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Feature article

The Opinion Management Framework: Identifying and addressing customer concerns extracted from online product reviews

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ABSTRACT

Online product reviews appear in many e-commerce websites and help merchants understand any obstacles experienced by existing customers. Negative reviews can discourage potential customers, especially when such reviews appear with no response from the merchant. After the appearance of an unfavourable review, the merchant is at risk of incurring negative impact on the community of present and future customers, which can harm the business. He or she may be able to deflect this by promptly communicating any planned actions, completing them, and reporting that they are complete. The initial communication is the most urgent. When presented with a set of online reviews, a merchant's predicament is to quickly decide what tasks need to be done, which are the most important, and when each can be completed.

In this paper, we describe our *Opinion Management Framework* that assists a merchant to quickly identify, select, and schedule tasks that can rectify issues mentioned in online reviews. We also describe an interactive web-based prototype that helps the business owner (1) to select a set of tasks with an optimal cost/benefit tradeoff, (2) to ensure that all tasks can be completed within a specific time limit, and (3) to conservatively estimate a completion date for each issue's resolution.

1. Introduction

Customers have the opportunity to share experiences and product reviews over social networks and on e-commerce websites. This makes available a vast amount of user-produced information to assist future customers. Sentiment analysis and topic extraction have been very active research fields in recent years. These capabilities make it possible to automatically identify users' emotions about the topics they discuss. In particular, processing data related to customer's opinions as expressed in reviews has been of major interest.

Existing work has focused on providing useful information to users who want to check the sentiment expressed by others with respect to a business, service or product before buying it or marketers who want to know the general sentiment for their brands (Go et al., 2009) While the problem of topic extraction and discovering of sentiments polarity has been recently addressed in the literature (Lin et al., 2012; Chen et al., 2014; Yin et al., 2014),there is no existing work to examine how topics and related sentiments can be used for providing advice for businesses. This advice should enable businesses to better understand their clients' opinions about products and services, to better respond to those concerns with specific, relevant and proactive responses, to resolve the issues with workable plans given limited resources, and to immediately engage any unhappy customers in a meaningful conversation that presents specific actions and timelines by which issues will be addressed.

1.1. The Merchant's challenge

We address our work to a retailer with a large number of reviews from existing customers of this retailer that cover possibly many topics that have arisen when using a single product or service. We assume that these reviews are gathered together for one product or service, but they have not been organized further than that. The merchant wants to make the best use of the information within those reviews to address customer's concerns. This merchant faces a number of challenges.

1. There may be a large number of concerns addressed in the reviews. The merchant must identify a set of issues to be resolved that address these concerns. This may address only a subset of the concerns.

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2. A clear picture of each issue is needed. Each review may describe or partially describe zero or several concerns. Often more than one customer will mention a specific concern. To fully understand any given concern, the business may need to identify a set of related reviews focused on that concern from the perspectives of various customers.
3. It may be difficult to decide which issues are most important to the user community as a whole. One measure available to the merchant is the sentiment attached to the comments associated with each issue. Some issues may not be addressed at all, for example, if doing so would be contrary to company policy.
4. Customers indicating that some issue is important should receive a response as quickly as possible (Solomon, 2015; Gottschalk and Mafael, 2017). Online reviews have an immediate positive or negative impact on attracting and retaining customers. These responses should provide specific actions to address the concerns. Ideally they should describe whether the concern can be addressed. If so, the merchant should communicate what will be done and a date by which it will be completed. If not, the reason for not addressing it should be communicated.
5. Work plans should be comprehensive and achievable. Typically, the merchant will have limited resources to address the concerns raised. Sometimes the same resources, such as maintenance staff, will be employed to address several issues, but they cannot be deployed to work concurrently on different issues. Such constraints need to be considered when creating an overall plan, and this includes computing the time by which all tasks will be completed.

