Do Users Rate or Review? Boost Phrase-level Sentiment Labeling with Review-level Sentiment Classification

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Motivation and Basic Findings

- Many online applications allow users to express his/her opinions by reviews. Two basic gradients of a review are the numerical star rating and the review text.
- Phrase-level Sentiment Analysis is important in many tasks, e.g., product summarization, keyword extraction.
- A sentiment lexicon is usually constructed with general sentiment words (e.g., Phone quality, perfect, positive)
- Current approaches for polarity labeling assume that user’s numerical rating represents the overall sentiment of the corresponding review text, however, we find that this assumption is not necessarily true.

User Rating Analysis and Statistics

- Adopt the reviews from DianPing.com
- Each piece of review has an overall rating + three sub-aspect ratings
- Sub-aspects: Flavor, Environment, Service
- The percentage of each (of the five) stars on Overall rating, Flavor, Environment and Service.
- The percentage of 4+ ratings made by each user.

Framework for Sentiment Polarity Labeling

- Step 1: Review-level Sentiment Classification
  - Classify the sentiment of each review by a general sentiment lexicon.
  - Construct review sentiment matrix $X = [x_1, x_2, \ldots, x_m]^T$
  - Positive: $x = [1, 0, \ldots, 1]^T$
  - Negative: $x = [0, 1, \ldots, 0]^T$

- Step 2: Phrase-level Sentiment Polarity Labeling
  - An optimization framework with four constraints.
  - 1) Review-level Sentiment Orientation.
  - 2) General Sentiment Lexicon
  - 3) Linguistic Heuristics (for ‘and’ / ‘but’)
  - 4) Sentential Sentiment Consistency

Phrase-level Polarity Labeling Results

When fixing $\lambda_1 = \lambda_2 = \lambda_3 = 1$

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The Unified Model for Polarity Labeling

$$\min R = \lambda_1 R_1 + \lambda_2 R_2 + \lambda_3 R_3 + R_4 + \lambda_4 R_4$$

$$X_{ij} \leftarrow \frac{1}{\lambda_i \lambda_j} \left( A \cdot x + \lambda_2 G X + \lambda_3 W X + \lambda_4 W X^2 + \lambda_5 W^2 X \right)$$

Parameter Analysis

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Precision</th>
<th>Recall</th>
<th>F-measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP3 Player Dataset (English)</td>
<td>0.9238</td>
<td>0.4201</td>
<td>0.5776</td>
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<tr>
<td>Optimization framework [3]</td>
<td>0.8269</td>
<td>0.7626</td>
<td>0.7934</td>
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<tr>
<td>Our framework with overall rating</td>
<td>0.8288</td>
<td>0.7525</td>
<td>0.7888</td>
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<tr>
<td>Our full framework</td>
<td>0.8504*</td>
<td>0.7683</td>
<td>0.8073</td>
</tr>
</tbody>
</table>

Restaurant Review Dataset (Chinese)

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Precision</th>
<th>Recall</th>
<th>F-measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>By general sentiment lexicon</td>
<td>0.9017</td>
<td>0.3571</td>
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<td>Optimization framework [3]</td>
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<td>Our framework with overall rating</td>
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<td>Our full framework</td>
<td>0.8879*</td>
<td>0.7818</td>
<td>0.8315</td>
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</tbody>
</table>

Demo for Online Product Comparison