Sentiment and Belief Extraction
(Part 1)

Lecture #6
What will we cover today?

• **Sentiment Analysis**
• **Terminology**
  – Sentiment vs. Opinion vs. Attitude vs.....
• **Features typically used**
• **Tools and resources for sentiment analysis**
• **Techniques in Sentiment Analysis**
• **Sentiment Analysis of Political Text**
What is it?

• Sentiment
• Polarity
• Affect
• Opinion
• Attitude
• Emotion
• ??????
• Are these terms referring to the same thing??
First some terminology

• ‘The beginning of wisdom is the definition of terms,’ - Socrates

• Holder/Source
• Object/Target

• Source expresses sentiment/opinion/attitude etc..... about the Target
Emotion and Affect

• Emotion: Source has feelings regarding something
  – Happy, angry, sad

• Affect: is a *psycho-physiological* state
• Measured along three dimensions – *valence*, *arousal*, and *motivational intensity*
• For example:
  – the word “murderer” has negative valence and high arousal
  – the word “peaceful” has positive valence and low arousal
Sentiment

• Typically instantiated as a polarized view about a Target

• Polarity can expressed as positive, negative, or neutral
Opinions/Attitudes

• To be covered in Part 2 lecture
Sentiment Analysis

• Computational treatment of digital media (text, images etc.) to ascertain subjective value
  – Intended or perceived
• Also referred to as opinion mining and subjectivity analysis
Applications

• Review related websites
  – Examples?
• As a sub-component technology
  – Recommendation systems
  – Information extraction
  – Summarization
• Interdisciplinary
  – sociology
  – anthropology
  – And many others...
Why is it hard?

• Consider this movie review:
  – This film should be *brilliant*. It sounds like a *great* plot, the actors are *first grade*, and the supporting cast is *good* as well, and Stallone is attempting to deliver a *good* performance. **However, it can’t hold up.**

• Based on simply counting positive and negative words in the text, an automatic system would classify it as positive
It is a classification task

• Simple: Is this sentence positive or negative towards the target?
• More complex: Rank these reviews in order of how positive they are.
• Slightly more complex: Is the writer a conservative or a liberal?
• Advanced sentiment detection: Detect the source, the target, and the complex attitude relationship between them
Open issues

• Sarcasm

• Irony

• Extremely challenging to detect these
Sentiment detection from words/short phrases

• The building blocks of sentiment expression

• Short phrases may be just as important (or more so) as words:
  – “lowest prices”
  – “high quality”

• We need an approach to deal with these before moving on to other classification tasks
Sentiment detection from words/short phrases

• There might be some relation between positive words and positive reviews
Classifying movie reviews (Pang 2002)

- Data available from IMDb (Internet Movie Database)
- Number of stars indicate rating

- Thus ground truth data for positive or negative sentiment towards a movie is obtained
Classifying movie reviews (Pang 2002)

- Using unigrams and bigrams features
- And machine learning,
- For example, Naïve Bayes

\[ P(+ \mid \text{token}) = \frac{P(+) \cdot P(\text{token} \mid +)}{P(\text{token})} \]

- Similarly for \( P(- \mid \text{token}) \)

- Average performance 77%-80%
  - Note that baseline will be 50% for evenly distributed corpus (why?)
Features typically used

1. Term presence vs. frequency
   • Information Retrieval uses frequency information
     – $tf \times idf$ measure
   • In sentiment analysis, the presence was shown to be more effective (Pang & Lee)
     – 0 or 1 value in vector instead of real values
Features typically used

2. Term-based features beyond unigrams
   • What are unigrams?
   • What about bigrams? n-grams?

   • Position information of tokens
Features typically used

3. Parts of speech (POS)
   • Adjectives (The *good*, the *bad* and the *ugly!*...)
   • Adverbs (*slowly*, *peacefully*..)
   • Verbs (I *love*, I *like*,..)
   • Certain nouns (*gem*, *hope*)
Features typically used

4. Syntax

• Parsing gives us the syntactic structure of a piece of text

• Which adjective applies to which noun?

