# Developing Trust in Recommender Agents

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## ABSTRACT

Trust is one of the most important social concepts that helps human agents to cope with their social environment and is present in all human interaction. Like in real world, agents should rely in some agents and mistrust in other ones to achieve a purpose. In this paper we develop a model of trust in the collaborative world as a new approach of recommender agents development. Mainly, we provide recommender agents with a technology to look for similar agents that advice him. The model presented comprehends the evolution of trust, that is, trust dynamics. Moreover, the model proposed emphasizes proactiveness since the agent looks for other agents in a lack for information situation instead of remaining passive or providing either a negative or empty answer to the user.

## Keywords

Information Filtering, Recommender Agents, Trust, User modelling, Evolution, Adaptation and Learning

## 1. INTRODUCTION

Trust is one of the most important social concepts that helps human agents to cope with their social environment and is present in all human interaction [2]. Some efforts have been done in the study of social models of trust in market environments [6], where several agents compete for their individual profit as well as in other environments where agents need to delegate actions to other agents [1]. Trust, however, is also important in filtering information environments where recommender agents asses users. As well as in the real world people ask to their friends for interesting items in order to get advice, an agent should be able to ask not to all other agents but the reliable ones. In this context, then, agents are not considered as reliable due to either their honesty or their trustworthy information but even because of similar preferences, interest, styles.


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In this paper we introduce a model of trust in the collaborative world as a new approach of recommender agents development. Mainly, we provide recommender agents with a technology to look for reliable agents upon which a given agent can be adviced. The model presented comprehends the evolution of trust, that is, trust dynamics [4].

With the capability of trust, a new information filtering method comes up, it is explained in section 2. Section 3 introduces the formal social model of our approach to trust for recommender systems. Section 4 presents related work and, finally, we end in section 5 by providing some conclusions.

## 2. THE OPINION-BASED INFORMATION FILTERING METHOD

Trust provides a new method for filtering information. The main idea consists in thinking about the other agents as personal entities in which you can rely on or not. Reliability is expressed through a trust value with which each agent labels his/her neighbors. Once the agent has a set of friends, he can use them to filter information. When the agent is not sure about a recommendation or he just discovers a new item, he asks for the opinion to the reliable agents and uses their trust values to conclude whether the item is interesting for the user. We call this new process of filtering information based on agents opinions the opinion-based information filtering method. It differs from the typical collaborative filtering approach in the way that the agent does not ask for a recommendation, the agent ask for an opinion. The opinion is the interest that the other agent thinks that his user has about the given item. Instead of using this opinion directly as a recommendation, the agent includes it in his/her own reasoning and combines it with other agents opinions in order to decide whether recommending a given item.

## 3. SOCIAL TRUST MODEL FOR RECOMMENDER AGENTS

The opinion-based filtering method is based on the social model of trust that we describe following. Each agent has experiences on several products. An experience is defined as $E_i =< p_i, Int_i^e, Int_i^i, \delta_i >$, where $p_i$ is the product identifier, $Int_i^e$ is the set of explicit interests of the user in product $p_i$ and $Int_i^i$ is the implicit one. $\delta_i$ is a temporal parameter in [0,1] that indicates the relevance of the experience.

Each agent $a_i$ has a list of contact neighborhood agents in which it relies: $C_i = \{(a_{i_1}, t_{i,i_1}), (a_{i_2}, t_{i,i_2}), \ldots, (a_{i_n}, t_{i,i_k})\}$,

where $a_{i_j}$ is an agent identifier and $t_{i,i_j}$ is a number between [0,1] that represents the truth value the agent $a_i$ has on agent $a_{i_j}$.

Initially the contact list is empty. Thus, agents contact other agents in the world and elaborate the initial trust using a procedure that we have called *playing agents* following [7]. The agent asks for the opinion about the items that the user "loves" or "hates" to the enquired agent.The answer consist of a quantitative value $v_{i,j}$, between 0 and 1, that represents the degree of interest the agent has on the product (0-hates, 1-loves) and is computed as follows:

$$v_{i,j} = \delta_j * g(f^e(Int_j^e), f^i(Int_j^i)) \quad (1)$$

where $f^e$ is the function that combines the explicit interest of agent $a_i$ in product $p_j$, $f^i$ is the function that combines the implicit attributes and $g$ is the function that combines the results of $f^e$ and $f^i$. See [5] for further details.

