Chapter 72
A Hybrid Multilayer Perceptron Neural Network for Direct Marketing

M. Govindarajan
Annamalai University, India

RM. Chandrasekaran
Annamalai University, India

ABSTRACT

Data Mining is the use of algorithms to extract the information and patterns derived by the knowledge discovery in database process. It is often referred to as supervised learning because the classes are determined before examining the data. In many data mining applications that address classification problems, feature and model selection are considered as key tasks. That is, appropriate input features of the classifier must be selected from a given set of possible features and structure parameters of the classifier must be adapted with respect to these features and a given data set. This paper describes feature selection and model selection simultaneously for Multilayer Perceptron (MLP) classifiers. In order to reduce the optimization effort, various techniques are integrated that accelerate and improve the classifier significantly. The feasibility and the benefits of the proposed approach are demonstrated by means of data mining problem: Direct Marketing in Customer Relationship Management. It is shown that, compared to earlier MLP technique, the run time is reduced with respect to learning data and with validation data for the proposed Multilayer Perceptron (MLP) classifiers. Similarly, the error rate is relatively low with respect to learning data and with validation data in direct marketing dataset. The algorithm is independent of specific applications so that many ideas and solutions can be transferred to other classifier paradigms.

INTRODUCTION

Direct marketing (Bauer, 1988) has become an important application field for data mining. In direct marketing, companies or organizations try to establish and maintain a direct relationship with their customers in order to target them individually for specific product offers or for fund raising. Large databases of customer and market data (Lee & Cho, 2007) are maintained for this purpose. The customers or clients to be targeted in a specific campaign are selected from the database, given different types of information such as demographic information and information on the customer's

personal characteristics like profession, age and purchase history.

Data Mining has become a very useful technique to reduce information overload and improve decision making by extracting and refining useful knowledge through a process of searching for relationships and patterns from the extensive data collected by organization. Data mining technologies, such as rule induction, neural networks, genetic algorithms, fuzzy logic, and rough sets are used for classification and pattern recognition in many industries. The primary objective of this paper is to show that the ensemble of multilayer perceptron is superior to individual approach for direct marketing in terms of classification rate.

Classification is a very common data mining task. In classification, the features of a newly presented object are need to be examined and it is assigned to one of the predefined set of classes. Supervised learning methods are applied to solve classification problems. k-Nearest Neighbor, Multilayer perceptron, radial basis function and case based reasoning (CBR) are representative supervised learning methods that can be applied to classification problems. In the process of handling classification tasks, an important issue usually encountered is determining the best performing method for a specific problem. Several studies address the issue. However, the common understanding of data mining practitioners and researchers is that there does not exist a universal best-performing method. That is, different kinds of methods have their own advantages and disadvantages. So, a method can perform best for one specific problem, but given another problem, another method can work better. This situation is called selective superiority (Michie et al., 1994). Also, that fact implies that all of the supervised learning methods have their intrinsic limitations to improve Classification rate.

Hybrid models have been suggested to overcome the defects of using a single supervised learning method, such as k-Nearest Neighbor, Multilayer Perceptron and radial basis function techniques. Hybrid models combine different methods to im-

prove classification rate (Oza & Tumer, 2008). This paper proposes new comparative cross validation technique for the estimation of error rate and run time of base classifier and hybrid classification method to improve the Classification rate.

RELATED WORK

Hybrid models and combined models, terms often used synonymously, have been developed to improve prediction accuracy by using several supervised learning methods together. Some studies on hybrid or combined models utilize different supervised learning methods sequentially. For example, Coenen, Swinnen, Vanhoof, and Wets (2000) propose a hybrid model to improve the response rate of direct mailing. Also, Hsu, Lai, Chui, and Hsu (2003) have studied the learning capability improvement of students using a hybrid model that was a mixture of the optimal tree model disclosed by association analysis with categorical variables and the tree model directly applied to continuous variables.

The above hybrid models use different models with a phased approach. That is, one method is used first in some data mining phase, and the other method is used in a next phase. Another hybrid approach is embedded. That is, a method or technique is embedded into part of a main method and carries out a subtask to improve the performance of the main method. For example, Chen (2003) suggests a hybrid framework for textual classification in text mining using fuzzy theory embedded in a SOM (self-organized map). Versace, Bhatt, Hinds, and Shifier (2004) propose a model combining artificial neural networks and a genetic algorithm. In that study, neural networks are chromosomes in the genetic algorithm cycle, so they are generated, selected, and reproduced to improve prediction performance on the closing price of a security. Some hybrid models also use different methods in parallel to produce final predicted values by mixing the results of two or more

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