Non-Monotonic Modeling for Personalized Services Retrieval and Selection

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ABSTRACT

With growing interest in Semantic Web services and emerging standards, such as OWL, WSMO, and SWSL in particular, the importance of applying logic-based models to develop core elements of the intelligent Semantic Web has been more closely examined. However, little research has been conducted in Semantic Web services on issues of non-monotonicity and uncertainty of Web services retrieval and selection. In this paper, the authors propose a non-monotonic modeling and uncertainty reasoning framework to address problems related to adaptive and personalized services retrieval and selection in the context of micro-payment processing of electronic commerce. As intelligent payment service agents are faced with uncertain and incomplete service information available on the Internet, non-monotonic modeling and reasoning provides a robust and powerful framework to enable agents to make service-related decisions quickly and effectively with reference to an electronic payment processing cycle.

Keywords: Electronic Commerce, Intelligent Agents, Non-Monotonic Reasoning, Services Retrieval, Services Selection, Web Services

INTRODUCTION

The growing interests in Semantic Web services has led to the development of emerging standards such as OWL, WSMO, and SWSL in recent years. In particular, the importance applying logic-based models to develop the core elements of Semantic Web services has been realized by many researchers (Diaz et al., 2006; Guo, 2008; Liu et al., 2008; Roman & Kifer, 2007; Steller & Krishnaswamy, 2009). In the context of Semantic Web services, the classical logic-based models have been applied to services discovery (Steller & Krishnaswamy, 2009), services choreography (Roman & Kifer, 2007), services enactment (Guo, 2008), and services contracting (Liu et al., 2008). However, classical logic such as description logic which is the basis of the OWL reasoning framework of the Semantic Web is monotonic (e.g., old knowledge can never be retracted from a knowledge base). Such an assumption does not really modeling the reality well because when one finds a piece of new information which contradicts the previous information archived on the Web,
s/he will probably discard the old information. Moreover, classical logic is also weak in dealing with the uncertainty present in many real-world applications. Unfortunately, little research work has examined the issue of non-mono-tonicity and uncertainty for Web services retrieval and selection. Because of the large number of web services that exist nowadays, discovering and invoking one or several web services to fulfill the functional requirements of a user, becomes a very complex (e.g., non-mono-tonicity and uncertainty) and time consuming activity for application developers. One possible solution to alleviate such a problem is to develop a sound inference mechanism to autonomously deduce the most suitable services to fulfill the partially defined functional requirements of the user.

The exponential growth of the Internet has rapidly changed the way businesses are performed, and the way consumers do their shopping (He et al., 2003). Recently, a number of electronic payment services have emerged on the World Wide Web (Web) (Song et al., 2006). No doubt, electronic payment services will grow very rapidly and several large online organizations such as Yahoo, Amazon, eBay, etc. have already joined in the race. There are several advantages for the consumers to make use of electronic payment services on the Web. Firstly, these payment services autonomously and accurately process the incoming bills on behalf of the consumers. Therefore, consumers do not need to worry about the tedious job of keeping track of their bills, and perhaps paying penalties for late payments. Secondly, there could be financial advantage of using electronic payment services on the Web. For example, the total transaction cost may be reduced by having a single bulk payment from the payment service rather than having several individual micro-payments settled between a consumer and their biller. Security is also an important issue for electronic commerce. Payment service providers take care of all the security issues with other payment service providers, or the ultimate financial institutes where bill settlements take place. Therefore, the consumer’s risk of conducting on-line shopping and payment is reduced to a minimum. In fact, similar advantages are also brought to the virtual stores or utility companies (e.g., electricity, gas, etc.). For instance, they do not need to spend a lot of money to set up their own payment services on the Web. Moreover, they are guaranteed by the payment service providers that outstanding bills will be settled once the services or goods are delivered to their clients.

The market of Internet-based electronic payment services is highly competitive, and there are new payment services brought to the Web every day. In order to make profit and survive under such a keen competition, payment service providers must be able to select the best settlement options (e.g., cheap, secured, and reliable settlement services) according to the latest market information such as the transaction costs and the service qualities of the external payment or settlement service providers. An agent-based electronic payment service is appealing because payment agents, a kind of service agents, can proactively monitor the latest market information on the Internet (Lau, 2007; Sim & Wang, 2004). Moreover, they can autonomously keep track of bill payments on behalf of each registered client and make sensible decisions regarding optimal settlement options available in a payment cycle. Some business agents can even learn the consumers’ shopping requirements and recommend appropriate products for purchasing (Lau et al., 2000; Lau et al., 2008; Maes et al., 1999). Nevertheless, one difficulty that payment agents need to deal with is that market information (e.g., prices and service qualities of settlement services) available on the Internet is highly volatile. For instance, even though a settlement Web service was up and running few hours’ ago, it might be out of service at the current payment processing cycle. Transaction cost pertaining to a settlement Web service may also vary quite frequently. This trend has already been revealed in nowadays telecommunication market. When a new payment or settlement Web service is first introduced to the Internet, it may even be difficult to have full knowledge about its service characteristic (e.g., reliability).
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