  – *This is an awesome car, but it has poor controls.*
Features typically used

4. Negation
   – *I don’t like the shoes.*
   – is negative towards the shoes

• Compared to
   – *No wonder I like the shoes.*
   – is positive towards the shoes
4. Negation
   – Also presence negation does not always imply the opposite sentiment
   – *It was a terrible movie.*
     is negative

   – *It wasn’t a terrible movie.*
     is mildly negative, NOT positive
Features typically used

5. Topic-based features or context features
   • Certain text may carry different sentiment depending upon the topic under consideration
   • For example,
     – Walmart profits rose again.
     – Target profits rose again.

If the first sentence is found in a news article about Walmart → positive
If the second sentence is found in a news article about Walmart → negative
Features typically used

5. Topic-based features or context features
Consider the word *unpredictable* in the following two contexts:

*The movie had an unpredictable ending.*
*This car has unpredictable steering.*
Question

• What additional features can be considered for informal text, such as Twitter messages?
Informal text additional features

• What additional features can be considered for informal text, such as Twitter messages?
• #hashtags
• emoticons
• Tools and resources for sentiment analysis
General Inquirer

• Content analysis tool
  – Created in 1966
• Database of words and manually created semantic and cognitive categories, including positive and negative connotations
• Used to generate counts of words in categories

http://www.wjh.harvard.edu/~inquirer
LIWC

• Similar to General Inquirer

http://www.liwc.net/
Wordnet

• A lexical database for English with emphasis on synonymy
• Nouns, verbs, adjectives and adverbs are grouped into synonym sets
• Words are linked according to lexical and conceptual relations (creating a “net”)
• Not specifically sentiment oriented, but has been used to help derive sentiment related information (Hu & Liu)

http://wordnet.princeton.edu/
SentiWordnet

- A lexical resource for opinion mining
- Based on Wordnet synsets
- Each synset is assigned three sentiment scores: positivity, negativity, and objectivity

http://sentiwordnet.isti.cnr.it/
ANEW

• Affective Norms of English Words Lexicon

• Contains scores of ~13,000 words

• Collected using human raters

• Valence, Arousal and Dominance scores on scales of 1-9

• Can be downloaded from http://crr.ugent.be/archives/1003
• Datasets for Sentiment Analysis
How to obtain training data?

• Self-annotated data
  – Data has “built in” ordinal or binary labeling of some kind to complement text, ideally by the author of the text
  – E.g. Amazon reviews (1-5 stars)

• Hand-annotated data
  – Annotated independently of the author
  – Usually labor intensive
Inter-annotator agreement

• Hand annotated sentiment data can vary in reliability
• Inter-annotator agreement is the degree to which multiple human annotators arrive at the same annotations when confronted with the same text
• Represents theoretical upper bound for sentiment classification
Existing datasets for sentiment analysis

• Pang and Lee datasets
  – Movie reviews:
    http://www.cs.cornell.edu/People/pabo/movie-review-data/
  – Congressional floor hearings:
    http://www.cs.cornell.edu/home/llee/data/convote.html
Existing datasets for sentiment analysis

• Reviews from Amazon.com from many product types (domains)
• Include star ratings
• Also divided into positive/negative
• http://www.cs.jhu.edu/~mdredze/datasets/sentiment/
• Techniques in Sentiment Analysis
Approaches

- Semantic orientation and polarity of words
- Text-based sentiment classification
- Incorporating shallow linguistics
- Other approaches
Where to begin?

