

Social Media Analytics (SMA)

Sentiment Analysis

Part 1

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DIPARTIMENTO DI
INFORMATICA, SISTEMISTICA E
COMUNICAZIONE

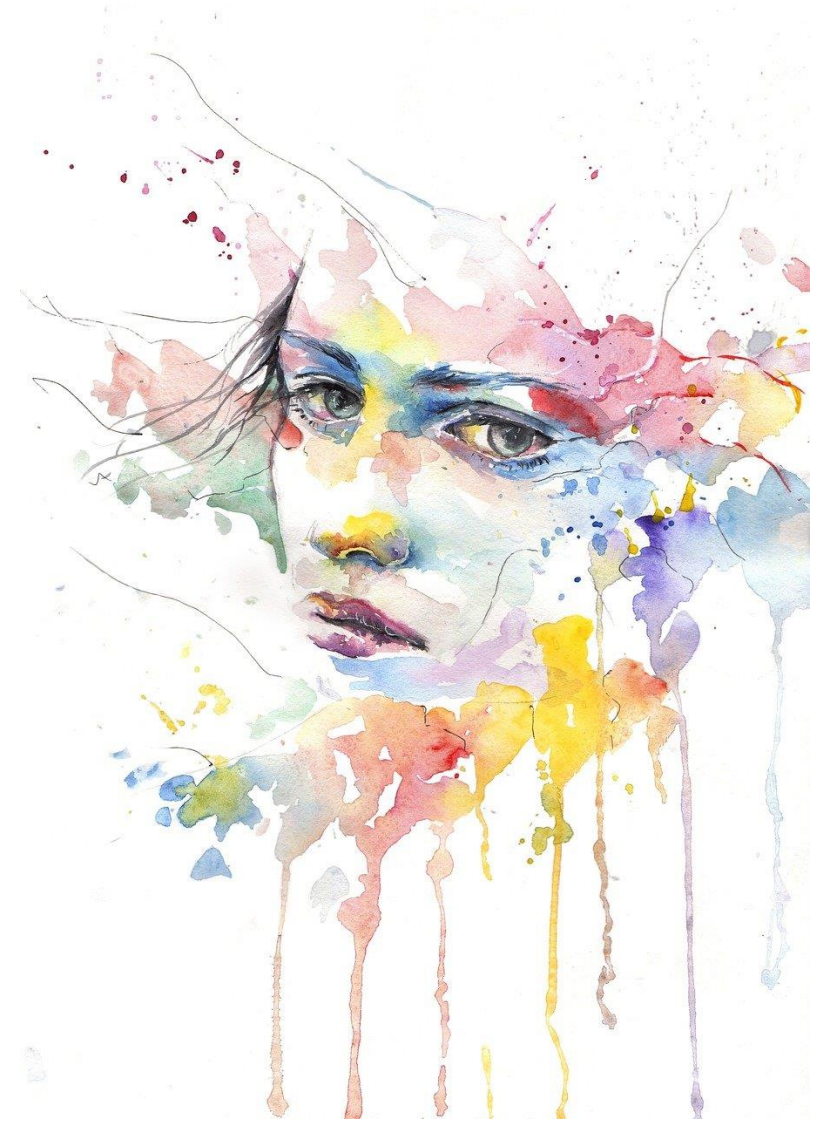
Outline

- The considered **scenario**
 - The importance of emotions
 - Emotions and sentiment in big data
- **Affective computing** and **sentiment analysis**
 - Emotion recognition
 - Polarity detection
 - Applications and usefulness
- Sentiment analysis **definitions**
 - Opinion, sentiment, entity, target, holder, time
 - Opinion summary
- Sentiment analysis **tasks**
- Sentiment analysis **challenges**

Introduction

The Importance of Emotions

- **Emotions** play an important role in successful and effective human-human relationships.
- In many situations, **human emotional intelligence** is more important than IQ for successful interaction.
 - Pantic, M., Sebe, N., Cohn, J. F., & Huang, T. (2005, November). Affective multimodal human-computer interaction. In Proceedings of the 13th annual ACM international conference on Multimedia (pp. 669-676).
- There is also significant evidence that **rational learning** in humans is **dependent on emotions**.
 - Picard, R. W. (1997). Affective Computing.



