Prediction of Students' Sports Performance Based on Genetic Neural Network

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Abstract. Achievement prediction is an important content of educational data mining, and accurate achievement prediction is of great benefit to teaching management. In this paper, we propose a performance prediction method based on genetic neural network. This method first uses correlation analysis to screen the scores of other courses with high correlation with the target courses as the input variables of the neural network model, and then optimizes the model by back propagation (BP), in which the super parameters of the neural network are optimized by genetic algorithm. We apply the model method to the prediction of college students' sports performance. The results show that compared with BP neural network model, the root mean square error of prediction is reduced from 8.8 to 3.0.

Keywords: genetic neural network · BP neural network · Performance prediction · Correlation analysis · genetic algorithm

1 Introduction

With the development of information technology, data mining technology has penetrated various industries. Education data mining has received people's attention [1]. Student achievement prediction is an important part of educational data mining. The prediction of students' achievements can help improve teaching methods and plan teaching plans reasonably. However, students' grades are affected by various factors, and the relationship between these factors and grades is not linear, but nonlinear, and usually there are few samples of grades in the same course, which brings difficulties to the prediction of grades.

At present, some researches of performance prediction are based on genetic neural network. The principal component analysis-radial basis function (PCA-RBF) neural network [2, 3], uses the principal component analysis (PCA) to reduce the dimension of data, and uses the RBF neural network to predict student achievement [4]. BP neural network is used to predict students' grades, but the prediction accuracy of BP neural network is low [5]. The method of grade prediction based on feature selection regression and BP neural network provides an important reference for the analysis of students' grades, but the prediction accuracy of this model is insufficient.

In order to improve the accuracy of student achievement prediction, this paper proposes to adopt a student achievement prediction model based on genetic neural network [5–8]. The model selects the input items of the model by calculating the correlation coefficient, introduces the genetic algorithm to optimize the initial weight and threshold of the BP neural network, improves the BP neural network prediction model, and realizes the prediction of students' sports performance.

2   Methods

2.1   Correlation Analysis Method

The correlation analysis method is a statistical method to study whether there is a certain dependency between the observed values, explore the correlation direction and degree between the variables with dependency, and analyze the correlation between the random variables. Use the correlation analysis method to calculate the correlation between the basic course performance and the target course performance, and analyze the impact of the basic course performance on the target course performance. In the correlation analysis method, Pearson correlation coefficient is generally used to study the correlation degree.

2.2   BP Neural Network

BP neural network is a multi-layer forward network, including input layer, hidden layer, and output layer, as shown in Fig. 1. The input layer is mainly responsible for receiving signals, the hidden layer maps and converts signals, and the output layer mainly outputs the prediction results of BP neural network [5].

The number of input layer nodes, hidden layer nodes and output layer nodes of BP neural network are set respectively. The number of nodes in the input layer is the number of input course grades, and the number of nodes in the output layer depends on the number of output target courses. The number of hidden layer nodes is determined by trial-and-error method, and the optimal number of hidden layer nodes is selected according to the experimental results. Determine the initial value of hidden layer by trial-and-error method as follows:

$$l = \sqrt{n + m} + \partial \tag{1}$$

where ∂ is an arbitrary constant between 1 and 10. The BP neural network prediction model is established. The input data is the students' basic course scores of surveying and mapping engineering technology in Yunnan Vocational College of Land and Resources, and the output data is the students' physical education course scores.

2.3   BP Neural Network Optimized by Genetic Algorithm

Genetic algorithm is an adaptive global optimization probability search algorithm based on natural population genetic evolution mechanism, which simulates the phenomena of reproduction, hybridization, and mutation in biological evolution [7, 8]. The genetic algorithm optimizes the BP neural network. It mainly uses the initial weight and threshold
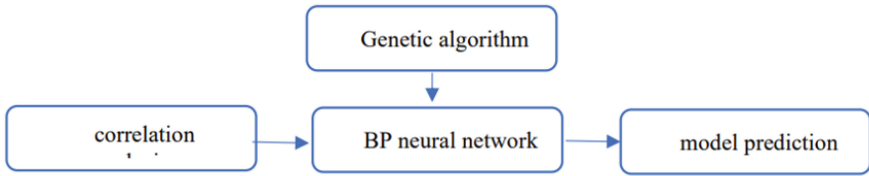
Fig. 1. Genetic Neural Network Prediction Model

of the BP neural network as the chromosome of the genetic algorithm to generate the initial population. The genetic operator of the genetic algorithm is used to select, cross, and mutate the individuals of the population generation by generation [7, 8]. The optimal solution of the initial weight and threshold of the BP neural network is found and assigned, and then it is substituted into the BP neural network model training to obtain the global optimal prediction value, Reduce the prediction error of BP neural network.

2.4 Prediction of Students' Grades Based on Genetic Neural Network

In order to overcome the low prediction accuracy of the prediction model established by BP neural network, a prediction model based on genetic neural network is adopted, as shown in Fig. 1.

3 Experimental Results and Analysis

3.1 Data

The data studied in this paper comes from the final examination results of the first year of the 2021 surveying and mapping engineering technology major in Yunnan Vocational College of Land and Resources in the first semester. The curriculum includes 6 courses, including advanced mathematics, college Chinese, innovation and entrepreneurship, career planning, ideological and moral cultivation and legal basis, and college physics. For the collected raw data, do data preprocessing, delete all the data of the absent students in this exam, and then normalize the data to get the final student score data, a total of 120 students' scores.

3.2 Data Processing by Correlation Analysis

Taking signal and system as the prediction target course, with reference to formula (2), the scores of 6 basic courses of 120 students majoring in communication engineering after data preprocessing can be obtained, and the correlation coefficient between the scores of signals and system in the target course is shown in Table 1.

Table 1. Correlation coefficient between basic courses and target courses

Public basic courses	Correlation coefficient
Advanced mathematics	0.30
College Chinese	0.43
Innovation and entrepreneurship	0.45
Career planning	0.41
Ideological and moral cultivation and legal basis	0.32
College Physics	0.29

Table 2. Comparison of prediction results of two models

Student's real score/point	BP neural network prediction/ point	Prediction value of genetic neural network / point
70	78	75
56	58	65
82	73	77
84	86	83
62	55	65
76	62	74
78	64	71
52	57	49
81	75	84
62	72	68

3.3 Prediction of Students' Sports Performance

The R language software is selected as the experimental platform, and the BP neural network model and the genetic neural network model are used for prediction respectively. Set up test sets and training sets, including 110 training sets and 10 test sets. The prediction results are shown in Table 2.

The root-mean-square error predicted by BP neural network model is 8.8, and the root-mean-square error predicted by genetic neural network model is 3.0. By comparing the root mean square error, the genetic neural network model has higher prediction accuracy than the BP neural network model. It is more suitable for student performance prediction.

4 Conclusion

Aiming at the prediction of students' grades by genetic neural network, based on the prediction model of BP neural network, the correlation coefficient between the basic course grades and the target course grades is solved by correlation analysis method, and the basic course grades with low correlation degree with the target course grades are removed. The optimal initial weights and thresholds of BP neural network are obtained

by combining genetic algorithm with BP neural network, and the prediction model of students' grades by genetic neural network is established. By collecting the actual basic course scores of 120 students and substituting them into the genetic neural network student performance prediction model, the college physical education course scores of these students are predicted. The experimental results show that compared with the BP neural network model, the root mean square error of the prediction is 8. 8 is reduced to 3.0, with higher prediction accuracy, which verifies the effectiveness of the model.

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