

A Framework For Ontology-Based Service Selection In Dynamic Environments

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Abstract

Previous approaches to service selection are mainly based on capturing and exchanging the ratings of consumers to providers. However, ratings reflect tastes of the raters. Therefore, service selection using ratings may mislead the consumers having a taste different than that of the raters. We propose to use experiences instead of the ratings. Experiences are the representation of what is requested by a consumer and what is received at the end. Unlike ratings, experiences do not reflect the opinion of the others, but the actual story between consumers and providers concerning a service demand. Using experiences, the consumer models the services of a provider for a specific service demand and selects the provider that is expected to satisfy the consumer the most. Our simulations show that proposed approach significantly increases the overall satisfaction of the service consumers.

Introduction

Reputation systems enable consumers to rate the service providers in a centralized location. The ratings of the consumers are then aggregated to decide whether a service provider will act as expected (Sabater & Sierra 2002). eBay (eBay 1995) uses such a reputation system. Distributed approaches to service selection consider *trust* among entities (Yu & Singh 2002; Yolum & Singh 2005; Huynh, Jennings, & Shadbolt 2004). Trust captures a trustor's expectation from a trustee for a particular service. Most formalizations of trust depend on ratings. However, ratings should be evaluated within their scope. Scope of a rating is the context in which the rater experienced the service. In different contexts, a service has different values for a consumer (i.e., it is rated differently by the consumer). Therefore, scope of ratings should be considered while using the ratings.

Accordingly, the main goal of our research is to develop a context-aware service selection framework so that consumers could make the context of their service demands explicit and make service decisions primarily on their own satisfaction criteria. For this purpose, we first propose an ontology-based representation that is more expressive than ratings. This representation and its usage in service selection is introduced in the next section. Then, we propose an approach for ontologies to evolve over time to represent

consumers' evolving service needs better. Next, we plan to integrate these two proposed approaches to make context-aware service selections in dynamic environments where consumers' service needs evolve over time. Our approaches depend on the information exchange and interactions of the consumers in a P2P setting. Therefore, we plan to integrate a trust mechanism into our research so that consumers can differentiate who is trustworthy and who is not.

Completed Research

Even if their service interests are the same, different consumers rate the same service differently depending on their satisfaction criteria. That is why ratings reflect the satisfaction criteria and subjective opinion of the raters. The main question at this point is how to get rid of subjectiveness of ratings in service selection. In our completed research (Şensoy & Yolum 2006a; 2006b), we propose that, instead of ratings, consumers can record their interactions with service providers in a great detail within an experience structure. An experience contains a consumer's service demand and the supplied service in response to this service demand. In our approach, instead of sharing their ratings, consumers share their experiences. An experience expresses the story between the consumer and the provider regarding a specific service demand. Hence, any consumer receiving an experience can evaluate the service provider according to its own satisfaction criteria using the detailed data in the experience. This approach may get rid of the subjectiveness of the rating-based approaches.

Although ratings can simply be represented using plain numbers, representation of consumers' experiences requires representational power of ontologies. In our completed research, we assume that consumer agents share a static shared ontology through which the consumers can represent their service needs and past experiences in the best way possible. Consumers use experiences to decide on a service provider. For this purpose, consumers first collect experiences related to their current service demands from other consumers using a P2P protocol. Then, information in the experiences is used for the modeling of providers' behaviors for different service demands (i.e., using machine learning methods such as parametric classification (Şensoy & Yolum 2006a) or case-based reasoning (Şensoy & Yolum 2006b)). After modeling service providers, the provider having the highest

probability of supplying satisfactory service is chosen.

Using various simulations, we compared performance of the proposed approach and that of various rating-based service selection approaches. The performed simulations show that the use of experiences improves the decisions of the service consumers and increases the overall satisfaction significantly compared with the rating-based service selection approaches.

The Work In Progress

Although the proposed experience-based service selection approach is successful in identifying service providers, it has a major weakness: assumption of a static, shared ontology among agents. This assumption cannot account for the fact that a consumer's service needs may evolve over time and new concepts may be necessary for the consumer to describe its evolving service needs. Hence, a service selection approach should be able to accommodate this, since in many e-commerce settings, individuals learn new concepts and services from different sources, add them to their ontology, and further form service requests that are based on these new concepts.

Accordingly, we propose a distributed approach for evolution and maintenance of local ontologies for service selection (Şensoy & Yolum 2007). In this approach, a consumer queries its neighborhood to learn a suitable concept if the concepts in its local ontology are not sufficient to describe its current service need. If such a concept is not known by its neighbors, the consumer creates the concept, and teaches it to its neighborhood. This way, the consumer prohibits its future communication problems by informing its neighbors about the created concept before using it. Furthermore, if the neighbors find the new concept useful, they can use it in their forthcoming interactions with others. This way, the semantics of new concepts circulate and get established in the consumer society. This interaction-based learning scheme leads to cooperative evolution of service ontologies. When a consumer learns a useful concept from its neighbors, it can directly use it or create another concept that builds on the learned concept. Hence, more accurate concepts that describe the service needs and experiences of the consumers are cooperatively and iteratively created. Integration of this approach into our previously proposed experience-based service selection approach is in progress.

We evaluated our approach using simulations. Our simulations show that consumers' ontologies evolve considerably so that at the end of the simulations each consumer is able to represent its service needs and past experiences as concisely as possible. The evolutions are not only due to individual effort but mostly a result of cooperation. That is, most of the concepts used by each consumer are devised by others in the society. Further, the consumers learn a small portion of the concepts that emerge in the society, making sure that most of the learned concepts are useful for them in representing their service needs. Through cooperation, consumers can have different but evolving ontologies, yet they can communicate with those that are similar to them to represent their service needs.

The Work To Be Done

The proposed approaches highly depend on domain dependent ontologies. These ontologies are used to represent service demands and the provided services. In our research, ontologies are represented using OWL, but standard service description languages such as WSDL or OWL-S are not used. In order to support interoperability and for compliance with current Web services standards, the service ontologies should be represented using OWL-S.

In this work, we have assumed that consumers exchange their experiences honestly. However, experiences are produced by consumers and some consumers may want to defame some providers because of personal or commercial reasons. This situation imposes the requirement of using a trust mechanism so that some consumers could be ranked as trustful and others could be ranked as distrustful (cheater or slanderer). As a result, we plan to integrate a collaborative trust mechanism into our service selection framework.

As a future work, we also plan to deal with the incentive problem: i.e., willingness of participants to provide information such as experiences. Sharing experiences is important for better decision making and it creates reciprocity between agents. However, additional mechanisms are needed to encourage agents for sharing their experiences and other valuable information.

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