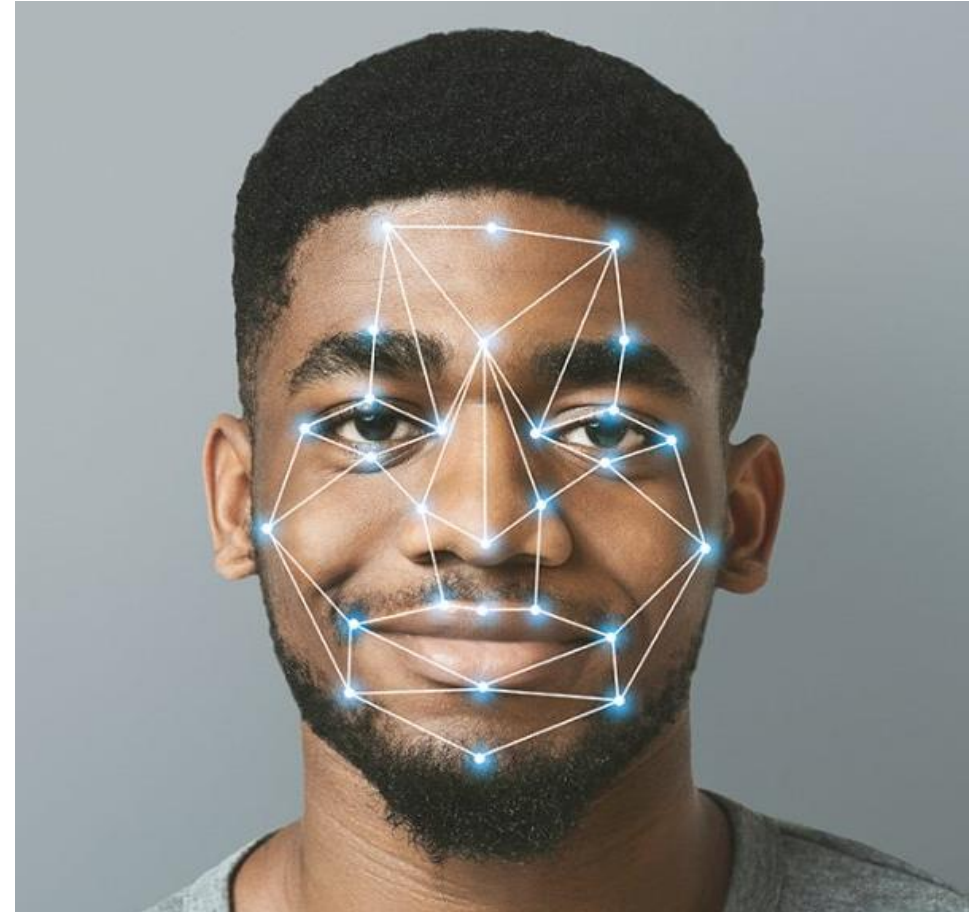
Emotions and Sentiment in Big Data

- There is today an enormous amount of data – **big data** – generated every day on social media, forums, reviews, and other online platforms.
 - A variety of data types and modalities.
 - Text, images, audios, videos, ...
 - Structured/unstructured/semi-structured.
 - Static/interactive.
 - Multi-modal.
- From this mass of data, it is possible to **extract emotions** and **sentiment** expressed by people.
- **Numerous techniques** can be applied for this purpose, which fall into two main categories:
 - **Affective computing**
 - **Sentiment analysis**



Affective Computing

- **Affective computing** is a broader field that encompasses the design and development of systems and devices that can recognize, interpret, and respond to human emotions.
 - It includes a variety of technologies, such as **facial recognition**, **speech analysis**, and **physiological measurements**, to understand and respond to human emotional states.



Sentiment Analysis



- **Sentiment analysis**, also known as **opinion mining**, is a narrower aspect of affective computing.
 - It specifically deals with analyzing and determining the **sentiment or emotional tone** expressed in a piece of text, such as a review, social media post, or customer feedback.

Usefulness for Businesses

- **Customer Feedback and Satisfaction**

- Monitoring sentiment allows businesses to gauge customer opinions about their products and services, overall customer satisfaction, identify areas for improvement, and enhance customer experience.

