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Promotion of Mathematical Algorithms to the Development of Computer Artificial Intelligence

YuBao Chang
College of Mathematics and Statistics, Baicheng Normal University, Baicheng ,Jilin, China,137000

Abstract:

Through the analysis of network structure, the network model can be expressed by mathematical formula. This paper studies the promotion of mathematical algorithms to the development of computer artificial intelligence. This paper mainly solves the problem of how to transform complex networks into simple logic and mathematics. Based on the theoretical background of intelligent concept, that is, artificial intelligence theory, and combined with the discipline structure characteristics of intelligent technology, this paper attempts to comb and analyze the development of intelligent concept with mathematical algorithm. Through the optimization of the network through operation analysis, a more general network mathematical model can be abstracted. It makes the network structure relationship more simple, practical, safe and reliable, and is more suitable for the application environment of various types of network mathematical models. In addition, the application of mathematical theory to artificial intelligence network can simplify the artificial intelligence network and facilitate the analysis and calculation of artificial intelligence network.

Keywords: Forest Model, Network Structure, Mathematical Algorithm, Artificial Intelligence.

I. INTRODUCTION

The emergence of information civilization has created the rapid progress of human society. It is not only the result of continuous innovation of human cognition, but also an important embodiment of the realization of human intelligence [1]. As the concentrated embodiment of the troika of information civilization - computer algorithm, Internet and artificial intelligence, intelligent science and technology will inevitably become the research core with the most attention and exploration potential [2]. When scientific researchers and technical experts feel all kinds of doubts, puzzles and obstacles to the essence of intelligence in the wave of exploration and practice of intelligence theory, philosophical reflection and analysis highlight the great importance. In the introduction to the philosophy of artificial intelligence, Margaret emphasizes the concept very similar to the concept of AI to explain intelligence. With the development of intelligence theory research, the mathematical and philosophical discussion on the understanding of intelligence concept has never stopped [3-4].

With the emergence of cutting-edge technologies such as social network, Internet of things, cloud computing [5], big data, industrial Internet and edge computing, various complex data computing have been derived. However, the topology of traditional large-scale networks is complex and difficult to observe [6-9]. Therefore, this paper explores and establishes a new network architecture mathematical model, uses the network structure branch stratification, and forms a simple network mathematical model from various structural topologies in the network. The mathematical model can turn the complex network into a simplified logical mathematical representation [10], solve the sorting problem of each unit of the network under various conditions, and encrypt the network, so as to optimize the network and be more conducive to network topology and hierarchical management.

The application of artificial intelligence in computer network system is universal. It can realize the analysis and processing of data, effectively solve the omission problem existing in computer system, and is also conducive to the renewal of computer system. It can also continuously enhance the security of computer system, so as to provide a strong guarantee for the sustainable development of computer network technology. As we all know, artificial intelligence is inseparable from mathematical modeling. In the process of solving artificial intelligence problems, we have enlarged the establishment and solution of the model to make the results more accurate and make AI closer to human performance in a specific task. In this paper, we apply the network mathematical model to the artificial intelligence network, which can make the logical relationship of the artificial intelligence network more simple and practical, can be used for troubleshooting, optimization and speed calculation, improve the network cooperation ability and nonlinear processing ability, and ensure the effective operation of the network.

The application prospect of artificial intelligence is very broad. At present, it has made great efforts in all aspects to help mankind solve one problem after another, but there are still many things it can't do. How to move forward to a deeper field is a problem to be solved now and in the future. This paper also discusses how to help solve mathematical problems.

II. MATHEMATICAL MODEL AND SOLUTION OF NETWORK

In computer network topology, mesh structure is the most complex network form. It means that any node in the network maintains the state with two or more lines. Because its nodes are connected with many lines, its reliability and stability are greatly enhanced. The mesh topology is shown in Figure 1.

Suppose that the total number of the three types of parameter at the moment is: $X_1(t)$, $X_2(t)$, $X_3(t)$;

The initial rates of the three groups are: b_1, b_2, b_3;

The natural rates were: d_1, d_2, d_3;

The probability of the second group of parameters affected by nature is: d^*.

