

# Sentiment Analysis

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# Announcements

- Thursday 25/04: Project update 0
- Friday 26/04: Reading assignment: Bias in word embeddings
- Wednesday 08/05: Project update 1

## BERT reading assignment: Questions

- In the paper, they argue that one architectural feature of BERT that improves its question-answering capabilities is the possibility to embed two sentences at the same time. How is it possible to do so without losing the individuality of the sentence themselves in the process?
- What would have a bigger impact on BERT's performance, more extensive pre-training using more tasks, or a larger training dataset?
- More about bidirectionality?
- We learned BERT is used in google search. How is it applied to social media like Instagram for example?
- How possible is it to install/download these kinds of models on your own computer and run them yourself, since the code and pre-trained models are public?

## BERT reading assignment: Questions

- What is a limitation of BERT, compared to, for example, ChatGPT?
- How are models like BERT different to industrial scale models used today like GPT-4, Mistral models and Llama2?
- How does BERT's pre-training process differ from other language models like ChatGPT, and what are the implications of these differences for downstream task performance? Is it significantly better?
- Could BERT make a comeback onto GPT-4 if same data and resources are available?
- In this paper they show that BERT was the leading model in the field, what happened that made Google fall behind other companies like OpenAI, and Meta?

# Sentiment Analysis

★★★★★ 6 maanden geleden

This is really a top notch sea and honestly my favorite sea out of all of them. I learned that the water gets saltier the further east you go in the sea which makes people more buoyant when swimming. If I could give it 10 stars, I totally would!

# Sentiment Analysis

**This review is from: Black Dragon T-Shirt 100% Cotton Short Sleeve Shirt Pre-Shrunk (Apparel)**

This is, without a doubt, the best black shirt with an angry monochrome dragon perched on two natural pillars on a cliff that I have ever seen. I know that when I get married, this is the undershirt I'll wear. The amount of awesome displayed on your chest canvas while wearing this shirt, obviously a shirt given to man by Zeus himself, is currently impossible to calculate using our current mathematical constructs. We actually need to devise a new form of mathematics which we should call Wurm Theory in order to parse the data.

# Demo

<https://text2data.com/Demo>

# Definition

- Sentiment Analysis: The study of **opinions, attitudes and emotions** towards an entity expressed in a text
  - ▶ Persons, objects, events, topics
- Text classification of subjective information
- A one-dimensional scale of opinions is often assumed
  - ▶ like/dislike
  - ▶ for/against
  - ▶ positive/negative
  - ▶ five stars - one star
- Negative and positive polarity
  - ▶ Negative polarity item



# Tasks

- Sentiment Classification
  - ▶ Classify the opinions expressed in a text or document into categories or on a scale
- Subjectivity Classification
  - ▶ Detect to what extent a text contains opinions, evaluations, emotions, beliefs etc.
- Opinion Summarization
  - ▶ Summarize the opinions generated by describing a specific entity
- Opinion Retrieval
  - ▶ Retrieve documents that express an opinion about an entity of interest
- Emotion Detection
- Sarcasm/Irony Detection
- Opinion Spam Detection
  - ▶ Messages/reviews that aim to distort the public perception of an entity

# Opinions on entities?

- ① I bought an iPhone a few days ago.
  - ▶ a fact, not an opinion
- ② It was such a nice phone.
  - ▶ positive opinion
  - ▶ on the phone as a whole
  - ▶ from the author of the review
- ③ The touch screen was really cool.
  - ▶ positive opinion
  - ▶ on a component of the phone
  - ▶ from the author of the review
- ④ The voice quality was clear too.
  - ▶ positive opinion
  - ▶ on a characteristic of the phone
  - ▶ from the author of the review

# Opinions on entities?<sup>1</sup>

- ⑤ Although the battery life was not long, that is ok for me.
  - ▶ negative opinion?
  - ▶ on a characteristic of the phone
  - ▶ from the author of the review
- ⑥ However, my mother was mad with me as I did not tell her before I bought it.
  - ▶ negative emotion/opinion
  - ▶ towards the author of the review
  - ▶ from the mother of the author of the review
- ⑦ She also thought the phone was too expensive, and wanted me to return it to the shop.
  - ▶ negative opinion
  - ▶ on a characteristic of the phone
  - ▶ from the mother of the author of the review

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<sup>1</sup>Example from Liu (2010) Sentiment Analysis and Subjectivity. In Indurkha & Damerau (eds.) Handbook of Natural Language Processing, CRC Press: Chapter 26.

