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A Novel Proposed Approach for Trust Calculation

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Abstract

The world of internet provides many complex system and services. Many of these systems provide good quality of services which ends up in better user satisfaction. Other services/systems do not satisfy user's need. Some of the systems/services maintain user confidentiality and other simply violate or provides low quality of confidentiality. In this scenario, how a user can pick a service from service pool and how to rely on that is a big challenging task. Many methods are proposed for giving a numerical value for the so called goodness provided by the system/services. This numerical value gives a measure of system's trustworthiness. The ranking is one of the methods. These methods mainly rely on user's feedback and there is no role of measuring entity other than collecting the feedback. Feedback is a strong mechanism but suffering from a serious illness. Whether a user giving feedback is lying or not is a big issue. Simply working on the number of feedback is not enough for calculating the trustworthiness. Also calculating trustworthiness without concerning the system/service in consideration is also not fair. In this paper we are proposing a fair methodology for calculating the trust value of system/service where the system/service will also be given a chance for claiming. The calculated value is not biased towards the user only. Rather it gives weightage to each feedback received.

Keywords: Trust, Multi Agent System

1. INTRODUCTION

Today's world is internet world and more and more people are getting connected. They share, store and retrieve vast amount of information through numerous electronic services provided on internet. It is a common belief that whatever information is shared through these services must be kept confidential. But fraudulent cases are also not uncommon. Many technologies are employed to overcome this problem. But technologies alone are not enough. Trust is one of the key factor for electronic services over internet. From the service providers' point of view, how they can convince users' to trust their services. Also from the users' point of view, how to trust systems which provide reliable electronic services. Trust is actually a belief in another. Trust is a subjective probability which varies from 1 (complete trust) to 0 (complete distrust).

A related concept to the trust is reputation. In some of the contexts trust is considered same as reputation but there are some differences between them. Trust can be calculated based on reputation. Reputation is the opinion of an entity, whereas trust is derivation of reputation of an entity.

Trust can be advantageous by number of ways:

1. Trust can eliminate much of unnecessary communication that may be required. It will improve the performance.
2. Based on trustworthiness, decisions can be taken faster and easier.
3. Trust is a kind of soft security compared to hard security like encryption.

Trust can be estimated through number of ways:

1. Direct Experience: It is based on direct experience.
2. Communicated Experience: It is based on repeated communication that has been done till now between service provider and user.
3. Social Information: It is purely based on social information.
4. Reputation: It is based on position of trustee in the society.

2OVERVIEW OF PROBABILITY AND PROBABILISTIC MODEL

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2.1 Probability

Probability is a branch of mathematics that deals with calculating the likelihood of a given event's occurrence, which is expressed as a number between 0 and 1.

Mathematically probability can be expressed as:

$$Probability\ of\ an\ event = \frac{No\ of\ events\ can\ occur}{Total\ no\ of\ possible\ outcome} \quad (1)$$

Properties of probability

1. The sum of probabilities of an event and its complementary is 1.

$$P(A) + P(A^r) = 1 \quad (2)$$

2. The probability of impossible event is zero.

$$P(\emptyset) = 0 \quad (3)$$

3. The probability of union of two events is the sum of their probabilities minus their interaction.

$$P(A \cup B) = P(A) + P(B) - P(A \cap B) \quad (4)$$

4. If an event is subset of another events then its probability is less than or equal to it.

$$If\ A < B\ then\ P(A) \leq P(B) \quad (5)$$

2.2 Bayes' Theorem

Reverend Thomas Bayes' proved most important theory in statistics: Let T denotes "theory" and D denote "Data". Then probability of theorem being true, given that the data has been observed is –

$$P(T|D) = P(D|T)P(T)/P(D) \quad (6)$$

Where,

$$P(D) = P(D|T)P(T) + P(D|T^r)P(T^r) \quad (7)$$

Where, T' being the event that the theory is false.

2.3 Random Variable

A Random Variable is a function or mapping f: E→ R from event space to real number. In other words, a random variable is a way to associate an event with a number.

