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Evaluation of Scientific Research Ability in Colleges and Universities Based on Discrete Hopfield Neural Network

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ABSTRACT. *With the development of China's economy and the continuous enhancement of its comprehensive strength, the development of China's higher education has entered the upper-middle level of the world, but the development of education in China is not balanced.Taking Jiangsu Province as an example, this paper gives a comprehensive evaluation of the quality of undergraduate education in 13 prefecture-level cities in Jiangsu Province.This paper firstly reviews the data of relevant indicators given in the paper, and considers the impact of a small number of indicators that cannot be accurately quantified. Combined with the associative memory ability of discrete Hopfield neural networks, an evaluation model of discrete Hopfield undergraduate education quality is established.Secondly, the university is divided into five grades and the average value of each index is used as the ideal evaluation index of each grade, which is the balance point of Hopfield neural network.Finally, the results of the simulation of the example are obtained by using the neural network toolbox that comes with Matlab.*

KEYWORDS: *discrete Hopfield neural network evaluation of scientific research ability*

1. Introduction

Colleges and universities are not only the place to teach and educate people, but also the "main position" of scientific research in various countries. The scientific research ability of colleges and universities is also an important part of the comprehensive strength of colleges and universities.But nowadays colleges and universities are considering the scale of their research and the quality of their research.

Among them, the scientific research evaluation of colleges and universities only depends on the indicators of science and technology input, the number of papers produced, etc., and must also pay attention to the relationship between science and technology and economic and social development, innovative policies and cultural

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environment, the efficiency of the innovation system itself, a certain subsystem. The innovation contributes to the innovation of other systems, not the destruction.In other words, the ability of a country's research and innovation not only refers to the ability of science and technology investment, the ability of science and technology resources allocation, but refers to the sum of the ability of science and technology to innovation in all walks of life in the country.Only by improving the country's overall innovation system capability can it be built into an innovative country. These problems will seriously affect the sustained and healthy development of science and technology work in universities.Therefore, how to evaluate the scientific research ability of colleges and universities is a problem that needs to be solved quickly in today's society.

2. Network structure of discrete Hopfield neural network

The Discrete Hopfield Neural Network (DHNN) is a single layer, feedback network with an output of 1 or -1.Therefore, when the evaluation index is mapped to the neuron state, it needs to be encoded.The coding rule of this paper is: when the index is greater than or equal to a certain level, the corresponding neuron is 1, otherwise it is 0.Figure 1 shows the structure of the network.

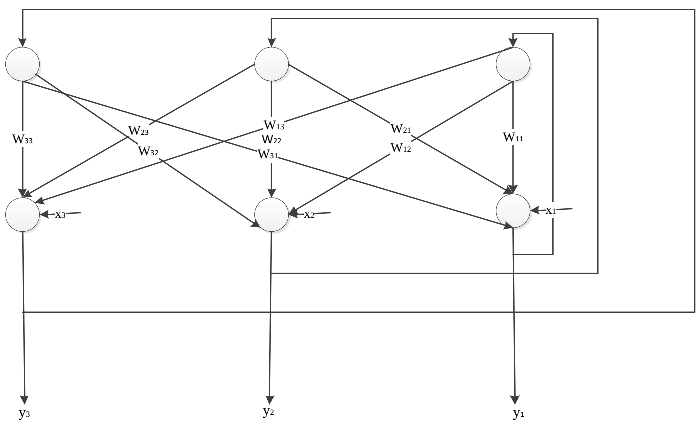

Figure. 1 Discrete Hopfield Neural Network

As shown in Figure 1, layer 0 is the input of the network and does not have the function of calculation; the first layer acts as a neuron and generates output information through a simple threshold function f if its threshold θ is less than that of the neuron. The stimulus, then the neuron is in a state of 1; when its threshold θ is greater than the stimulus to which the neuron is subjected, then the neuron is in a state of -1.

For the neural network of the binary system, the relationship shown in formula (1) is satisfied.

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$$u_j = \sum_i \omega_{ij} y_i + x_j \tag{1}$$

Where x_j is the external input.And satisfy the relationship of formula (2)

$$\begin{cases} y_j = 1, u_j \geq \theta_j \\ y_j = -1, u_j \leq \theta_j \end{cases} \tag{2}$$

For a network whose output layer is a neuron, the state at time t is an m-dimensional vector as shown in equation (3).

$$Y(t) = [y_1(t), y_2(t), \cdots y_n(t)]^T \tag{3}$$

Using $y_j(t)$ to represent the jth neuron, that is, the state of the jth node at time t, the state of the next time (t+1) of the node can be obtained by equation (4).

$$y_j(t+1) = f[u_j(t)] = \begin{cases} 1, u_j(t) \geq 0 \\ -1, u_j(t) \leq 0 \end{cases} \tag{4}$$

$$u_j(t) = \sum_{t=1}^{n} \omega_{ij} y_i(t) + x_j - \theta_j \tag{5}$$

3. Design ideas

In this paper, several classification levels are designed as the balance points of the network. After the network learning is completed, the evaluation indicators corresponding to all classification levels are the equilibrium points of the network.When the original data is imported into the neural network, the network will gradually become a certain equilibrium point of storage, and the balance point is the classification level to be sought until the state is not changed.

