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A multi source product reputation model

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ABSTRACT

Product reputation model is very important for customers and manufacturers in order to make decisions. Several product reputation models are proposed in literature which use customer reviews in order to compute reputation values. However, the aggregation methods used are not able to estimate a good reputation value when some ratings are false. Some of these aggregation methods are not robust to false and biased ratings because a single false rating is enough to change the result. Others are robust to false ratings but not able to reflect the recent opinions about product quickly. In addition, most of the product reputation models are based on single source, therefore suffer from availability and vulnerability issues. In this paper, we propose a multi-source product reputation model where robust and strategy proof aggregation methods are used. A source credibility measure method is proposed, which uses four factors to determine malicious sources. Furthermore, a suitable decay principle for product reputation is also introduced in order to reflect the newest opinions quickly. The results show that proposed model is robust, strategy proof and able to provide a good estimation even if some ratings are false.

1. Introduction

With the rapid growth of Internet, people have the opportunity to express their opinions about products and services on the Web. Several websites such as e-commerce and review sites allow users to post evaluation information about different products, which can be used to compute product reputation. Product reputation is a perception about product quality and future behaviors. Several reputation values such as aggregated star value (also called five star or simply star value) [5], feature reputation [8,1] and product reputation based on features [1] are computed in literature in order to assess the reputation of a product. These reputation values are useful for both customers and organizations to make decisions. The customers can use the reputation values to compare different products in order to make purchase decision. Similarly, the manufacturers can use the reputation values to know the customers opinions in order to improve their products and to launch different marketing strategies. The product reputation systems can be divided into two types based on the type of ratings which is considered to compute reputation value. Two types of ratings (i.e. numeric and textual ratings) are aggregated by the existing reputation models. Several online product reputation systems are available such as Amazon, Ebay and Cnet, etc., where both numeric and textual ratings are posted. However, these rating sites aggregate numeric ratings using simple arithmetic mean to determine a single reputation value [26,1,5]. Users can also read textual ratings to know the customers' opinions and to make purchase decision. However, reading all the reviews about a product is time consuming. On the other hand, some authors also proposed reputation systems based on sentiment analysis to analyze textual ratings in order to produce a summary of opinions either about product or product features [8,21,20,27].

All these reputation systems use summation, arithmetic mean or weighted mean as an aggregation method in order to aggregate different types of ratings. These aggregation methods assume that all users give honest ratings. However, this is not always the case, especially in industrial products some users may post false reviews in order to promote their own product or to damage the reputation of a competitor's product. Therefore, the aggregation methods are not able to provide a good estimation when some ratings are false. In addition, these methods are not robust to biased and false ratings because a single false rating is enough to move the reputation value up or down. Mean and weighted mean are also not strategy proof because they provide sufficient

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incentives to opportunistic users to change the reputation value substantially by posting false ratings [5]. An aggregation method is said to be strategy proof if it does not provide incentives to a reviewer in order to obtain their preferred reputation value by lying or hiding the actual evaluation. Some authors suggested to use robust aggregation methods such as mode and median. However, these methods are not able to reflect the recent opinions about product quickly and also treat all the ratings equally regardless of their importance.

Most of these reputation systems are based on single web source. One of the significant issues in single source based reputation systems is the vulnerability to falsifying information [11]. Since the ratings are obtained and stored on a single location, therefore the malicious users can easily post false ratings. In addition, sometimes single source based reputation systems lack evaluation information because these systems have only one source to obtain ratings. Furthermore, the credibility of the source or central server is another issue [11]. When the source itself is a buyer, seller or intermediate then how we can trust the reputation system? Does the source adopt sophisticated security measures so that the credibility of evaluation information can be trusted?

The existing product reputation systems are also not able to reflect the recent opinions about product because the same weight is assigned to recent and old ratings. Several decay principles are proposed for e-commerce and peer to peer network [29,13,12,10,4,25,13,30], however, these methods are not suitable in product reputation context because of three main reasons. First, these decay principles are not robust to false and biased ratings, second these methods are not strategy proof because they provide sufficient incentives to bring reputation value from highest to lowest or from lowest to highest with few recent ratings. Third, these methods are also not able to estimate a good reputation value. On the other hand, rating parameters which increase accuracy and reliability of reputation values such as ratings trustworthiness and source credibility are also ignored by the existing reputation models. Rating trustworthiness determines that whether the rating or review posted on e-commerce or review site is genuine or fake (i.e. false, biased and spam). Source credibility determines the extent to which a web source from where ratings are extracted is credible to be considered for product reputation.

