

Development of Customer Relationship Management System in E-Commerce Based on BP Neural Network

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Abstract. BP neural network can learn and store a lot of input - output mode mapping, without prior reveal the mathematical equations describe the mapping. The model based on BP neural network algorithm is constituted by an input layer, output layer and one hidden layer, three-layer feed forward network. CRM is to acquire, maintain and increase the methods and processes of profitable customers. The core of CRM is the customer value management, customer value; it is divided into the de facto value, potential value and model value. The paper presents development of customer relationship management system in e-commerce based on BP neural network. The experiment shows BP is superior to RFCA in CRM.

Introduction

Customer satisfaction evaluation of customer satisfaction as a means of understanding as a supermarket and tools for the supermarket is of great significance. Supermarkets through the evaluation of customer satisfaction, on the one hand, and past results of operations compared with the other hand, horizontal comparison, the level of customer satisfaction and other supermarkets in the industry to recognize their place in the competition in the market, identify the main competitors, and opportunities and obstacles that exist in the market [1]. Analyze the customer satisfaction evaluation to the supermarket can also help to understand their weak links, and promote the reform of the mechanism of the supermarket business, to help the supermarket to the right development strategy and market policies, a more reasonable distribution supermarket limited resources, the maximum possible increase customer satisfied with the effectiveness of the strategy. Customer satisfaction evaluation model is a key issue for the supermarkets evaluation of customer satisfaction.

The artificial neural network has many outstanding features, the most good to make decisions on approximate, uncertain, and even contradictions in the knowledge environment, you can solve the artificial design of the weights and the calculation of the correlation coefficient. Neural networks through artificial neural network model of learning can determine the stability of the sample to the model, the dynamic evaluation of the competitiveness of the C2C electronic retailers and sorting, calculation error, which can guarantee the objectivity of the evaluation results.

BP learning algorithm processes. First, initialization, it is given a random value of (-1.1). Second, the randomly selected study sample mode operation. The third step is the calculation of the middle layer unit input and output, where. The fourth step is the calculation of the output layer unit input and output. Fifth step, it is the general error of calculation of the output layer unit. Step 6 to calculate the general error of the middle layer of each unit. The seventh step, the revised weights. First, take a large number of (0,1) (eg 0.6), cycle calculation many times (eg 50), if the error still did not meet the accuracy requirements, then gradually reduce the value. Step 8, calculation error. First, the definition of error type, k is the k -th sample. At the end of the training, otherwise it returns the second step, where m is the number of training samples for the pre-determined value. The ninth step is to determine the models to determine the value of the weights. Finally, the department store industry data input model can be applied.

The evaluation index system is in order to determine the main factors of the supermarket customer satisfaction and management focus. Determining the customer satisfaction index should follow the principle of comprehensiveness, representative ness, discrimination and the effectiveness of such

evaluation must also be determined according to the needs of the supermarket, at the same time as the supermarket customer credit management level to improve and marketing changes in the environment should make appropriate adjustments. The paper presents development of customer relationship management system in e-commerce based on BP neural network.

The research of BP neural network

BP (Back Propagation) network is the team of scientists led by Rumelhart and McClelland 1986, is an error back propagation algorithm to train the multilayer feedforward network, is one of the most widely used neural network model. BP neural network can learn and store a lot of input - output mode mapping, without prior reveal the mathematical equations describe the mapping. Learning rule is to use the steepest descent method and back-propagation to adjust the network weights and thresholds, so that the error sum of squares and minimum of the network. BP neural network model topology including input layer (input), hidden layer (hide layer) and output layer (output layer).

