Sentiment Analysis and Opinion Mining

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Introduction to Sentiment Analysis

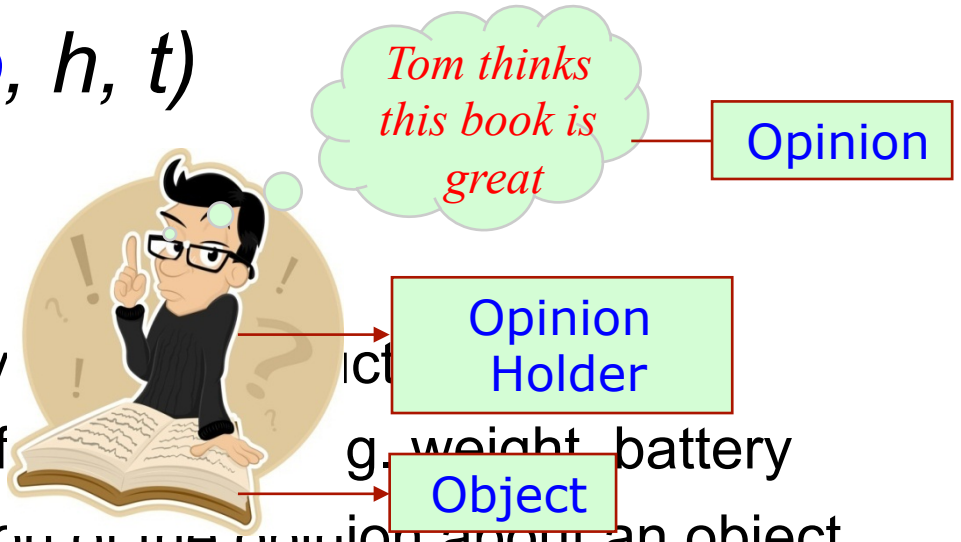
What is Sentiment Analysis

- Sentiment
  - A thought, view, or attitude, especially one based mainly on emotion instead of reason
- Sentiment Analysis
  - Computational treatments for discovering opinions and attitudes expressed in text by opinion holders (e.g. positive vs. negative)
  - Can be generalised to richer emotion dimensions (e.g., Joy, Sadness, Fear, Anger, etc.)

Definitions

- Modelling opinion as a quintuple: (Bing Liu 2012)

(o, a, so, h, t)



Where

- ***o*** is an object or target entity
- ***a*** is the aspect or attribute of
- ***so*** is the sentiment orientation of the opinion about an object or aspect
- ***h*** is an opinion holder
- ***t*** is the timestamp when an opinion is expressed.

Different Types of Opinions

- Explicit opinion: opinion or sentiment directly expressed on a target object
  - "*My mood is really bad.*"
  - *"His basketball skill is really amazing*!"
- Implicit opinion: objective text implying opinion or attitude
  - "*The new bike fell apart within two days.*"
  - "*He has learnt a lot from this course*."
- Sarcasm: a sharp or bitter remark, usually conveys the opposite of their literal meaning (context-dependent)
  - **Context**: "*The food is totally burned*! (very angry)"
  - "*You really did a great job!*"

Why Sentiment Analysis

- Web 2.0 and the social web
  - has facilitated rich user-generated contents
  - contains valuable information for both business and end-users
- We have a *decision support* need and an *operational* need
  - **Marketers and governments**
  - Finding out customers' opinions about their products/services
  - Tracking how these opinions evolve over time
  - Accessing public opinion polls on political campaigns
  - **Consumers**
  - Decision support for purchasing and recommendation
  - What are people saying about X versus Y

