Application of SOM、BP Neural Network in Physical Health Assessment of Students

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Abstract: At present, the physical fitness measurement carried out by the school is an important way to detect the students' physical health. How to use the students' physical fitness scores to scientifically and reasonably evaluate the students' physical fitness and health. This paper attempts to apply BP neural network to evaluate students' physical health, use software to study and train the designed network, establish the corresponding neural network model, and use SOM neural network clustering to analyze the results of physical health. And realize the physical health evaluation of physical test results. Analysis of the results shows that the BP neural network can evaluate the physical health of the physical test results and show the quality of the students' physical quality. By using BP neural network to evaluate physical health, the method is operable and has wide practicability, and provides the basis for the credibility of physical health.

1. Introduction
On campus, physique measurement managers often need to analyze students' physical fitness. The determination of physical fitness is an important content. It is decided that the determination of college students' physique, the evaluation of physique, the evaluation of the effect of physical exercise of college students, and the scientific guidance of college students to carry out physical activities, so that the school must analyze the students' physical fitness and health. With the development of science and technology and the progress of society, people's ideas are constantly updated, and the detection of physical health has changed from traditional artificial physical health analysis to scientific and systematic analysis. This paper uses the SOM (BP) neural network to grade the students' physical test scores, and uses the BP network to evaluate the students' physical health.

2. Algorithm for 2SOM Neural Networks
SOM network is a clustering algorithm, which takes n dimension vector as input, corresponding to an input layer containing n nodes. The input layer and the competition layer pass the weight vector, and each sample corresponds to a competition layer node. At the end of the training, the nodes corresponding to the input sample layer are classified into the same category,Physical layer and competitive layer, without hidden layer. learning algorithms use Kohonen learning rules in SOM networks.

Neurons in a field near each neuron will also be updated, but relatively distant neurons will not be updated, so that geometrically similar neurons become similar. domain neurons when the domain
value is \(d\). \(\mathbf{N}(\mathbf{d}) = \{j, \mathbf{D}(i, j) < d\}\) General algorithms for SOM neural networks:

1. Set variables and parameters. For each sample, \(m\), input samples are listed as:
   \[ x = [x_1, x_2, ..., x_m] \] (1)
   The weights between nodes and output neurons are as follows:
   \[ \mathbf{w}_i(h) = [\mathbf{w}_{i1}(k), \mathbf{w}_{i2}(h), ..., \mathbf{w}_{im}(h)] \] (2)

2. Initialization. The random value of the weight of the network is reduced to the minimum, given the initial value, initialization, input vector and weight normalization:
   \[ X' = x / \|x\| \quad \mathbf{w}_i'(h) = \mathbf{w}_i(h) / \|\mathbf{w}(h)\| \] (3)

3. Input randomly selected samples into the network. Find out the winning neurons:
   \[ D = \|x - \mathbf{w}_i\|, \quad i = 1, 2, ..., l \] (4)

4. Update weights. Train all neurons in the topological domain of the winning neuron to update weights between adjacent and input layers:
   \[ \mathbf{w}(h + 1) = \mathbf{w}(h) + \eta(t)(x - \mathbf{w}(h)) \] (5)

5. updating the learning rate and topology domain will decay over time and normalize the weight values after learning.

6. Judge whether convergence. Until the maximum number of iterations is reached.

3. Algorithm for 3BP Neural Networks

BP neural network standard learning algorithm. And in a three-layer BP network, Assuming \(M\), number of input neurons \(I\), number of neurons in the hidden layer \(J\), number of neurons in the output layer The \(m\) neurons in the input layer are recorded as \(x_m\), The \(i\) neurons in the hidden layer are recorded as \(k_i\), The \(j\) neuron in the output layer is \(y_j\). The connection weight from \(x_m\) to \(k_i\) is \(\omega_{mi}\), The connection weight from \(k_i\) to \(y_j\) is \(\omega_{ij}\). Implicit layer transfer function is Sigmoid function, The output layer transfer function is a linear function, as shown in Table 1. A neural network accepts a vector of \(M\) length as input, a vector with a final output length of \(J\). The inputs and outputs of each layer are represented by \(u\) and \(v\), as representing the input of the first neuron in the \(I\) layer, i.e., the hidden layer. The actual output of the network is:

\[ u_1 = e^{6} \] (6)

The desired output of the network is:

\[ d(n) = [d_1, d_2, ..., d_J] \] (7)

\(n\) is the number of iterations. Error signals for the \(n\) iteration are defined as:

\[ e_j(n) = d_j(n) - y_j(n) \] (8)

The error energy is defined as:

\[ e(n) = 1/2 \sum_{j=1}^{J} e^2_j(n) \] (9)

4. Application of 4BP Neural Network in Physical Health Assessment

4.1. Neural Network Model Establishment

The model is input by each physical test score, and the output is good or bad (good 1, bad 2), the input node is 8, and the output node is 1. A three-layer multi-input single-output BP neural network with a hidden layer is used to build an evaluation model. The formula according to the number of neurons in the hidden layer of demand (\(n\) the number of neurons in the input layer, \(m\) the number of neurons in the output layer, \(a\) the constant between \([1, 10]\)):

\[ l = \sqrt{n + m + a} \] (10)

It can be seen that the number of neurons is between 4-13, and the number of hidden layer neurons is 6. According to the advice of relevant experts, this paper divides the evaluation of physical health into two categories (one is good, the other is bad, the other is 2), which can express the evaluation results of physical health intuitively.

In this study, the network structure was adjusted according to the size of each group of data groups, and the grade of physical test scores was divided into four grades (physical education teachers
generally used evaluation system), but the organizational structure of neural network was also different because of the different items of data group. The first set of data cluster analysis, the dimension is 4, the competitive layer of the network contains 4 nodes, and the input layer also contains 4 nodes. A SOM neural network with adjustable structure is used to cluster the input vectors.

4.2. **BP Network assessment analysis**
First, the function is used to normalize the input sample, transform it into input data of neural network; Second, by default, Set the maximum number of iterations to 1500, Training is then conducted; In the network 0-3 a total of four iterations that converge. Finally, BP the output value of the network is a real number, It needs to be converted into integers. Get an ideal correct rate. As shown in the legend, Figures 1, 2 and 3 are the network structure diagrams, Key indicators, training status and regression.

![Figure 1 Main indicators](image1.png)

![Figure 2 Training status](image2.png)

![Figure 3 Regression](image3.png)
4.3. Analysis of results
Based on the analysis of the students' physical test scores, it is found that the students' physical health assessment is wrong, on the one hand, because the students' physical test scores belong to the middle area (bad but not bad), which directly leads to the correct rate of the evaluation results. With the exception of this part of the factor, we can provide a small number of training samples, through comparative analysis and evaluation results, we can see that the BP neural network is used to achieve a better physical health evaluation of the actual body test data. It is proved that BP neural network model has good availability and accuracy.

5. Concluding remarks
By applying BP network to students' physical health evaluation, this paper constructs the corresponding network model. With the help of students' physical test scores, they are trained and studied to obtain the relevant results of students' physical health assessment. By using BP network, the error caused by human subjective factors in the evaluation process can be reduced, and the reliability and conviction of students' physical quality analysis can be improved. Here, we suggest that universities should strengthen the awareness of physical exercise. Call on students to adjust their weight to a reasonable range, actively exercise, and control their diet.

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