The artificial neural network reflects certain basic characteristics of human brain function, but not a realistic description of biological systems, only some kind of imitation, simplification and abstraction. Digital computer, artificial neural networks constitute the principles and features closer to the human brain, it is not a given program step-by-step operation is performed, but can self-adapt to the environment, summed up the law, to complete a computation, identify or process control. Neurons and other cell types, it is including cell membrane, cytoplasm and nucleus. However, the morphology of nerve cells is rather special, with many protruding cell bodies, axons and dendrites; it is also divided into three parts [2]. Cell body, it is nucleus, protruding role in the transmission of information. Dendritic prominence as the introduction of the input signal, while the axon as output processes, it is only one, as is shown by equation 1.

$$MSE(d) = \frac{1}{N \times N} \sum_{x=1}^N \sum_{y=1}^N [I_k(x, y, d) - I_t(x, y)]^2 \quad (1)$$

BP neural network evaluation model: a network architecture design. The main component analysis of the results, with three layers (input layer, middle layer and output layer) neural network model, the input layer input according to the characteristics of the evaluation object, the output of the output layer to pre-set value; 2 layers of parameters. Input of the input layer; hope that the output of the output layer; the middle layer input; middle layer of the output; the input of the output layer; the actual output of output layer; the threshold of middle layer neurons; output layer threshold; input layer and middle layer of connection weights: the middle layer and output layer connection weights.

$$C(w) = \sum_{j=1}^N [Col_k(j+w) - Col_r(M+j)]^2 \quad 1 \leq w \leq 2M+1 \quad (2)$$

BP (Back Propagation) neural network, ie, error back propagation error back-propagation algorithm learning process consists of two processes of the information forward propagation and error back-propagation. Input layer neurons is responsible for receiving input from the outside, and passed to the middle layer neurons; the middle layer is the internal information processing layer, responsible for information transformation, according to the capacity requirements of information change, the middle layer can be designed as a single hidden layer or more hidden layer structure; the last hidden layer to the output layer neurons pass information after further processing, the forward propagation to complete a learning process, the outside world output by the output layer to the results. When the actual output and expected output does not match, the error back propagation stage.

Correction layers of the weight error of the output layer, the error gradient descent back-propagation to the hidden layer and input layer, layer by layer. Information cycle of forward propagation and error back-propagation process, the layers of the weight adjustment process, the neural network to learn the training process, this process has been carried out to the network output

error to be reduced to an acceptable level, or pre-set given so far to learn the number of it. BP neural network model of BP neural network model, including its input-output model, the role of function model, the error calculation model and self-learning model, as is shown by equation3.

$$REDUCE(I)[i, j] = \sum_{m=1}^5 \sum_{n=1}^5 w(m, n) I[2i + m, 2j + n] \quad (3)$$

Node output model hidden-output model: $O_j = f(\sum W_{ij} \times X_i - q_j)$ (1) output node output model: $Y_k = f(\sum T_{jk} \times O_j - q_k)$ (2) f -non-linear role function; q -nerve cell threshold. (2) model of the role of function, role function is to reflect the lower input to the upper node to stimulate the function of the pulse intensity, also known to stimulate the function, Sigmoid function is generally taken to be a continuous value (0,1): $f(x) = 1 / (1 + e)$ (3) error calculation model error calculation model to reflect the function of the error between the desired output and calculate the output of the neural network size: of $E_p = 1/2 \times \sum (t_{pi} - O_{pi})$ (4), t_{pi} -i node is the desired outputvalue; O_{pi} -i node to calculate the output value.

Neural network learning process, namely the connection between the nodes on the lower and upper node weights matrix is W_{ij} set and the error correction process. BP network has the teacher learning - need to set expectations and without a teacher to learn - just enter the model points. Self-learning model for $\Delta W_{ij} (n+1) = h_i \times \Phi_i \times O_j + a \times \Delta W_{ij} (n)$ (5) h - learning factor; Φ_i -output node i , calculate the error; the calculation of output O_j -output node j ; a -momentum factor.

The neural network can be used as classification, clustering, and forecasting. The neural network needs a certain amount of historical data, historical data training, the network can learn the knowledge implicit in the data. In your question, first of all to find some of the characteristics of some of the issues, as well as the corresponding evaluation data, and use these data to train the neural network.