The current querying agent, $a_q$, gathers a total of $n$ interest values of each enquired agent $a_e$, one for each product in the training set. Then, the trust that agent $a_q$ has on agent $a_e$, noted as $t_{q,e}$ is computed as follows:

$$t_{q,e} = \frac{\sum_{i=1}^{n} \delta_{p_i}(1 - |v_{q,i} - v_{e,i}|)}{\sum_{i=1}^{n} \delta_{q_i}} \quad (2)$$

This function computes the interest similarity between both agents, $a_q$ and $a_e$, weighted by the relevance of the products ($\delta_{p_i}$) according to $a_q$ interests (the querying agent). The result of the function is a normalized value in [0,1].

Once the contact list of agents is figured out, it is used when an agent has a lack of information when regarding a new product $p_{new}$. In such situation, an agent $a_q$ acts proactively querying their *"friends"* (reliable agents on the contact list) about their opinion on $p_{new}$. Then, the agent computes a global recommendation value for the new product based on the opinion of all the queried agents.

$$p_{new} = \frac{\sum_{i}^{|C_q|} t_{q,i} * v_{e_i,new}}{\sum_{i}^{n} t_{q,i}} \quad (3)$$

where $t_{q,i}$ is the trust value that the agent $a_q$ has on the queried agent $a_{e_i}$; and $|C_q|$ is he cardinality of the contact list of the querying agent $a_q$.

Finally, if agents provide a recommendation based on the opinions of his/her *"trustworthy"* agents, how such trust should be updated according to the outcomes? First of all, we need to consider if the recommendation has been successful or not. This can be inferred from the relevance feedback on the new product: $Int_{new}^e, Int_{new}^i$. According to the feedback, the *real* interest of the user on the product $r_{real}$ can be computed following equation 1. Thus, for every agent $a_{e_i}$ in the contact list of the agent $a_q$, his/her trust value $t_{q,i}$ is updated as follows:

$$t_{q,i} = \varphi * t_{q,i} + (1 - \varphi) * r_{real} \quad (4)$$

where $\varphi$ is a parameter of the system that manages the evolution dynamics of trust. This function is proposed by Jonker and Treur in [4]. For a value of $\varphi = 0.8$ we get a slow positive, fast negative dynamics; and for a value of $\varphi = 0.5$ we get a slow negative, fast positive dynamics. Obviously, a slow positive, fast negative dynamics is more appropriate for critical domains where a negative experience is strongly penalized.

# 4. RELATED WORK

There are really few approaches of trust in the collaborative world applied to the information filtering field. Knowledge Pump introduces the community-centered collaborative filtering (CCCF) [3]. In CCCF, the collaborative filter is bootstrapped by the partial view of the social network constructed from user-input list of "advisors" (people whose opinion users particularly trust). The set of advisors is generated through statistical algorithms that mine the usage data automatically. The main difference to our model is the computation of the trust value that Glance bases on the person-person correlation. So transparency of user data is required trough agents while in our system prevail privacy. The collaborative filter weight higher the opinions of his/her most trusted contacts when prediction the user's opinion on items.

We also distinguish the work of Yu and Singh [8] in which the idea of using the opinion of other agents to build a reputation is also applied. They aim at avoiding interaction with undesirable participants and formalize the generation and propagation of the reputation in electronic communities.

# 5. CONCLUSIONS

Trust in the collaborative world is a new approach that seems to be suitable for recommender agents. Like in the real world, agents rely in some agents and mistrust in other ones to achieve a purpose. If we provide agents with a technology to evaluate and trust in the other agents, agents can exploit the collaborative world with a better performance. The model presented goes through this line. We provide the opinion-based filtering method that emphasize proactiveness properties of agents in a collaborative world.

# 6. REFERENCES


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