Some Practical Examples

Product Review Insights

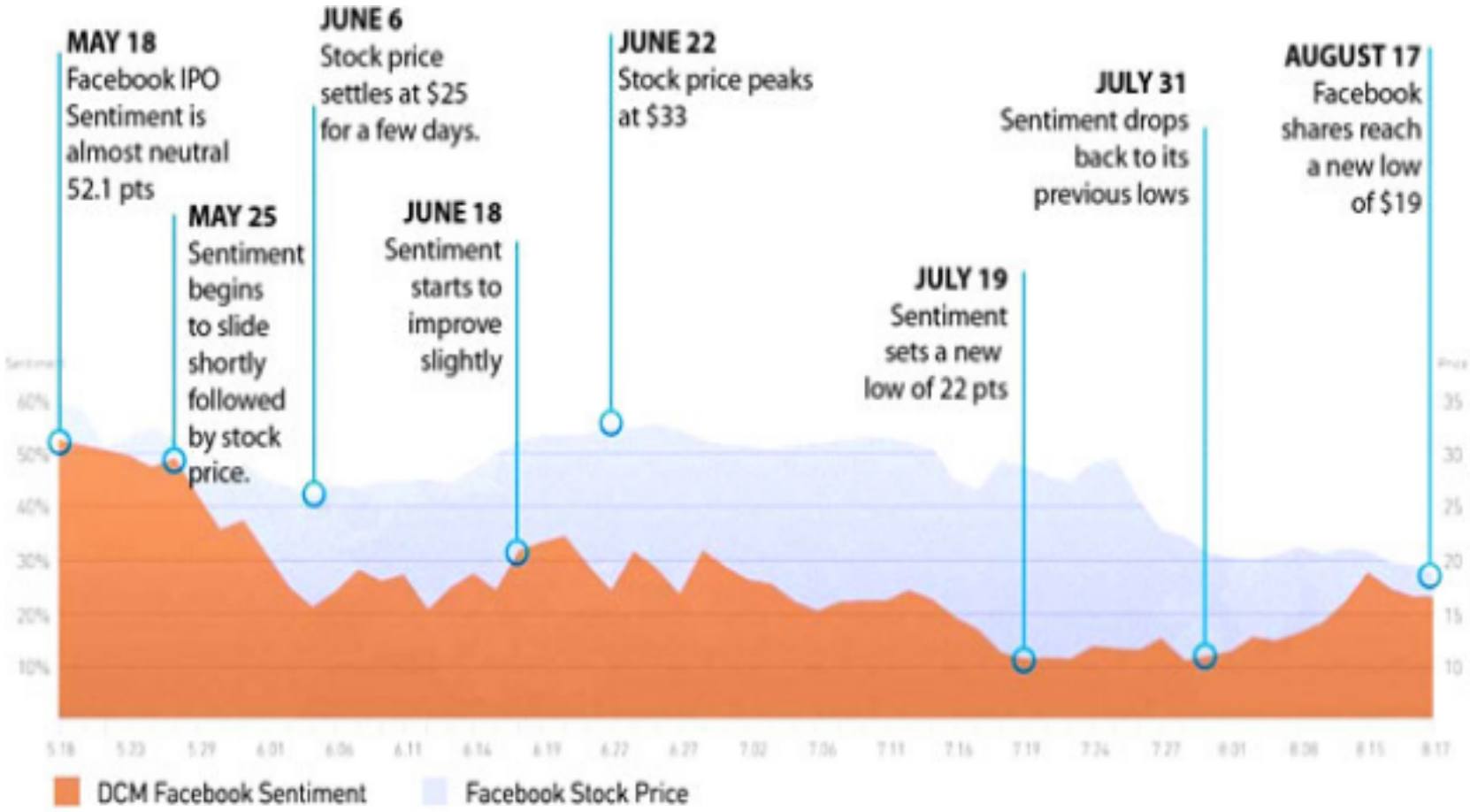
- What are people's opinions about this product?
- What are the pros and cons?

Brand and Consumer Perception

- Music artists analytics: provide aggregated sentiment statistics for artists, songs or albums over all reviews collected online.

