Evaluation of an Algorithm for Aspect-Based Opinion Mining Using a Lexicon-Based Approach

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Introduction
Aspect-based opinion mining:

- Find opinions in user-generated texts uttered about aspects or features of entities
- Most fine-grained approach
- Required to analyze people’s opinions about products, companies etc. in detail

Example: technical domain

The display of this phone is not good.
Opinion Lexicon I

We use an opinion lexicon which ...

- is called *Sentiment Phrase List (SePL)*\(^1\).
- contains adjective- and noun-based phrases (e.g. *very good*).
- includes full phrases with negation words (e.g. *not*) and valence shifters (e.g. *very*).
- includes 2,833 German phrases with a length of up to five words.
- has an opinion value (OV) for each phrase with 
  \[-1 \leq OV(p) \leq +1.\]
- is lemmatized\(^2\).

\(^1\)http://www.opinion-mining.org/
\(^2\)Except comparative and superlative forms of adjectives.
Opinion Lexicon II

Some real examples:

<table>
<thead>
<tr>
<th>Adjective-Based Phrases</th>
<th>OV</th>
<th>sp/sn</th>
</tr>
</thead>
<tbody>
<tr>
<td>großartig - great</td>
<td>0.94</td>
<td>sp</td>
</tr>
<tr>
<td>sehr günstig - very low priced</td>
<td>0.89</td>
<td>sp</td>
</tr>
<tr>
<td>kompetent - competent</td>
<td>0.77</td>
<td>sp</td>
</tr>
<tr>
<td>freundlich - kind</td>
<td>0.58</td>
<td>—</td>
</tr>
<tr>
<td>mies - lousy</td>
<td>-0.71</td>
<td>sn</td>
</tr>
<tr>
<td>nur schlecht - just bad</td>
<td>-0.88</td>
<td>sn</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Noun-Based Phrases</th>
<th>OV</th>
<th>sp/sn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herz - heart</td>
<td>0.83</td>
<td>sp</td>
</tr>
<tr>
<td>Mogelpackung - bluff package</td>
<td>-0.70</td>
<td>sn</td>
</tr>
<tr>
<td>Frechheit - impertinence</td>
<td>-0.91</td>
<td>sn</td>
</tr>
</tbody>
</table>
The Algorithm
Overview of the Algorithm

Data Retrieval
- Crawling
- Data

Preprocessing
- Sentence Detection
- Word Tokenizing
- POS Tagging

Opinion Extraction
- Pattern-Based Phrase Extraction
- Opinion Value Calculation

Aspect Extraction
- Aspect List
- Opinion Lexicon
- Aspect List Lookup

Aspect – Opinion Composition
- Distance Calculation
- Composition Decision
Aspect Extraction

Aspect definition:

• For this study only aspects from the insurance domain are needed

• Generate aspect model to organize entities (insurances) and connected aspects

  1. Manually collect entities and aspects in a base list
  2. Extend this list using the community-generated German synonym lexicon OpenThesaurus
  3. Lemmatize the list

Aspect extraction:

• Simple search

• Longest possible aspect phrase is taken

  → service vs. public service

3http://www.openthesaurus.de/
Opinion Extraction

Extraction of the phrases:

- Same patterns as for generation of opinion lexicon used\(^4\)
- Because all phrases in opinion lexicon are lemmatized
  \(\rightarrow\) lemmatize the extracted phrases

Application of the opinion lexicon:

- **Best case:** obtain OV for given phrase directly (frequent)
- **But:** sometimes phrases are missing in opinion lexicon
  \(\Rightarrow\) Phrase consists of one word \(\rightarrow\) no chance to get OV
  \(\Rightarrow\) Phrase consists of more than one word
    \(\rightarrow\) phrase gradually shortened by one word
    \(\rightarrow\) another lookup in opinion lexicon
  \(\Rightarrow\) No cut of negation words!

- **Finally:** categorize each opinion phrase (sp / sn)

\(^4\)A Phrase-Based Opinion List for the German Language, KONVENS 2012
Aspect - Opinion Composition

Distance-based linking:

- Distance-based approach applied on sentence level
  → each strong positive or negative opinion phrase is linked to the next aspect

Example I

I am very disappointed of the service.
⇒ Opinion tuple: \(<\text{very disappointed} | \text{sn} | \text{service}>\)

Example II

The employees and the service are very good!
⇒ Opinion tuple I: \(<\text{very good} | \text{sp} | \text{employee}>\)
⇒ Opinion tuple II: \(<\text{very good} | \text{sp} | \text{service}>\)
Experiments
Test Data