1. Let an experiment of tossing coin is made. The event space is {H, T}. Let the function is defined as f(H)=3 and F(T)=2. So, the event of coming up H is associated with 3 and that of T is associated with 2. So, f:E→R is a random variable.

2.4 Stochastic Process

A Stochastic Process (SP) is nothing but a collection of random variables to express the evolution of any system. The evolution of any system must have a start point and final point. The start point is always known to us. But the final point depends upon various conditions that a system met during its evolution. Again, the system does not reach final point immediately after start point. There may have been many intermediate points. By introducing intermediate points, a system is allowed to take any random path to reach the final point. Also there may be more than one final point in which system can stay.

The Stochastic Process normally depicted as in figure-1.

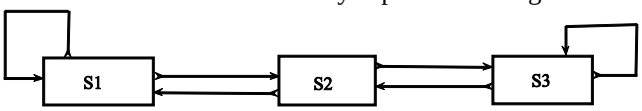

Figure 1 Stochastic Process

2.5 Markov Chain

As described earlier, Markov Chain is a stochastic process in which future point (either intermediate point or final point) depends only on the current intermediate point. Markov property can also be called as memory less property as the state of the system at future time t_{n+1} is decided by the system state at the current time t_n and does not depend on the state at earlier time instance t_1, t_2, t_3..., t_n. In general term, the distribution of where to go next depends on where the system is now not on where the system have been. Markov chains are the combinations of probabilities and matrix operations. Markov chain models a process that proceeds in steps (time, sequence, trial, etc.); like a series of probability trees. This model can be in one "state" in each step. When the next step occurs, the process can be in the same state or move to another state. These movements are defined by probabilities. One can always find the probabilities of being in any given state many steps into the process. The Markova chain can be demonstrated using a transition diagram. The state of the diagram represents the intermediate point of the stochastic process. The advancement from the one state to another depends only upon the current state and not on the previous state of the system. The above transition diagram represents an evolution of the system where S1, S2, and S3 are states of the system. The arrow represents the transition from one state to another state. The weight of the transition arrow represents the chance or the probability for the transition.

If the system's current configuration is

$$C=\begin{bmatrix} a \\ b \\ 1-(a+b) \end{bmatrix}$$

then that means the probability that the system is in state S_1 is a, in S_2 is band obviously in S_3 is (1-(a+b)). Again if probability that that the system can migrate from S_1 to S_2 is p_1, S_2 to S_1 is p_2 and so on then that matrix, called transition matrix, can be represented as:

$$T=\begin{bmatrix} p1 & p2 & 1-(p1+p2) \\ p3 & p4 & 1-(p3+p4) \\ p5 & p6 & 1-(p5+p6) \end{bmatrix}$$

We can predict the future state of the system from equation-8

$$F=C*T \quad (8)$$

This matrix multiplication represents the next configuration of the state. The row of resultant column matrix represents the next probability of the corresponding state.

3 Literature Survey and Related Work

3.1 On How Agents Make Friends: Mechanism for Trust Acquisition

Babak Esfandairi and Sanjay Chandrashekharan had referred simple mechanisms for trust acquisition and propagation. Authors had studied one to one trust acquisition mechanisms. Authors had given propagation model which is uses a directed graph methods to calculate trust for human agents. A problem with their work is that it does not make a distinction between distrust and lack of knowledge about trust.

3.2 Bayesian Network-Based Trust Model

Yao Wang and Julita Vassileva proposed Bayesian network based trust model. Authors had considered situation where frequent interactions are there between two agents. They have presented a flexible method for presenting differentiated trust.

3.3 FIRE - An Integrated Trust and Reputation Model for Open Multi-Agent Systems

T. Dong Huynh and Nicholas R. Jennings and Nigel R. Shadbolt had presented novel model named FIRE which is an integrated trust and reputation model for open multi-agent systems. Authors claimed that FIRE can be easily adapted to multi domains because of its modularized design and parameterized configuration.

3.4 Modeling Trust in Multi-Agent Systems

Eli Stickgold, Sam Mahoney, Jonathan Pfautz , Joseph Campolongo and Erik Thomsen had proposed graph based

approach for estimating trust for each agent in multi agent systems. In order to achieve above task authors have used Katz Centrality Matric as a measure of trust. The authors claimed that the developed algorithm does not require any hard facts and calculates trust based on relative information.

