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Analysis of Neural Network Algorithms in Computer Network Model

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Abstract. With the continuous growth of social economy in China, our computer network technology has also made great progress. The development of computer networks is not only limited to meet people's daily needs, but also needs to continuously improve the overall performance of computer networks. The performance of computer network is mainly optimized by computer network model. Because the computer network model can store distributed information, and has the function of scale and associative memory. Therefore, this paper studies and analyzes the network neural algorithm in the computer network model to improve the overall performance of the computer network.

Computer network is an important manifestation of the progress and success of people's scientific research achievements. Nowadays, computer network technology is applied in education, work and scientific research, which provides people with a lot of convenience. Most of the network service periods now use a hub-type network to effectively implement network interconnection. This is an advancement in computer network technology, but at the same time, it is also an obstacle to the further development of computer networks. Network interconnection has greatly increased the content of computer networks, but now there is an imbalance between the development of multimedia information technology and the power of network. The neural network algorithm is a mature algorithm in the computer network model. Therefore, it is necessary to continue to analyze the neural network algorithm, and optimize the overall performance of the computer network continuously to enable the computer network to deal with larger scale and more complex content.

1. The Understanding of Neural Network Algorithms

1.1 Basic Concepts of Neural Network Algorithms

From the perspective of thinking, the three ways of thinking, such as inspiration thinking, logical thinking and image thinking, are the thinking in the human brain. The neural network simulation belongs to the nonlinear dynamic system, which uses the network to simulate the way of human thinking and concretizes the thinking. The neural network algorithm expresses the specific process of logical thinking through calculation. In modern research, neural networks have received a lot of attention and are still being studied.

In 1982, American physicists put forward Hopfield neural network, which is an optimized neural network. It can simulate the memory mechanism of the neural network through some formulas and coding. Hopfield neural network can realize full connection, in which here are many neurons, and each neuron can output signals. At the same time, it can also use other neurons to feed back information, so Hopfield neural network can also be called feedback neural network [1].

1.2 Ways to Optimize the Neural Network

Simply speaking, the working process of the neural network is a process of the evolution of a non-linear dynamic system. The stability of the system is accurately analyzed through the energy function. The variables in the function are the factors that may affect the stability of the system. The initial state of the function is slowly transformed into a stable state, which is the optimization process of neural network. In short, the evolution of neural networks is actually a computational associative memory or solution optimization process [2].

1.3 Algorithms of Neural Network Optimization Model

In the feedback neural network, the relationship between associative memory and solution optimization is relative, so it is necessary to optimize the calculation, and then know the value of W to find out how to achieve the minimum stable state. In associative memory, its stable state is given, but it is necessary to find the appropriate W to optimize the network effectively [3]. This problem can be regarded as solving an objective function, which is expressed by a quadratic energy function as follows:

$$E = -\frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N}T_{ij}v_i v_j - \sum_{i=1}^{N}\theta_i v_i = -\frac{1}{2}x^T W x - x^T I$$

In the above formula, “I” represents an additional input vector.

There are two common types in the Hopfield neural network, namely CHNN (continuity) and DHNN (discrete), and their equations of state are different. The equations can been seen in the follows:

(1) The dynamic equation of continuous network (CHNN) is:

$$du_i/d_t = f_i\ (v_1,\ v2,\ \ldots,\ v_N)$$

$$V_i = g_i(u_i),\ i = 1, 2, \cdots, N$$

In the above formula, gi represents our commonly used sigmoid function, $v_i = g_i(u_i) = 1/2\cdot[1 + \tanh(u_i/u_o)]$, where u_0 represents the slope of the controllable function, when u_0 infinitely tends to infinite, g_i becomes a step function [4].

(2) The dynamic equation of discrete network (DHNN) is:

$$ui = f_i(v_1, v_2, \ldots, v_N)$$

$$V_i = g(u_i),\ v_i \in \{0, 1\},\ i = 1, 2, \cdots, N$$

In the above formula, g_i represents a step function, $V_i = g(u_i)$. When $u_i > 0$, the function value is 1, when $u_i < 0$, the function value is 0; N represents the number of neurons, and u_i indicates input from the i-th neuron, and V_i indicates output from the i-th neuron [5].

1.4 Steps of Neural Network Algorithm Optimization

(1) After identifying the problem, we should find a suitable method to express the problem, and the output of the neural network should correspond to the solution to the problem;

(2) An appropriate energy function should be set according to the actual situation, and require the optimal solution to correspond to the minimum value;

(3) The energy function should make full use of the favorable function and the energy function to create network parameters;

(4) To set neural networks and dynamic equations that can correspond to each other;

(5) The initial value setting must be valid, and the dynamic equation must be checked. The final result is that the convergence is valid.

