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Faculdade de Ciências e Tecnologia
Departamento de Engenharia Informática

Human-Centered Artificial Intelligence

Master in Data Science and Engineering

Human-AI Communication

Sentiment Analysis

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Overview

- 1 Introduction
- 2 Tasks
- 3 Emotion Recognition
- 4 Approaches
- 5 Also in the Scope of Sentiment Analysis

Introduction

Sentiment Analysis [Liu, 2012]

- Computational **treatment of opinions and sentiments** in order to provide more efficient decision making
- Often targeting **text**, sometimes **facial expressions** or based on biometrical sensors
- Different tasks
 - Subjectivity Analysis
 - Polarity Detection (of document, sentence)
 - Aspect-based
 - Emotion Recognition
- Useful for Marketing, Trend Analysis, **Recommender Systems**, ...



Polarity



Example

(1) I bought an iPhone a few days ago. (2) It was such a nice phone. (3) The touch screen was really cool. (4) The voice quality was clear too. (5) However, my mother was mad with me as I did not tell her before I bought it. (6) She also thought the phone was too expensive, and wanted me to return it to the shop ...

Sentence Polarity

- Sentences (2), (3) and (4) express **positive** opinions.
- Sentences (5) and (6) express **negative** opinions.
- We can say that sentence (1) is **neutral**, i.e., it expresses no opinion.

Document Polarity

- Does the document overall express positive or negative opinion?
- ≈ What is the opinion of the author about the iPhone?

Subjectivity Analysis

Example

- (1) I bought a Motorola phone and my girlfriend bought a Nokia phone yesterday.
(2) We called each other when we got home. (3) The voice of my Moto phone was unclear, but the camera was good. (4) My girlfriend was quite happy with her phone, and its sound quality. (5) I want a phone with good voice quality.
(6) So I probably will not keep it.

— Posted by: bigXyz on Nov-4-2010

Subjectivity Analysis

- An **objective** sentence presents **factual** information about the world
 - Sentences (1) and (2) are objective.
- A **subjective** sentence expresses personal **feelings, views or beliefs**.
 - Sentences (3) and (4) are subjective
- Subjectivity is related to sentiment, but not all subjective sentences must contain an opinion (5)

Other tasks

Example

(1) I bought a Motorola phone and my girlfriend bought a Nokia phone yesterday. (2) We called each other when we got home. (3) The voice of my Moto phone was unclear, but the camera was good. (4) My girlfriend was quite happy with her phone, and its sound quality. (5) I want a phone with good voice quality. (6) So I probably will not keep it.

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- **Entity** extraction and grouping synonyms
 - e.g., 'Motorola', 'Moto', 'Nokia'
 - 'Motorola' and 'Moto' are synonyms
- **Aspect** extraction and grouping synonyms
 - e.g., 'camera', 'voice', 'sound'
 - 'voice' and 'sound' are synonyms
- **Opinion holder** extraction and **time**
 - e.g., bigXyz, bigXyz's girlfriend
 - posted on Nov-4-2010

Other tasks

Example

(1) I bought a Motorola phone and my girlfriend bought a Nokia phone yesterday. (2) We called each other when we got home. (3) The voice of my Moto phone was unclear, but the camera was good. (4) My girlfriend was quite happy with her phone, and its sound quality. (5) I want a phone with good voice quality. (6) So I probably will not keep it.

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- **Aspect sentiment extraction**

- Sentence (3) gives a negative opinion on the voice quality of the Motorola phone, but a positive opinion to its camera
- Sentence (4) gives positive opinions on the Nokia phone as a whole and also its sound quality
- Sentence (5) seemingly expresses a positive opinion, but it does not

- **Opinion quintuple generation (entity, aspect, opinion, holder, time)**

- * (Motorola, voice quality, negative, bigXyz, Nov-4-2010)
- * (Motorola, camera, positive, bigXyz, Nov-4-2010)
- * (Nokia, GENERAL, positive, bigXyz's girlfriend, Nov-4-2010)
- * (Nokia, voice quality, positive, bigXyz's girlfriend, Nov-4-2010)

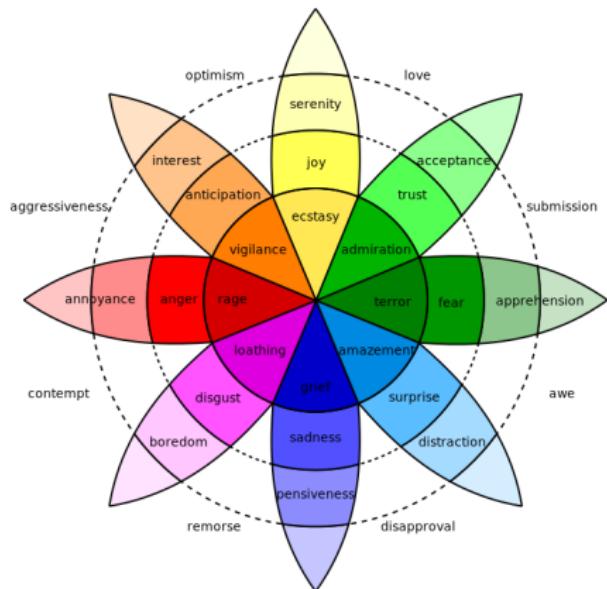
Emotions

Categorical Models

- Six basic emotions [Ekman, 1999]