- **Brand Monitoring, Reputation and Risk Management**

- Sentiment analysis aids in monitoring how the public perceives a brand and to responding promptly to any negative sentiment or crises.

- **Market Research and Competitor Analysis**

- Sentiment analysis can help to identify emerging market trends and consumer preferences in reviews, forums, and social media.
- Monitoring sentiment around competitors helps businesses understand their strengths and weaknesses in the eyes of customers.

- **Social Media Marketing**

- Sentiment analysis informs social media strategies by revealing the types of content that resonate positively with the audience.
- Analyzing sentiment allows businesses to measure the success of marketing campaigns and adjust strategies accordingly.

Usefulness for Individuals

- **Product and Service Decision Making**

- Sentiment analysis assists individuals in making informed decisions about products and services by providing insights from the experiences of others.

- **News and Information Consumption**

- Individuals can use sentiment analysis to gauge the sentiment around news articles, blog posts, and online content, helping them assess credibility and bias.

- **Job Hunting**

- Job seekers can use sentiment analysis to evaluate the reputation of potential employers by analyzing sentiments expressed by current and former employees.

- **Personal Branding**

- Understand the sentiment surrounding their personal brand on social media, allowing individuals to tailor content and engage with their audience more effectively.

- **Education and E-Learning**

- Adaptive learning systems can adjust content based on the learner's engagement and emotional response.

Usefulness for Society

- **Public Opinion Monitoring**

- Government entities can use sentiment analysis to gauge public opinion on different policies, helping policymakers make decisions that align with public sentiment.
- Sentiment analysis can be applied to feedback on public services, allowing for improvements based on citizen feedback.

- **Crisis Response and Emergency Management**

- During emergencies or crises, sentiment analysis can be used as part of early warning systems to monitor social media and detect public sentiment, helping emergency responders allocate resources effectively.

- **Healthcare**

- Sentiment analysis on social media can aid in monitoring public sentiment during disease outbreaks, providing insights into the public's concerns and perceptions.
- Monitoring sentiment in online forums and social media can contribute to identifying individuals expressing signs of mental health challenges, allowing for targeted support.

Emotion Recognition and Polarity Detection (1)

- The basic tasks of affective computing and sentiment analysis are **emotion recognition** and **polarity detection**.
- **Emotion recognition** involves identifying and categorizing the specific emotions expressed by an individual.
 - Emotions can include **happiness**, **sadness**, **anger**, **fear**, and more.
 - This task often requires analyzing various modalities such as facial expressions, voice tone, and body language.
- **Polarity detection** focuses on determining the sentiment or polarity of a piece of text, typically classifying it as positive, negative, or neutral.
 - This analysis is applied to textual data like reviews, comments, or social media posts.