Considering these issues, in this paper, we propose a multi-source product reputation model which offers several benefits over single source based approach. A method which uses four factors to rank the credibility of a web source is proposed. In addition, robust and strategy proof aggregation methods are introduced which provide a good approximation of the actual reputation value even if some ratings are false or biased. Furthermore, two decay principle methods, which are more suitable in product reputation context are proposed in order to reflect the recent opinions about the product. Besides decay principle and source credibility, rating trustworthiness is also considered, which increases the reliability of the determined reputation value.

This paper is organized as follows. In Section 2, related works are presented and analyzed. Section 3 gives an overview of the proposed model. Section 4 explains different rating parameters on the bases of which rating credibility is computed. Section 5 describes the aggregation method proposed to compute aggregated star value. Finally, Section 6 describes the experimental settings and results.

2. Related work

The literature review is divided into three subsections. The first subsection gives an overview of the reputation models, the second subsection discusses the existing aggregation methods, and the last subsection summarizes the literature about decay principle.

2.1. Product reputation model

Many authors have investigated reputation models in last few years, most of them devoted their efforts to user trust and reputation in e-commerce environment, very few of them focused on product reputation. The most common product reputation model is based on opinion mining, which analyze textual ratings in order to form a summary of opinions either about product and/or product features. Several supervised and unsupervised methods have been proposed in literature [8,21,20,27]. Some of these methods determine the global opinions about products and others are more refined which summarize the opinions about different features of the product. In all product reputation models based on opinion mining the researchers focused on sentiment analysis instead of mathematical modeling, therefore simple summation is used as an aggregation method in most cases. In [1] a mathematical model based on opinion mining has been proposed. The reputations of all product features are computed based on the ratio of positive and negative opinions. The important features are given more weight while computing reputation. However, the overall product reputation is computed using simple weighted mean, which has several issues [5,6]. In addition, this model is based on manual hierarchy of product features and sub-features, while determining feature reputation positive opinions about sub features are also considered. However, developing a manual hierarchy for every product is difficult and time consuming. Moreover, no proper experiment is performed to validate the results. On the other hand, several online product reputation systems are also available such as Amazon, Ebay and Cnet which aggregate numeric ratings using simple arithmetic mean to determine product reputation value [26,1,5]. All these reputation models considered that the users give honest ratings, therefore do not take into account the malicious users which give false ratings in order to promote their own product or to damage the reputation of a competitor's product. Other rating parameters such as source credibility and decay principle are also ignored. On the other hand, simple summation, arithmetic mean or weighted mean are used as an aggregation method, which have several issues. Moreover, most of these models are single source, hence vulnerable to falsified information and suffer from availability issue.

2.2. Aggregation methods

Several aggregation methods such as summation [8,21], simple mean, weighted mean [1], mode and median [5] are proposed in literature to aggregate user ratings. All these aggregation methods have some issues. Before discussing the issues, we first define three different concepts (i.e. robustness, strategy proofness, sensitivity and estimation accuracy) which are used to evaluate the performance of these aggregation methods. The robustness actually measures the resilience of an aggregation method to false and biased ratings. An aggregation method is said to be robust if the false and biased ratings may not easily affect the reputation value. An aggregation method is said to be strategy proof if it does not provide incentives to a reviewer in order to obtain their preferred reputation value by lying or hiding the actual evaluation. If the reviewers are aware of strategy proofness of an aggregation method, then they may rate the product according to actual perception instead of hiding or lying in order to obtain a preferred reputation value. On the other hand, sensitivity measures the ability of an aggregation to reflect the recent ratings about a product quickly. For example, if a product is rated with highest ratings by most reviewers. However, due to some reasons the opinion of reviewers changed and they started to rate the product with lowest ratings. Now sensitivity will measure that how quickly an aggregation method is able to reflect the change in reviewers' opinions. Estimation accuracy measures