4. Design method

The weight correction method adopted by the Matlab neural network tool newhop() function is called orthogonalization method. In this paper, the orthogonalization method is adopted, and the overall adjustment algorithm is as follows:

Step 1: Input M input patterns a={a^2, a^2,..., a^{m-1}, a^m} and parameters τ,r.

Step 2: Calculate B = {a^2-a^{m}, a^2-a^m, ..., a^{m-1}-a^m}.

Step 3: Perform a singular value decomposition B = WSV^a on B, and calculate the rank r = rank (B) of B.

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Step 4: respectively by W^p={W^1, W^2..., W^k} and w^n={w^{k+2}, w^{k+2}...,w^m} , calculation

$$T^n = \sum_{i=1}^{r} w^i (w^i)^A, T^p = \sum_{i=r+1}^{m} w^i (w^i)^A.$$

Step 5: Calculate $F^t=T^n-\tau\times T^p$, $n^t=a^m-F^t\times a^m$.

Step 6: Calculate $P = exp(s \times F^t)$.

Step 7: Calculate $d = W \times \begin{bmatrix} D_1 \times I(R) & 0(M, M-R) \\ 0(M-R, M) & D_2 \times I(M-R) \end{bmatrix} \times W^p \times n^t$ Where D_1=exp(s)-1, D_2=-exp[(-τ×s)-1]/τ.M^{mmm}

The algorithm flow chart is shown in Figure 2.

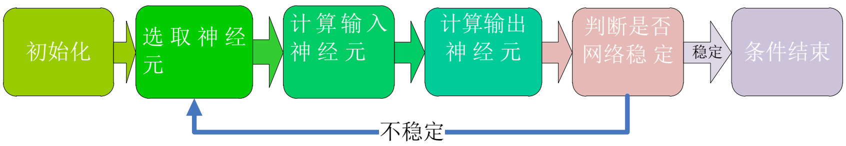

Figure. 2 Orthogonal method design weight coefficient

5. Design steps

Based on the above, the design steps of this paper are shown in Figure 3:

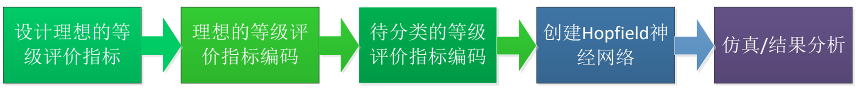

Figure. 3 design step flow chart

6. Example simulation analysis

There are many indicators that affect the quality of undergraduate education.Find information on the following nine indicators (number of undergraduate institutions, number of enrolled students, faculty and structure, student-teacher ratio, teaching conditions and utilization, professional construction and teaching reform, student employment, scientific research input and output, and dual-level discipline construction)).This paper takes Jiangsu Province of China as an example to comprehensively evaluate the quality of undergraduate education in 13 prefecture-level cities in Jiangsu Province.First of all, this paper first divides the university into five grades, and its ideal grade evaluation index code is shown in Figure 4.Secondly, a discrete Hopfield neural network is established, and 13 prefecture-level cities are classified, and the corresponding results are obtained through simulation

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analysis.Finally, a comprehensive ranking of the quality of undergraduate education in 13 prefecture-level cities was obtained.

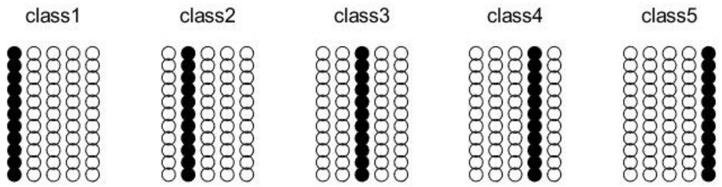

Figure. 4 The ideal five-level evaluation index code

6.1 Classification evaluation index code to be classified

The university is divided into five grades, and the relevant data is consulted. The average value of each index is used as an ideal evaluation index for each grade.