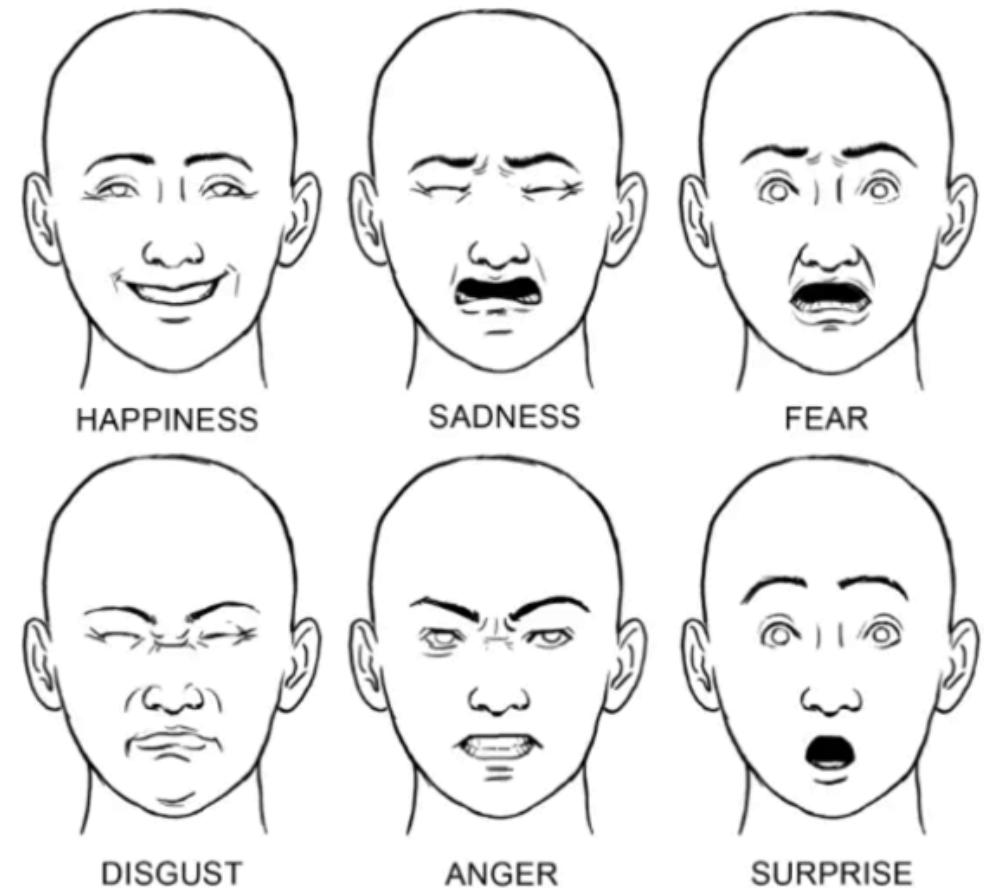
Theories of Emotion

- A **theory of emotion** in psychiatric and neuroscience research posits that humans are evolutionarily endowed with a **discrete and limited set of basic emotions**.
 - Ekman's six basic emotions.
 - Plutchik's «wheel» of emotions.
- A more complex model has been proposed.
 - The circumplex model of affect.

Basic Emotion Classification Models (1)

- **Ekman's six basic emotions**

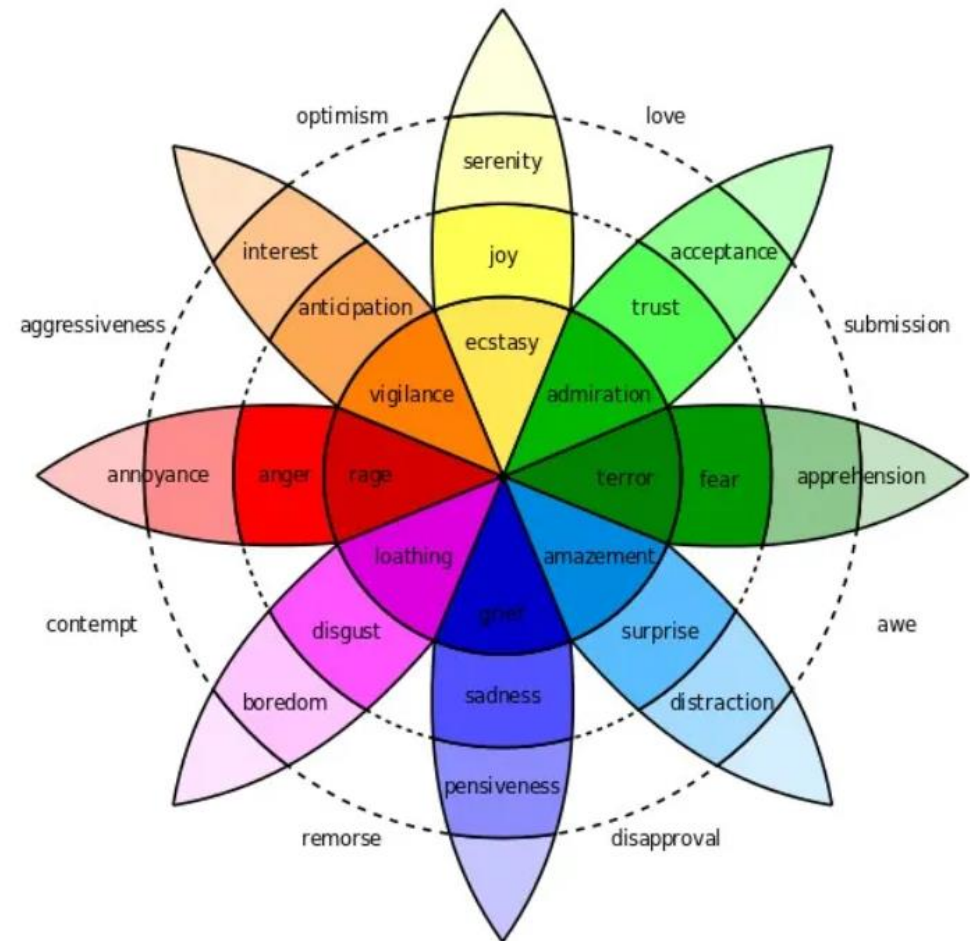
- Six basic emotions identified by psychologist Paul Ekman.
- Happiness, sadness, surprise, fear, anger, disgust.
- They can be used as discrete categories or mapped onto a scale to represent the intensity of each emotion.



