

Lecture 20: Sentiment Analysis: Lexicon-Based Approach

Sentiment analysis is a field within Natural Language Processing (NLP) that aims to identify and extract the subjective information in a piece of text. The goal is to determine the attitude of a writer or speaker towards a particular topic or the overall contextual polarity of a document. This attitude can be their judgment or evaluation, their affective state (the emotional feeling), or the intended emotional communication.

Methods:

- **Lexicon-Based:**
 - **Description:** Uses a dictionary of words and their associated sentiment scores (e.g., positive, negative, neutral).
 - **Example:** Analyzing customer reviews by counting positive/negative words to determine overall satisfaction. VADER is a refined version.
- **Machine Learning-Based:**
 - **Description:** Trains a model on labeled data to classify text sentiment (e.g., using algorithms like Naive Bayes, SVM).
 - **Example:** Predicting sentiment of movie reviews (positive/negative) using a model trained on a dataset of labeled reviews.
- **Deep Learning-Based:**
 - **Description:** Employs neural networks (e.g., RNNs, Transformers) to capture complex language patterns and context.
 - **Example:** Analyzing social media posts with BERT to understand nuanced opinions and emotions towards a brand or event.

Lexicon-Based Approach

The lexicon-based approach is one of the primary methods used in sentiment analysis. It relies on a sentiment lexicon, which is a collection of words and their associated sentiment scores. These scores indicate whether a word has a positive, negative, or neutral connotation. Some lexicons may also include more granular emotions like anger, joy, or sadness.

Methods

Sentiment Lexicon: A sentiment lexicon is created or obtained. Popular English sentiment lexicons include:

- **AFINN:** A list of English words rated for their valence (positive or negative) with a score between -5 and +5.
- **SentiWordNet:** A lexical resource where each WordNet synset is assigned a positivity, negativity, and objectivity score.

- VADER (Valence Aware Dictionary and sEntiment Reasoner): A lexicon and rule-based sentiment analysis tool that is specifically attuned to sentiments expressed in social media.

VADER: Valence Aware Dictionary and sentiment Reasoner A Refined Lexicon-Based Approach

While the basic lexicon-based approach has limitations, tools like VADER represent a significant improvement and are still very relevant, especially for social media text.

VADER is a lexicon and rule-based sentiment analysis tool specifically designed for sentiment analysis in social media contexts. It's very effective at handling the nuances of short, informal text, including emoticons, slang, and abbreviations.

Core Components

1. **Sentiment Lexicon:** VADER has a built-in lexicon, which is a dictionary of words and their associated sentiment scores (called "valence" scores). Each word is rated on a scale from -4 (most negative) to +4 (most positive). This lexicon was created and validated by human raters. It contains not only individual words but also many common multi-word expressions (bigrams and trigrams).
2. **Valence Scores:** The valence score of a word indicates its sentiment intensity. For example:
 - "good" might have a valence of +2
 - "great" might have a valence of +3
 - "terrible" might have a valence of -3
 - "okay" might have a valence of +1
3. **Rules and Heuristics:** VADER's key innovation is that, in addition to the lexicon, it incorporates a set of rules and heuristics to handle how sentiment is expressed in text. These rules account for:
 - **Negation:** VADER can handle negation words like "not," "never," "no," etc. It reduces the valence score of the subsequent words in the phrase.
 - For example, "not good" would be recognized as having a negative sentiment, even though "good" itself is positive.
 - **Intensification/De-intensification:** VADER considers intensifiers (words that increase sentiment intensity) and de-intensifiers (words that decrease sentiment intensity).
 - Intensifiers: "very," "extremely," "really," etc., increase the valence. "very good" is more positive than "good."
 - De-intensifiers: "slightly," "barely," "kind of," etc., decrease the valence. "slightly good" is less positive than "good."
 - **Punctuation:** VADER takes into account the effect of punctuation:
 - Exclamation marks (!): Increase sentiment intensity. "Good!" is more positive than "Good."

- Question marks (?): Can decrease sentiment intensity or express uncertainty.
- **Capitalization:** VADER recognizes that using all capital letters can amplify sentiment intensity. "GOOD" is more positive than "good."
- **Emoticons and Acronyms:** VADER's lexicon includes many common emoticons (e.g., ":", ":(", "D") and acronyms/abbreviations (e.g., "LOL," "OMG," "WTF") and their associated sentiment scores.

How VADER Works: Step-by-Step

1. **Input Text:** VADER takes a text string as input.
2. **Word Tokenization:** The text is broken down into individual words (tokens).
3. **Valence Scoring:**
 - Each word is looked up in the VADER lexicon to retrieve its base valence score.
 - If a word is not found in the lexicon, its valence is considered neutral (0).
4. **Contextual Adjustments:** VADER's rules and heuristics are applied to adjust the valence scores of words based on their context. This is where VADER goes beyond a simple lexicon lookup. For example:
 - Negation handling: If a negation word is found before a word, the word's valence score is modified.
 - Intensifier handling: If an intensifier is found, the word's valence score is increased.
5. **Aggregation of Scores:** The adjusted valence scores of all the words in the text are combined to calculate an overall sentiment score for the text. VADER produces four sentiment metrics:
 - **Positive score:** The proportion of words that fall in the positive category.
 - **Negative score:** The proportion of words that fall in the negative category.
 - **Neutral score:** The proportion of words that fall in the neutral category.
 - **Compound score:** A normalized, weighted composite score that represents the overall sentiment of the text. This is the most useful single measure of sentiment. It ranges from -1 (most negative) to +1 (most positive).
6. **Sentiment Classification:** The compound score is used to classify the sentiment of the text:
 - Positive: Compound score ≥ 0.05
 - Neutral: $-0.05 < \text{Compound score} < 0.05$
 - Negative: Compound score ≤ -0.05