Development of customer relationship management system in e-commerce based on BP neural network

Determined to build the evaluation model is based on the established customer satisfaction evaluation index system and the BP neural network structure. Based on BP neural network algorithm, the model is constituted by an input layer, output layer and one hidden layer, three-layer feedforward network [3]. The input layer evaluation indexes owned by a treatment of the sample values as neurons; Output layer is a measure of customer credit rating, is a qualitative and quantitative, from quantitative to qualitative, qualitative transformation of BP neural network model output for the quantitative, qualitative evaluation based on output and predetermined criteria, the customer credit. The hidden layer is a difficulty in the design, set the number of hidden nodes depends on the number of training samples, sample size and the sample contains the complexity of the law, as is shown by equation4.

$$Z = \begin{bmatrix} \frac{\partial I}{\partial x} \\ \frac{\partial I}{\partial y} \end{bmatrix} \begin{bmatrix} \frac{\partial I}{\partial x} & \frac{\partial I}{\partial y} \end{bmatrix} = \begin{bmatrix} g_x^2 & g_x \cdot g_y \\ g_x \cdot g_y & g_y^2 \end{bmatrix} \quad (4)$$

The network input is a comprehensive description of the supermarket customer satisfaction indicators. Therefore, different supermarket customer satisfaction index system corresponds to a different network model, but also the formation of different input nodes, input nodes is equal to the satisfaction index number [4]. From the front of the supermarket customer satisfaction index system shows the customer satisfaction indicators, including product features, service status, shop capacity store appearance; shopping environment, and five other parts, so make sure to enter the number of nodes 5.

In this study, the BP network structure is a layer 2 network with 20-10-1 structure build in matlab7.0. The named openwork, select the type of network Feed-forward backdrop input data range is determined according to the input data in the training sample, the training function to select

TRAINLM, adaptive learning function select LEARNNGDM, the effect of a function to select the MSE, the number of layers, the first layer 10 neurons, the transfer function TANSIG second layer neuron number is 1, the transfer function for the TANSIG. Competitiveness of C2C electronic retailers is in order to build a good evaluation of the BP model, as is shown by equation5.

$$Z = \sum_{x \in \Omega_i} \begin{bmatrix} \frac{\partial I}{\partial x} \\ \frac{\partial I}{\partial y} \end{bmatrix} \cdot \begin{bmatrix} \frac{\partial I}{\partial x} & \frac{\partial I}{\partial y} \end{bmatrix} = \sum_{x \in \Omega_i} \begin{bmatrix} g_x^2 & g_x \cdot g_y \\ g_x \cdot g_y & g_y^2 \end{bmatrix} \quad (5)$$

Hidden layer node, the role of the hidden nodes is extracted from the sample and stored in its internal law, each hidden node has a number of weights, and each weight value is a parameter of the enhanced network mapping capability [5]. Too few hidden nodes is not enough to refine the law of the training set, too much may also be samples of non-regular noise, etc. bear in mind, so you must select the appropriate hidden nodes in order to make the training to meet the requirements. The best way to determine the hidden nodes is by trial and error, the first set of fewer hidden nodes and then gradually increase, due to the neural network parallel distributed structure and nonlinear dynamic characteristics, has not been a simple and common hidden layer unit determination of the formula.

In this paper, the momentum and adaptive gradient descent training function namely Traingdx. For gradient descent, it is the training success of a great relationship with the selection of learning rate. Adaptive learning algorithm to adaptively adjust the learning rate to increase stability, improve the speed and accuracy. Random access survey of 100 customers during the visit to pay attention to coordination of all ages, income levels and occupation, making the survey more representative, to increase the validity of the questionnaire, and discard seriously unreasonable questionnaire to extract 90 survey data, 54 of them as the modeling of the training sample set, 36 data set as a test sample used to test the network. Our system runs on a Windows XP-based PC with an Intel Pentium 1 CPU at 3.2 GHz. The system is developed using Java on Java SDK 4.5.6 platform, as is shown by figure1.