Basic Emotion Classification Models (2)

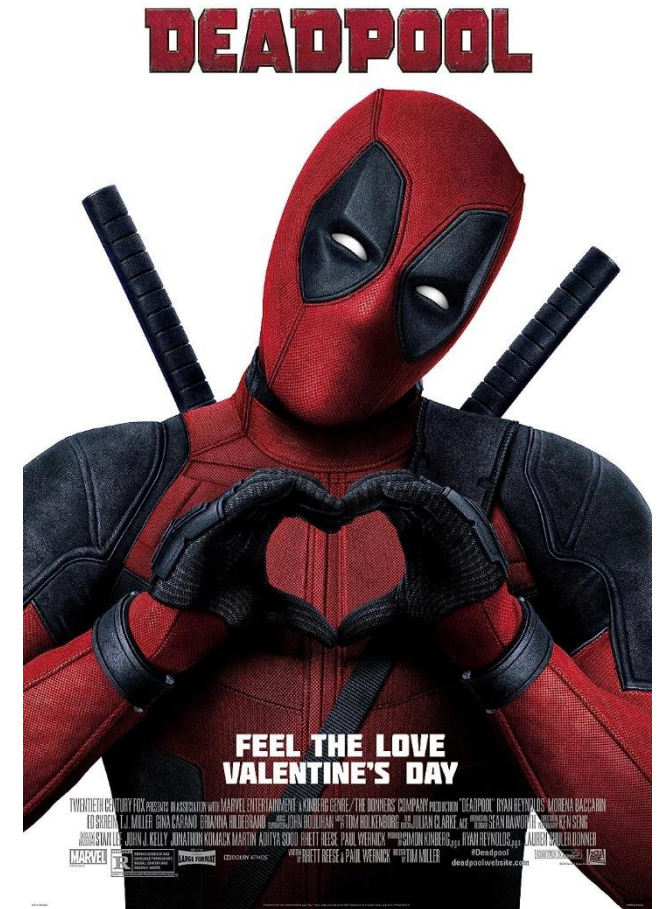
- **Plutchik's wheel of emotions**

- Psychologist Robert Plutchik proposed a model that organizes emotions into primary and secondary categories.
- Joy, trust, fear, surprise, sadness, disgust, anger, and anticipation.
- The intensity of each emotion can be represented on a scale.



Plutchik's Wheel of Emotions: Example

- [Anger] #DeadpoolI wasted time and money grrrrrrrrr
- [Anticipation] Can't wait to see Deadpool!!!
- [Joy] Deadpool was A-M-A-Z-I-N-G
- [Trust] Best movie ever #Deadpool! Trust me!
- [Fear] Saw #Deadpool last night. I was frightened during some crude scenes
- [Surprise] Much to my surprise, I actually liked Deadpool
- [Sadness] I finally got to watch deadpool and im so sad this is so boring
- [Disgust] Deadpool is everything I hate about our century combined in the trashiest movie possible

