Chapter 4

Adaptive Higher Order Neural Network Models for Data Mining

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ABSTRACT

Data mining, the extraction of hidden patterns and valuable information from large databases, is a powerful technology with great potential to help companies survive competition. Data mining tools search databases for hidden patterns, finding predictive information that business experts may overlook because it lies outside their expectations. This chapter addresses using ANNs for data mining because ANNs are a natural technology which may hold superior predictive capability, compared with other data mining approaches. The chapter proposes Adaptive HONN models which hold potential in effectively dealing with discontinuous data, and business data with high order nonlinearity. The proposed adaptive models demonstrate advantages in handling several benchmark data mining problems.

INTRODUCTION

Data mining, the extraction of hidden patterns and valuable information from large databases, is a powerful technology with great potential to help companies survive competition (Cios et al 2007, Han et al 2006). Traditionally, analysts have manually performed the task of extracting useful information from recorded data, however, the increasing volume of data in modern business calls for computer-based approaches. As data sets have grown in both size and complexity, there has been an inevitable shift away from direct hands-on data analysis towards automatic data analysis using more complex and sophisticated computational tools. The modern technologies of computers together with computer networks have made data collection and organization an easy task. However, the captured data needs to be converted into useful information and knowledge. Data mining refers to the entire process of applying

DOI: 10.4018/978-1-61520-711-4.ch004
Adaptive Higher Order Neural Network Models for Data Mining

computer-based methodology, including new techniques for knowledge discovery, from collected data (Masseglia et al 2007, Witten et al 2005).

Data mining tools can answer many business questions that traditionally were too time-consuming to resolve. They search databases for hidden patterns, finding predictive information that business experts may overlook because it lies outside their expectations. An example of pattern discovery is the analysis of retail sales data to identify seemingly unrelated products that are often purchased together. Another pattern discovery example is detecting fraudulent credit card transactions from collected data (Witten et al 2005). Data mining techniques can be implemented rapidly on existing software and hardware platforms to enhance the value of existing information resources. When implemented on high performance client/server or parallel processing systems, data mining tools can analyze massive databases to deliver answers to questions such as, “Which customers are most likely to buy this new product, and why?” (Masseglia et al 2007, Bigus 1996)

Data Mining, the idea of finding valuable information from large databases, is not new. What is new is the large-scale computerization of business transactions and the resulting flood of business data. What is new is the distributed computational power and the storage capabilities, which allow terabytes of business data to remain online, available for processing by client/server data mining systems. What is new are new neural network models with advanced algorithms for pattern recognition and prediction. When combined, these new technologies offer the promise of bringing huge benefit to businesses, and more importantly, preventing businesses from drowning in a sea of their own data (Masseglia et al 2007, Bramer 2007).

Looking for new ways to survive tense competition and to beef up sales, Australian retailers have been preparing customer loyalty and data mining systems to give them an insightful view of customer shopping habits. In 2006, Coles spent nearly $60 million on data mining systems for storing and analyzing customer data, and David Jones and Myer were conducting detailed data mining of customer information down to individual product sales (Woodhead 2006). Myer is now moving to adopt data mining techniques used by global giants Wal-Mart and Tesco as it works on making use of its information mountain collected through its loyalty and credit card schemes. Myer IT director Timothy Clark said that the company would deploy powerful new data mining tools in the near future as it introduces online shopping and data warehousing platforms in an $88 million investment program. However, Australian retailers lag well behind UK and US companies in mining consumer information (Woodhead 2007).

BACKGROUND

Data mining is usually supported by the following technologies: massive data collection, powerful multiprocessor computers, and data mining algorithms.

Whilst data collection is a relatively easy task and powerful computers as well as distributed systems are readily available, commonly used data mining algorithms include Artificial Neural Networks (ANNs), Decision Trees, Support Vector Machines, and Rule Induction (Bramer 2007, Han et al 2006). There are also several traditional approaches such as Nearest Neighbor Classification and Cluster Analysis (Witten et al 2005, Bigus 1996). Data mining is often applied to two separate processes: knowledge discovery and prediction. Knowledge discovery provides explicit information that has a readable form and can be understood by users. Forecasting, or predictive modeling provides predictions of future events and may be transparent and readable in some approaches (e.g. Rule Induction), but opaque in others such as
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