



I-TRUST: investigating trust between users and agents in a multi-agent portfolio management system

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Abstract

There is considerable research investigating trust among agents in multi-agent systems. However, the issue of trust between agents and users has rarely been reported in the literature. In this paper, we describe our experiences with I-TRUST, where trust is introduced as a relationship between clients and broker agents in terms of the amount of money clients are willing to give to these agents to invest on their behalf. The goals of broker agents are not only to maximize total revenue subject to clients' risk preference, but also to reinforce trust with their clients. To achieve this, broker agents must first elicit user models both explicitly through questionnaires and implicitly through three games. Then based on the initial user models, a broker agent will learn to invest and later update user models when necessary. From the three experiments conducted in this study, we found that the controllability of a client towards the autonomous system plays a significant role for trust building.

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Keywords: Multi-agent systems; Trust; User modeling; Portfolio management; Online investment

1. Introduction

Trust is multi-dimensional which concerns many different attributes such as reliability, dependability, security, honesty, competence, etc., which may have to be addressed based upon the environment where it is specified [1]. It has been studied extensively in multi-agent systems [2–7], where it is the *'attitude an agent has with respect to the dependability/capabilities of some other agent (maybe itself)'* [3]. However, dealing with trust between humans and

agents in a multi-agent e-commerce system is also important because in order to attract more clients to take advantage of the services they provide, winning the trust of their clients becomes central. As Kini and Choobinch put it, trust in a system involves *'a belief that is influenced by the individual's opinion about certain critical system features'* [8]. This definition highlights human trust towards agents in electronic commerce, which motivates our study in this paper. In particular, we address the issue of the *degree* of trust a client has towards his/her broker agent to invest on his/her behalf: how can a client be sure that the broker agent will make a sound judgment based upon the risk–return preference of him/her. To describe our approach, let us first look at the following scenario.

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2. A scenario

Suppose Bank A offers customers a 24-h on-line portfolio management service (investment in stocks, bonds, mutual funds, etc.) where each software agent will represent one customer to invest/manage his/her portfolio.¹ For Bank A, the overall goal is to attract as many customers as possible along with their optimal investment, and through that, receive higher revenues. Therefore, all the broker agents belonging to the bank are expected to cooperate to convince their respective clients that they are trustworthy.² As a result, customers will be willing to rely on them and ‘dump’ more money into the market. From the company’s perspective, the cooperation among broker agents is the expected collective behaviors; whereas, for each individual broker agent, he/she must also do his/her own jobs to build the trust of his/her client.

This scenario highlights an important issue facing agent-based e-commerce systems: win the trust of their clients and thus attract more customers to take advantage of the services they provide. It is the theme of our study in this paper: investigating trust between software broker agents and their clients in the context of an artificial stock market. Specifically, our study is based on a multi-agent portfolio management system, I-TRUST, where each broker agent represents a client to invest on his/her behalf in the market based on the client’s characteristics (especially risk–return preference). After each investment period, a broker agent will give an investment report to his/her client, and the client will evaluate and rate it. A broker agent needs not only to maximize the total revenue subject to his/her client’s characteristics, but also has to learn the best portfolio selection strategy so as to attract his/her client to follow his/her expertise, e.g. invest more money in the next investment period. The higher amount of money a client is willing to put into the market, the higher

degree of trust he/she has towards his/her broker agent.

Therefore, the degree of trust between a client and his/her broker agent is measured in terms of the amount of money a broker agent invests on his/her client’s behalf. This trust can also be regarded as the degree of the client’s reliability on the capabilities/competence of a broker agent and the service the agent controls or provides. It can be seen that this trust relationship is difficult to create, yet very easy to lose. Therefore a broker agent has to learn to elicit his/her client risk–return preference model so as to make a best investment strategy.

2.1. Related work

The trust investigated in our study can be regarded as a *partial* trust implemented by a client towards his/her agent, which is different from most of the current studies of this kind [9–12]. In Refs. [9–11], agents are *fully* delegated to make decisions in an artificial stock market, i.e. users hold 100% *trust* towards the ability/competence of their agents; while in Ref. [12], users have *no trust at all* towards their agents: a broker agent acts only as an information agent to collect relevant information, and the ‘intelligent client’ will make final decisions on his/her own. Therefore, the client implements *no delegation* at all to his/her broker agents. However, we argue that it is reasonable to add another layer of delegation (*partial trust*) into the trust relationships because it can generalize trust into a wider and general spectrum by introducing trust between humans and agents. The understanding of this kind of relationship can make an e-commerce system more successful, and profitable, since the underlying aim of electronic commerce is to attract more users to take advantage of the services the system can provide.

In Ref. [13], the authors analyze trust, autonomy and delegation in a multi-agent system and a framework is given for the theory of adjustable social autonomy in a complex scenario. Our reported work in this paper can be regarded as investigating trust, autonomy and delegation in a specific domain and expanding it when necessary.

The organization of this paper is as follows: in the next section, an overview of the system architecture is given. We will then describe how to elicit initial

¹A client can be an individual investor or a business investor representing a company.

²Of course, for each broker agent, he/she might have his/her own self-interested goal to maximize his/her own revenue by building strong trust between him/her and his/her client(s), and through that, attracting more customers. But in the context of this paper, we only study the cooperation among agents to achieve a common goal.

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