Financial Marketing

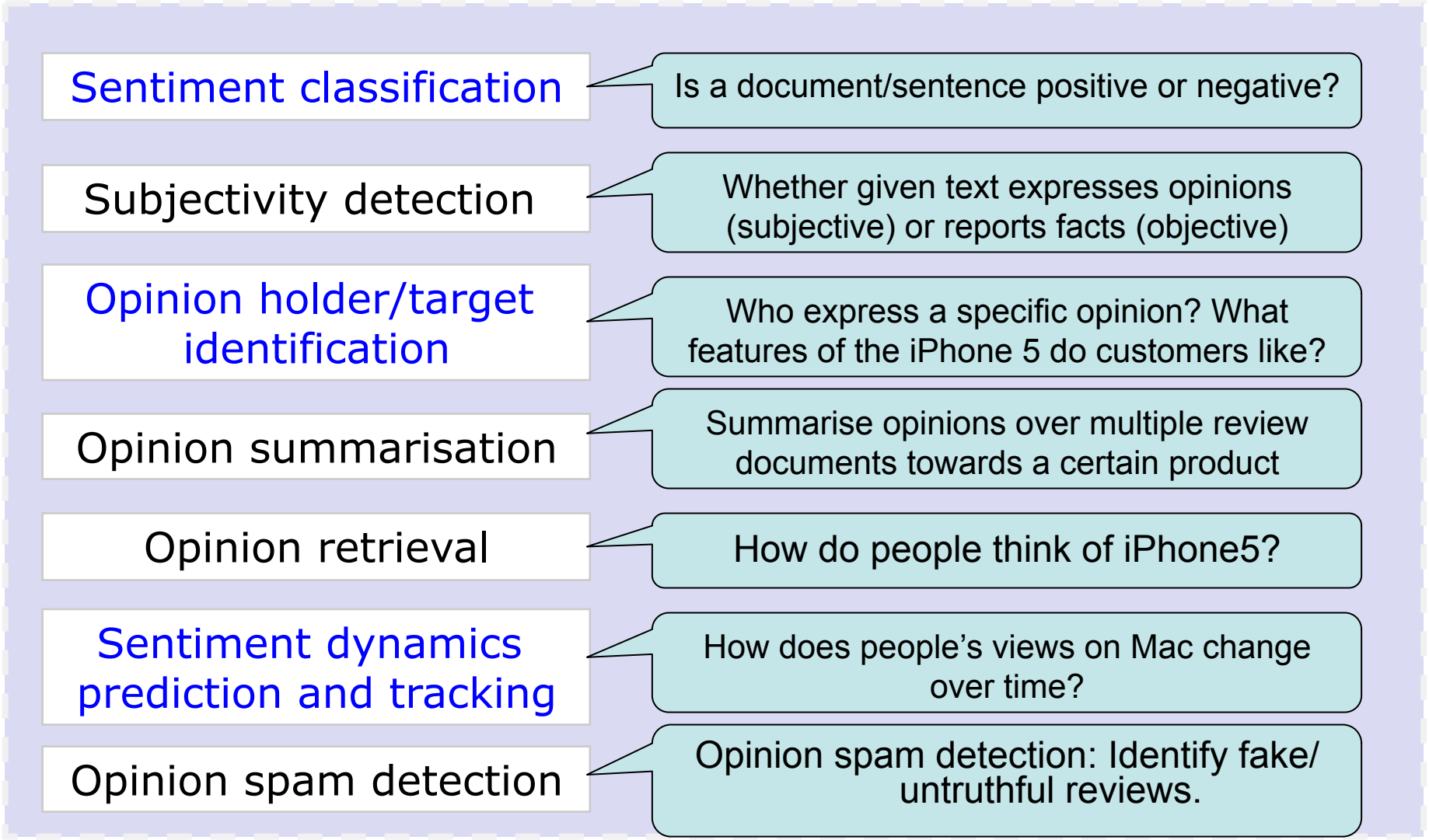
- Use general Facebook sentiment to predict the company's stock performance. (http://www.dailyfinance.com/)




tweetfeel
iphone 4s
Percentage of positive sentiment about "iphone 4s"
Try some Twitter trends: No Basketball Anymore Drake and Big Sean Stop Online Piracy Act
49
33
60%
Whoa the iphone 4s is great! My dad is thinking about getting one for me for xmas! Thanks dad luv ya!
@ssaudiaaK fuck iphone 4s
I really Love iphone 4s
@Ahmedmob8 thank u for listening they are
I hate iphone 4s please come up with a jailbreak before I sell this shit lol @Gojohnnyboi
@andyrmyers tell her it would be easier to transfer it to your 3gs and then suggest that you could use the shiny new iphone 4s...! WIN
I really love iphone
I hate iphone 4s please come up

Sentiment Analysis Tasks

The Big Picture



Sentiment Classification

Sentiment Classification

- **Goal:** classify the overall sentiment orientation expressed in a given text, i.e. positive, negative or (possibly) natural.
- Classification can involve different levels of granularity
  - Document-level
  - Sentence-level
  - Word/phrases-level
- Traditional sentiment classification techniques
  - Lexicon-based approaches
  - Corpus-based approaches

Sentiment Classification Techniques

- Lexicon-based approaches
  - Use sentiment lexicons as prior knowledge
  - Unsupervised/weakly supervised learning

- Corpus-based approaches
  - Annotated corpus with class labels available (e.g. positive or negative)
  - Supervised learning, e.g., Naïve Bayes (NB), SVMs, Maximum Entropy Model (MaxEnt), etc.

