
A Reputation Based fuzzy logic Framework for Virtual Enrollment in Grid Computing Environments

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ABSTRACT

A major problem with the process of selecting members of a virtual organization is that it relies heavily on complete reputation ratings from external bodies. Several solutions have been proffered to solve this problem but most of them put organisations with incomplete reputation ratings at a disadvantage. Against this background, a fuzzy logic approach, capable of handling incomplete information is proposed to determine the trust ratings for potential members of a virtual organization. This paper gives insight into the specific objectives of the research which are to identify reputation rating variables that provide a consistent approximation of the trustworthiness of potential members of a virtual organization, build a static Mamdani fuzzy logic system to determine whether or not to grant membership in the virtual organization and finally to implement a dynamic simulation of the Fuzzy logic Trust system.

Keywords: Reputation, fuzzy logic, framework, grid computing, virtual enrollment and organization.

1. INTRODUCTION

Grid computing seeks to create the illusion of a large and powerful self-managing virtual computer out of a collection of connected heterogeneous systems sharing various combinations of resources. This self-managing computer is sometimes created by the collaboration of enterprises with similar goals. When this happens, a virtual organisation (VO) is said to have been formed. A VO is a temporary or permanent coalition of geographically dispersed individuals, groups, organizational units or entire organizations that pool resources, capabilities and information in order to achieve common goals. VO's are formed within what is known as a virtual breeding environment in a process known as network activation (Camarihna et al., 2003). To belong to the environment, entities in such networks usually have some commonalities, the key one is having similar computing goals.

This VO's are dynamic in nature and this implies that the entire setup of a VO must be able to adapt to changes in its environment. Virtual Breeding Environments (VBE) was pioneered by Camarihna et al., (2003) to model and support the express formation of virtual organizations. Virtual organisations face challenges similar to grid computing including security, coordination of resource sharing as well as problem solving (Foster and Kesselman, 1999; Foster et al., 2001; Foster, 2002; Unger and Haynos, 2003). Before an organisation or entity can participate in a Virtual Organisation it must apply for membership in the VO by registering with a VO manager service. This registration includes information about the resources and services the organisation is offering. However in the event of an organisation wishing to establish a new VO, it assumes the role of a VO owner and with the assistance of the VO Manager and other VO services, it is responsible for populating the VO with resources and users.

2. RELATED WORKS

Trust has been defined as the extent to which one party (The trustor) is willing to participate in an action with a given partner (The trustee), considering the risks and incentives involved (Mayer and Davis, 1995; Jøsang and Presti, 2004). The trustor is the party offering a service while the trustee is the party requiring access to the service. Both the trustee and trustor act as an agent or one of the agents representing an entity whose actual identity it might not be possible to confirm. Therefore both parties must make a decision based on the balance between trust and risk.

On the part of the trustee, if it decides to use services offered by the trustor, it is said to have performed an action. At this point the trustor can decide to deny or grant access to the trustee. In most cases, the trustor does not grant full access initially but instead it offers limited resources under vigilant observation. This observation of the trustee is necessary because granting full unobserved access to the trustee comes with a lot of risk, a key concern in trust studies. For instance, a component of the trustor/trustee might be attacked by the other party for an extended period of time, if the actions of each party are not observed.

2.1 Reputation

An obvious solution to this trust problem is to employ a reputation based model, where parties with bad reputations are unlikely to be granted access to perform actions. Reputation has been defined as the perception a party creates through past actions with regards to its intentions and norms (Fogg et al., 2002). Resnick and Zeckhauser (2002) propose a simple but inaccurate method for computing reputation. It simply measures reputation by finding the quantity of positive and negative ratings separately, and it evaluates the total score as the difference of the two scores. This model has the drawback that it gives an inaccurate estimate of the actual measure of an entities reputation. Xiong and Liu (2004) used an adjusted weighted average of the amount of satisfaction that a user gets for each transaction. The parameters of the model were derived from the feedback from various transactions. Similar models compute a weighted average of all the ratings, using measures such as the credibility of the rating entity, its reputation, the age of the rating, the distance between the rating and current score amongst others.

Bayesian models directly model the statistical interaction between the consumers and the providers. Wang and Vassileva (2003) use a naive Bayesian network to represent the trust between a trustor and trustee. The concept of trust was defined in terms of the capability of the provider in providing services, and the reliability of the user in providing recommendations about other users. Kamvar et al. (2003) made the observation that each workstation has a local copy of its trust assessment of its peers. This copy was the result of evaluating each of the previous transactions carried out between it and each of its other peers. Each workstation normalised these trust values within a range of (0, 1), 1 being assigned to the most trusted peer and 0 being the least trusted peer.

This approach was extended by Bin and Singh (2002), where each peer sought referrals from its neighbours with regards to a third peer. The received trust values were then aggregated using the local trust values, and this was used to create a trust evaluation for the neighbour. Boolin and Jizhou (2006) discussed a similar trust model based on reputation. In their model both direct and indirect trusts are calculated by using reputation. Direct trust is calculated, and the value of the direct trust of others is used to find the value of indirect trust. Stakhanova (2004) proposed a decentralized reputation based trust model for selecting the best peer. The model calculates a trust and mistrust value based on their reputation values, the number of bad transactions that occurred and the total number of transactions performed. The general drawback of all reputation based models is that it exists only in an environment in which all parties are observed and this is infeasible on public networks due to limitations of scale.

2.2 Recommendations

A way suggested out of this problem might be through the use of recommendations (Mui et al., 2001). A recommendation is simply an attempt at communicating a party's reputation from one environment to the next. The problem with recommendations is that all parties to a recommendation system must agree to the systems perception of each party even when it is detrimental to their reputations. Most human operators of these services tend not to come to agree to this arrangement. Instead most practical recommendation systems tend to replace negative recommendations with "unclear information" tags.

