Trust and Reputation on the Web

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1 Introduction

Trust is verbally defined as “firm belief in the reliability, truth, or ability of someone or something” or “an assured reliance on the character, ability, or strength of someone or something”. Trust has also been studied extensively in different fields of computer science from the web to multi-agent systems and has been given different definitions. It has also been put to practice in different areas. However, the application and the theoretical basis of trust and reputation systems seem to exhibit a gap across different domains, with it being studied and used more extensively in one field than the other.

Here we address these concepts under two areas of the web: web sites and web services. We first have a look at how researchers divide work on trust and reputation into different categories, then we provide a brief explanation on some of the web sites that utilize these concepts. We then focus on web services and how research on trust and reputation is being carried out in this area and provide a few sample works.

2 Trust Systems

Trust is defined as the belief the trusting agent has in the trusted agent’s willingness and capability to deliver a mutually agreed service in a given context and in a given time slot. Reputation is also defined as the aggregation of all the recommendations from the third-party recommendation agents about the quality of the trusted agent \cite{3}.

Artz and Gil \cite{2} have categorized the research on trust into four categories: Policy-based trust, where the focus is on exchanging credentials in order to establish trust; Reputation-based trust, which uses the history of past interactions or performance to determine trust; General models of trust, which rely on psychology or sociology to describe what trust comprises of; and Trust in information resources, which focus on making web resources and web sites more reliable including capturing ratings from users.

Wang and Vassileva \cite{8} break down the existing trust and reputation systems via three different criteria: centralized vs. decentralized; personal/agent vs. resource; and global vs. personal. Based on these criteria, they have categorized some of the major web systems and their corresponding research basis. For example, eBay is categorized as a global personal centralized system, Google, Amazon
and Epinions are categorized as a global resource-based centralized system, and collaborative filtering is categorized as personalized resource-based centralized method. As the architecture of these systems require, it seems that most of them are categorized under the centralized and global category, with some focusing on trust of a resource, while other on the human or agent. Here we have a brief look at some of the websites that utilize trust and reputation in their systems and provide some of the features that each provide.

2.1 Amazon

In Amazon, first there is the trustworthiness of transaction partners, i.e. buyers and sellers, in which a 5-star rating is given by buyers to sellers. Users (buyers) can also give comments or feedbacks on sellers, and Amazon provides a ‘safe buying guarantee’. There is also the trustworthiness of produces, in which it uses customer review and a thing called spotlight review. Customer reviews can be voted on leading to top reviewers, etc.

2.2 eBay

In eBay, the trustworthiness of eBay members is based on feedback from transaction partners in the form of comments and ratings. The ratings can be either positive, negative or neutral. Then the reputation of members is determined by percentage of positive ratings, negative ratings to all of the ratings.

2.3 Bizrate

Bizrate uses what is known as ShopRank algorithm, where popularity, availability and price of products are given weights against the reputation of merchants that sell them. The reputation or trustworthiness of merchants is also determined by assigning one of four types of smiley faces to 12 or more quality dimensions. Merchants, who prove to be trustworthy, get a customer certified logo. As for product rating, it is done using 5-star rating system, by breaking down the pros and cons of the product. The ratings can also be reviewed by voting and displaying the number of people who found the review helpful. [3]

3 Trust and Reputation for Web Services

Web services are software system designed to support interoperable machine-to-machine interaction over a network which has an interface described in a machine-processable format, usually an XML file. [1]

In contrast to web sites, web services do not have a graphical user interface to allow service clients to rate the services, nor currently there a central service authority to collect and measure the user ratings and provide a systematic service trust and reputation feedback. Therefore, this constraint would make the existing systems mostly personalized rather than global, as given in [8]. But on the other
hand, Quality of Service criteria such as reliability and response time are used in some work to measure the trustworthy of services, which is not available for other systems using trust for matters such as merchandise.

However, work on web service trust and reputation does exist that depend on client ratings for measuring trust and reputation of services or service providers. They try to provide a global trust and reputation management system, similar to the global service directory, marking them under the centralized category. A few works also provide a distributed system as solutions to the trust management system. Here we will focus more on the former.

Josang and Ismail [4] describe the semantic characteristics of ratings, reputation scores and trust measures in two dimensions: specificity-generality dimension, which describes the aspect that trust is related to, and subjectivity-objectivity dimension. According to their work, eBays’s reputation system falls into the general and subjective category.

Also, another thing distinguishing web services from web sites in matter of trust and reputation is that web services can be invoked in composition with other services, in the form of an orchestration or choreography. With services invoking each other in a composition, complexities do arise in that fact that service parameters might not be syntactically or semantically compatible. So, basically trust and reputation measures for web services are not only used for selecting the best service provider, but also for checking functional service compatibility and consistency. It is worth noting that recently some research has appeared for computing trust and reputation of web service compositions that provide a subjective solution. Here we will have a look at some of them.

In [5], Li et al. provide a method for computing trust value of singular services based on user ratings and extend it to the composition. They first define the rating space and trust space, and then map the user ratings to trust values using Bayesian inference. By interpreting each of the trust values as a subjective probability in the range of zero to one, they provide a method for computing the trust of the whole service composition using joint subjective probability which multiplies the trust conditional trust values of services succeeding each other in the composition.

In [6], Li et al. use Bayesian inference to estimate the trust value of each service using ratings from different clients. Given a set of rating from different clients that they assume follows a normal density, and clients prior belief, they provide the Bayesian estimation for the service’s trust value. Then they provide a Monte-Carlo based algorithm for finding the service that results the highest global trust. In [7], Nguyen et al. expand the range of input for measuring trust and consider three different sources: direct experience opinion, recommendation from other consumer, and QoS monitoring information. In other words, both subjective and objective view is incorporated into the trust value. They utilize Bayesian networks for measuring the overall satisfaction of a web service based on direct experience opinion, based on customer preference on different criteria.
4 Conclusion and Future Work

In this paper, we reviewed the concepts of trust and reputation on the web. We provided some of the categorization of trust by other researchers, then we reviewed some of the systems on the web that utilize trust and reputation concepts. We then gave a simple comparison between trust on the web and trust defined for web services and provided some sample work for computing trust for web services. As we explained, each has their own characteristics that make it easier to perform trust analysis based on the specified methods.

However, what we look to accomplish hereon is how to apply the trust models in web service compositions to existing web systems and vice versa. Since many of the web systems incorporating trust and reputation are online shopping malls, the similarities between such systems and web service compositions could be benefited. For example, by considering the items in a shopping cart as services in a composition and applying the trust computation methods of composite web services, more complex measurements for product reputation and rating could be provided for online shopping systems. The trust and reputation on transaction partners could be taken to higher level, where the type of products sold and context of the order are taken into account. The same can be said about product reputations. We believe trust and reputation in web service compositions can be applied to such systems.

References