Preprocessing

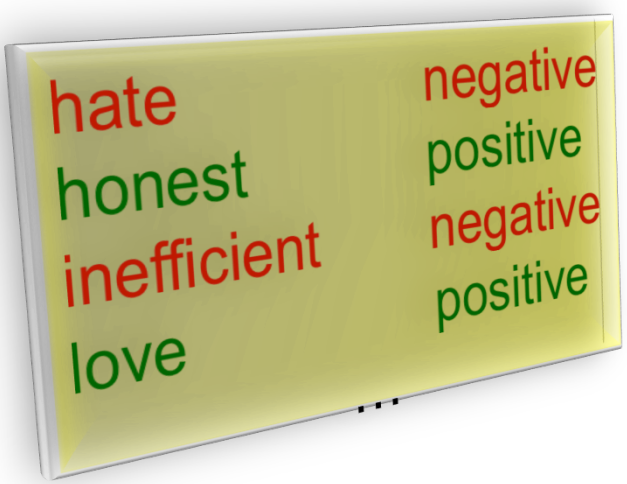
- Text preprocessing
  - An essential part of any NLP system
  - Segment text into appropriate unit (e.g. characters, **words**, sentences, etc.) and prepare in appropriate forms (e.g. canonical form) before passing for further processing
  - Also called text tokenization and normalization
- Easier in some languages (e.g. English) and highly non-trivial for the languages without space between words (e.g. Chinese).
- Have a great impact on NLP system performance, e.g. speed, accuracy, etc.

Preprocessing (cont.)

Typical steps of preprocessing in English:

- **Clean up unwanted stuff**, e.g. HTML tags. But sometimes can be helpful, e.g. tags preserving document structures like headings, sections.
- **Text unit segmentation**: normally white space and punctuations as word boundaries. Instances like '*e-mail*', '*aren't*', can be problematic.
- **Stopword removal**: (1) remove the most frequent words that do not carry much meaning. E.g., '*the*', '*and*', '*a*', etc. (2) can greatly reduce corpus size.
- **Stemming**: convert the inflected words to their stem, e.g., '*stocking*', '*stocks*', '*stocked*' → '*stock*'.
  - Porter stemmer
  - Reduce vocabulary size
  - May collapse words with different meaning into the same stem – '*pass*', '*passe*' → '*pass*'