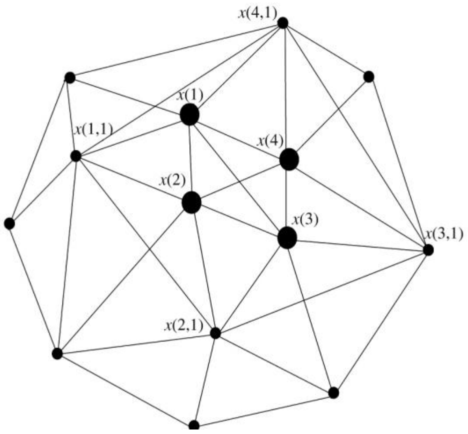

Fig 1: Mesh topology

Considering the characteristics of nonlinear transfer, during dt time, The number of nonlinear transfer in the first group is directly proportional to the total number $X_1(t)$, and it is proportional to the total number of nodes $X_2(t)$. Let the scale factor be β, we have:

The number of nodes in dt period was $\beta X_1(t)X_2(t)$. These parameter turn into the second kind of parameter;

In dt period, if the transformation rate of the second group is γ, the number of transformationd parameter is $\gamma X_2(t)$, and these parameter become the third group;

In the time period dt, the proportion of the third group of parameter losing immunity is θ, then the number of parameter losing immunity is $\theta X_3(t)$, and these parameter become the first group of parameter.

Where $b_i, d_i, d^*, \theta, \gamma > 0, i = 1,2,3$

In dt period, the increase in the first category is:

$$\frac{dX_1(t)}{dt} = (b_1 - d_1)X_1 + b_2X_2 - \beta X_1X_2 + (b_3 + \theta)X_3 \quad (1)$$

In dt period,the increase in the second category is:

$$\frac{dX_2(t)}{dt} = \beta X_1 X_2 - d_2 X_2 - d^* X_2 - \gamma X_2 \quad (2)$$

In dt period, the increase in the third category is:

$$\frac{dX_3(t)}{dt} = \gamma X_2 - d_3 X_3 - \theta X_3 \quad (3)$$

Assuming that t = 0, the numbers of the three types of nodes are:

$$X_1(0) = X_1^0, X_2(0) = X_2^0, X_3(0) = X_3^0 \quad (4)$$

Then the nonlinear ordinary differential equations with initial value problem are obtained:

$$\begin{cases} \dfrac{dX_1(t)}{dt} = (b_1 - d_1)X_1 + b_2 X_2 \\ -\beta X_1 X_2 + (b_3 + \theta)X_3 \\ \dfrac{dX_2(t)}{dt} = \beta X_1 X_2 - d_2 X_2 - d^* X_2 - \gamma X_2 \\ \dfrac{dX_3(t)}{dt} = \gamma X_2 - d_3 X_3 - \theta X_3 \end{cases} \quad (5)$$

$$(X_1(0), X_2(0), X_3(0))^T = (X_1^0, X_2^0, X_3^0)^T \quad (6)$$

Where $b_i, d_i, d^*, \theta, \gamma > 0, i = 1, 2, 3$

Connecting x (1), X (2), X (3) and X (4) points into a layer of mesh network, and the mathematical model is shown in Figure 2.

$$\begin{cases} D^\alpha X_1(t) = (b_1 - d_1)X_1 + b_2 X_2 \\ -\beta X_1 X_2 + (b_3 + \theta)X_3 \\ D^\alpha X_2(t) = \beta X_1 X_2 - d_2 X_2 - d^* X_2 - \gamma X_2 \\ D^\alpha X_3(t) = \gamma X_2 - d_3 X_3 - \theta X_3 \end{cases} \quad (7)$$

$$(X_1(0), X_2(0), X_3(0))^T = (X_1^0, X_2^0, X_3^0)^T \quad (8)$$

Where $b_i, d_i, d^*, \theta, \gamma > 0, i = 1, 2, 3$, $0 < \alpha \le 1$

Note: $R_+^3 = \left\{ X \in R^3 \mid X \ge 0 \right\}$, and $X(t) = (X_1(t), X_2(t), X_3(t))^T$ (9)

According to Figure 1, a two-layer network topology logic mathematical model is established, as shown in Figure 3. The operation dynamics of the network mathematical model is represented by the ratio V, which represents the dynamic situation of the real-time expansion, contraction, rotation and distortion of the network. It is the real-time operation situation in which the points or lines in the network change during the operation of the network, which is collectively referred to as the network dynamic ratio. A single-layer network dynamic ratio formula can be established from Figure 4.

