An Intelligent Shopping Agent for Optimal Purchasing Decision on the Semantic Web

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Abstract. Shopping in the Internet does not proceed smoothly as customers expect currently. In particular customers have many obstacles in finding an optimal combination of products and shopping malls to minimize the total purchasing cost. To solve such problems, this paper proposes a new framework of an intelligent shopping agent based on the Semantic Web and the Integer Programming technologies. Starting from the search of products, it will show how to build an intelligent agent by using concepts of the Semantic Web and how to connect information to formulating and solving an optimization problem to achieve a customer’s goal.

Keywords: Semantic Web, Integer Programming, OWL, SWRL, Internet Shopping Agent.

1 Introduction

When customers purchase products in Internet shopping malls, they experience difficulties in many ways. One comes from the conventional search systems. Current search systems are keyword-based such as in Amazon.com and Buy.com – they use combinations of words, phrases and sentences in query and search for items that contain the specified combinations. This kind of search method does not, however, satisfy customers with vague ideas about what they want. Also, even with clear ideas on products, they have to visit lots of shopping malls to find their best deals. While some websites such as MySimon.com and Dealtime.com try to give customers services of comparing products, it is still far behind what they want. When customers purchase multiple products from Internet shopping malls, they may still visit many websites to compare products from various shopping malls and struggle to handle complicating business rules such as price policy, sales taxes and delivery costs. After collecting all necessary information, finding an optimal combination of products and shopping malls with the lowest cost is not easy to customers.

W3C proposed the Semantic Web with implementation languages such as RDF, OWL and SWRL as a step to make more intelligent Web. The Semantic Web makes an agent understand meanings on the Web and process the data to provide what customers want while the conventional approach can’t. RDF is a language for

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representing information about resources in the Internet. OWL, an extension of the concepts in RDF, describes Web ontologies of information for objects that can be identified on the Web and make them processed by applications; so, it is quite useful when information of products needs to be represented on the Web. SWRL, a semantic web rule language combining OWL and RuleML, helps to describe relations between Web ontologies.

Benefits of the Semantic Web technology have enticed many researchers to apply the technology to various applications: medical and biological information search [6] and product information representation in e-commerce. [5] and [3] applied the technology to product information search while [4] and [2] addressed product information integration and tracking. All the preceding works, however, address only a part of the whole process of shopper’s decision making. This paper will address how to support the whole process of shopper’s decision making with the Semantic Web and the Integer Programming technologies. It will propose how to make an agent more intelligent by using the Integer Programming (IP) as a reasoning method. With this reasoning method, the agent can deduce what customers really want such as an optimal combination of products and shopping malls. More details will be showed in the following: customer-product information description using the Web Ontology; description of business rules using SWRL; query generation method based on the Web Ontology; the price minimization of multiple products based on the Integer Programming. The agent will be explained with the case of purchasing CDs.

This paper is organized in four sections. The first is this section. The second shows how the proposed agent works to solve the problems mentioned above. The third section will show details of implementation, and finally a conclusion follows.

2 How Ontology Rule and IP-Based Intelligent Agent Works

The agent collects information about CDs from Internet shopping malls and finds an optimal selection to achieve the goal a customer sets. The agent starts with receiving an ID and a password from a customer and showing the registered shopping malls the customer can access to. Also, it displays the status of the customer’s membership for each shopping mall, stored in each shopping mall’s ontology.

Next, the agent displays a dialogue box with three fields to get data keywords necessary to search for a CD. The keywords include the name of an album, the list of songs and the artist’s name. A query to search for the CD is generated in RDQL and is conducted in an ontology, Whole CD Ontology, containing information of all CDs. After the search, the agent displays the result in a table. The customer may put the found CDs into the shopping cart, and either continue shopping or go to the table showing all information about the chosen CDs. Then, the customer puts the number of each CD to purchase in the shopping cart.

In the next step, the agent retrieves all information about shopping malls stocking the chosen CDs and business rules from Shopping Mall Ontologies. A table called Price Table appears and shows the prices for CDs, delivery rates and discounts shopping malls are proposing. In other words, the agent queries information about