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Personalized Item Review Ranking Method Based on Empathy

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- **Taketoshi Ushiama** received a Dr.Eng. degree in information engineering from Nagoya University, Japan in 2002. He is an Associate Professor in the Faculty of Design, Kyushu University.

- His research interests include content environment design, social computing, recommender systems and intelligent web content.

Introduction

- Reviews on E-commerce sites play an important role in users' selection of items
- However, when a large number of reviews about the same item are included, it is impractical to browse through all reviews
  - 80% of users read only a maximum of 10 reviews when purchasing an item

- Review ranking functions are essential to assist users in merchandising recommended items

Problem

- E-commerce sites provide a mechanism for rating reviews
- Drawback of conventional ranking function
  - Review ranking is not personalized
    - Reviews that are valuable to one user may not be valuable to another user
- Review ranking mechanisms are expected to reflect the values and preferences of user

Objective

- Proposal of a method for ranking online reviews of a target item based on user empathy.
- The proposed method predicts a target user's empathy for a reviewer based on the reviews the user has rated in the past.
- It ranks the reviews based on their empathy for the reviewer.

Proposed Method

Typicality of reviews to authors

- Reviews are considered to reflect the values and personality of the author (reviewer).
- The degree to which a review reflects the values and personality of the reviewer who wrote it is called the ***typicality*** of the review.

$$\mathrm{typi}(d, r) = p(r|d)$$

the degree of typicality of a review document d to a reviewer r

conditional probability that given a review document r, its author is d

Similarity of reviewers

- To predict empathy for unknown reviewers, similarities between reviewers are used.
- In a two-layer neural network that takes reviews as input and predicts authors, the all-connected layer in front of the output layer is considered to be the manifestation of the features used to classify reviewers.
- The vector obtained by inputting a single document that is a concatenation of all reviews posted by reviewer r as input to the machine learning model of author estimation is denoted as $\boldsymbol{v}(r)$.
- ***Similarity*** between tow reviewers r_1 and r_2

$$\mathrm{sim}(r_1, r_2) = \frac{\boldsymbol{v}(r_1) \cdot \boldsymbol{v}(r_2)}{\|\boldsymbol{v}(r_1)\| \times \|\boldsymbol{v}(r_2)\|}$$

Estimation of the empathy for reviewers based on review ratings

- The proposed method uses the user's ratings of previous reviews to extract the level of empathy toward the reviewer.
- In this study, we assume that users can vote "like" and "dislike" for some reviews.
- The user is not required to rate all reviews.
- ***The empathy*** of a user u toward a reviewer r

$$\mathrm{empathy}(u,r) = \sum_{d \in D_{pos}(r)} \mathrm{typi}(d,r) - \sum_{d \in D_{neg}(r)} \mathrm{typi}(d,r)$$

The topicality of a review document d to reviewer r

set of review documents posted by reviewer r that the target user rated as ***"like"***

set of review documents posted by reviewer r that the target user rated as ***"dislike"***

Ranking of reviews for unknown items

- ***The recommendation score*** of a review d for a target user u

$$\mathrm{score}(u,d) = \frac{\sum_{r \in R(u)} \mathrm{empathy}(u,r) \times \mathrm{sim}(r, \mathrm{reviewer}(d))}{\sum_{r \in R(u)} \mathrm{sim}(r, \mathrm{reviewer}(d))}$$

