Sentiment and Belief Extraction (Part 1)

Lecture #6
What will we cover today?

• Sentiment Analysis
• Terminology
  – Sentiment vs Opinion vs Attitude vs.....
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 dominance
  • For example the word “murderer” has negative valence and high arousal
  • And 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

• 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
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
  ex: Yes, she’s *very* good.

• Irony
  ex: It’s as devoid rain here as Seattle.

• 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

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

• Similarly for \( P(- | \text{token}) \)

• 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*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
Features typically used

4. Negation
   – Also presence of 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

  - 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></th>
<th>Sentence orientation accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recall</td>
<td>Precision</td>
<td></td>
</tr>
<tr>
<td>Digital camera 1</td>
<td>0.719</td>
<td>0.643</td>
<td>0.927</td>
</tr>
<tr>
<td>Digital camera 2</td>
<td>0.634</td>
<td>0.554</td>
<td>0.946</td>
</tr>
<tr>
<td>Cellular phone</td>
<td>0.675</td>
<td>0.815</td>
<td>0.764</td>
</tr>
<tr>
<td>Mp3 player</td>
<td>0.784</td>
<td>0.589</td>
<td>0.842</td>
</tr>
<tr>
<td>DVD player</td>
<td>0.653</td>
<td>0.607</td>
<td>0.730</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>0.693</strong></td>
<td><strong>0.642</strong></td>
<td><strong>0.842</strong></td>
</tr>
</tbody>
</table>
Wordnet and Polarity

• Results (Hu and Liu 2004)
• Predicting sentence polarity based on constituent word orientations
• Lowish 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
Assigned Reading

• Political ideology detection using recursive neural networks.
  – Mohit Iyyer, Peter Enns, Jordan Boyd-Graber, and Philip Resnik
  – In Proceedings of the 2014 Association for Computational Linguistics

• Responses due March 1st, 11:59 pm