2.3 Research Gaps

Several solutions have been proffered in literature to solve the problem of enrolling participants in virtual organizations but most of them put organisations with incomplete reputation ratings at a disadvantage. Organisations wishing to join a virtual organisation directly are selected based on security and resource considerations. These organisations are offered membership based on service descriptions, security grades, trust and reputation ratings, etc.

Another factor considered when offering these organisations membership is the resources they have available for sharing. The actual process of selecting the members of a virtual organisation may consist of a simple matching or a more complex process, which involves adaptive, context-sensitive parameters. The problem with this process of selecting members is that it relies heavily on complete reputation ratings from external communities. This usually puts competent organisations with incomplete reputations at a disadvantage. Also, in an open universe, it is difficult to judge the sincerity or otherwise of these reputation ratings since in many cases, the identity of the communities cannot be established directly.

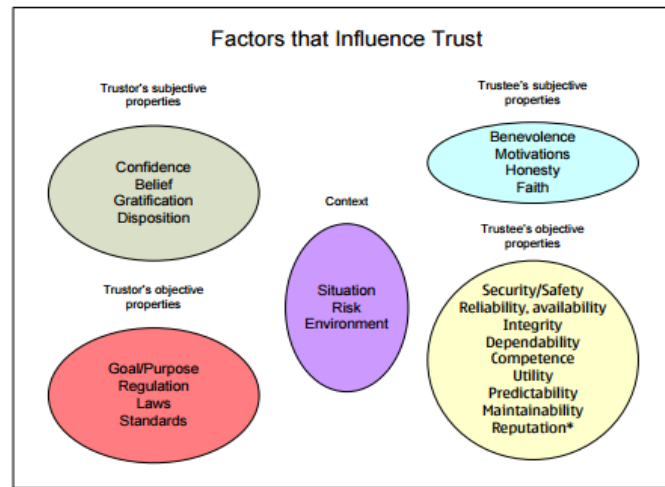


Fig. 1: Factors that Influence Trust

Source: <http://lib.tkk.fi/Diss/2007/isbn9789512291205/isbn9789512291205.pdf>

3. RESEARCH DIRECTION

Against this background, a fuzzy logic approach, capable of handling incomplete information is proposed to determine the trust ratings for potential members of a virtual organization. Competent organisations with incomplete reputation information are usually at a disadvantage in joining virtual organisations. They are sometimes overlooked for less reliable and less secure organisations because of their lack of complete information. We propose a Fuzzy Logic based approach, capable of handling incomplete information for the selection of potential members of Virtual organisations. Our approach to solving the problem will attempt within a scientific framework to achieve the following:

1. Identify reputation ratings that provide a reliable estimate of the trustworthiness of organisations applying for membership in a virtual organization.
2. Build a static fuzzy logic system using the Mandami inference system capable of using the selected reputation ratings of an organization to determine whether or not to grant it membership in the virtual organization.
3. Design and implement a dynamic simulation of the Fuzzy logic Trust system.

4. PROPOSED FRAMEWORK

Our framework will at the interim identify reputation rating variables (input) that provide a reliable estimate of organization trust levels. These ratings include positive approval, negative approval, rating body credibility and performance ratings. The performance ratings will be calculated as an average of the following parameters: actual execution time, availability, number of success, number of failures, bandwidth and latency.

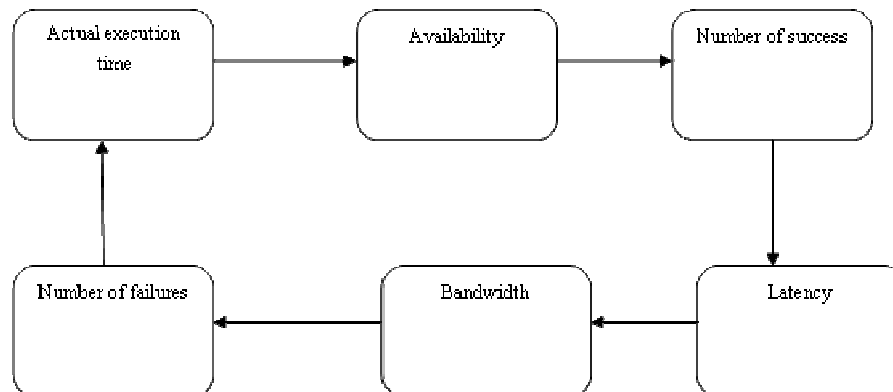


Fig. 2: Performance Rating Framework

Subsequently, Gaussian membership functions will be selected for each of these reputation ratings and the output trust rating based on intuition. The rules of the system will be developed based on the expected behaviour of the system. These rules will be implemented as “if-then” rules. Finally, SIMULINK will be employed to simulate performance and produce expected performance of the system.

5. EXPECTED CONTRIBUTIONS TO KNOWLEDGE

It is expected that the framework being proposed when implemented will result into a fuzzy logic based enrolment system that can be used to model the trustworthiness or otherwise of candidate organisations seeking enrollment and participation in a virtual network.

6. CONCLUDING REMARKS

This paper proposes a solution paradigm to the challenges faced by participating organizations willing to enroll in a virtual environment. A major problem with the process of selecting members of a virtual organization is that it relies heavily on complete reputation ratings from external bodies. Our research will intends to x-ray the peculiarities of parameters needed to measure trust viz-a-viz enrolment and provide a framework that enable same.

7. FUTURE WORKS

Future work will identify reputation rating variables that provide a consistent approximation of the trustworthiness of potential members of a virtual organization, build a static Mamdani fuzzy logic system to determine whether or not to grant membership in the virtual organization and implement a dynamic simulation of the Fuzzy logic Trust system.

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