# Entities

- Entity of interest can be a product, person, event, organization or topic
- Entities can have components (battery, screen)
- Entities can have attributes (size, weight, price)
- Or just 'object features'

# Opinions

- A view, attitude, emotion, or appraisal on a feature from an opinion holder
- **polarity**: positive, negative or neutral orientation
- **emotion**: subjective feelings and thoughts. Many categorization schemes exist, e.g. VADC, Valence - Arousal - Dominance - Concreteness
- **opinion holder**: a person or organization. Often the author of a post, or sometimes another party that is mentioned (e.g. in a news article)

# Unit of analysis

Sentiment of...

- A community
- A specific other person
- The user/author
- Expressed in a document, e.g. a song
- Clause, sentence or paragraph
- Entity or object feature

# Applications

- Movies: is this review positive or negative?
- Product: what do people on Twitter think about the new iThingy?
- Advertising: show an ad of our product to people who expressed positive sentiment on a similar product
- Politics: how much do people like this political party currently?
- Economics: is the Twitter stock going to go up or down?
- Users: what other users share similar feelings towards an entity of interest?
- Public sentiment: how is consumer confidence?
- Customer support: is this customer happy or unhappy?
- ...

# Characteristics

Sentiment analysis is a type of text classification, but...

- Relatively few categories
- Categories not independent, but e.g. ordinal
- Often not connected to particular domains, topics or users
- Opinions are expressed in complex ways
  - ▶ Lexical content may not be enough
- Ordering effects
- Use of rhetorical devices such as sarcasm and irony
- Information often left implicit
- Different sentiments expressed within a text or even sentence
- Relevance of smileys/emoji



# Characteristics

- Negation is complicated
- What is the scope?

*I do **not** call this film a comedy movie and it's bad*

- Scope ambiguity

*I wasn't watching all the time*

= I was watching none of the time, or I was watching some of the time?

- Long distance negation

*I really like horror movies, but I do **not** feel the same about this one*

# Methods

- Supervised classification
  - ▶ e.g. (binarized) Multinomial Naive Bayes
  - ▶ Many datasets available, e.g. movie review polarity datasets, Amazon reviews
  - ▶ Plenty of self-annotated data
- Use of lexical resources
  - ▶ SentiWordNet
  - ▶ WordNet synsets with sentiment scores: positivity, negativity and objectivity
  - ▶ Whissell's Dictionary of Affective Language
  - ▶ About 9000 words rated in terms of their Pleasantness, Activation, and Imagery (concreteness)

# Methods

- Use of lexical resources
  - ▶ Regular WordNet (Hu & Liu, 2004)
  - ▶ Begin with known adjectives: “great”, “excellent”, “awful” etc
  - ▶ For unknown adjectives, measure distance to seed adjectives
  - ▶ Use k-nearest neighbour style classification to decide
- Hu & Liu, 2004 developed their own polarity lexicon using this method (2006 positive and 4783 negative words)

# Methods

- Supervised classification

Useful features:

- Terms and their (weighted) frequency
- Part-of-speech tags
- Opinion words and phrases (“what a trainwreck!”)
- Negation
- Emoticons/emoji
- Syntactic dependencies

# Evaluation issues

- Low inter-rater reliability, hard to get a ground truth
- STS-Gold dataset: Full agreement only on 2/3rd of tweets (for negative/positive/neutral)
- Krippendorff's alpha of 0.765 for tweet-level annotation
- 0.416 for entity-level annotation per tweet

Sentiment is subjective and can be reader-dependent

# Group project formation