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BUILDING AN eCRM ANALYTICAL SYSTEM WITH NEURAL NETWORK

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Abstract

ECRM provides effective solutions to improve customer relationship management. But the analysis on the data of customers has not been given adequate effort. This paper discusses an in-progress research motivated from this point. Its objective is to develop a simple eCRM analytical system, which uses Neural Network as its analyzing tool. The ultimate system should be able to classify online customers and predict their purchasing behavior, to help further marketing campaigns of e-business enterprises.

Keywords: eCRM, neural network, data warehouse, data analysis, decision tree

ECRM (Electronic Customer Relationship Management)

From the birth of the concept of CRM (Customer Relationship Management), the CRM systems have been widely used in various industries. With the development of communicating channels based on Internet, and the increasing bottleneck of the application of CRM into the huge amount service systems, it provides the need and possibility to expand the advantage of CRM. The electronic extension of CRM comes into birth, so called eCRM.

ECRM is a process that helps to boost sales revenue and strengthen interactive relationships between companies and their customers, by finding most valuable customers and customizing communications to their preferences. The value of the eCRM exists in the ability to transform raw customer data into valuable customer information. ECRM is an evolution of traditional non-browser based CRM applications. Huge data can be collected directly from the website. With the technologies of data warehouse and data mining, it is more powerful to reach such targets.

Many eCRM solutions focus on viewing historical data. These approaches provide merely statistical descriptions, but do not play an analytical role. But in real business implementations, companies are eager to know more meaningful and instructive information for conducting further decision-making. This requires us to put more effort on analytical research.

Neural Network

Neural Network is a widely used data mining technique and is among the most powerful general nonlinear modeling techniques available. A Neural Network is an interconnected assembly of simple processing elements, *units* or *nodes*, whose functionality is loosely based on the animal neuron. The processing ability of the network is stored in the inter-unit connection strengths, or *weights*, obtained by a process of adaptation to, or *learning* from, a set of training patterns.

Neural Network performs well in classification and prediction. It can find pattern from huge amount of data. It can deal with not-rule-defined problems. Furthermore, the learning characteristic of Neural Network enables them to deal efficiently with nosy data-partial, incorrect and potentially conflicting data, and perform generalization well in situations which are not encountered previously.

Neural Network, particular the back-propagation (BP) networks, can be used as effective non-linear general-purpose function approximators. The BP network simply learns from historical data and then the learned BP network can be used to predict future types of customers. So we use the Back-Propagation Neural Network with sigmoidal Feed-Forward (FF) learning as the basis for our research. This model employs a supervised learning algorithm.

The detail of the Neural Network we developed will be discussed in the following system developing section.

ECRM Analytical System

We try to build a simple system, using Neural Network as the main analysis tool, to implement eCRM analytical process. The objective of the system is to realize classification and prediction of consumer online purchasing behavior. The resulted information can be used for more customized interaction between consumers and enterprises.

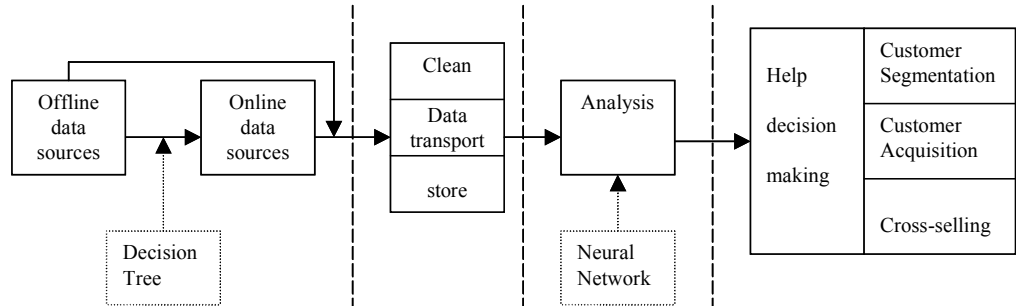


Figure 1. System Process Model

The process consists of sequential steps: data collection, data preparation, data analysis, and information application. See figure 1.

Data Collection

The data are collected from both online and offline sources.

The offline data are provided by some e-business companies from their customer databases. The industries of these companies vary in financial service, manufacturing, and retailing. These data contain more detail customer variables.

We collect another part of our data on line. The aim of this is to contain data from more disparate data sources to improve the representativeness of the data set. And these online data can be directly added into database for further analysis. To collect online data, we first use the decision tree algorithm to find out the key factors of online purchasing behavior from the dataset of offline data. Decision tree performs well at finding key factors. On the basis of the result, we use the survey methodology. We designed a questionnaire to collect online data, which contains the key factors concluded from decision tree. The questions cover main demographic variables, Internet usage variables, and online purchasing variables.

Data Preparation

Before the data can be further analyzed to get valuable information, the data have to be prepared for the next task, because the data are collected from different sources and are in some different forms.

The first step is to clean data. The task is to detect if the values are legal and correct. For example, are the numbers in a certain range? And for the missing values, the entire record will be ignored.

The next step is to transfer data. Data transport refers to moving data from some systems to the warehouse or analysis environment. We use SQL server language and Java scripting and Visual Basic scripting language, which automatically check and modify the data type before transferring data into warehouse.

The last step is to store data into data warehouse in the Central Repository, which is the database containing the data. The SQL server and Access database are employed in our system. Each of the databases uses open database connectivity standard (ODBC). And the logical data model enables communicating the contents of the database to a wider audience. Now the data are ready for further analysis.

Data Analysis

For the data analysis process, we use the Neural Network as the analyzing tool.

The first step is to identify the input and output features.

The second step is to massage the inputs and outputs so that their range is between 0 and 1.

The third step is to set up a Multi-layer Feed-forward Neural Network with three layers: input layer with 8 nodes, hidden layer with 3 nodes, output layer with one node. We use sigmoid function as the activation function. The Back-Propagation Learning Algorithm is adopted to train the neural network. The goal of training is to make the output of the network as close as possible to the desired output by adjusting weights on each node of each layer.

The fourth step is to train the network with appropriate data. We randomly choose 300 data from the database. We modify the training set and parameters of the Neural Network by repeating the training process to make its output as close to our desired output as possible.

The fifth step is to apply the neural network model with fixed weights and threshold to predict outcomes for other inputs.

As the result of the process, ideally, we can get the following information:

- Main characteristics of online purchasing customer profile
- Classification of customers
- What is the favorite product for each class of customers
- What kind of products group is most likely preferred by each class of customers

Information Application

The ultimate purpose of any system is application. The information concluded and predicted in the former steps should be instructive for business operations.

The information should have business value. On the basis of the information, enterprises can implement targeted marketing campaigns better.

- Customer segmentation: to segment the customers on similarity
- Customer acquisition: to identify and attract customers
- Cross-selling: to offer existing customers new products and services matching their needs

And such information should also be useful for customer retention, up-selling, etc.

System Testing

As we have mentioned above, because of the characteristics of Neural Network, this analytical system has high tolerance for data and high pattern detecting ability. It is flexible to adjust the parameters and structure of the Neural Network, to improve the performance of the system. The system can also perform the function of predict, which cannot be fulfilled by normal statistical tools.

The system will be tested through comparing its classification and prediction results with other tools built in some CRM and data analysis systems.

Research Progress and Future Work

The basic database has been established. The programming of the Neural Network analyzing section has been mostly finished and is under implementation and testing. The next task for future work is to integrate the whole system, and implement the system.

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