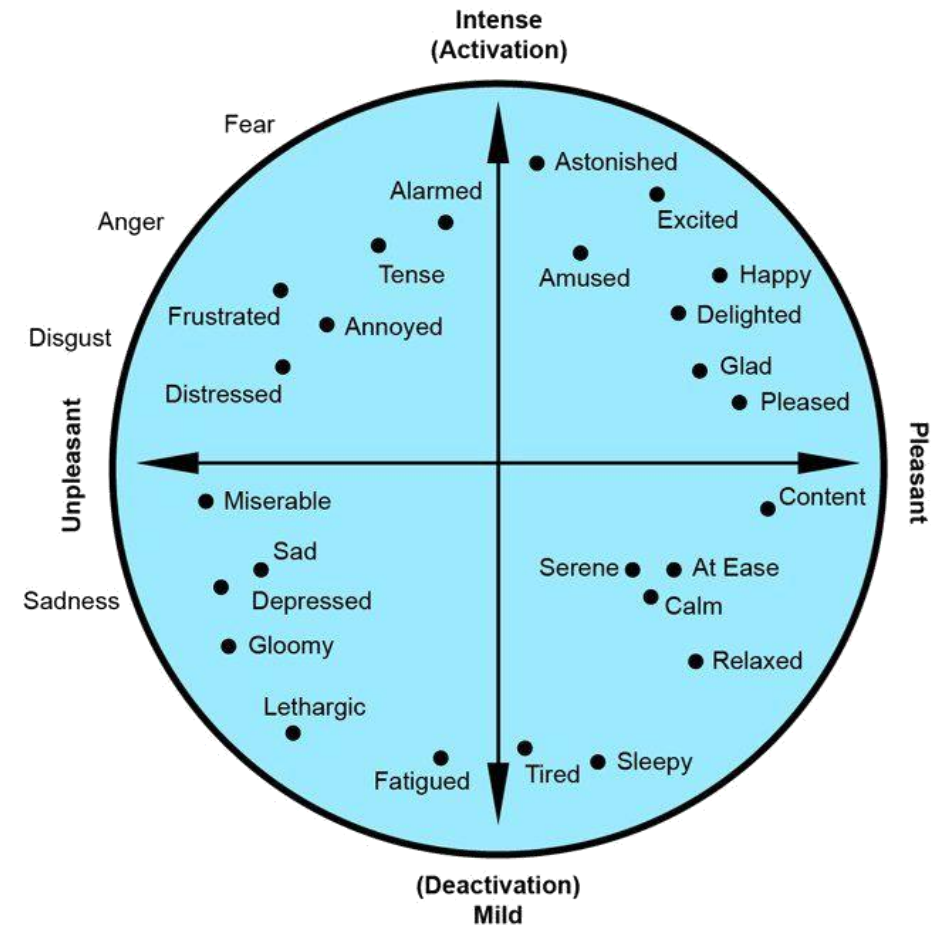


The Circumplex Model of Affect (1)

- The **circumplex model of affect** proposes that all affective states arise from cognitive interpretations of core neural sensations that are the product of two independent neurophysiological systems.
- This model stands in contrast to theories of basic emotions, which posit that a discrete and independent neural system subserves every emotion.
- In this model the structure of human emotions are based on two primary dimensions: **valence** and **arousal**.

The Circumplex Model of Affect (2)

- The horizontal axis representing the **valence** dimension.
 - The **positivity** or **negativity** of an emotion.
- The vertical axis representing the **arousal** or activation dimension.
 - The **intensity** or **arousal** level of an emotion.



Emotion Recognition and Polarity Detection (2)

- The basic tasks of affective computing and sentiment analysis are emotion recognition and polarity detection.
- **Emotion recognition** involves identifying and categorizing the specific emotions expressed by an individual.
 - Emotions can include happiness, sadness, anger, fear, and more.
 - This task often requires analyzing various modalities such as facial expressions, voice tone, and body language.
- **Polarity detection** focuses on determining the sentiment or **polarity** of a piece of text, typically classifying it as **positive**, **negative**, or **neutral**.
 - This analysis is applied to textual data like reviews, comments, or social media posts.

Opinionated Text

opinion noun

opin·ion ə-ˈpin-yən 

[Synonyms of opinion >](#)

1 a : a view, judgment, or appraisal formed in the mind about a particular matter

| We asked them for their *opinions* about the new stadium.

b : **APPROVAL, ESTEEM**

| I have no great *opinion* of his work.