the **reviewer** who submitted a review d

$$\mathrm{R}(u) = \{x | x = \mathrm{reviewer}(d), d \in PR(u) \cup NR(u)\}$$

the **review set** that was ***positively*** rated by user u

the **review set** that was ***negatively*** rated by user u

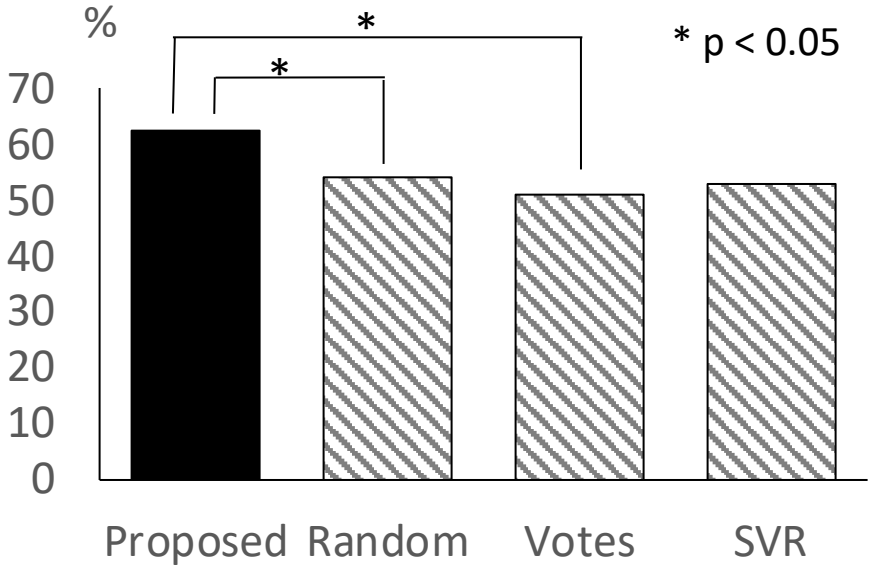
Evaluation

Experimental setup

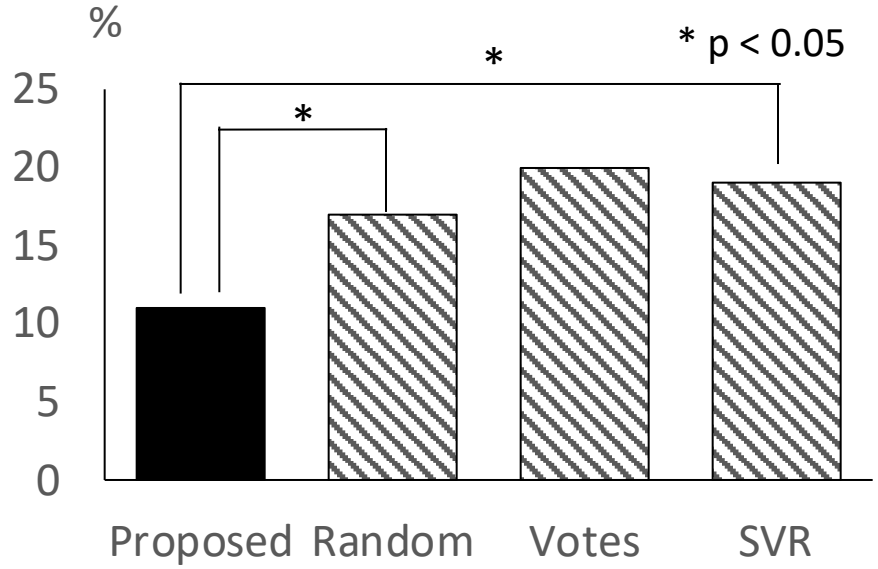
- Dataset
  - obtained by crawling from one of the famous Japanese online book review sites ``Dokusho meter''
- Six subjects were asked to select two books from among those they had recently read and to input their evaluation feedback for the reviews of the two books.
- The subjects were asked to rate the reviews of two books on a three-point scale ``agree,'' ``don't know,'' and ``don't agree,'' based on the question of ``do you agree with this review?''
- The evaluation data for one book review was used as training data to predict the recommendation score for the other book review.
- To evaluate the effectiveness of the proposed method, we compared the results with those of three different methods.
- They are random sampling, vote ranking, and Support Vector Regression (SVR).
- In the vote ranking, we compared the top 10 reviews with the highest number of votes with the top 10 reviews using the proposed method.
- In SVR, the explanatory variables for the regression analysis were the Term Frequency–Inverse Document Frequency (TF-IDF) vector of words, the percentage of each part of speech in the reviews, the total number of words, and the number of word types.

Experimental results

- The percentage of reviews that subjects rated as ***"sympathetic"*** and ***“not sympathetic”*** out of the top 10 ranked reviews in the proposed and comparative methods



The results for the reviews that were evaluated as ***"sympathetic"***



The results for the reviews that were evaluated as ***”not sympathetic"***

Discussion

- The experimental results show that the proposed method includes more reviews with content that users can relate to and fewer reviews that users cannot relate to in the top ranking than the comparative methods.
- It shows the effectiveness of the proposed method.

Conclusion

- Summary
  - Proposal of a review ranking method based on user empathy
  - It predicts the reviewer's empathy based on the user's review ratings to achieve a personalized ranking
  - Results of evaluation experiments using subjects showed the effectiveness of the proposed method
- Future work
  - Use of advanced resource language models such as BERT to more accurately predict the degree of empathy of unknown users