

# Applying Genetic Neural Network in Case Analysis of Police Office

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## Abstract

*The data-mining model based on genetic neural network has been widely applied to the procedure of data mining on case information in the command centre of police office. This system uses a method that combines the learning algorithm of Back Propagation (BP) neural network with genetic algorithm to train BP network and optimize the weight values of the network. The system uses a single hidden layer. Input for the system is training data set of police office data.*

## 1.Introduction

Neural networks (NNs) and genetic algorithm (GAs) are computational abstractions of biological information processing systems, and both have captured the imaginations of researchers all over the world. In general, NNs are used as learning systems and GAs as optimization systems, but as many researchers have discovered, they may be combined in a number of systems. A neural network is a computational model consisting of a number of connected elements, known as neurons. A neuron is a processing unit that receives input from neurons, applies a local transformation to that input, and provides a single output

signal which is passed on to other neurons. Each of the inputs is modified by a value associated with the connection strength, or weight, which represents how much importance the neuron attaches to that input source. The local transformation is referred to as the activation function and is usually sigmoid in nature. Alternatively, in a collaborative approach, the GA and NN are integrated into a single system in which a population of neural networks is evolved. The goal of the system is to find the optimal neural network solution. A genetic algorithm can be applied to optimizing a neural network in a variety of ways. The populations of the GA are all NNs with the same basic topology with different weight values. Using a GA instead of a gradient descent algorithm to train the weights can result in faster and better convergence [8]. The main purposes of this system are to achieve an effect for assisting people to solve cases and make good decisions and to study the principle and the practical application of genetic neural network based data mining models. To apply the data mining technology in case

analysis of police office and to optimize the neural network weight values by combining BP algorithm with genetic algorithm are also included.

## **2. Background Theory**

Neural network is a massively parallel distributed processor made up of simple processing units, which has a natural propensity for storing experiential knowledge and making it available for use. The procedure used to perform the learning process is called a learning algorithm, the function of which is to modify the synaptic weights of the network in an orderly fashion to attain a desired design objective. The word ‘artificial’ is sometimes used to make it clear that discussion is about an artificial device and not about the real biological neural networks found in humans. It is the human brain that has inspired the creation of artificial neural networks and no doubt will influence further development. However, in comparison to the human brain, artificial neural networks (ANNs) are at present highly simplistic abstractions. One of the original aims of artificial neural networks was to understand and shape the functional characteristics and

computational properties of the brain when it performs cognitive processes such as sensorial perception, concept categorization, concept association and learning.

However, today a great deal of effort is focused on the development of neural networks for application such as pattern recognition and classification, data compression and optimization. Neural networks are also referred to as literature as neurocomputers, connectionist networks, parallel distributed processors, etc. A neural network is a collection of units that are connected in some patterns to allow communication between the units. These units, also referred to as neurons or nodes, are simple processors whose computing ability is typically restricted to a rule for combining input signals and an activation rule that takes the combined input to calculate an output signal. Output signals may be sent to other units along connections known as weights. The weights usually excite or inhibit the signal that is being communicated. A neuron is an information-processing unit that is fundamental to the operation of a neural network. The block diagram of Figure 2.2 shows the model of a neuron, which forms the basis for

designing (artificial) neural networks. Here, three basic elements of the neuronal model are identified:

- A set of synapses or connecting links, each of which is characterized by a weight or strength of its own. Specifically, a signal  $x_j$  at the input of synapse  $j$  connected to neuron  $k$  is multiplied by the synaptic weight  $w_{kj}$ . It is important to make a note of the manner in which the subscripts of the synaptic weight  $w_{kj}$  are written. The first subscript refers to the neuron in question and the second subscript refers to the input end of the synapse to which the weight refers. Unlike a synapse in the brain, the synaptic weight of an artificial neuron may lie in a range that includes negative as well as positive values.
- An adder for summing the input signals, weighted by the respective synapses of the neuron; the operations described here constitutes a linear combiner.

- An activation function for limiting the amplitude of the output of a neuron. The activation function is also referred to as a squashing function in that it squashes (limits) the permissible amplitude range of the output signal to some finite value.

### **3. Data Mining Model for Neural Network**

Backpropagation (BP) neural network is a kind of feedforward network that is now in most common use. Generally it has a multi-layer structure that consists of at least three layers including one input layer, one output layer and one or more hidden layers. There are full connections between neurons in adjacent layers and no connection between neurons in the same layer. Based on a set of training samples and a set of testing data, BP neural network trains its neurons and complete the procedure of learning. The application of BP algorithm is suitable for data mining environment in which it is impossible to solve problems using ordinary methods. Therefore, complex function of several variables is used to complete non-

linear calculation to accomplish the semi-structural and non-structural decision-making supporting procedure [7]. So, in the procedure of data mining in the command centre of police office, the BP neural network model is chosen.

The basic structure of BP neural network is as follows: The learning procedure of neural network can be divided into three phases:

- The first one is a forward propagation phase in which a specified input pattern has been pass through the network from input layer through hidden layers to the output layer and becomes an output pattern.
- The second one is an error back propagation phase. In this phase, BP algorithm compares the real output and the expected output to calculate the error values.
- After that, it propagates the error values from output layer through hidden layer to input layer in the opposite direction. The connection weights will be altered during this phase.

