Chapter 6
Evolution of Trust and Formation of Preference Clusters in Distributed Networked Structure

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ABSTRACT

Distributed network researchers are trying to address one important issue concerning networked structures and how the network came into existence, i.e., dynamics of network evolution. From the knowledge of social science it is observed that trust is one such metric that evolves with the network particularly where human interaction is involved. This work presents a “trust” model of the authors’ studies and its various properties. In virtual (and “real”) communities (chat rooms, blogs, etc.) behavioral segregation over time is observed. Differences in identities of interacting agents result in evolution of various degrees of “trust” (and “distrust”) among them over a period of time. This process ultimately leads to emergence of self-segregation in behavioral kinetics and results in formation of preference clusters.

1. INTRODUCTION

Last decade has seen a tremendous growth in internet usage as well as emergence of numerous virtual communities and file sharing networks. These networks are generally distributed in nature. The distributed networked structures are human social network, P2P file sharing network, collaborative network, virtual community (http://www.orkut.com, http://www.paypal.com), and information source network in a search engine. An important characteristic of these systems is that nodes may
Evolution of Trust and Formation of Preference Clusters in Distributed Networked Structure

to leave the network anytime. The participation of large number of entities with conflicting interest in an open system requires a metric for faithful transaction. In real human social network under the same scenario one such metric is trust. Trust is a prevalent concept in human society that, in essence, concerns our reliance on the actions of other entities (“someone” or “something”) within our environment. In human society, the fulfillment of even our most basic needs and desires depends on other people’s actions. So, in human or human made network the notion of trust, reputation, co-operation will emerge particularly in the context of confrontation with strange and malicious behavior by the entities. In this work we use the words “entity”, “node” and “agent” interchangeably.

2. MOTIVATIONS AND AIM

To study and to simulate behavioral kinetics of a virtual community we need a trust model. The trust model should be based on purely decentralized peer-to-peer architectures and algorithms. It should involve cooperative tasks or transactions, and model trust as a quantitative (e.g., monetary) unit, so as to combine trust estimates with transaction values. A similar design methodology was adopted by (Androutsellis-Theotokis et al., 2007). This allows design of algorithms for the estimation and propagation of trust estimates throughout the network and depicts the way trust is used in real life. Marsh in his thesis (Marsh, 1994) first formalized trust as a computational concept. In his dissertation he mentions that cooperation between individuals ultimately leads to the formation of groups (Marsh, 1994). In 2004 US Presidential election blogs played an important role. We intend to emulate that phenomenon in the form chat room dynamics and test a model that couples our trust model with a learning automata (Narendra & Thathachar, 1989; Thathachar & Sastry, 2004) type algorithm. The numerical computations show that the behavioral difference among agents of two different types ultimately leads to self-segregation of chat room preferences among agents. A similar notion is characterized and studied by Professor Lada Adamic (Adamic et al., 2005) using raw metadata about blog sphere. The focus of our work is the notion of evolution of trust i.e., allowing the bottom-up development of trust as a result of repeated transactions. In case of trust score calculation enabled cellular mobile phones it should be the case that in the address book of every subscriber there may be number of addresses but that particular subscriber will assign higher trust values to those with whom his previous conversation had some form of “positive” outcome and he will place a confidential special call to some “selected/trusted” person(s) only. We intend to investigate the fundamental reason behind the initiation and outcome of every communication, the role of trust in such scenarios and emerging properties of social networks over time. Please note that this sort of phenomena is well studied in the domain of conversation analysis (Pomerantz, 1984; Schegloff, 2007). This will help us better while designing secure routing protocols and secure QoS based services in ad-hoc networks and sensor networks. This also enhances security and confidentiality in web based social networks and help design trusted online transaction procedures in e-commerce applications like e-bay (http://www.ebay.com).

In what follows we discuss a mathematical representation of Trust in Section 3. Section 4 introduces proposed trust model. Section 5 is devoted for trust model validation under different social/logical mobility conditions and the robustness of our model is also discussed in the same. Section 6 studies group formation and emergence of trust based self-segregation in virtual communities. Section 7 presents the interpretation of our numerical calculations. We conclude in Section 8 and also present the scope of future work.