Available online at www.sciencedirect.com
ScienceDirect
Expert Systems with Applications 36 (2009) 3263–3277
Expert Systems with Applications
www.elsevier.com/locate/eswa

TREPPS: A Trust-based Recommender System for Peer Production Services

Yung-Ming Li *, Chien-Pang Kao

Institute of Information Management, National Chiao Tung University, 1001 Ta-Hsueh Road, Hsinchu 30010, Taiwan

Abstract

Peer production, a new mode of production, is gradually shifting the traditional, capital-intensive wealth production to a model which heavily depends on information creating and sharing. More and more online users are relying on this type of services such as news, articles, bookmarks, and various user-generated contents around World Wide Web. However, the quality and the veracity of peers' contributions are not well managed. Without a practical means to assess the quality of peer production services, the consequence is information-overloading. In this study, we present a recommender system based on the trust of social networks. Through the trust computing, the quality and the veracity of peer production services can be appropriately assessed. Two prominent fuzzy logic applications – fuzzy inference system and fuzzy MCDM method are utilized to support the decision of service choice. The experimental results showed that the proposed recommender system can significantly enhance the quality of peer production services and furthermore overcome the information overload problems. In addition, a trust-based social news system is built to demonstrate the application of the proposed system.

Keywords: Peer production; Recommender systems; Trust computing; Fuzzy inference systems

1. Introduction

Historically, Internet has followed the separation of consumer and producer roles in which most information are offered by professional service providers due to the technological obstacles (Kolbitsch & Maurer, 2006; Lindahl & Blount, 2003). With the ubiquitous networking and cheap computing, Internet starts to give the production power back to people and thereby let the lines between producers and consumers are blurred. A new mode of production called peer production (Benkler, 2006), is gradually shifting the traditional capital-intensively wealth production to a new model which heavily depends on information creating and sharing (Gillmor, 2006). The beginning of creating and sharing information between people worldwide greatly contributes to the emergence of social network sites/services (SNS). SNS are online communities where people are sharing similar interest with each other based on the social relationship between them. In April 2006, SNS have captured the attentions of almost 45% of active Web users (Bausch & Han, 2006). Enormous services and communities allow individuals to contribute over SNS. For instance, the social bookmarking services including Del.icio.us and Spurl.net provide users an easy way to share their online discovery. Other social media services such as YouTube.com and Flickr.com provide a platform for online users to contribute their collections based on originality. Social news sites such as Digg.com and Newsvine.com allow the citizens of the community to share, vote for, and comment on news. Wikipedia, the well-known collaborative online encyclopedia, lets anyone create and edit encyclopedia articles without the intervention of formal review process. What's more, online users are relying on these services around World Wide Web. In order to

* Corresponding author. Tel.: +886 3 5712121.
E-mail addresses: yml@mail.nctu.edu.tw (Y.-M. Li), java.gang@gmail.com (C.-P. Kao).

0957-4174/$ - see front matter © 2008 Elsevier Ltd. All rights reserved.
doi:10.1016/j.eswa.2008.01.078

accelerate the probe and organization of peers' contributions, two new emerging approaches have been extensively incorporated in SNS. Folksonomy (Folksonomy, 2007), a combination of the words *folk* and *taxonomy*, is a collaborative categorization framework using the freely-chosen keywords called tags to help the information easily to be discovered, navigated, and organized. Social voting, a simple but widely used mechanism, is applied to reflect what the contents are popular and what the things the communities most care about. However, the tricking incidents include vote-buying, vote-exchanging (Doctorow, 2007), and fake news (Web 2.0 Television, 2006) reveal that the popularity are not closely aligned with the quality and cannot sufficiently reflect the trustworthiness of sources. None of two mechanisms can function as the role to improve the quality and the veracity of peer production services. Wikipedia integrates both centralized revision control system and real-time peer review mechanisms such as IRC (Internet Relay Chat) Channels and Watchlists (Watchlist (Internet), 2007) to alleviate the concerns of quality control. But it is not appropriate for the most peer production services which are huge and continuously refreshed such as news, articles, bookmarks, and various user-generated contents.

