

An associative classification-based recommendation system for personalization in B2C e-commerce applications

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Abstract

It has been recognized that e-commerce and mass customization will emerge as a primary style of manufacturing. The main challenge for such a paradigm originates from difficulties in personalization – providing support for customers to find the most valuable products that match their heterogeneous needs. Traditional approaches to the personalization problem adopt pre-defined formats to describe the customer requirements. This always leads to distortion in eliciting requirement information and thus inaccurate recommendations. Knowledge discovery lends itself to dealing with semi-structured data and makes it possible to capture customer requirements more accurately. This paper proposes an associative classification-based recommendation system for personalization in B2C e-commerce applications. Knowledge discovery techniques are applied to support personalization according to an inner established model that anticipates customer heterogeneous requirements. The framework and methodology of the associative classification-based recommendation system have been addressed. The system analysis, design, and implementation issues in an Internet programming environment are presented. The feasibility of the proposed recommendation system has been validated with a prototype for personalization in mobile phone B2C e-commerce applications.

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Keywords: Recommendation system; Advisory system; Personalization; E-commerce; Collaborative filtering; Content-based filtering; Text mining

1. Introduction

With the advent of customer-driven marketing, it has been envisioned that e-commerce and mass customization will emerge as a primary style of manufacturing in the coming decade and beyond (Economist, 2001). The capabilities of e-commerce enable the customer's involvement in design, manufacturing, and service, thus to make it possible for product/service providers to interact directly with their customers and capture the customer requirements. A number of online product customization systems have been launched recently (for example, Dell.com, Iatown.com, and Cannondale.com). These systems support manufacturers to respond to a high variety of customer requirements

and orders by customizing the offerings and anticipating the customer requirements.

The online customization systems often encounter difficulties when dealing with support for customers' finding the valuable products that match their heterogeneous needs (namely personalization). It is not uncommon that searching for information or buying complex products (e.g. digital products) via the Internet are always frustrated (Francisco, Rafael, & Rodrigo, 2005). As in the World Wide Web, the available products and the corresponding electronic information lead to the problem of information overload. Online customers have to access all the information contents in order to find what they mostly prefer. Without the face-to-face advice, customers always have difficulties in making trade-offs among numerous competing products on the Internet (Huffman & Khan, 1998). For example, as in real purchase decisions, buyers cannot get all the best features at the lowest prices. In some cases,

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for some specific products, especially for digital products, professional knowledge is always required for evaluation. It is difficult for non-experts to compare products' performances. For example, online customers may be frustrated by the feature information of digital camera products because they do not know how each feature or its parameters can influence the picture quality.

Recommendation systems have been traditionally used by some e-commerce sites to solve the personalization problem by guiding customers to find the products they would like to purchase (Yong, Yum, Song, & Su, 2005). A number of recommendation systems have been proposed for different businesses (for example, Group-Lens recommendation system and Ringo). Most of them are either homogeneous (i.e., content-based filtering) or heterogeneous (i.e., collaborative filtering) product recommendation systems (Yuan & Cheng, 2004). However, both of the two paradigms yielded few promising results. The content-based filtering (CBF) approach recommends products to target customers according to the preferences of their neighbors (Hill, Stead, Rosenstein, & Furnas, 1995). However, it is often inhibitive to estimate the preference similarities between various customers. For example, similar preferences may be defined as the preferences of customers who have similar ratings of items (Yoon & Jae, 2004). It is difficult to obtain the accurate customer ratings of products especially when special knowledge is needed for rating. The collaborative filtering (CF) approach, on the other hand, recommends products to target customers based on their past preferences (Basu, Hirsh, & Cohen, 1998). When dealing with new customers, this type of recommendation systems cannot recommend any product as no historical preference records are available (Avery & Zeckhauser, 1997). Nevertheless, both approaches require the customers to express their requirements according to certain system pre-defined formats (e.g., product ratings or customer profiles), and thus real customer requirement information may be distorted.

Due to the drawbacks of traditional approaches, a new paradigm is preferred to advise proper products by capturing accurately individual requirement information (Cheung, Lee, Wang, Chu, & To, 2003). As individual customer requirements are heterogeneous, an open environment is required to allow customers to express their diverse requirements completely in their own manners. On the other hand, to avoid the difficulties involved in preference estimation, it is preferred to establish certain models that allow the prediction of product labels according to customer requirements directly. As a result, the main difficulties in establishing recommendation systems for personalization in B2C e-commerce applications can be manifested in two aspects. First, customers always use their own natural languages to express what they need. Their requirements are normally qualitative and tend to be imprecise and ambiguous due to their linguistic origins. Synonymous words may be used to express the same requirements. Furthermore, numerous words that contribute nothing to information retrieval are always

found, which cause difficulties in understanding the customer requirements. Second, classification has been proven to be an effective means to predict future data objects for which the class label is unknown. Many efficient methods, such as the decision tree, regression models, etc., are developed to identify the relationships between the objects and class labels. However, these methods only excel in classifying structured data – the object data are organized according to a fixed set of attributes or dimensions. Therefore, commonly used relational data-oriented classification methods cannot be adopted to classify customer requirements which are organized into a set of text-based documents.

In this regard, this research proposes an associative classification-based recommendation system for personalization in B2C e-commerce applications. Products are recommended to customers according to the inner established model that anticipates specific customer needs. Due to the difficulties inherent in designing recommendation system for personalization, customer requirements are processed by semantic analysis and represented as text documents. A set of significant phrases are identified to describe diverse requirements. As association rule learning method excels in dealing with semi-structured data, associative classification method is employed to establish the customer requirement classification model. By reusing the knowledge from historical data, a set of associated, frequently occurring text patterns (classifiers) are built by applying an association rule learning method to a training set of requirement text documents. These classifiers are used to predict the product labels for new customer requirements and distinguish one label from others.

The subsequent sections are organized as follows. Section 2 presents the background research leading to the associative classification-based recommendation system. In Section 3, the associative classification-based recommendation problem is described. The framework and the methodology of an associative classification-based recommendation system are discussed in Section 4. In Section 5, the system analysis and design of the proposed recommendation system for personalization in B2C e-commerce applications are presented. Section 6 describes the architecture and implementation issues of the proposed recommendation system for personalization in B2C e-commerce applications. Section 7 demonstrates the prototype of the proposed recommendation system for personalization in mobile phone B2C e-commerce application. The research is concluded in Section 8.

2. Background review

2.1. Recommendation systems

Diverse recommendation systems have been developed. Tapestry (Goldberg, Nichols, Oki, & Terry, 1992) is one of the earliest recommendation systems. It is a mail filtering

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