- Domain: automobile insurances
- Data from review platform Ciao\(^5\)
- Total corpus consist of about ...
  - 14,000 sentences extracted from
  - 1,600 reviews concerning about
  - 120 insurances.
- Comments to posts not considered
- To avoid mistakes done by sentence tokenizer
  → length of sentences must be < 200 characters
- Errors also occurs if
  - sentence delimiters used in an improper way or
  - the whitespace after a sentence delimiter is missing.
- After preselection steps: approx. 12,000 sentences remained

\(^5\)http://ciao.de/
Manual Classification of Sentences

Creation of a reference corpus:

- Classify sentences manually
- Tag strong opinions expressed about aspects of insurances
- Therefor: we ordered two annotators which are not involved in the project
- Only selection criterion: presence of at least one aspect per sentence
- Agreement of annotators very good ($\kappa = 0.821$)

Reference corpus:

- 221 sentences with 234 aspects
- 119 tagged as strong positive
- 115 tagged as strong negative
Results and Summary
Experimental Results

- Calculation of accuracy for strong positive and strong negative subset
- To be counted as correct
  - the **detection of the tonality** and
  - the **link to the aspect** had to be correct.
- 74 out of 119 positive statements recognized correctly (62.2%)
- But only 17 out of 115 negative statements recognized correctly (14.8%)
Error Sources: Overview

1. Opinions expressed via opinion bearing verbs
2. Phrases missing in the opinion lexicon
3. Opinions uttered with idiomatic expressions
4. Spelling mistakes and specialties
5. Wrong links of the opinions to the aspects
6. Indirect expression of opinions
7. Wrong opinion values in the opinion lexicon
8. Irony and sarcasm
9. Comparisons
### Error Sources Summary: Strong Positive

<table>
<thead>
<tr>
<th>Statements</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total - strong positive</td>
<td>119</td>
<td>100.0%</td>
</tr>
<tr>
<td>Correctly recognized</td>
<td>74</td>
<td>62.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error Source</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verb-based phrases</td>
<td>19</td>
<td>16.0%</td>
</tr>
<tr>
<td>Phrases missing</td>
<td>6</td>
<td>5.0%</td>
</tr>
<tr>
<td>Idiomatic expressions</td>
<td>4</td>
<td>3.4%</td>
</tr>
<tr>
<td>Spelling mistakes</td>
<td>6</td>
<td>5.0%</td>
</tr>
<tr>
<td>Wrong links</td>
<td>5</td>
<td>4.2%</td>
</tr>
<tr>
<td>Indirect opinion expressions</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Wrong opinion value</td>
<td>1</td>
<td>0.8%</td>
</tr>
<tr>
<td>Irony / Sarcasm</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Comparisons</td>
<td>4</td>
<td>3.4%</td>
</tr>
</tbody>
</table>
Error Sources Summary: Strong Negative

<table>
<thead>
<tr>
<th>Statements</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total - strong negative</td>
<td>115</td>
<td>100.0%</td>
</tr>
<tr>
<td>Correctly recognized</td>
<td>17</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Error Source</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verb-based phrases</td>
<td>43</td>
<td>37.4%</td>
</tr>
<tr>
<td>Phrases missing</td>
<td>19</td>
<td>16.5%</td>
</tr>
<tr>
<td>Idiomatic expressions</td>
<td>16</td>
<td>13.9%</td>
</tr>
<tr>
<td>Spelling mistakes</td>
<td>6</td>
<td>5.0%</td>
</tr>
<tr>
<td>Wrong links</td>
<td>5</td>
<td>4.3%</td>
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<tr>
<td>Indirect opinion expressions</td>
<td>4</td>
<td>3.5%</td>
</tr>
<tr>
<td>Wrong opinion values</td>
<td>2</td>
<td>1.7%</td>
</tr>
<tr>
<td>Irony / Sarcasm</td>
<td>2</td>
<td>1.7%</td>
</tr>
<tr>
<td>Comparison</td>
<td>1</td>
<td>0.9%</td>
</tr>
</tbody>
</table>
Summary

- Solutions possible for some categories of problems
- Inclusion of verb-based phrases essential $\rightarrow$ main error source
- Further main error sources
  - Improper links of phrases to aspects
  - Missing phrases in the opinion lexicon
  - Wrong POS-tags due to spelling mistakes
  - Usage of idiomatic expressions (negative utterances)
Future Work
To be Done

Next steps:

- Include verb-based phrases
- Address the recognized problems with
  - phrases missing in the opinion lexicon (#2)
  - opinions uttered with idiomatic expressions (#3)
  - wrong links of the opinions to the aspects (#5)
- Compare method with a machine learning approach

Furthermore:
Apply the aspect-based opinion mining to other domains and texts ⇒ Learn more about possible sources of problems
Thank you for your attention!