

Product ranking using hierarchical aspect structures

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Abstract Product-related comparative reviews are one of the most helpful information sources for consumers to rank the competing products and make purchase decisions. The comparative reviews are even more valuable if they are concerning specific aspects. However, the fact that very few comparative reviews express direct opinions on product aspects makes aspect-based product ranking a difficult task. In this paper, we present a novel hierarchical aspect-based product ranking approach. We first mine aspect-based pairwise comparative opinions from both user reviews on multiple review websites and community-based question answering pairs containing product comparison information. Next, we use our hierarchical structure-based model to propagate and reassign the aspect-based comparative opinions by using the parent-child and sibling relations between aspects in the product aspect hierarchy. The structure-based model helps to address the data sparsity issue of very few or no comparative reviews for some aspects. Finally, we employ graph-based ordering algorithms to consolidate these reassigned pairwise opinions into listwise comparison

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results. Experiments on a set of candidate electronic products prove that the proposed approach is effective for aspect-based product ranking.

Keywords Comparative opinion mining · Product ranking

1 Introduction

With the prevalent use of Internet and social networking systems, consumers commonly compare several candidate products by seeking public opinions from online reviews before making purchase decision. However, this process is labor-intensive and time-consuming. To help consumer make purchase decision effortlessly, many review websites provide a simple product comparison functionality, which compares several candidate products in terms of various aspects. For each aspect, it scores each candidate by averaging the corresponding users' ratings within the website. However, this product comparison functionality is usually not effective due to the following limitations: (1) there are usually too few ratings to make the scores reliable for some products in a website; (2) one website usually does not contain all the products that the consumer wants to compare; and (3) pairwise product comparison does not provide an overall ranking when multiple candidates are available. Meanwhile, it is not reasonable to simply integrate the comparison results from multiple websites, since different websites have different scoring strategies based on different user ratings. Some existing works on product comparison (Liu et al. 2005; Sun et al. 2009; Zha et al. 2014) mainly make use of user ratings on individual products. These approaches however do not explicitly deal with comparison between pairs of products.

In view of the above, we propose a novel graph-based framework to sort competing products with respect to aspects for **Product Ranking** by aggregating user reviews from various sources into a comparison graph for each aspect.

To build a comparison graph of candidate products, one of the great challenges are the sparsity of comparative reviews, as there are very few comparative review sentences readily available, especially when product aspects are concerned. It often happens that the comparative sentences found do not directly match the aspects of the products the consumers are concerned with. For some aspects, there are very few or no comparative reviews to support reliable comparison results. Take the hierarchy in Fig. 1 as an example, in phone reviews, there are only a few comparative opinions about the 'hardware' aspect which mention the word 'hardware' directly. However, there are many opinions related to the 'battery', 'screen' or 'keyboard' which are parts of a phone's hardware. On the other hand, some child nodes may not contain any comparison sentences, while their parent node contains many general reviews. For example, there are opinions about the candidate products A, B and C which are parts of the whole candidate products under 'battery', while its parent node 'hardware' has all the candidate products A, B, C and D related opinions. In traditional opinion mining, such as Hu and Liu's paper (Hu and Liu 2004), the opinion on an aspect is extracted from the existing sentences in the source reviews related to that particular aspect, if there is no sentence concerning an aspect, no opinion analysis on the aspect will be given.

To overcome the data sparsity problem, we propose to employ the hierarchical aspect structure to reassign the strength of the comparative relations for existing aspects and even aspects not directly mentioned in the reviews. While the opinion about 'battery' can be considered as opinion about 'hardware' of a phone; the opinion about 'hardware' cannot be considered as talking about the 'battery', but it has a certain probability about 'screen', 'battery' or 'keyboard'.

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