- Texts are made up of words
- Words are in dictionaries
- Let's look up the words in the text, see what they mean, and be done with it!
- This (slightly more sophisticated) is what we do when we use heuristic tools
Heuristic Methods

• “Heuristic” means applying what we know
• Dictionaries, thesauruses, word lists, etc.
General Inquirer and Polarity

• For identifying word polarity, we can use Neg and Pos categories

• Some problems
  – Binary, no gradations/weighting
  – Manually classed (intuitions are not always reliable)
  – Single word level only
  – Blind to context

• You cannot accurately classify texts as positive or negative using only lexical General Inquirer values
Wordnet and Polarity

• Synonyms grouped in synsets
• Relationships between synsets:
  – HYPONYM: “type-of” relationship
  – HYPERNYM: \{oak\} -> \{tree\}
  – HAS-MEMBER: \{family, family unit\} -> \{child, kid\}
  – HAS-STUFF: \{tank, army tank\} -> \{steel\}
  – ENTAIL: \{snore, saw wood\} -> \{sleep, slumber\}
  – CAUSE-TO: \{develop\} -> \{grow, become larger\}
  – ATTRIBUTE: \{hypocritical\} -> \{insincerity\}
Wordnet and Polarity

• Relationships between words:
  – PERTAINYM: academic -> academia
  – ANTONYM: presence -> absence
  – SIMILAR-TO: abridge -> shorten
  – SEE-ALSO: touch -> touch down
Wordnet and Polarity

• Hu & Liu (2004) identify polarity for adjectives using Wordnet
  – Begin with a set of “seed” adjectives of known orientation: “good”, “fantastic”, “wonderful”, “awful”, “terrible”, “bad”, etc.
  – For unknown adjectives, measure proximity via synonymy/antonymy relations to seed adjectives
  – If an adjective is close in synonymy to positive words, or close in antonymy to negative words, it's positive
  – Add newly labeled words to seed set
Wordnet and Polarity

- Extract “opinion sentences” based on the presence of a predetermined list of product features and adjectives
  - e.g. “The lens is excellent”
- Evaluate the sentences based on counts of positive vs negative polarity words (as determined by the Wordnet algorithm)
Wordnet and Polarity

• Results (Hu and Liu 2004)

<table>
<thead>
<tr>
<th>Product name</th>
<th>Opinion sentence extraction</th>
<th>Sentence orientation accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recall</td>
<td>Precision</td>
</tr>
<tr>
<td>Digital camera1</td>
<td>0.719</td>
<td>0.643</td>
</tr>
<tr>
<td>Digital camera2</td>
<td>0.634</td>
<td>0.554</td>
</tr>
<tr>
<td>Cellular phone</td>
<td>0.675</td>
<td>0.815</td>
</tr>
<tr>
<td>Mp3 player</td>
<td>0.784</td>
<td>0.589</td>
</tr>
<tr>
<td>DVD player</td>
<td>0.653</td>
<td>0.607</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>0.693</strong></td>
<td><strong>0.642</strong></td>
</tr>
</tbody>
</table>
Wordnet and Polarity

• Results (Hu and Liu 2004)
• Predicting sentence polarity based on constituent word orientations
• Relatively low extraction recall and precision due to disagreement with human annotators on what constitutes an “opinion sentence”
• Sentiment Analysis of Political Content
Political Sentiment Analysis

• Public opinion
  – Attitudes to policies, parties, government agencies, politicians

• Policy-making and government
  – Arguments and beliefs informing discussions between lawmakers or representatives

• Informal or formal environments
Analyzing Political Opinion

• Possible applications:
  – Analyzing political trends/Augmenting opinion polling data
  – Targeting advertising and communications such as notices, donation requests, or petitions
  – Identifying political bias, e.g. in news texts
  – Evaluating lawmakers positions, arguments, or biases
Analyzing political content

• What is “political opinion?”
  – Sentiment analysis often considers a binary “thumbs up” vs “thumbs down” classification
  – This is too simple to represent political opinion

• Political attitudes encompass a variety of favorability judgments

• Relations between judgments are not always clear; e.g., in the US political domain anti-abortion judgment often corresponds to pro-death penalty judgment.
Possible goals

- Aside from binary judgments about a specific issue, candidate, or proposal, we might want to:
  - Identify political party affiliation
  - Classify according to some more general taxonomy, e.g. right vs. left
  - Gauge the “extremeness” or distance from a politically centrist position of the writer’s views
  - Evaluate the degree of confidence with which the writer expresses views
  - Evaluate the degree of agreeability/argumentativeness with which the writer communicates
  - Identify particular issues of special importance to the writer