3.5 SecuredTrust: A Dynamic Trust Computation Model for Secured Communication in Multi-Agent Systems

Anupam Das and M. Mahfuzul Islam presented a novel and dynamic trust computation model called SecuredTrust for evaluating agents in multi-agent environments. Here authors had analyzed parameters related to the evaluation of trust and then proposed comprehensive quantitative model for calculating trust. They also proposed load balancing algorithm based on analyzed parameters.

3.6 Trust Decision Making in Multi Agent System

Chris Burnett, Timothy J Norman and Katia Sycara proposed their system considering risk, uncertainty and high dynamicity. Authors had found a new approach to select trustworthy partner. They have given five delegation strategies for trust evaluation which are Simple Delegation, Delegation with Monitoring, Delegate without Monitoring, Delegate with Reputational Incentive and Abstain from Delegation.

4 PROPOSED APPROACH

After going through some research papers, we are proposing a new general approach for calculating trust for any particular system. Figure-2 shows the flowchart for proposed system. The proposed system has following steps

4.1 Calculating the Initial Trust Value

Initially the initiator will assign some work to the system with supplied weight and will also calculate the chance of failure. Like this, he will setup the initial trust value for each and every system (the testing stage). Let us suppose we have three suppliers S1, S2 and S3.

4.2 Bayesian Network-Based Trust Model

Now if at any point of time system S3 say complains that the work get fail due to some other reason like delivery system, then we will use Bayes' theorem to calculate the weight to truth. And the trust will be increased or decreased accordingly.

4.3 Future Calculation

Now if a buyer is using any system say S2 then the initiator can give the probabilistic view of the chance of failure using the Markov Chain as we have the previous data on which we can predict the future. Now if the buyer reports the failure result, we again calculate the truth weight of the buyer using Bayes Theorem and increase or decrease the trust factor accordingly.

4.4 Future Calculation

If any system reports that it is recovered from the previous illness, the initiator will first calculate Probability of Truth using Markov Chain. If it is above the threshold value, the initiator will put the system in testing stage. Otherwise the trust will go down to zero.

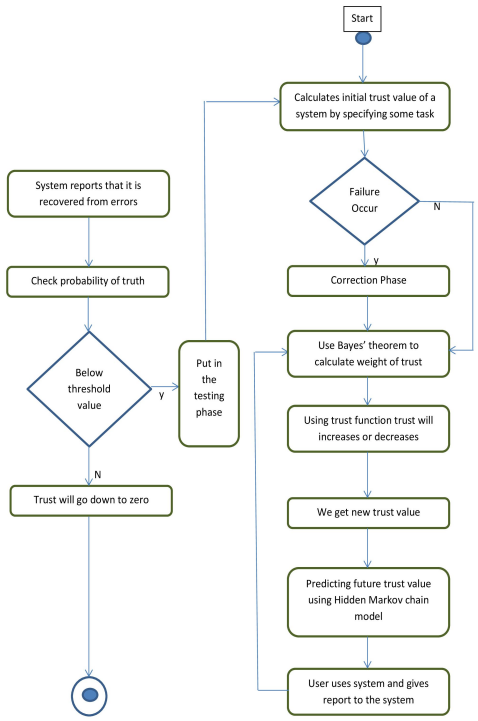

Figure 2 Flow chart

5 PROPOSED APPROACH

5.1 Conclusion

We propose a new approach for calculating trust of a particular system. Our proposed approach is parameter independent as it uses weight of a parameter instead of parameter, so it makes our system dynamic. Typical mathematics used in proposed approach is: Probability approach, Bayes theorem and Markov chain model.

5.2 Future Work

Future work of this report is to implement Trust function, implementation of Markov chain model, implementation of Bayes theorem, and implementation of proposed approach. In the implementation of proposed approach, number of parameter and weight of those parameters will be taken as input and trust value is generated as output of the approach.

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AUTHOR

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