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Analyzing Sentiment while Accounting for Negation Scope and Strength

Introduction

- Decisions in, e.g., economics, politics, or reputation management require information monitoring tools for tracking **sentiment**
- The Web offers an overwhelming amount of **textual data** (e.g., blogs, reviews, or tweets), containing traces of sentiment
- Existing quantitative **sentiment analysis** approaches are typically based on **word frequencies**, yet one may want to consider a simple, computationally tractable way of accounting for **negation** by, e.g., exploiting negation **keywords**
- How to model the **influence** of **negation** keywords on the **sentiment** conveyed by natural language text?

Accounting for Negation

- The **challenge** lies in finding the **scope** of influence of a negation keyword, which can be done by means of several **methods**:
  - ✓ Consider the following **positive sentence** with one ***negation keyword***, some ***positive***, and many ***negative*** words:
    - **Example** review sentence: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
  - ✓ One way of accounting for negation is ***negating*** the sentiment of the **Rest of the Sentence** (RoS):
    - **Following** a negation keyword: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
    - **Around** a negation keyword: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
  - ✓ Another common method would ***negate*** the sentiment of the **First Sentiment-carrying Word** (FSW):
    - **Following** a negation keyword: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
    - **Around** a negation keyword: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
  - ✓ One may assume adverbs to simply modify sentiment-carrying words, and hence ***negate*** the **Next Non-Adverb** (NNA):
    - **Following** a negation keyword: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
  - ✓ Alternatively, one could ***negate*** the sentiment of words within a **Fixed Window Length** (FWL), e.g., 2 words:
    - **Following** a negation keyword: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
    - **Around** a negation keyword: *This **great** product removed the **nasty stain** **without** **badly damaging** my shoe!*
- We propose to also **optimize** the **negation strength**, as negated sentiment is not necessarily exactly the opposite sentiment

Assessing the Impact of Negation Handling Methods

- **Framework** for assessing the impact of our considered negation handling methods in sentence-level sentiment analysis
- Evaluation based on **sentiment classification** performance on a test set of annotated **sentences**; for each sentence:
  - ✓ Extract all **words** (simple and compound) and retrieve their **part-of-speech** and **lemma**
  - ✓ **Disambiguate** each word's sense by means of a Lesk-based algorithm which iteratively selects the word sense that is semantically most similar to the already disambiguated words in the rest of the sentence
  - ✓ Retrieve sentiment **scores** of words, ranging from -1 (negative) to 1 (positive), from the **SentiWordNet** sentiment lexicon
  - ✓ **Negate** sentiment scores of negated words by multiplying these scores with an **inversion factor** (typically negative)
  - ✓ Calculate sentence score as **sum** of word scores and **classify** sentence as positive (score ≥ 0) or negative (score < 0)
- The **inversion factor** can be **optimized** in a range of -2 to 0 by means of hill-climbing on a training set

Evaluation

- Corpus of **930 positive** and **1,355 negative** manually annotated **English** movie review **sentences** (60% training, 40% test)
- **Baseline**: sentiment analysis without accounting for negation; **alternatives**: RoS, FSW, NNA, and FWL (window sizes 1 to 4)
- **Most alternatives fail** to improve the performance of the baseline on the test set, **except** for negating the **FSW following** a negation keyword or negating words within a **FWL** of 1 to 4 words **following** a negation keyword
- The **best** performing method turns out to be negating words within a **FWL** of **2** words **following** a negation keyword, which yields a **significant increase** in both overall **accuracy** and macro-level **F1** of approximately **6%** on the test set
- **Optimizing** this method's **sentiment inversion** factor to a value of **-1.27** rather than -1 on our training set yields a **significant increase** in **accuracy** and macro-level **F1** of **7%** and **8%**, respectively, on the test set, compared to the baseline

Conclusions

- Accounting for **negation** in automated sentiment analysis can help **improve** the **performance** of classifying text as carrying either positive or negative sentiment, when properly modeling **scope** and **strength** of negation keywords
- In future work, we will explore the applicability of **distinct** sentiment inversion factors for negated positive and negative words

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