2. Neural Network Flow Optimization Model in Computer Network Model

In the optimization model of neural network flow in computer network model, the key points of the model are minimum cutting, graph partitioning and maximum flow.

2.1 Minimum Cutting

It refers to finding a cutting method that can minimize the capacity of the cut set. A cut of a graph represents a partition, that is, $N \rightarrow n1 \cup n2$. A cut set is a set of arcs (i, j), in which $i \in n1$, $j \in n2$. The sum of weights on the arc is the capacity of the cut set. If $N = (W, T)$ is regarded as a network of T = 0, the problem of foot-proofing cutting is a small cut of N when the energy is minimum. The energy function of N is expressed as follows:

$$E = -\sum_{i=1}^{n}\sum_{j=1}^{n}w_{ij}v_i v_j$$

2.2 Graph Partitioning

The so-called graph partitioning is to divide the graph into K parts, so that the number of nodes in each part is basically the same, and the energy function can be expressed as:

$$E = -\frac{1}{2}\sum_{i,j}\sum_{a\neq b} w_{ij} V_{ia} V_{ib} + \frac{A}{2}\sum_{a\neq b} V_{ia} V_{ib} + \frac{B}{2}\sum_{a}\Big(\sum_{i} V_{ia} - \big(\tfrac{N}{K}\big)^2\Big)$$

In the above formula, v_{ia} denotes the state of a unit. When the value of v_{ia} is 0 or 1, a = 1, 2,..., K denotes a partitioned set, $v_{ia} = 1$ denotes that node i belongs to set a, and $v_{ia} = 0$ denotes that node i does not belong to set a.

2.3 Maximum Flow

Given a digraph G (v, e), points S and Z denote the start and end points. Their capacity is Gij, and a non-negative number FIJ can satisfy the $f_{ij} \leqslant G_{ij}$ of each edge. Besides the start and end points, they can satisfy $\sum f_{ij} = \sum f_{ki}$. If $\sum f_{ij} = \sum f_{ki} = W$ is satisfied at the start and end points, the maximum value of W is not greater than the capacity of any cutting.

3. Dynamic Routing Selection Model in Neural Networks

In the current network, the physical network uses a point-to-point connection. This connection can be represented by the undirected graph G= (v, e), where the vertex represents the switched node, and the edge means the path. There is a maximum capacity on each side, which is the basis for realizing point-to-point communication in the network. At the same time, it is necessary to make appropriate adjustments from the changes in the network traffic demand of the user, and arrange the route reasonably.

In the current routing, many of them are static. The route has been selected and set in advance, but the traffic of the network is in a dynamic process. Therefore, dynamic routing is more in line with the current requirements and improves efficiency effectively [7]. The neural network algorithm in the computer network model provides a good theoretical basis for the dynamic path selection, and the model is optimized.

Suppose the network diagram is represented as G=(v,e). At the same time, each side of the network is numbered to make the real data be more clear and convenient to calculate. The number 1 indicates that the path will pass through this edge, and the number 0 indicates that the path does not pass. This edge, in a route, can use 0,1 to indicate the path direction. If L neurons need L*M routes, M indicates the number of alternative routes, and N nodes are shared in the communication network. The objective function can be expressed as $E = E_1 + E_2 + E$, and the secondary function has two constraints, that is

(1) There is at most one route per call: $E_1 = \frac{A}{2}\sum_{i=1}^{L}\sum_{j=1}^{M}\sum_{q=1,\, q\neq j}^{M} V_{ij} V_{iq} = 0$

(2) Each call may have a route: $E_2 = \frac{B}{2}\sum_{i=1}^{L}\Big(1 - \sum_{j=1}^{M} V_{ij}\Big)^2 = 0$

(3) The selected route has low congestion and delay: $E_3 = (C/2) \sum_{I=1}^{L} \sum_{J=1}^{M} \sum_{P=1}^{J} V_{ij} V_{pi} \sum_{K=1}^{N} C_k (\int_{ijk} V \int_{pjk})$

4. Conclusion

From the above analysis, we can find that the optimization of the network model based on the neural network algorithm and the selective and effective combination with other algorithms can greatly improve the overall performance of the computer network. Some progress has been made now, but the model construction in neural network algorithms is not very rigorous. The decline of core strategy is its most obvious shortcoming, which may lead to the phenomenon that the convergence solution of network can not be used to solve practical problems and the improper selection of network parameters. Therefore, the analysis of neural network algorithms needs to be further studied and perfected.

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