Subjective Analysis of Text: Sentiment Analysis Opinion Analysis

Certainty

Terminology

- Affective aspects of text is that which is "influenced by or resulting from emotions"
  - One aspect of non-factual aspects of text
- Subjective aspects of text
  "The **linguistic** expression of somebody's **opinions**, **sentiments**, emotions, evaluations, beliefs, speculations *(private states)*"
  - A private state is not open to objective observation or verification
  - Subjectivity analysis would classify parts of text as to whether it was subjective or objective

Elusive Aspects of Text Semantics

- In addition to representing documents, email, blogs, etc or answering questions on just the basis of thematic content

- Recognition of more subtle aspects of what is being conveyed in language

- Includes affective, emotive, opinion, certainty & evaluative aspects of meaning

Task Description

- Simplest level - Measuring polarity of text
  - Negative / positive attitude of reporter / blogger
  - Favorable / unfavorable review of a product
  - Right / left political leaning of speaker
  - Certainty / uncertainty about what's reported

- Huge amounts of text available
  - Blogs
  - Message boards
  - Discussion groups
  - eCommerce product sites
  - Email

What Could Be Done Now

- Business
  - Gauge reactions to new products
  - Understand which features of products have emotion-invoking affects on customers
  - Compare to competitors' products
  - Contribute to company's reputation management

- Consumers
  - Summarize key pros and cons in product reviews

- Government
  - Track attitudes towards government policies
  - Understand trends in the public's views
  - Gauge public reaction to campaign ads
  - Predict election outcomes

What is Possible Now [cont'd]

- Learn '*the buzz*' on the street
  - Extracting market sentiment from stock message boards to predict impact on stock price

- Identify financial scams

- Estimate political orientation of documents / sites / authors / blogs

- Understand the nature of relationships between cited and citing documents

- Discern level of certainty about events / statements

General Challenge: Sentiment classification

- Classify documents (e.g., reviews) based on the overall sentiments expressed by authors,
  - Positive, negative, and (possibly) neutral
- Similar but different from topic-based text classification.
  - In topic-based text classification, topic words are important.
  - In sentiment classification, sentiment words are more important, e.g., great, excellent, horrible, bad, worst, etc.

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What's the problem?

- Consider classifying a subjective text unit as either positive or negative.
  - Example: .The most thoroughly joyless and inept film of the year, and one of the worst of the decade. [Mick LaSalle, describing *Gigli]*

- Can't we just look for words like .great. or .terrible. ?
  - Yes, but ...
  - ... learning a sufficient set of such words or phrases is an active challenge.
  - [Hatzivassiloglou&McKeown '97, Turney '02, Wiebe et al. '04, and more than a dozen others, at least]

One experiment in creating polarity words

- Human 1
  - Positive: dazzling, brilliant, phenomenal, excellent, fantastic
  - Negative: suck, terrible, awful, unwatchable, hideous
  - 58% (on movie reviews)
- Human 2
  - Positive: gripping, mesmerizing, riveting, spectacular, cool, awesome, thrilling, badass, excellent, moving, exciting ,
  - Negative: bad, cliched, sucks, boring, stupid, slow
  - 64%
- Statistics-based
  - Positive: love, wonderful, best, great, superb, beautiful, still
  - Negative: bad, worst, stupid, waste, boring, ?, !
  - 69%

Pang and Lee, 2008

Issues

- Can't we just look for words like .great. or .terrible.?
- Yes, but …
  - This laptop is a **great deal**.
  - A **great deal** of media attention surrounded the release of the new laptop.
  - This laptop is a **great deal** ... and I've got a nice bridge you might be interested in.

  - This film should be brilliant. It sounds like a great plot, the actors are rst grade, and the supporting cast is good as well, and Stallone is attempting to deliver a good performance. However, it can't hold up.

Domain Adaptation

- Certain sentiment-related indicators seem domain-dependent.
  - .Read the book..: good for book reviews, bad for movie reviews
  - .Unpredictable.: good for movie plots, bad for a car's steering [Turney '02]
- In general, sentiment classifers (especially those created via supervised learning) have been shown to often be domain dependent
  - [Turney '02, Engstr ¨om '04, Read 05,Aue & Gamon '05, Blitzer, Dredze & Pereira '07].

- But let's take a closer look at the types of problems . . .