- Under the assumption that the considered input is **opinionated**, and it is about one single issue or item, new challenging tasks arise.
 - E.g., subjectivity detection, opinion target identification, and more.
 - (Cambria et al. 2015).
- A text can also have a polarity **without necessarily containing an opinion**.
 - E.g., a news article can be classified into good or bad news without being subjective.

Opinion in Sentiment Analysis

- In sentiment analysis, the term **opinion** can be used as a **broad concept** that covers **sentiment**, **evaluation**, **appraisal**, or **attitude**, and its associated information such as opinion target and the person who holds the opinion.
 - Liu, B. (2017). Many facets of sentiment analysis. A practical guide to sentiment analysis, 11-39. https://doi.org/10.1007/978-3-319-55394-8_2
- The term **sentiment** can be used to mean only the underlying **positive or negative feeling** implied by opinion.
- Due to the need to analyze a large volume of opinions, in defining opinion we consider two levels of abstraction:
 - A **single opinion**.
 - A **set of opinions** (opinion summary).

Sentiment Analysis Definitions

Anatomy of a Review

Review α

Posted by: *John Smith*

Date: *September 10, 2011*

(1) I bought a Canon G12 camera six months ago. (2) I simply love it. (3) The picture quality is amazing. (4) The battery life is also long. (5) However, my wife thinks it is too heavy for her.

Opinion: Examples

(1) I bought a Canon G12 camera six months ago. (2) I simply love it. (3) The picture quality is amazing. (4) The battery life is also long. (5) However, my wife thinks it is too heavy for her.

- Review α has **several opinions** about the Canon G12 camera.
 - Sentence (2) expresses an **opinion** about the Canon camera as a whole.
 - Sentence (3) expresses an **opinion** about its picture equality.
 - Sentence (4) expresses an **opinion** about its battery life.
 - Sentence (5) expresses an **opinion** about the camera's weight.

Opinion: Sentiment and Target

An **opinion** has **two key components**:

- A **target** g .
 - g can be any **entity** or **aspect/attribute of the entity** on which an opinion has been expressed.
- A **sentiment** s on the target, i.e., (g, s) .
 - s can be a **positive**, **negative**, or **neutral** sentiment, or a **numeric rating**.

Opinion: Entity

- An **entity** e is a product, service, topic, person, organization, issue or event.
 - An entity can be decomposed and represented **hierarchically**.
- It is described with a pair, $e: \langle T, W \rangle$ where T is a hierarchy of parts, sub-parts, and so on, and W is a set of **aspects/attributes** a of e .
 - This definition describes an entity hierarchy based on the **part-of relation**.
 - Each part or sub-part also can have also its own set of aspects/attributes.
 - The Canon G12 camera has a set of attributes, e.g., **picture quality**, **size**, and **weight**, and a set of parts, e.g., **lens**, **viewfinder**, and **battery**.
 - Battery also has its own set of attributes, e.g., battery life and battery weight.
 - A **topic** can be an entity too, e.g., tax increase, with its subtopics or parts 'tax increase for the poor,' 'tax increase for the middle class' and 'tax increase for the rich.'

Target and Entity: Examples

(1) I bought a Canon G12 camera six months ago. (2) I simply love it. (3) The picture quality is amazing. (4) The battery life is also long. (5) However, my wife thinks it is too heavy for her.

- Sentence (2) → **Target** → **Entity**: the Canon G12 camera.
- Sentence (3) → **Target** → **Aspect** of the entity → Picture quality of Canon G12
- Sentence (4) → **Target** → **Aspect** of the entity → Battery life of Canon G12
- Sentence (5) → **Target** → **Aspect** of the entity → Weight of Canon G12

Target, Entity, and Sentiment: Examples

(1) I bought a Canon G12 camera six months ago. (2) I simply love it. (3) The picture quality is amazing. (4) The battery life is also long. (5) However, my wife thinks it is too heavy for her.

- Sentence (2) → A **positive** sentiment about the Canon camera as a whole.
- Sentence (3) → A **positive** sentiment about its picture equality.
- Sentence (4) → A **positive** sentiment about its battery life.
- Sentence (5) → A **negative** sentiment about the camera's weight.