Lexicon-Based Approaches



Sentiment lexicon

I really love iphone
4s

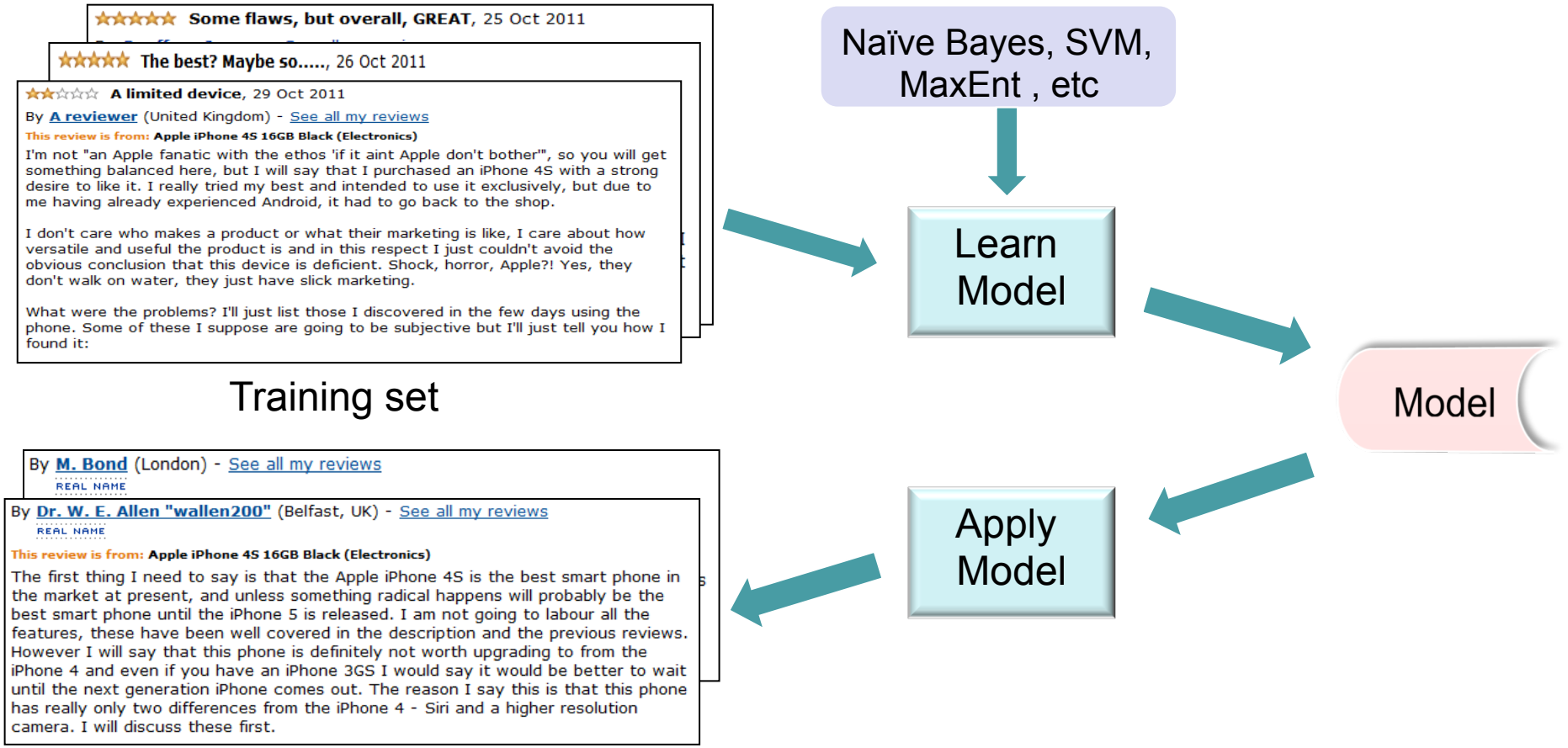
I hate iphone
4s

- Use sentiment words as reference features for polarity detection
- Does not rely on labelled data for training

Corpus-based Approaches

- **Basic idea**: treat sentiment classification as a binary classification problem with two topics, i.e. 'positive' and 'negative'.
- Supervised classification algorithms
  - Naïve Bayes (NB)
  - Support Vector Machines (SVM)
  - Maximum Entropy (MaxEnt), etc.
- Commonly used benchmark dataset
  - Movie reviews (http://www.cs.cornell.edu/people/pabo/movie-review-data/)
  - Product reviews (http://www.cs.jhu.edu/~mdredze/datasets/sentiment/)

Corpus-based methods (cont.)



- Rely on syntactic or co-occurrence patterns in large text corpora

Example: Supervised Learning

Supervised machine learning algorithms for sentiment classification (Pang et al, 2002, 2004)

- **Goal**: predict the sentiment orientation of a document as positive or negatives
- **Algorithms**
  - Navie Bayes (NB)
  - Support Vector Machines (SVMs)
  - Maximum entropy (MaxEnt)
- **Data and setting**
  - 700 positive (4-5 stars) and 700 negative (1-2 stars) reviews
  - 3-fold cross-validation
  - No stemming or stopword removal

Feature Engineering

- Features used for building classifier
  - Unigrams [I, like, the, new, iPad]
  - Bigrams [I_like, like_the, the_new, new_iPad]
  - POS [I(p), like(v), the(d), new(a), iPad(n)]
  - Negation [not_good]
  - Punctuation [!!]
  - Position
  - Frequency vs. presence

Performance

- SVMs performs best
  - With 82.9% accuracy on the Movie review dataset
  - Based on unigram (presence) features

	Features	# of features	frequency or presence?	NB	ME	SVM
(1)	unigrams	16165	freq.	**78.7**	N/A	72.8
(2)	unigrams	"	pres.	81.0	80.4	**82.9**
(3)	unigrams+bigrams	32330	pres.	80.6	80.8	**82.7**
(4)	bigrams	16165	pres.	77.3	**77.4**	77.1
(5)	unigrams+POS	16695	pres.	81.5	80.4	**81.9**
(6)	adjectives	2633	pres.	77.0	**77.7**	75.1
(7)	top 2633 unigrams	2633	pres.	80.3	81.0	**81.4**
(8)	unigrams+position	22430	pres.	81.0	80.1	**81.6**

What you should know

- What is opinion mining
- What is sentiment classification
- Text preprocessing
- Feature engineering
- How to perform corpus-based sentiment classification