Chapter XX

Distributed Recommender Systems: New Opportunities in Internet Commerce

Badrul M. Sarwar, Joseph A. Konstan and John T. Riedl
University of Minnesota, USA

INTRODUCTION

Internet commerce has exploded in the past three years. Consumers went from spending almost nothing on Internet commerce in 1996, to an estimated $4 billion that will be spent just between Thanksgiving and New Year's Day in 1999! (Forrester Research, 1998). Several types of products are emerging as the early leaders. Table 1 shows the top products in Fall 1998.

These products share several characteristics. First, many of them are commodity products in which the name is sufficient to identify the product to the consumer. Books, music, and travel are almost completely commodities. Hardware and apparel are less of a commodity. Brand is extremely important, but individual products within a brand change rapidly. Second, these products are easy to ship. Books, music, and apparel are relatively dense in value per unit of size or weight, and are nearly unaffected by extremes of climate. Travel *is* shipping, of the consumers, and the tickets are easy to transport, especially with the emergence of e-tickets that are not physically transferred at all. Third, consumers buy many of these products over the course of a year, so online businesses see the same consumers frequently.

One implication of the first two of these characteristics is that consumers may feel that it does not matter who they purchase their products from. Since the products are commodities, and since they are easy to ship anywhere, consumers may feel they can choose to purchase their products from any business that carries those products, independent of location. If the three most important at-

Table 1: Top Internet commerce products (source: Jupiter Communications, Fall 1998).

Product	Market Share
Hardware	30.1%
Travel	29.6%
Books	9.2%
Apparel	4.3%
Music	1.9%

tributes of retail in the pre-Internet age – "location, location, and location" – have been rendered irrelevant in Internet commerce, what will replace them?

Future of Internet Commerce

Clearly service in delivering products will be one of the new attributes. Internet commerce companies that do not deliver products as promised are already seeing their names posted on special Web pages. New companies have been created, such as *BizRate*, whose sole function is to evaluate the delivery service of other companies. Because the Internet will continue to make delivery of information about service easy, we believe that over the long term, consumers will have information about which companies are actually fulfilling their promises, and which ones are not. We believe, therefore, that in the steady-state of Internet commerce, all successful businesses will deliver the products they promise in a timely manner.

The next candidate for the crucial new attribute of retail is price. Many researchers have argued that in Internet commerce, consumers will be drawn to the cheapest price (Lynch et al., 2000). Tools now exist to make it easy for consumers to shop over the entire Internet looking for the cheapest price for a commodity product (e.g., www.mysimon.com, www.Jango.com, and www.roboshopper.com). These tools are a matter of concern to many businesses. If price becomes the deciding factor in consumer purchase decision, then price wars will inevitably break out. Profit margins for the businesses will plummet to near zero, reducing profitability for the businesses (Greenwald et al., 1999). Some observers have even suggested that the entire Internet economy may collapse under the most intense price pressure ever seen in history!

Many businesses are turning to other ways to deliver value to their customers in the Internet economy. They embrace the need for strong service, but reject the inevitability of price wars. These businesses are seeking ways to enhance their relationship with their customers by delivering services those customers cannot find at other businesses, on or off the Internet. Many businesses are creating services that help their customers sort through the available products to find the ones that are most valuable to them. Services like these have been shown to reduce the price sensitivity of consumers, while increasing their satisfaction with the purchase experience (Lynch et al., 2000). One of the most successful of those emerging services is a new type of database marketing, created for the Internet, and known as *recommender systems*.

Contributions of this Chapter

In this chapter, we introduce the concepts of recommender systems as a very successful Internet commerce tool. Then, we describe the basic principles of recommender systems and carefully analyzes how these systems relate to other prevailing data-analysis techniques and how they are more suitable for providing real-time personalized recommendations for customers of Internet commerce. The following section depicts the importance of recommender systems and their strategies for improving sales. We then analyze the nature and necessity of recommender systems in future commerce applications and establish the need for distributing such services to make them widely available. Later we present a detailed taxonomy of distributed recommender system applications and three different implementation frameworks for providing distributed recommender system services for Internet commerce, we analyze some of the design issues as well.

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