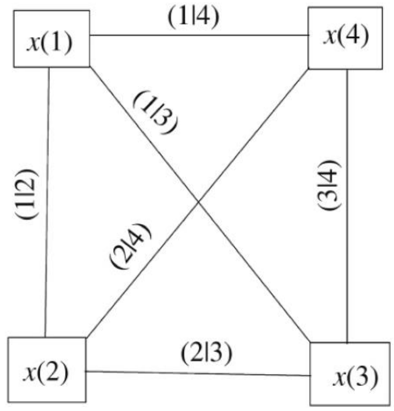

Fig 2: Mathematical model of one-layer mesh network

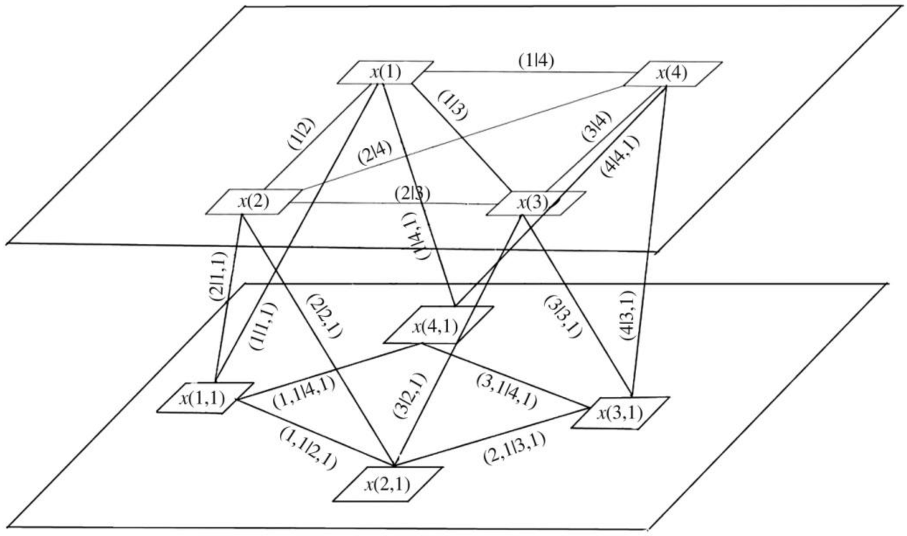

Fig 3: Mathematical model of two-layer network topology logic

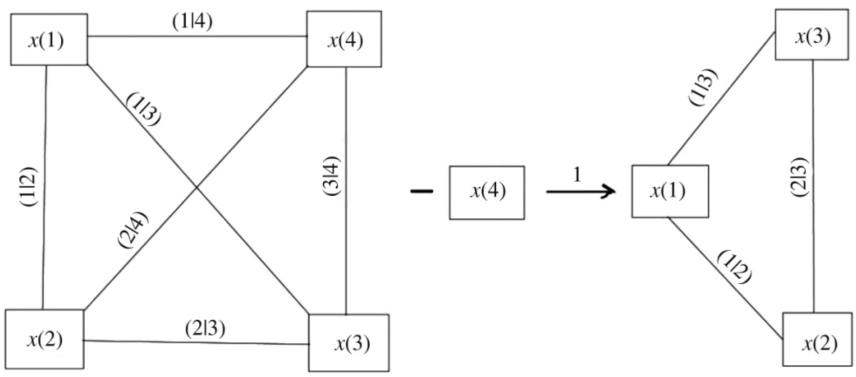

Fig 4: Single layer network topology logic diagram

Lemma 2.1 (generalized mean value theorem)

If $f(x) \in C[a,b]$, $D^{\alpha} f(x) \in C(a,b)$, to all $0 < \alpha \le 1$ and arbitrary $x \in C[a,b]$, we have

$$f(x) = f(a) + \frac{1}{\Gamma(\alpha)} D^{\alpha} f(\xi)(x-a)^{\alpha}, a \le \xi \le x$$

Inference 2.2 : If $f(x) \in [a,b]$, $D^{\alpha} f(x) \in (a,b)$, to all $0 < \alpha \le 1$,

If $D^{\alpha} f(x) \ge 0$, $x \in (a,b)$, to each $x \in [a,b]$, $f(x)$ is a nondecreasing function;

If $D^{\alpha} f(x) \le 0$, $x \in (a,b)$, to each $x \in [a,b]$, $f(x)$ is a nondecreasing function.

Artificial intelligence network is a network composed of a large number of neurons connected through a certain topology in a large-scale parallel manner. At present, the most widely used is (BP) neural network and its variation form. It is composed of input layer, middle layer (hidden layer) and output layer. It has three or more layers of hierarchical neural network. The neurons between adjacent layers are fully interconnected, and the neurons in the same layer are not connected. Fig. 5 is a neural network algorithm for solving w weight. It solves the weight according to the error value, updates its weight according to the w gradient, and iterates repeatedly until the w optimal solution is found (regardless of local optimization).