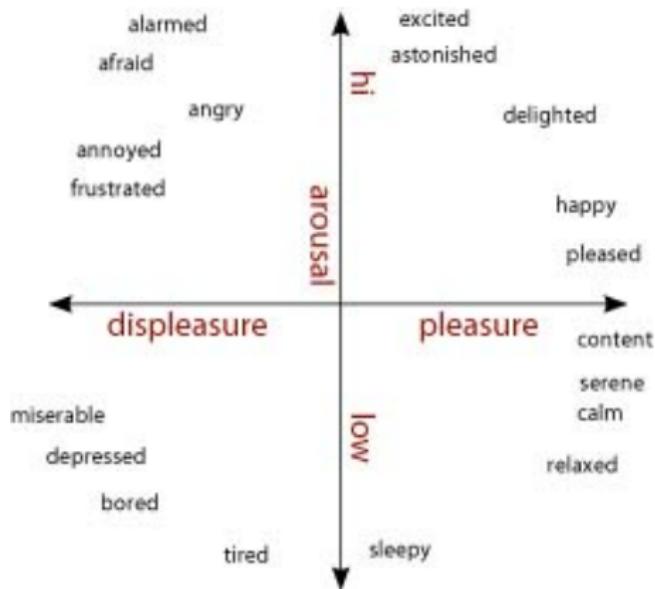
- Wheel of emotions [Plutchik, 2001]



Emotions

Dimensional Model

- Circumplex model of affect [Russell, 1980]
 - Emotions represented in the **Valence–Arousal** axis
 - Sometimes also Dominance



Sentiment Lexicons

word	sentiment	word	valence	arousal	dominance
...
clear	1	clear	0.857	0.327	0.573
clever	2	clever	0.896	0.353	0.729
chaotic	-2	chaotic	0.115	0.847	0.442
cheat	-3	cheat	0.125	0.776	0.400
...
disgusting	-3	disgusting	0.031	0.796	0.245
dishonest	-2	dishonest	0.191	0.491	0.163
dislike	-2	dislike	0.156	0.406	0.321
...
goddamn	-3	goddamn	0.125	0.760	0.422
good	3	good	0.938	0.368	0.534
...
happy	3	happy	1.000	0.735	0.772
hard	-1	hard	0.302	0.708	0.616
harm	-2	harm	0.073	0.679	0.423
...
like	2	like	0.719	0.353	0.446
limited	-1	limited	0.229	0.273	0.380
...
unclear	-1	unclear	0.229	0.463	0.202
...

Sentiment Analysis

Challenges



Sentiment Analysis

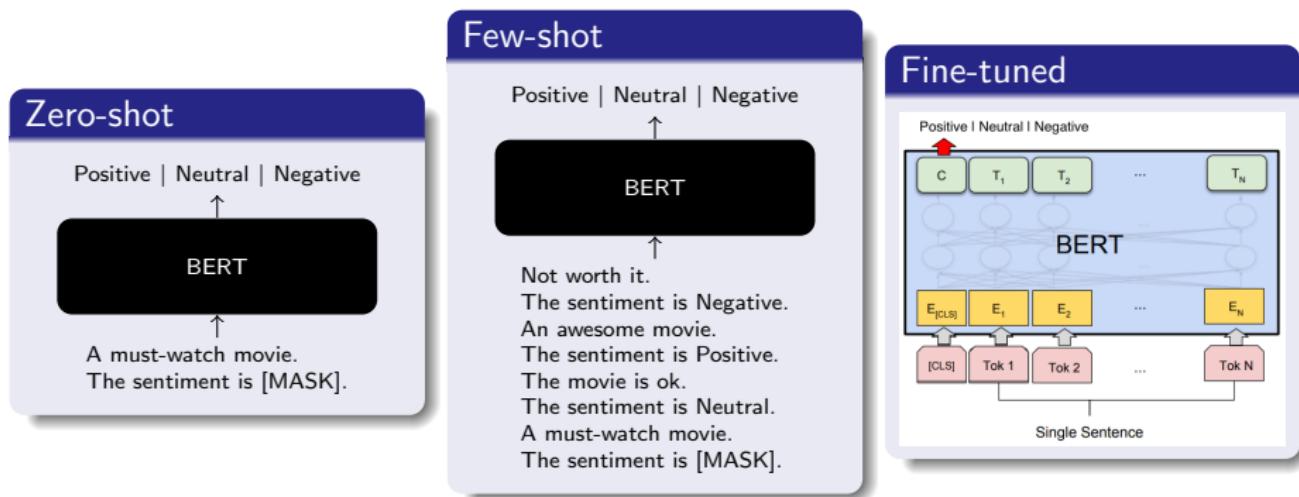
Challenges: lexicons are not enough!