Sentiment Polarity and Degrees of Positivity

- This set of problems has the general character
    - Given an opinionated piece of text, classify the text
        - By giving one of two opposing opinions, or
            - Movie reviews: thumbs up or thumbs down
        - By situating the opinion along a continuum
            - Movie reviews: number of stars

- Typical problems (besides Pang and Lee, Movie Reviews)
    - Whether political text is "for" or "against" a topic
    - Whether a consumer product review "likes" or "dislikes" the product

Subjectivity Detection and Opinion Identification

- For many applications, first decide if the document contains subjective information or which parts are subjective
  - Focus of TREC 2006 Blog track
- Sentence level or sub-sentence level detection of subjectivity
  - Wiebe, many projects
  - Pang and Lee – for movie reviews, first determine which sentences express opinions and then label for opinion polarity
- Clause level opinion strength
  - Wilson, "How mad are you?"

Joint Topic-Sentiment Analysis

- Although in many cases, it is already known that a collection of documents has opinions on a particular subject, sometimes it is necessary to first identify what topics the opinions are on
  - Comparative studies of related products
  - Topics that have various features and attributes
    - Consumers
    - Political areas

Viewpoints and Perspectives

- In some types of documents, the authors are not necessarily discussing opinions on particular topics, but are revealing general attitudes or sometimes a set of bundled attitudes and beliefs
  - Classifying political blogs as liberal, conservative, libertarian, etc.
  - Identifying Israeli vs. Palestinian viewpoints
- One type of this is Multi-perspective Question Answering
  - On next slide . . .

MPQA

- Multi-Perspective Question Answering
  - *What does Bush think about Hillary Clinton?*
  - *How does the US regard the latest terrorist attacks in Baghdad?*

- Sentence, or part of a sentence, that answers the question:
  - *"How does X feel about Y?"*
  - *"It makes the system more flexible," argues a Japanese businessman.*

- Looking for opinion <u>linked to</u> opinion-holder

Stoyanov, Cardie, Wiebe, & Litman,
Evaluating an Opinion Annotation Scheme Using a Multi-Perspective Question and Answer Corpus. *2004 AAAI Spring Symposium on Exploring Attitude and Affect in Text,*

Stance and Argumentation

- Some forms of online discourse takes the form of trying to argue a viewpoint or opinion, or taking a stance in a particular debate
  - Ideological Debates
    - Somasundaram and Wiebe – look at argumentation
    - Abbot, Walker, et al – classifying stance in on-line debates
      - "Cats rule, dogs drool!" is much easier to classify than debates on abortion, religion, politics

Techniques, Features for Classification

- Unigrams are the most widely used features
  - Represent each word by its presence
  - Not by frequency or TF/IDF as is commonly done in topic classification
    - Pang and Lee, Movie Reviews
- Polarity words and polarity measures
  - Various ways to count and combine presence of polarity words
    - Using several lexicons available (LIWK, Subjectivity, ANEW)
- Bigrams and n-grams have been experimented with, but not often effective
- POS tags are quite often used
  - Adjectives have often been a focus
    - Number of adjectives in a sentence a good clue that the sentence is subjective
    - Using only adjectives instead of all words is not effective

Techniques, Features for Classification

- Syntax
  - Constituent or dependency parses are sometimes used
  - Particularly at phrase level to find dependencies of opinion words
  - Can be used to shift the "valence"
    - For negation, intensification and diminution
      - Very good, deeply suspicious

- Negation
  - "this movie is good" vs. "this movie is not good"
  - Simple negation indicated by words "not", "'nt", etc. and can be applied to succeeding object
  - Negation has both scope and focus
    - These may be represented in more complex structures
    - Details in Wilson "Fine-grained sentiment analysis"

Examples

- Negation
  - John is clever.   - John is *not* clever.
- Modals
  - The film is brilliant.   - The film *should* be brilliant.
- Intensifiers
  - They are suspicious.   - They are *deeply* suspicious.
- Presuppositions
  - He got into Harvard.   - He *barely* got into Harvard.

    - He *even* got into Harvard.
- Discourse connectors
  - *Although* Boris is brilliant at math, he is a horrible teacher.

Example of Valence Shifting

*The film **should** be brilliant*$^+ \Rightarrow 0$

The characters are appealing

Stallone plays a happy man$^+ \Rightarrow 0$

It sounds like a great story,

***however**, as a movie it* $+ \Rightarrow 0$

is a failure

$+ \Rightarrow 0$

$+ \Rightarrow \text{-}$

brilliant within scope of *should*

appealing under scope of *characters*

happy part of story world

great within the scope of *sounds like*

however reverses the "+" valence of *great*

Techniques, Features for Classification

- Relationships between items can be a rich source of information about for performing classification on the items.
  - Nearby sentences can share the same subjectivity status, subjective or objective [Pang&Lee '04]
- Mentions separated by "and" usually have similar sentiment labels; those separated by "but" usually have contrasting labels
  - [Popescu&Etzioni '05, Snyder&Barzilay '07];
  - similar reasoning holds for synonyms and antonyms [Hu&Liu '04]
- In some domains, references to other speakers generally indicate disagreement
  - [Agrawal et al '03, Mullen&Malouf '06, Goldberg, Zhu & Wright '07] (cf. Adamic&Glance ['05]
- Use of pronouns can indicate opinions

