

# A hybrid system combining self-organizing maps with case-based reasoning in wholesaler's new-release book forecasting

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## Abstract

In this paper, we proposed a hybrid system to combine the self-organizing map (SOM) of neural network with case-based reasoning (CBR) method, for sales forecast of new released books. CBR systems have been successfully used in several domains of artificial intelligence. In order to enhance efficiency and capability of CBR systems, we connected the SOM method to deal with cluster problems of CBR systems, SOM/CBR for short. Case base is acquired from a book selling data of a wholesaler in Taiwan, and it is applied by SOM/CBR to forecast sales of new released books. We found the SOM/CBR method has excellent performance. The result of the prediction of SOM/CBR was compared with the results of K/CBR, which is divided by K-mean, and traditional CBR. We find out that the SOM/CBR is more accurate and efficient when being applied to the forecast of the data than K/CBR or traditional CBR.

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*Keywords:* Case-based reasoning (CBR); Self-organizing maps (SOM); Neural network; K-main method; Sales forecasting

## 1. Introduction

Under the extremely competitive business environment, in order to face the complex market competitions, enterprises are trying their best to make the ultimate policy. The completeness of the information available to the decision maker is the key factor influencing the quality of the decisions. An enterprise could have better controls of the trend for the sales growth of a new product if a sales forecast is conducted for this new product. In business forecasting, managers often use the outcomes of past similar cases to predict the result of the current one. The methods to be used are nothing more than naive prediction, statistical methods, or artificial intelligent methods. Among these methods, artificial intelligent (AI) methods are mostly used in academic studies because of the ability to provide rapid solutions with high accuracy and to deal with diversified cases. Among AI methods, case-based reasoning (CBR) has been paid attention gradually. The earliest contributions to the area of CBR were from Schank and his colleagues at Yale University (Schank, 1982; Schank & Abelson, 1977).

During 1977–1993, CBR research was highly considered as a conceivable high-level model for cognitive processing. Aamodt and Plaza (1994) indicated that CBR systems have been successfully used in several domains such as diagnosis, prediction, control, and planning. Based on the survey conducted by Watson (1997), there were more than 130 enterprises using CBR systems to solve many kinds of problems in companies at the end of 1997.

For the book industry in Taiwan, it is very difficult to predict sales volumes because the products have various classifications and different lengths of life-cycles. On an average, there are about 3412.6 new books being published every month in Taiwan, and the speed for new released books is really high. The returning rate of books is more than 30% in this industry according to the actual data collected from the wholesaler and from past studies (Council for Culture Affairs, 2000). The main reason of high book returning rate is caused by the insufficient information of book sales status in the book supply chain which brings up bullwhip effect and form up the unbalanced situation between supply and demand. High book returning rate is a very heavy burden for all companies in this industry. Hence, we propose a sales forecasting system for new released books to assist on decision making regarding book ordering. The system is a hybrid CBR method integrating a conventional CBR with SOM neural network-based clustering to conduct a high accurate

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and efficient book sales forecasting to reduce high book returning rate and increase profits.

The remainder of this paper is organized as follows. Section 2 describes relevant literature review. Section 3 presents the hybrid method that integrates CBR with SOM neural network-based clustering. Section 4 shows problem description. Section 5 depicts experimental results. In Section 6, the conclusion is presented.

## 2. Literature review

In this section, sales forecasting and integrated CBR and artificial neural networks (ANNs) are briefly reviewed.

### 2.1. Sales forecasting

Sales forecasting always plays an important role in a decision support system. The first step for business planning is sales forecasting, and enterprises have to understand the changing demands of the products for future markets in order to reserve appropriate resources for future production. Sales forecasting results would be very important input information for strategy and production planning. Effective sales forecasting obtained in advance can help the decision maker compute production and materials costs, even determine the selling price. It can result in a lower inventory level and achieve the objective of just-in-time (LeVee, 1992). The barrier of communication for sales forecast occurred because managers usually ignore the application, test, control of key information and execute of forecast of the model (Gross, 1988). On the other hand, staffs participated in forecasting process were paying too much attention on computer operation and they did not know the practical situation of the market, such as changes of demands from consumers and price. Therefore, managers must understand the relationships among the variables thoroughly, evaluate the objectivity of the forecast system and build up an open and real time.