Table 1 13 University rating indicators to be classified

	Number of undergraduate institutions	Enrollment	Total number of teachers	Number of students	Student ratio	Student employment	Research input and output	Double-class discipline construction
Nanjing	99.00	96.50	94.50	96.00	98.00	95.00	98.00	93.00
Suzhou	17.12	18.75	21.60	18.75	62.37	18.83	67.31	2.61
Xuzhou	14.26	14.80	22.38	14.80	11.74	14.88	59.05	5.21
Taizhou	11.41	4.55	4.45	4.55	77.05	4.70	80.12	0.01
Changzhou	5.71	10.42	14.86	10.42	20.77	10.63	28.10	0.01
Nantong	5.71	8.21	12.84	8.21	6.10	8.39	46.58	0.01
Yangzhou	5.71	5.49	7.74	5.49	20.47	5.64	45.80	0.01
Huai'an	2.85	5.19	5.61	5.19	62.36	5.08	17.31	0.01
Lianyungang	2.85	2.28	3.14	2.28	19.11	2.41	0.00	0.01
Wuxi	2.85	9.04	10.47	9.04	56.52	9.23	25.50	5.21
Yancheng	2.85	4.29	6.98	4.29	0.21	4.15	33.96	0.01
Zhenjiang	2.85	5.30	5.69	5.30	63.66	4.98	80.20	0.01
Suqian	0.01	0.01	0.01	0.01	0.01	0.01	20.88	0.01

6.2 Creating a network

After designing the ideal five-level evaluation index, the discrete Hopfield neural network is created by using the neural network toolbox function that comes with matlab.

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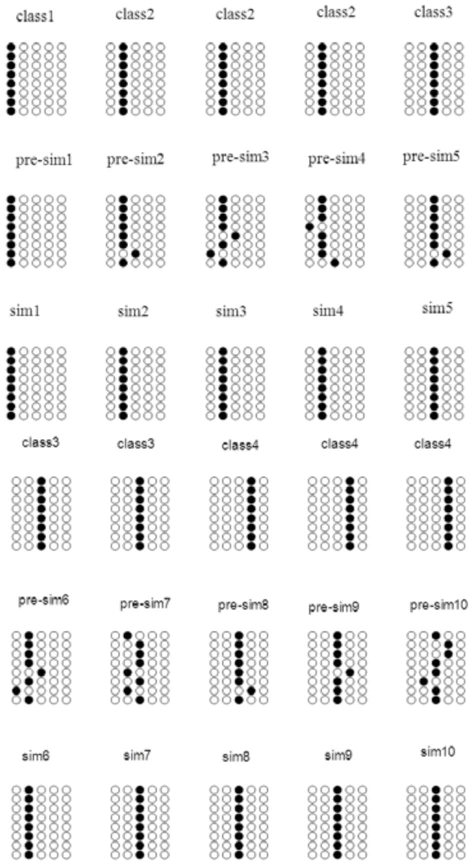
6.3 Simulation Analysis

After the network is created, the grade evaluation index of colleges and universities in Jiangsu Province is coded as the input of Hopfield neural network. After a certain learning, the results shown in Figure 5 are obtained.



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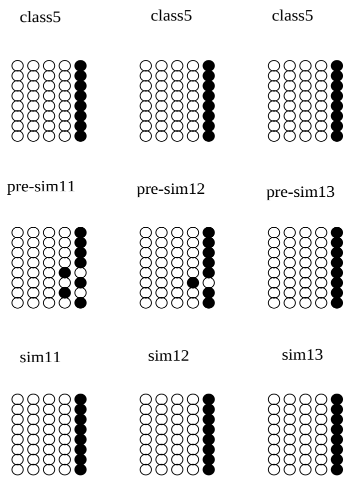

Figure. 5 13 University ranking evaluation index code to be classified

It can be seen from Fig. 5 that the first row of Fig. 5 corresponds to Fig. 4 and represents the evaluation code of each index.The second line of Figure 5 represents the grade code of the university.The third behavior is classified.Therefore, it can be seen from the figure that Nanjing is at the first level.Suzhou, Xuzhou and Changzhou are located at the second level.Wuxi, Yancheng and Nantong are located at the third level.Zhenjiang, Yangzhou and Huai'an are located at the fourth level.Taizhou, Lianyungang and Suqian are located at the fifth level.

7. Conclusion

Through the above principle and simulation analysis of the example, it can be seen from the running results that the Hopfield neural network can classify the various indicators, so it is reasonable to use the Hopfield neural network to evaluate the scientific research ability of the university.However, the model established in this paper is not used in all colleges and universities. When certain majors of a certain university are particularly prominent and some professions are more general, the model cannot find the closest balance, that is, the college cannot be classified correctly.Therefore, it is necessary to consider the actual situation of colleges and universities when evaluating colleges and universities.

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