

# Intimacy-based approach to reasoning customer trust for intelligent e-commerce systems

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**Abstract.** We propose a trust reasoning method dedicated to the mature stage of using e-commerce systems. A new method of unobtrusively estimating the degree of user intimacy is developed, because intimacy has been highly associated with trust as well as reputation. Our experiments show that the proposed method is valid and can be used in conjunction with reputation-based trust reasoning.

**Keywords:** trust; intimacy; context-aware system; intimacy technology

## 1 Introduction

Estimating trust levels is a way of realizing and evaluating trust-based e-commerce. Trust reasoning refers to automated and relevant estimation of human trust in an e-commerce system or service. Trust reasoning research in computer science encompasses two major areas: policy-based and reputation-based trust reasoning. Policy-based trust is established simply by obtaining a sufficient number of credentials pertaining to a specific party. Reputation-based trust reasoning refers to past interactions and performance that enable the trustee to estimate the future trustworthiness of the object of trust. The policy- and reputation-based approaches to identifying the level of trust are related to the interesting assumption that what one person trusts will also be trusted by others. However, this may not be the case for all persons or situations. For example, people who are introverted tend to make decisions more independently of others' opinions than those who are extroverted. According to Enneagram's nine personality types, the individualist or challenger who wants to be independent does not prefer to follow others' thoughts (Palmer 1991). Indeed, referring to others may not be appropriate when a person's preferences are unique, or he/she prefers to use the same service repeatedly when the same or at least very similar situations recur. Intimacy is a more intrapersonal and quite persistent concept that is seldom affected by others (Lee and Kwon, 2011). Hence, a trust level based on intimacy is more stable than one based on other people's evaluations. In this regard, relevant estimations of intimacy can be very useful for personalizing trust-based e-commerce.

Hence, this paper aims to propose a method of trust reasoning in the mature stage of e-commerce usage. Intimacy is estimated with context data and an ensemble intimacy reasoning method. The proposed method shows an automated estimate of the user's current intimacy level based on context data.

## 2 Intimacy reasoning

### 2.1 Parsimonious vertical boosting applied to intimacy reasoning

To estimate the degree of intimacy, we applied the parsimonious model of the vertical boosting method (Kwon, 2011). The pseudo-code of the parsimonious algorithm consists of two parts: the ‘‘Get conclusion’’ procedure (Fig. 1) and the ‘‘Generate patterns’’ procedure (Fig. 2).

Input: pattern matrix	Output: output
<pre> Patterns = Generate patterns (); For (attr=N; attr&gt;=0; attr--) // N is the number of input items {   while ((NOT end_of_patterns) AND (NOT pattern found)) {     if (identified as right patterns) {       output = conclusion of this pattern;       Pattern found;    }     Go to next pattern;   } } Return output; </pre>	

Fig. 1. Procedure of ‘‘Get conclusion’’.

Input: training cases	Output: patterns
<pre> while (NOT end_of_cases) {   if NOT (at least one attribute hit the result) // false pattern found {     if (false pattern already exists in false pattern set) Append new false pattern;   }   Else // right pattern found {     If the attribute returns wrong answer, set value of the attribute as -99;     Else set value of the attribute as the answer;     Put answer to the result of the pattern;   } } Return patterns; </pre>	

Fig. 2. Procedure of ‘‘Generate patterns’’.

### 2.2 Trust reasoning with intimacy

Once the estimated degree of intimacy between the  $k$ -th user and the  $l$ -th e-commerce system ( $\hat{n}_{kl}$ ) is identified, the  $k$ -th user’s trust of the  $l$ -th e-commerce system ( $T_{kl}$ ) is estimated as a weighted average of reputation value and estimated degree of intimacy according to (1):

$$T_{kl} = (1 - \beta_l) \times r_l + \beta_l \times \hat{n}_{kl} \quad (1)$$

The reputation value of the  $l$ -th e-commerce system,  $r_l$ , can be acquired from a third-party organization or any other reputation rating system.  $r_l$  ranges from -1 to 1: -1 and 1 indicate that the reputation is ultimately negative or positive, respectively. Consequently,  $\beta_t$ , which is a function of usage pattern and time, is a sort of weight factor indicating to what extent the trust value relies on intimacy. Next, we have (2):

$$\beta_t = \alpha \times \phi_{kl} \times \rho_{kl} \times \pi_k \quad (2)$$

where  $\alpha$  is a normalization factor to make  $\beta_t$  ranges [0,1],  $\phi_{kl}$  and  $\rho_{kl}$  are the  $k$ -th user's frequency of visiting and elapsed time from the initial visit to the  $l$ -th e-commerce system, respectively. In addition,  $\pi_k$  indicates the  $k$ -th user's relative preference to rely on intimacy factors rather than reputation. Hence, the value of  $\beta_t$  tends to increase for the time being. This makes the trust value, which is a weighted average of the degree of intimacy and reputation.

### 3 Experiment

To show the feasibility of the intimacy-based trust reasoning algorithm proposed in this paper, we performed experimental studies with actual participants who were recruited via e-mail and a sign-up sheet. A survey technique was used to collect experience sets and profile data.

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