Review for Calculating Trust of a Particular System

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Abstract: Multi agent systems are made up of multiple interacting intelligent agents - computational entities to some degree autonomous and able to cooperate, compete, communicate, act flexibly, and exercise control over their behavior within the frame of their objectives. Trust is important in Multi Agent System for an agent, using which agents can communicate with each other. In this paper, we present a systematic study on different models for calculating trust and reputation of an agent. Here we have given comparative study of Bayesian network, FIRE model, and Secured Trust model for calculating a trust of a particular system.

**Keywords**: Multi agent system; agent; trust; reputation.

1. INTRODUCTION

A Multi Agent System (MAS) is a computerized intelligent system composed of multiple interacting intelligent systems within an environment. An agent is a computer system capable of flexible, autonomous (problem-solving) action, situated, in dynamic, open, unpredictable and typically multi agent domains [7]. There are two types of agents

1. Passive agents: agents without goal.

2. Active agent: agent with simple goal or complex agent: agents which has lot of complex calculation.

MAS is a loosely coupled network of software agents that interact to solve problems that are beyond the individual capacities or knowledge of each problem solver [1]. Trust and be defined as: "an agent's belief in another agent's capabilities, honest and reliability on its own direct experience". Belief, desire and intention (BDI) architectures are probably the most popular agent architectures. They have their roots in philosophy and offer a logical theory which defines the mental attitudes of belief, desire and intention using a modal logic. One of the most well-known BDI architectures is the Procedural Reasoning System (PRS) [6].This architecture is based on four key data structures: beliefs, desires, intentions and plans, and an interpreter (Fig 1).

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Figure: 1 The PRS agent architecture [6].
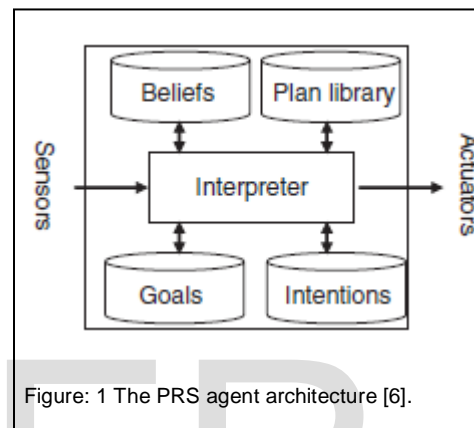
"Trust begins where knowledge [certainty] ends: trust provides a basis dealing with uncertain, complex and threatening images of the future" [8]. Trust and reputation proportional to each other i.e. trust increases, reputational will be increase and trust decrease reputation will be decreased.

2. LITERATURE REVIEW

In this section we look into some of the most recent and popular research work done on the trust model of MAS. Here we discuss the key idea of the following models- Bayesian network – based trust model, FIRE model, Secured Trust

2.1 Bayesian Network

Bayesian network is based on trust model [2]. It is used for a file sharing peer-to-peer application. Here [2] assumes is that all agents have identical Bayesian network architecture, which is not in real world because different agent has different requirements which lead to different network architecture [4]. It also assumes that all agents are providing their feedback is truthful. This assumption is not realistic because often false feedback provided by malicious agents to disrupt the system [2, 4].

2.2 FIRE model

FIRE model is a combination of trust and reputation model [3]. It consists of four main components: interaction trust, role-based trust, witness reputation and certified reputation. Interaction trust computes from the direct interaction between two agents. Role - based trust resulting from role-based relationship between two agents. Witness reputation of a target agent is built on observations about its behavior by other agents (witnesses). Certified reputation calculated by references provided by other agents about its behavior. However, among the four components two of them namely – witness reputation and certified reputation are directly dependent on third party agents and are therefore, harmful to dishonesty and unfair rating. Since agents in open MAS are self-interested; they may provide false rating to gain unwarranted trust from their partners and from collusive groups. Thus FIRE model may contain the above described problem [3].

2.3 Secured Trust

Secured Trust: A dynamic trust computation model for secured communication in Multi-Agent System [4]. It often take place that the higher trust value agent has more workload and the slighter low trust value agent has less workload although it has capability to provide service. So this model introduces a new way of load balancing in MAS for distributing their load between agents using their trust value. In this model [4] has derived three agent's behavioral pattern – non collusive: malicious agents cheat during transaction and give false feedback to other agents, collusive: malicious agents will deterministically help each other by performing fake transition to boot their own rating and strategically altering: malicious gents may occasionally decide to cooperate in order to confuse the system. In this paper [4] define three types of transaction setting

1. Random setting: agents randomly interact with each other.
2. Trust prioritized: selects the agent with the highest trust value to perform the desired transaction.
3. Load balancing schema: a service provider with least amount of workload is selected. Here they check performance evaluation index by taking ratio of number of successful transaction to the total number of transaction.

This model also prevents from shilling attack where malicious agents attack the system by submitting false rating to confuse the system. This attack is often followed by collusion attack where malicious agents collaborate to raise each other's rating by making fake transition. This Secured Trust model prevents such threats by assigning feedback credibility to each feedback provider [4].

2.4 Trust Decision-Making in Multi-Agent Systems

For any agent it is very difficult to make decision about with whom to interact with, given their degree of trust in the available partners. When agents are sensitive to risk, and choose not to interact, MAS can become 'paralysed'; without interactions, evidence cannot be gathered, trust cannot be formed, and interaction cannot take place. This can occur when the risks associated with interaction are high, but trust relationships between agents are weak. In this paper [5] find a new approach to solve this problem; four different trust delegation strategies for finding trustworthy of partner selection. Simple delegation: general trust evaluation. Delegate with monitoring: the trustor invokes the trustee to adopt the desired effort level, and also pays the monitoring cost to observe which effort levels were selected by trusteed. This permits the construction of conditional trust based on effort level choice. Delegate without monitoring; the trustor invokes the trustee to adopt the desired effort level, but does not monitor, and forfeits the ability to learn about the behaviors of trustees in different effort levels. Delegate with reputational incentive: trustor produce contracts which attempt to influence the trustees effort level choice by including the loss or gain. The trustee would suffer from a change in reputation as explicative incentive. In this simulations, these agents use Subjective Logic [5] as their trust mechanism.

3. CONCLUSION

In this paper, studies of different computation of trust and reputation models are presented. There are some drawbacks in these studies, Bayesian network assumes that all agents that are participant in the communication are having same architecture [2]. FIRE model has four components two of them namely – witness reputation and certified reputation are directly dependent on third party agents and are therefore, harmful to dishonesty and unfair rating [3]. Secured Trust made up for online transactions only [4]. Trust Decision-Making in Multi-Agent Systems, agents use

Subjective Logic [5] as their trust mechanism. This does not affect the generality of our approach, which requires only that probabilistic estimates to be produced [5]. Keeping in mind on these drawbacks major changes in architecture and algorithm is required for establishing trust.

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