Chapter 1
Background Review for Neural Trust and Multi-Agent System

Gehao Lu
University of Huddersfield, UK & Yunnan University, China

Joan Lu
University of Huddersfield, UK

ABSTRACT

This chapter provides a systematic background study in the neural trust and multi-agent system. Theoretic models are discussed in details. The concepts are explained. The existing systems are analyzed. The limitations and strength of previous research are discussed. About 59 references are cited to support the study for the investigation. The study did address the research importance and significance and finally, proposed the future directions for the research undertaken.

1. INTRODUCTION

Multi-agent systems are initially introduced as a branch of distributed artificial intelligence. In 1986, Minsky and Murata proposed the concept of agents and he thought some problems could be solved through the negotiation among the social individuals (Minsky & Murata, 2004). These social individuals are agents. Agents should be highly interactive and intelligent. Hewitt thought that it is difficult to define agent as it is to define intelligence (Hewitt, 1985). Wooldridge and Jennings thought that agents should be autonomous, social interactive, proactive, and reactive (Wooldridge & Jennings, 2002). Eberhart & Shi thought that agents can react through sensing the outside environments (Eberhart & Shi, 2007).

With the increased size and complexity of the computer systems, it is nearly impossible to design a system from scratch and control every details of the system purely by human brain (Simon, 1996). It is difficult to control millions of transactions occurring in a large-scale E-market. It is also difficult to monitor an enterprise information system which encompasses huge amounts of heterogeneous devices which covers thousands of different geographical locations (Rothkopf, 2003; Coulouris, Dollimore & Kindberg, 2000a). Grid Computing, Autonomous Computing, Pervasive computing and Multi-agent systems, are

DOI: 10.4018/978-1-7998-0951-7.ch001

all committing themselves to challenging the design of large-scale distributed system (Coulouris et al., 2000b). Computational trust is to make an intelligent agent trust another agent and delegate part of their tasks to the target agent in a heterogeneous distributed multi-agent environment. Delegation of action is the result of trust and it also forms the foundation of future large-scale cooperative computer systems. Generally, trust toward specific agent is generated through recognition and experience under repeated transactions with that agent. Reputation is the socialized trust which can be propagated through a social network of agents. It helps agents trust the target agent without any direct interaction with the target agent. The benefits of introducing trust and reputation into multi-agent system include:

- As a lubricant, trust can eliminate much of unnecessary communications which are currently necessitates many interaction protocols thus greatly improve the performance of the multi-agent systems.
- An agent can make decision easier based upon the evaluation of the trustworthiness of another agent. Computational trust is also a very beneficial addition to the traditional decision theory.

Trust is a kind of soft security which complements the traditional hard security like encryption, authorization, and authentication. An agent that exists in complex heterogeneous environment must possess both securities in order to be safe and effective.

The mechanisms for coordinating interactions among agents are always pre-defined, that is, the designer specifies how one agent responses to another agent in a fixed protocol (Huynh, 2006). Such mechanisms are not flexible enough because of the intrinsic high openness and variability of the distributed systems (Ferber, 1999). For example, in open MAS (Multi-agent Systems), an agent cannot expect to always interact with the agents in the predefined application domain in a predetermined way (Subrahmanian, Bonatti, Dix, Eiter, Kraus, Ozcan & Ross, 2000). Agents will interact with different agents coming from heterogeneous applications and they may face challenges from lying, deceiving and accidental incidents (Ferber, 1999). Such complexity creates the following questions: can agents accept services from other unfamiliar agents? Can agents make use of the interaction history and transform them into experiences? Can agents avoid excessive negotiation with a familiar agent in an efficient way? Computational trust seems to be the answer and the next step of research for the multi-agent systems. Thus, a systematic review on the existing trust models is necessary.

Trust actually is a belief that someone or agents can delegate the host to finish some actions. There are two layers of meaning in the expression: first, agents should generate the belief of trustworthiness toward some other agents in some specific form; second, agents should make decision whether to delegate actions to the trusted agent. The first layer is actually to study how agents generate and update their belief which is part of research from computational intelligence. The second layer is an extension of the traditional decision theory which adds agent's belief and trustworthiness as one of the concerns during decision making.

There are a few computational trust models and reputation models that have been proposed from (Subrahmanian et al., 2000) to (Huynh, 2006). From a point of dimensional view, there are two types of models involved, i.e. local trust based and reputation based models. For local trust based model, the early model developed by Marsh, University of Stirling, 1994, only considers the local trust dimension which only derives trust from the agent's direct interaction without referencing to the recommendations from other witness agents (Marsh, 1994a). For reputation based models, like SPORA (Zacharia, 1999), they only consider the reputation (witness trust) dimension without looking at the local experience of