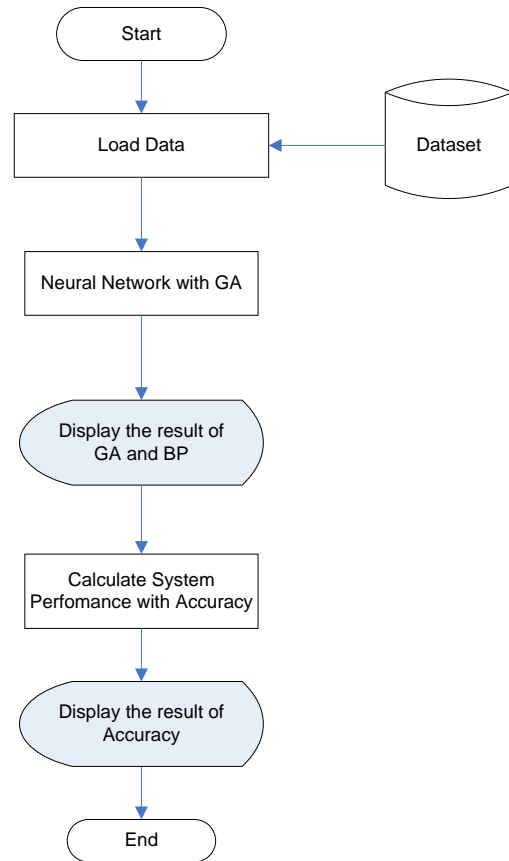
These three phases proceed repeatedly and alternately to complete the memory training of network until it tends to convergence and the global error tends to minimum.

The weights of the network to be trained are typically initialized at small random values. The initialization strongly affects the ultimate solution. If all weights start out with equal weight values, and if the solution requires that unequal weights be developed, the network may not train properly. Unless the network is distributed by random factors or the random character of input patterns during training, the internal representation may continuously result in symmetrical weights. Also, the network may fail to learn the set of training examples with the error stabilizing or even increasing as the learning continues. In fact, many empirical studies of the algorithm point out that continuing training beyond a certain low-error plateau results in the undesirable drift of weights. This causes the error to increase and the quality of mapping implemented by the network decreases. To counteract the drift problem, network learning should be restarted with other random weights [4]. Generally, this system generate

random nonzero floating numbers in  $[-1, 1]$  as the initial weight values. The choice of initial weights is, however, only one of several factors affecting the training of the network toward an acceptable error minimum.

#### 4. System Design and Implementation

For this system, the multi-layer network is used. Weights are first initialized among input nodes at input layer, one hidden layer and one output layer. Attributes numbers are set input nodes at input layer are make up of. The system analyses people's gender, age, education degree, history of crime, salary level, alcohol, opium, family status, gambling. And, to some extent these factors affect people's social actions that may lead to commit a crime. Using these factors as input variables, a genetic neural network can be utilized to predict the present crime possibility of these people.



**Figure 4.1 General System Flow**

At the beginning, the input training dataset is loaded from database. After that the training dataset is trained with backpropagation algorithm combined with Genetic Algorithm. The system displays the value of global error, fitness value, weights values, and crossover and mutation values during training time for each iteration. Then, it finally displays the output result of the given features.

There are four main parts in this system. These are

- Data inputs
- Normalize and train network

- Testing
- Accuracy

In data inputs, user can add new data, update and delete existing data. This is the training dataset of the system. When user wants to delete the existing data, user must first select the rows of the data to delete, and click “Delete Selected Row”. Then, the system displays the confirm message. After updating the existing data, user must save the data by clicking “Save” button. If user wants to add new data, the system automatically displays the data ID to add.

## **5. Conclusions, Limitios and Further Extension**

The knowledge learned by neural networks is hard to be understood by users because it is concealed in a large amount of connections. Neural networks achieve high accuracy in classification, prediction and many other applications. Neural network has been proven of their capabilities in many domains such as medical application. Genetic Algorithms are Heuristic Search Algorithms. They are basically intended to solve problems without Algorithm. Genetic Algorithms doesn't guarantee that this is the best solution

but it guarantees that this is a good solution. Neural Networks and Genetic Algorithms are two highly popular areas of research, and integrating both techniques can often lead to highly successful learning systems.

Using genetic algorithm to optimize the BP network can effectively avoid the problem of local minimum. Therefore, the genetic neural network based on data-mining model has many advantages over other data mining models. By inducing and analyzing these historical cases, people can get some experiences and learn some lessons that can help them solve cases and make decisions in the future. Therefore, the system can assist police departments to solve cases rapidly and make decisions efficiently. The system can only recognize numerical numbers. The best training algorithm still cannot be singled out for general neural network. Although BP algorithm has been widely used, it does not guarantee the global optimal solution. Although the genetic algorithm does not require normalization of the data, the backpropagation programs all normalized the data. Besides, the selection of some parameters in BP training also lacks of systematic guideline.

Genetic Neural Network has been also widely applied to medical treatment and genetic engineering and many other fields. In insurance companies, stock companies, banks and credit card companies, people apply genetic neural network to detect the deceptive actions of customers to reduce the commercial deceptions. Other applications can test the genetic algorithm, such as biology, engineering research, image processing and pattern recognition, and physical science. Genetic algorithms provide a potential method to learn neural networks for such tasks and hence to simplify the development of such networks and to make them more robust.

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