Analyzing Communities of Web Services Using Incentives

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ABSTRACT

This paper proposes an effective mechanism dealing with reputation assessment of communities of web services (CWSs) known as societies composed of a number of functionally identical web services. The objective is to provide a general incentive for CWSs to act truthfully. The considered entities are designed as software autonomous agents equipped with advanced communication and reasoning capabilities. User agents request CWSs for services and accordingly rate their satisfactions about the received quality and community responsiveness. The strategies taken by different parties are private to individual agents, and the logging file that collects feedback is investigated by a controller agent. Furthermore, the accurate reputation assessment is achieved by maintaining a sound logging mechanism. To this end, the incentives for CWSs to act truthfully are investigated and analyzed, while the proposed framework defines the evaluation metrics involved in the reputation assessment of a community. In this paper, the proposed framework is described, a theoretical analysis of its assessment and its implementation along with discussion of empirical results are provided. Finally, the authors show how their model is efficient, particularly in very dynamic environments.

Keywords: Autonomous Agents, Communities, Incentives, Reputation, Trust, Web Services

INTRODUCTION

As one of the recent technologies for developing loosely-coupled, cross-enterprise business processes (usually referred to as B2B applications), a plethora of web services exists on the web waiting to receive users’ requests for processing. Such requests are usually competitive in a security and reputation-driven environment (Martino & Bertino, 2009; Zhang, 2008). To this end, the reputation assessment has been addressed in recent proposals (Jurca & Faltings, 2003; Jurca & Faltings, 2007; Liu et al., 2004). One general solution for such reputation assessment is collection of the after-interaction feedback that users provide with respect to the quality of the received service. However, in feedback-based reputation mechanisms, the precise reputation assessment needs to be verified. Selfish web services might manage to provide feedbacks that support them in the reputation mechanism. In general, online
reputation mechanism is always subject to get violated with selfish web services. Another way to address the selection (and management) problem is to gather web services having similar functionalities to a community. Community of web services (CWSs) is a gathering of single and functionally similar web services that are aggregated to perform as one community while offering unique or variety services. The main property of a CWS is to facilitate and improve the process of web service discovery and selection and effectively regulate the process of user requests. There are underlying reasons for this. In general, the individual web services fail to accept all the requests for them, and thus refuse to accept a portion of their concurrent requests. This would decrease their overall reputation in the environment and would lead to loose some users. In CWSs, the community gathers a set of functionally homogeneous web services. Given that some communities offer the same functionality (hotels booking, weather forecasting, etc.), there is a competition between different communities. In this case, reputation is considered as a differentiation driver of the communities. Moreover, reputation helps users to select the most reputable community, which would provide the best QoS, and helps providers to join the best community, which would bring them the most value. Users assess the reputation of the community and upon that request for a service. Although the service selection process might be simplified, still communities might distract the reputation mechanism to support themselves. To this end, the reputation mechanism is needed to maintain a truthful service selection procedure.

Proposed Model

In this paper, we advance our previous work (Khosravifar et al., 2009) by providing more theoretical and practical results and discussions. Indeed in this paper, we extend the work done in (Elnaffar et al., 2008) by two contributions. In the first contribution, we propose a reputation model of a community of web services, which is based on involved metrics (responsiveness, inDemand, satisfaction that has been defined in (Elnaffar et al. 2008)). These factors are redefined here in a different way by considering the time factor we call time recency. This model is used by users and providers to estimate the reputation of a community. In the second contribution, we discuss more the feedback logging mechanism and give a reliable mechanism (capable of managing malicious acts of communities). We assume that CWSs may be encouraged to violate such run-time logging mechanism in support of themselves or against other communities. To this end, we try to discover feedback violations using the controller agent $C_g$ (the agent that is assigned to monitor the logging data) that to some extent, makes sure that the violation is taken place. Then we propose a method to properly react for such violations. We provide a theoretical analysis based on backward induction to prove that there is an incentive for communities not to violate the logging system. The idea is to prove that communities gain more if they do not violate the logging system compared to when they violate it. In this analysis, we derive the comparative values of reward and penalties for CWSs in order to obtain such an incentive. The simulation results reveal how, empirically, our trust model yields a system that autonomically adjusts the level of CWS’s reputation.

What specifically distinguishes our model from other similar works in the literature (Weaver & Wu, 2006; Jurca & Faltings, 2003; Jurca & Faltings, 2007; Jurca et al., 2007) is: (1) its sound formation of the reputation assessment for the CWSs; and (2) its incentive-based reputation adjustment in the sense that although the communities are capable of distracting the logging system in support of themselves (or against their opponents), they will not take the risk to do that, given the fact that they are aware of possible consequent penalty that would decrease their current reputation level. In this paper, we prove that the best strategy for CWSs is to act truthfully. The advantages of using the incentive-based mechanism are: (1)
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