- Negation
 - *The sound of the phone is never good*
 - *I do not dislike phablets*
- Different opinions on aspects of the same item
 - *The voice of my Moto phone was unclear, but the camera was good.*
- Comparative opinions
 - *My Moto camera is as good as its screen.*
- Common challenges of communication in natural language...
 - Anaphora resolution
 - *My girlfriend was quite happy with her phone, and its sound quality.*
 - * *her phone* → the phone of the author's girlfriend
 - * *its* → the sound of the phone of the author's girlfriend
 - Figurative Language, namely irony / sarcasm
 - *What a great car, it failed to start the first day*
 - *Oh, wasn't that clever!*



Text Classification

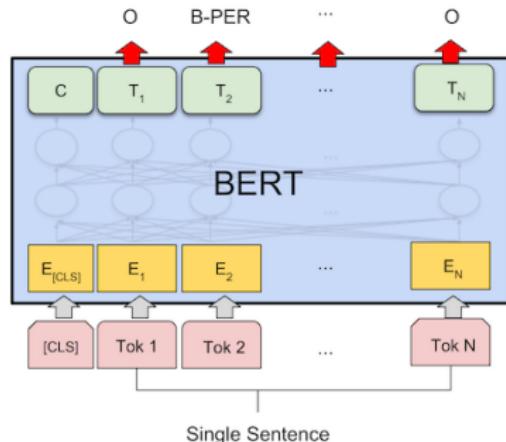
- Sentiment Analysis at the sentence / document level can be tackled with **Text Classification**
 - Subjectivity Analysis: Sentence → {Objective, Subjective}
 - Polarity Classification: Sentence → {Positive, Neutral, Negative}
 - Emotion Recognition: Sentence → {Anger, Joy, Surprise, Disgust, Sadness, Fear}
- Possibly, **Text Regression**
 - Polarity Classification: Sentence → [−1, 1]



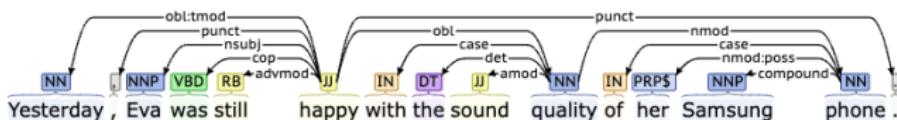
Information Extraction

- For the extraction of **entities**, **aspects**, **opinions**, one can adopt a **Sequence Labelling** approach...

Tokens	Entities	Aspects	Opinions
Yesterday	B-TIME	O	O
Eva	B-PER	O	O
was	O	O	O
still	O	O	O
happy	O	O	B-OP
with	O	O	O
the	O	O	O
sound	O	B-ASP	O
quality	O	I-ASP	O
of	O	O	O
her	O	O	O
Samsung	B-DEV	O	O
phone	I-DEV	O	O
.	O	O	O



- Dependency parsing useful for extracting the **opinion quintuple**



Zero-Shot Information Extraction

11:04

Consider the following sentence: "Yesterday, Eva was still happy with the sound quality of her Samsung phone". Extract its entities, aspects, opinions and conclude with the opinion quintuple.



Copilot, 11:04

Sure! Let's break down the sentence:

**Entities:**

- Eva
- Samsung phone

Aspects:

- Sound quality

Opinions:

- Happy

Opinion Quintuple:

- (Eva, Samsung phone, sound quality, happy, yesterday)

Is there anything else you'd like to analyze or discuss?

Other Text-based Tasks

- Detection of Problematic Language

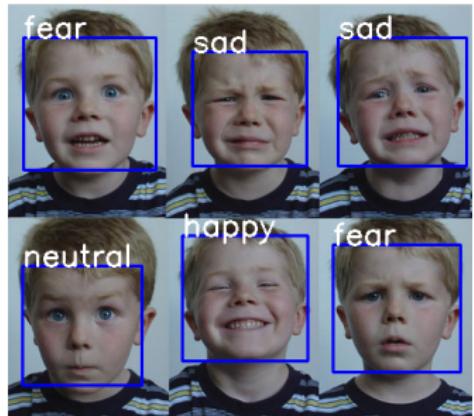
- Toxic
- Offensive
- Hate Speech
- Rumours
- Propaganda
- Patronising and Condescending
- Sexism
- Misogyny
- Intimacy

- Detection of Figurative Language

- Sarcasm
- Humour
- Emoji

Beyond text...

- Emotion Recognition from facial expressions!



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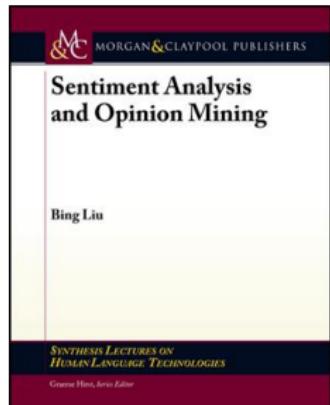
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Questions?