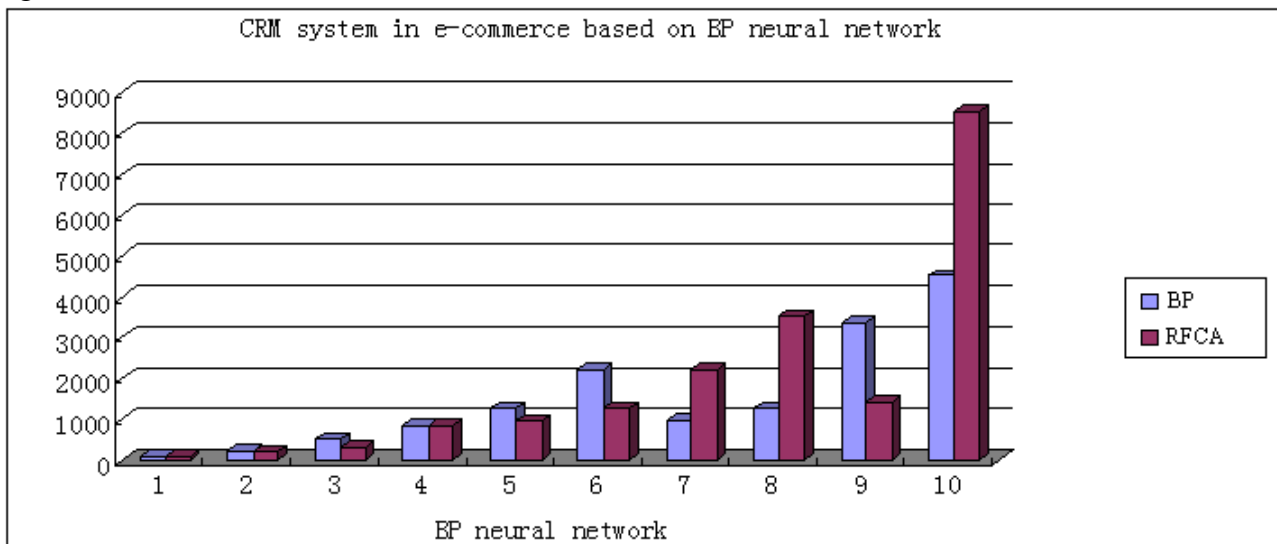


Figure1. Development of customer relationship management system in e-commerce based on BP neural network

The paper presents development of customer relationship management system in e-commerce based on BP neural network. The two lines intersect, the network error sum of squares and MSE of the error of the target goal = 0.00001 requirements, the end of the network model training, the network has been initially meet the requirements. m and b denote the optimal regression slope and y-axis intercept, when m = 1 and b = 0, the network output and target output are identical, at this time the network has the best performance; r indicates that the network output and target the correlation

coefficient of the output, it gets close to 1, indicating that the network output and target output is the closer, the better the network performance. Figure 1 shows m close to 1, b is almost zero; r is equal to 1, which shows the performance of this network is very good.

At the same time, MATLAB also provides function poster used for further analysis of the results of network training. Function `postreg` use of linear regression analysis of network output and the target of a relationship, the network output for changes in the target output rate of change, in order to assess the effect of network training.

Summary

BP neural network structure is to determine the evaluation system to build the model. Based on BP neural network algorithm, the model is constituted by an input layer, output layer and one hidden layer, three-layer feed forward network. The input layer evaluation indexes owned by a treatment of the sample values as neurons; Output layer is a measure of customer credit rating, is a qualitative and quantitative, from quantitative to qualitative, qualitative transformation of BP neural network model output for the quantitative, qualitative evaluation based on output and predetermined criteria, the customer credit. The hidden layer is a difficulty in the design, set the number of hidden nodes depends on the number of training samples, sample size and the sample contains the complexity of the law.

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