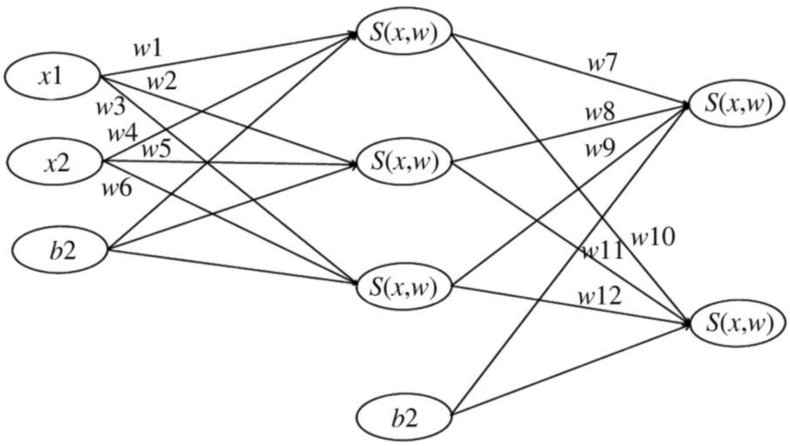

Fig 5: Structure diagram of BP neural network

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If $f(x) \in C[a,b]$, $D^{\alpha} f(x) \in C(a,b)$, to all $0 < \alpha \le 1$ and arbitrary $x \in C[a,b]$, we have

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If $D^{\alpha} f(x) \ge 0$, $x \in (a,b)$, to each $x \in [a,b]$, $f(x)$ is a nondecreasing function;

If $D^{\alpha} f(x) \le 0$, $x \in (a,b)$, to each $x \in [a,b]$, $f(x)$ is a nondecreasing function.

Substituting the network mathematical model into the above formula, as shown in Figure 6.

In (3.12), we take Laplace transform on both sides:

$$X_{t0t} \leq X(0)E_{\alpha,1}(Nt^{\alpha})$$

Where $N_{\max} = \max\left\{\left\|X(0)E_{\alpha,1}(Nt^{\alpha})\right\|, \left\|X(0)\right\|\right\}$.

Then $\left\|X_{t0t}\right\| \leq N_{\max}$ and $X_1, X_2, X_3 \leq N_{\max}$

Then:

$$\left|(b_1 - d_1)X_1 + b_2 X_2 - \beta X_1 X_2 + (b_3 + \theta)X_3\right| \leq$$
$$\beta X_1 X_2 + \left|(b_1 - d_1)\right|\left|X_1\right| + b_2\left|X_2\right| + \left|(b_3 + \theta)\right| X_3$$

$$\left|(b_1 - d_1)X_1 + b_2 X_2 - \beta X_1 X_2 + (b_3 + \theta)X_3\right| \leq$$
$$\beta N_{\max^2} + \left|(b_1 - d_1)\right|\left|X_1\right| + b_2\left|X_2\right| + \left|(b_3 + \theta)\right| X_3$$

Let the computer automatically "learn" the law from the data and use the law to predict the unknown data. This is the computer simulation or realization of human learning behavior to obtain new knowledge or skills, reorganize the existing knowledge structure and continuously improve its own performance. It is learned by extracting rules or patterns from the data to convert the data into information: the data is first preprocessed to form features, then a model is created according to the features, and then the collected data is assigned weights, offsets and other parameters to achieve the purpose of learning. The calculation of the whole neural network can be given by matrix formula. For the single-layer formula of neural network, the number of neurons in each layer is different, the input and output dimensions are different, and the row and column numbers of matrix and vector in the formula are different, but the form is consistent.

IV. CONCLUSION

The advantages of applying mathematics to artificial intelligence are as follows: (1) the network is abstracted by mathematical model and expressed by mathematical formula, which is simple and clear. (2) simple mathematical formula is convenient to analyze and calculate various data of network mathematical model, especially complex data such as big data and cloud computing. (3) the network mathematical model can be transformed into a dynamic data graph to reflect the real-time operation of the data. It can also solve the sorting of data units under various conditions, so as to form a more systematic and comprehensive network mathematical model analysis system. (4) the network mathematical model can be used to encrypt the data, optimize the data and meet the requirements of data topology management, so as to facilitate the hierarchical management of data. Network mathematical model can be trained on computer for artificial intelligence research, and then summarized for in-depth learning.

Expressing things with logical and mathematical formulas is the eternal dream of human scientific and technological workers. However, the network is complex and changeable. The forms of complex network structures including star structure, ring structure, tree structure, mesh structure and hybrid structure have different characteristics, advantages and disadvantages. The results of various analysis can be calculated by matrix with mathematical formula, and the data can be quickly calculated by software, but it needs a lot of data support and verification. At present, it is still in the theoretical stage. However, with the rapid development of artificial intelligence network, the theory of deep learning is still being explored, and these problems will be solved.

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