We propose an *Opinion Management Framework* (OMF) that integrates topic extraction, sentiment analysis and project management. Topic extraction places the comments into clusters, each of which is associated with an issue or set of issues to be resolved. From each cluster, one or several tasks can be identified. A measure of the sentiment expressed within each cluster represents the importance of each task. The framework advocates collecting comments around each issue and measuring the sentiment from this set of comments. Subtasks are then considered if they can be identified within the task. These tasks and subtasks are considered by the merchant, who selects a set of tasks and subtasks that will be addressed. The merchant also provides project management attributes for these tasks and subtasks, such as costs and durations, earliest start times, and constraints arising from shared resources. The framework considers combinations of tasks and selects a combination that balances the cost of performing the task against the expected benefit of improved future online opinions. Optimal selection depends on the value that the merchant places on improving sentiment, relative to what she can afford to do. It also balances the amount of time available to do the work against the importance/urgency of issues being addressed. Given this optimal selection of tasks, the framework prescribes a schedule that allows the merchant to begin doing the work. The merchant is then equipped to immediately provide specific online responses to the customer's comments.

Critical path calculations with resource constraints are known to be computationally hard (Słowiński and Węglarz, 1989; Kolisch and Hartmann, 1999). Because we want to consider all job combinations, and to compute an estimated completion time for each, we provide an approximate calculation for job scheduling in this setting with efficient computation time. It constructs an overall plan that almost immediately gives the merchant a conservative estimate of when each issue will be addressed. It is important to not underestimate the time required since the customers may be informed of this self-imposed deadline.

The approach taken by the OMF can be implemented in many ways. In this paper, we present a system that integrates specific selections for the OMF components. Topic clustering can be done with any topic mapping technique. There are many methods for measuring sentiment of the comments. Many optimization techniques and critical path calculations can be used.

Reviews may be found on the website of site of the business, on social media, or on an industry-specific website that offers reviews as a service to customers and businesses. For example, hoteliers can access reviews about their hotel service that are posted by hotel guests on TripAdviser.com by claiming their business's profile on TripAdviser.com. The Opinosis dataset (Ganesan et al., 2010) that we use in our examples contains reviews for several different businesses and services, including hotels, cars and technology products. It was prepared by sampling from various sources: Tripadvisor (hotels), Edmunds.com (cars) and Amazon.com (various electronics). We do not provide a comprehensive list of such services.

The rest of this paper is organized as follows: we discuss related work, present the Opinion Management Framework, and describe the running Sentiminder prototype implementation that schedules the recommended tasks. We conclude with a discussion of the main components of the framework.

2. Related work

2.1. Topic extraction

While the problem of topic extraction has been addressed in the past, in recent years research is relating topic extraction with sentiment analysis. Mei et al. (2007) are interested to mine users' opinions on Weblogs, analyzing the sentiments for subtopics. In their approach, the authors propose a probabilistic mixture model called Topic Sentiment Mixture (TSM) where words are sampled by a mixture model of background language, topic language and two sentiment language models. They present a mechanism for extracting subtopics, for associating every subtopic with a positive or a negative sentiment and for tracking how the opinions relating to a topic can change over time. Their approach is not based on the now-commonly used Latent Dirichlet Allocation (LDA) (Blei et al., 2003). The sentiment model is applied as a post-processing step to the topic discovery.

Lin et al. (2012) present joint sentiment-topic detection (JST), a method that uses a weakly-supervised approach to draw words from a corpus of documents, taking into consideration both topics and sentiment labels. Thus it extends LDA. As a result, JST performs document level sentiment classification where topics and sentiments are detected simultaneously, which means it can extract sentiment-oriented topics while effectively evaluating the sentiment of each topic. Li et al. (2010) extend JST proposing the Sentiment LDA, where sentiment labels are associated with topics instead of documents. They introduce sentiment dependency in their calculations. In more recent work, Chen et al. (2014) argue that the sentiment should not be used to influence the topic as done in Lin et al. (2012) but sentiment polarities, as well as topics of text, should be analyzed at the same time. They propose Double Latent Dirichlet Allocation (DLDA) for sentiment analysis in short texts. A review of on LDA-based topic extraction in sentiment analysis is presented (Rana et al., 2016).

2.2. Online product reviews

There is a large body of literature considering the effect of electronic word of mouth (eWOM) communication on the retail