Opinion Mining

- Businesses spend a huge amount of money to find consumer sentiments and opinions.
  - Consultants, surveys and focused groups, etc
  - Text in the form of transcripts of interviews or survey responses

- Opinions also available on the web
  - product reviews
  - blogs, discussion groups

Two forms of opinions

- Direct Opinions: sentiment expressions on some objects, e.g., products, events, topics, persons
    - E.g., "the picture quality of this camera is great"
    - Subjective

- Comparisons: relations expressing similarities or differences of more than one object. Usually expressing an ordering.
    - E.g., "car x is cheaper than car y."
    - Objective or subjective

Opinion mining tasks

- At the document (or review) level:

  Task: sentiment classification of reviews
  - Classes: positive, negative, and neutral
  - Assumption: each document (or review) focuses on a single object O (not true in many discussion posts) and contains opinion from a single opinion holder.

- At the sentence level:

  Task 1: identifying subjective/opinionated sentences
  - Classes: objective and subjective (opinionated)

  Task 2: sentiment classification of sentences
  - Classes: positive, negative and neutral.
  - Assumption: a sentence contains only one opinion
    - not true in many cases.
  - Then we can also consider clauses.

Opinion mining tasks (contd)

- At the feature level:

  Task 1: Identifying and extracting object features that have been commented on in each review.

  Task 2: Determining whether the opinions on the features are positive, negative or neutral in the review.

  Task 3: Grouping feature synonyms.

  - Produce a feature-based opinion summary of multiple reviews (more on this later).

- Opinion holders: identify holders is also useful, e.g., in news articles, etc, but they are usually known in user generated content, i.e., the authors of the posts.

Let us go further?

- Sentiment classifications at both document and sentence (or clause) level are useful, but
  - They do not find what the opinion holder liked and disliked.
- An negative sentiment on an object
  - does not mean that the opinion holder dislikes everything about the object.
- A positive sentiment on an object
  - does not mean that the opinion holder likes everything about the object.

- **We need to go to the feature level.**

Feature-based opinion mining and summarization
(Hu and Liu, KDD-04)

- Again focus on reviews (easier to work in a concrete domain!)
- Objective: find what reviewers (opinion holders) liked and disliked
  - Product features and opinions on the features
- Since the number of reviews on an object can be large, an opinion summary should be produced.
  - Desirable to be a structured summary.
  - Easy to visualize and to compare.
  - Analogous to multi-document summarization.

Different review format

Format 1 - Pros, Cons and detailed review: The reviewer is asked to describe Pros and Cons separately and also write a detailed review. Epinions.com uses this format.

Format 2 - Pros and Cons: The reviewer is asked to describe Pros and Cons separately. C|net.com used to use this format.

Format 3 - free format: The reviewer can write freely, i.e., no separation of Pros and Cons. Amazon.com uses this format.

Format 1

My SLR is on the shelf

by <u>camerafun4</u>. Aug 09 '04

Pros: Great photos, easy to use, very small
Cons: Battery usage; included memory is stingy.

I had never used a digital camera prior to purchasing have always used a SLR … **Read the full review**

Format 3

GREAT Camera., Jun 3, 2004

Reviewer: **jprice174** from Atlanta, Ga.

I did a lot of research last year before I bought this camera... It kinda hurt to leave behind my beloved nikon 35mm SLR, but I was going to Italy, and I needed something smaller, and digital.

The pictures coming out of this camera are amazing. The 'auto' feature takes great pictures most of the time. And with digital, you're not wasting film if the picture doesn't come out.

Format 2

User rating Perfect **10** out of 10

"It is a great digitbal still camera for this century"
September 1, 2004

Pros:
It's small in size, and the rotatable lens is great. It's very easy to use, and has fast response from the shutter. The LCD has increased from 1.5 in to 1.8, which gives bigger view. It has lots of modes to choose from in order to take better pictures.

Cons:
It almost has no cons, it would be better if the LCD is bigger and it's going to be best if the model is designed to a smaller size.

Feature-based Summary (Hu and Liu, KDD-04)

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….

Feature Based Summary:

Feature1: **picture**
Positive: 12
- The pictures coming out of this camera are amazing.
- Overall this is a good camera with a really good picture clarity.

…

Negative: 2
- The pictures come out hazy if your hands shake even for a moment during the entire process of taking a picture.
- Focusing on a display rack about 20 feet away in a brightly lit room during day time, pictures produced by this camera were blurry and in a shade of orange.