Without a practical means to assess the quality of peer production services, the consequence is information-overloading. Recommender systems have been widely advocated as a viable solution to the information overload problems (O'Donovan & Smyth, 2005; Wei, Moreau, & Jennings, 2005). However, the conventional recommender system, oriented to support the products that are produced (or sold) by a particular and limited number of manufacturers, is inapplicable for peer production services which are diversified and without specific features to capture. Therefore, how to strengthen the capability and to leverage the use of social networking technology to enhance the quality and the veracity of peer production services becomes the aim of this research. We present a recommender system based on the trust of social networks instead of the conventional recommender systems and aforementioned approaches. Through the trust computing, the quality and the veracity of peer production services can be appropriately assessed. To model subjective information such as trust knowledge, service satisfaction, and user preferences, the fuzzy set theory (Zadeh, 1965) and its linguistic terms representation are employed. Moreover, two prominent applications of fuzzy logic – fuzzy inference system and fuzzy MCDM method are utilized to support the decision of services choice. We also build a trust-based social news system to demonstrate the utilization of proposed system.

This study is to be organized and structured as follows. At first, we introduce the research background and methodologies of this study in Section 2, followed by the proposed recommender system in Section 3. A series of controlled experiments demonstrates the advantage and the performance of proposed system is conducted in Section 4. The trust-based social news system implemented on the proposed approach is presented in Section 5. At last, Section 6 offers conclusions and future works.

2. Related literature

2.1. Trust computing and trust-based recommender systems

The trust referred in this study can be classified as *interpersonal trust* (McKnight & Chervany, 1996) which means that people more than two trust each other in a certain situation. In general, interpersonal trust, a directional relationship, requires at least an involvement of two parties called *trustor* and *trustee*. It expresses that *trustor* expects *trustee* to behave the way she/he wants (Jøsang, 1996). Since the groundbreaking Internet technologies are being developed, many trust computing model has been proposed and applied in emerging core technologies such as Web Semantic, Peer-to-Peer and Multi-Agent systems. Several studies provide surveys and reviews of trust computing model and relevant applications (Artz & Gil, 2007; Jøsang, Ismail, & Boyd, 2007; Sabater & Sierra, 2005).

Essentially, trust network is an online social network in which peers are interlinked by trust relationship (Ding, Kolari, Ganjugunte, Finin, & Joshi, 2004). It can be represented by directed graph as shown in Fig. 1, where vertices are denoted as peers in social network, and directed solid edges along with trust value represent the degree of direct trust relationship between two peers. Due to the transitivity properties of trust (Abdul-Rahman & Hailes, 1998; Ding, Zhou, & Finin, 2003), the trust values along the chain of connected trust networks can be inferred and be formulated as follows:

$$T_{\alpha,\beta} = \frac{\sum_{k \in \text{neighbors}(\alpha)} T_{\alpha,k} \times T_{k,\beta}}{\sum_{k \in \text{neighbors}(\alpha)} T_{\alpha,k}} \quad (1)$$

where α and β are two distinct peers in trust network, and k is denoted as the neighbors of α, from which a one-way trust relationship exists. As depicted in Fig. 1, the indirect trust relationship (denoted as dotted edge) between peers α and β can be inferred, although the peer α does not have direct trust relationship to β. According to Eq. (1), the value of $T_{\alpha,\beta}$ is calculated as $T_{\alpha,\beta} = (0.3 \times 1 + 0.8 \times 0.5)/(0.3 + 0.8) = 0.636$.

Trust can be used to estimate the quality of a peer's beliefs, and furthermore to reduce the information search

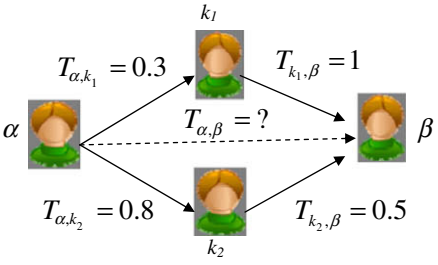

Fig. 1. Graph theory based representation of trust network.