In the early years, studies regarding forecasting mainly relied on statistical techniques such as exponential smoothing, regression model, autoregressive and moving average (ARMR), etc. (Chambers, Mullick, & Smith, 1971; Chase, 1993; Fliedner & Lawrence, 1995; Florance & Sawicz, 1993; Rice & Mahmoud, 1990). As time goes by, the internal and external environments for enterprises are becoming more and more complex. Traditional statistical prediction methods are no longer effective enough to deal with the problems. Therefore, more kinds of Artificial Intelligence algorithms were developed to face the change. The algorithms such as ANNs, Fuzzy method, CBR, genetic algorithm (GA) and data envelopment analysis, etc. have been widely applied to many fields such as bankruptcy prediction (Cielen, Peeters, & Vanhoof, 2004; Jo & Han, 1996, stock market prediction (Baba & Kozaki, 1992; Wang, Phua, & Lin, 2003) and all kinds of sales prediction.

There were so many researchers that have been comparing different prediction methods (Alon, Qi, & Sadowski, 2001; Kuo, Wu, & Wang, 2002; Mair et al., 2000).

From the literatures reviewed, we could see that there are very few studies focusing on sales forecasting for new released books. Therefore, this study would like to focus on the book markets and develop an accurate and practical sales forecasting model for new released books.

### 2.2. Integrated CBR and ANN

CBR is one of the emerging paradigms for designing intelligent systems. It shows significant promise for improving the effectiveness of complex and unstructured decision making. It solves new problems by adopting previously successful solutions to analogous problems. In general, the problem-solving life-cycle in a CBR system consists essentially of the following four parts (see Fig. 1).

1. *Retrieving* similar previously experienced cases whose problem is judged to be similar.
2. *Reusing* the cases by copying or integrating the solutions from the cases retrieved.
3. *Revising* or adopting the solution(s) retrieved as an attempt to solve the new problem.
4. *Retaining* the new solution once it has been confirmed or validated.

Hongkyu and Ingoo (1996) proposed a structured model with multiple stages. It consists of four phases of problem-solving (training, test, adjusting and prediction), and three types of external input data (training, testing and generalization). The integrated model combined three methods: discriminate analysis, neural network and case-based

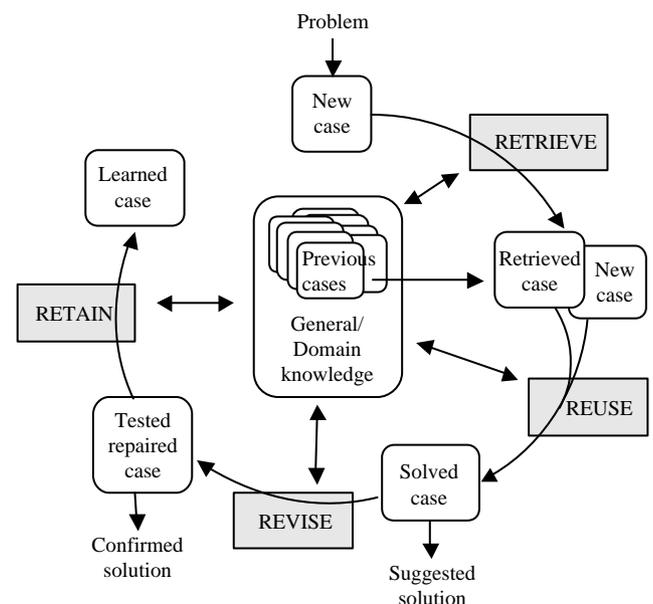


Fig. 1. CBR cycle. (From Aamodt & Plaza, 1994).

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