Feature2: **battery life**
…

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Certainty Recognition

- *Certainty*
  - the quality / state of being free from doubt, especially on the basis of evidence
- Related work:
  - Types of subjectivity (Liddy et al. 1993; Wiebe 1994, 2000; Wiebe et al. 2001)
  - Adverbs and modality (Hoye, 1997)
  - Hedging in different kinds of discourse
  - Expressions of (un)certainty in English (from applied linguistics)
- Goal – characterize 'certainty' of textual statements

Additional slides on certainty

Four-Dimensional Relational Model
for Certainty Categorization

D1: PERSPECTIVE	D2: FOCUS	D3: TIMELINE	D4: LEVEL
Writer's Point of View	Abstract Information (e.g. opinions, judgments, attitudes, beliefs, emotions, assessments, predictions)	Past Time (i.e. completed, recent in the past)	Absolute
Reported Point of View		Present Time (i.e. immediate, current, incomplete, habitual)	High
Directly involved 3rd parties (e.g. witnesses, victims)	Factual Information (e.g. concrete facts, events, states)		Moderate
Indirectly involved 3rd parties (e.g. experts, authorities)		Future Time (i.e. predicted, scheduled)	Low

Rubin, Kando & Liddy. Certainty Categorization Model. AAAI-EAAT Symposium, 2004.

Dimension 1: Perspective

Writer's Point of View

Reported Point of View

Directly involved 3rd parties (e.g. witnesses, victims)

Indirectly involved 3rd parties (e.g. experts, authorities)

- point of view, voice, or experiencer of certainty
- the writer is the author of the article

> *More evenhanded coverage of the presidential race would help enhance the legitimacy of the eventual winner, which* ***now appears likely to be*** *Putin. (ID=e8.14)*

- people or organizations, direct participants

The Dutch recruited settlers with an advertisement that ***promised*** *to provide them with slaves who "****would accomplish*** *more work for their masters, ... (ID=e27.13)*

- tangentially related to the event in the professional or other capacities

The historian Ira Berlin, author of "Many Thousands Gone," ***estimates*** *that one slave perished for every one who survived capture in the African interior… (ID=e27.8)*

Dimension 2: Focus

D2: FOCUS

An idea that does not represent an external reality but rather a hypothesized world, existing in the mind, separated from embodiment or object of nature.

*In Iraq, the first steps **must be taken** to put a hard-won new security council resolution on arms inspections into effect. (ID=e8.12)*

Abstract Information (e.g. opinions, judgments, attitudes, beliefs, emotions, assessments, predictions)

Factual Information (e.g. concrete facts, events, states)

Based on, characterized by, or contains facts, i.e. has actual existence in the world of events.

*The settlement **may not fully compensate** survivors for the delay in justice, ... (ID=e14.19)*

Dimension 3: Timeline

| D3: TIMELINE |

- accounts for relevance of time to the moment when the article was written
- the past includes completed or recent states or events;
- the present is current, immediate, and incomplete states of affairs;

- the future is predictions, plans, warnings, and suggested actions.

Past Time

(i.e. completed, recent in the past)

Present Time

(i.e. immediate, current, incomplete, habitual)

Future Time

(i.e. predicted, scheduled)

*The failure lasted only about 30 minutes and had no operational effect, the FAA said, adding that **it was not even clear** that the problem was caused by the date change.*
(ID=n4.19)

Dimension 4: Level

D4: LEVEL

*Eventually, however, auditors **will almost certainly have to** form a tough self-regulatory body that can oversee its members' actions… (ID=e24.18)*

Absolute

*… but **clearly** an opportunity is at hand for the rest of the world to pressure both sides to devise a lasting peace based on democratic values and respect for human rights. (ID=e22.6)*

High ←

*That fear **now seems** exaggerated, but it was not entirely fanciful. (ID=e4.8)*

Moderate ←

*So far the presidential candidates are more interested in talking about what a surplus **might buy** than in the painful choices that lie ahead. (ID=e3.7)*

Low ←

- currently, a 4-way distinction
- only sentences with explicit indication of certainty are in scope
- low certainty and uncertainty are lumped together

Potential Applications

- **Alerting** intelligence analysts to level above or below normal and associating certainty with its source

- **Searching** by level and point of view parameter
  - *What does Pres. Bush sound most certain about in his speeches?*

- **Ordering** retrieved information by certainty of authors or author's reports of certainty of others
  - Decreases amount of uncertain information presented
  - Prioritizes sources that provide highly certain information

- **Summarizing** per document, across documents, per topic

- **Inferring** true state of affairs based on high level certainty statements from multiple sources