \alpha\Delta\theta_{j}^{t} \tag{8}$$

$$\Delta\theta_{i}^{t+1} = \eta \frac{\partial E_k}{\partial x_i} + \alpha\Delta\theta_{i}^{t} \tag{9}$$

The number of correction are t, learning rate are $\eta \in (0,1)$, α is a little positive number, E_k is the error of a single sample point.

$$\frac{\partial E_k}{\partial x_j} = y_i(1-y_i)(y_i-d_k) \tag{10}$$

$$\frac{\partial E_k}{\partial x_i} = y_i(1-y_i)\sum_{j=1}^{j}\frac{\partial E_k}{\partial x_i}\omega_{ij} \tag{11}$$

Determine the appropriate network parameters

Set k=k+1. Sample points are provided to the network. It calculate the input and output values of each hidden layer and output layer sections, and corrects each weights and thresholds until the training of all the data in the nodes is completed. Repeat the above steps until the learning times are more than the present values. Then the research is end. We can get the required network parameter.

3. THE BP NEURAL NETWORK APPLIED ON THE COMPREHENSIVE EVALUATION OF STUDENTS

3.1 Import the Database Information of Students' Comprehensive Evaluation

The information samples of students' comprehensive evaluation indicators are obtained by student management system database, as shown in Table 1:

Table 1
The Information of the Index for Quality Evaluation

Name	The students' comprehensive evaluationindicators				
	Moral	Intellectual	Psychological quality	Creative thinking	Social skill
Bill	9.5	9	9	8.5	10
Jacky	10	9.5	9.5	9.5	10
Lucy	9	10	10	9.5	9
Ivy	9	9	9	10	8
⋮	⋮	⋮	⋮	⋮	⋮
Jane	5	5.5	5.5	5	5
Emma	6	5	6.5	5.5	5
Richard	6.5	5.5	5.5	6	6

3.2 Determine Sample Selection of Evaluation Indicators and Structure of BP Network

A comprehensive evaluation of the quality of the students needs to be objective, and comprehensive coverage of all aspects of student evaluation. We selected 5 indicators on students' quality evaluation which are: moral, intellectual, psychological quality, creative thinking, and social skills.

Determined each score in accordance with the level of ability is from 0 to 10 points. The composite score is obtained by the weighted sum of the comprehensive evaluation index according to the actual situation in various colleges and universities may be different. For convenience, each indicator is defined as 0.1. Therefore,

$X=(X_1, X_2, X_3,..., X_5)$ constitute feature vector of the BP neural network input whose dimension is 5, the input layer unit number is 5. The output layer unit number is 1, which is comprehensive quality assessment score as well. To reduce the size of the network and improve the learning speed, it selects a hidden layer. During network training, under different conditions, selected 20 samples as training samples, according to the aforementioned best hidden layer nodes estimation method can be obtained:

$$N_H = \sqrt{N_I \times N_O} + N_P/2 = \sqrt{5\times1} + 20/2 = 12.45 \tag{12}$$

Therefore, the number of the best hidden layer neurons is 12.45.

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[1]Identify applicable sponsor/s here. (sponsors)

3.3 Evaluation Analysis of Empirical Results

Firstly, the conversion rules from the identification value of neural network to the categories pattern have been set. If a pattern of neural network identification value is greater than or equal to 9, it is considered as "excellent" in a class; if the identification value greater than or equal to 8 and less than 9, the model is considered as "good" in a class; if the identification value is greater than or equal to 7 and less than 8, then the pattern is considered "medium" in a class; if the value is greater than or equal to 6 and less than 7, this is considered as "passed" in a class; if value is less than 6, the pattern is considered to have "failed" in a class. Secondly, we enter the new model results of the analysis are shown in Table 2:

Table 2
Test Results of the Sample Album of BP Neural Network

Sample No.	Evaluation objectives (quality of the true value)	Learning outcomes (neural network identification value F)	Category
X_1	9.4	9.2902	Excellent
X_2	9.5	9.4952	Excellent
X_3	8.55	8.4749	Good
X_4	8.35	8.4446	Good
X_5	7.8	7.9002	Medium
X_6	7.45	7.4035	Medium
X_7	7.35	7.1647	Medium
X_8	6.6	6.4489	Passed
X_9	6.5	6.578	Passed
X_{10}	5.8	5.7121	Failed

The results of Table 2 showed that 10 input mode networks, which we can see the evaluation results entirely correct. The network has a strong reasoning ability, and can achieve the correct evaluation. When network training has been completed, we can choose certain aspects of the specific topics of the students' ability to evaluate, or use the internet to select one or more aspects to evaluate.

CONCLUSION

It adopts BP neural network model for comprehensive evaluation of the quality of students, with a strong self-learning, adaptive capacity, and very small error between model identification rate and the true value. The evaluation result is satisfactory. After determine the network structure and algorithm, the accuracy of the model is closely related with the input number of training samples. The more training samples, the better the model of the evaluation would be.

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