Sentiment: Definition

- **Sentiment** is the underlying feeling (or attitude, evaluation, etc.), associated with an opinion.
- It is represented as a **triple**:

$$\langle y, o, i \rangle$$

where y is the **type** of the sentiment, o is the **orientation** of the sentiment, and i is the **intensity** of the sentiment.

Sentiment Type

- Sentiment can be classified into **several types**.
 - Linguistic-based.
 - Psychology-based.
 - **Consumer research-based**.
 - The simpler and easy to use in practice.
- Consumer research classifies sentiment broadly into two categories:
 - **Rational sentiment**
 - **Emotional sentiment**
 - Chaudhuri, A. (2006). Emotion and reason in consumer behavior. Routledge.

Rational Sentiment

- **Rational sentiments** are from rational reasoning, tangible beliefs, and utilitarian attitudes.
- They express **no emotions**.
- We also call opinions expressing rational sentiment the **rational opinions**.
 - The voice of this phone is clear
 - This car is worth the price

Emotional Sentiment

- **Emotional sentiments** are from non-tangible and emotional responses to entities which go deep into people's psychological state of mind.
- We also call opinions expressing emotional sentiment the **emotional opinions**.
 - I love iPhone
 - I am so angry with their service people
 - After our team won, I cried
- **Emotional sentiment is stronger** than rational sentiment and is usually more important in practice.
 - E.g., in marketing, to guarantee the success of a new product, the positive sentiment from a large population of consumers has to reach the emotional level.

Sentiment Orientation

- It can be **positive**, **negative**, or **neutral**.
- **Neutral** usually means the absence of sentiment or no sentiment or opinion.
- Sentiment orientation is also called **polarity**, semantic orientation, or **valence** in the research literature.

Sentiment Intensity

- Sentiment can have different levels of **strength** or **intensity**.
- People often use **two ways to express intensity** of their feelings in text.
 - The first is to choose **sentiment terms** (words or phrases) with suitable strengths.
 - The second is to use **intensifiers** and **diminishers**, which are terms that change the degree of the expressed sentiment.

Sentiment Intensity: Terms

- **Sentiment terms** (words or phrases) with suitable strengths.
 - Sentiment terms are words in a language that are often used to express positive or negative sentiments.
 - For example, good, wonderful, and amazing are positive sentiment words, and bad, poor, and terrible are negative sentiment words.
 - Intensity: e.g., good is weaker than excellent, and dislike is weaker than detest.

I **liked** that restaurant

That restaurant is **awesome**!

Sentiment Intensity: Intensifiers/diminishers

- **Intensifiers** and **diminishers**, which are terms that change the degree of the expressed sentiment.
 - An intensifier increases the intensity of a positive/negative term, while a diminisher decreases the intensity of that term.
 - Common English intensifiers include very, so, extremely, dreadfully, really, awfully, terribly, etc., and common English diminishers include slightly, pretty, a little bit, a bit, somewhat, barely, etc.

I **really** liked that restaurant

That restaurant is **fu**ing** awesome!

Sentiment Rating

- In applications, we commonly use some **discrete ratings** to express sentiment intensity.
- **Five levels** (e.g., 1–5 stars) are commonly employed.
- They can be **interpreted** as follows based on the two types of sentiment.
 - **Emotional positive** (5 stars)
 - **Rational positive** (4 stars)
 - **Neutral** (3 stars)
 - **Rational negative** (2 stars)
 - **Emotional negative** (0 or 1 stars)

Opinion: Holder and Time

(1) I bought a Canon G12 camera six months ago. (2) I simply love it. (3) The picture quality is amazing. (4) The battery life is also long. (5) However, my wife thinks it is too heavy for her.

- The review contains **opinions from two persons**, who are called opinion sources or opinion **holders**.
 - The holder of the opinions in sentences (2), (3), and (4) is the author of the review (“John Smith”), but for sentence (5), it is the wife of the author.
- **Time of opinion**: the date of the review was September 10, 2011.
 - This date is useful because one often wants to know **how opinions change over time** or the opinion trend.

Opinion: Formal Definition (1)

- An **opinion** is a quintuple:

$$\langle e, g, s, h, t \rangle$$

- e is the **target entity**,
- g is the **target aspect** of entity e on which the opinion has been expressed,
- s is the **sentiment** of the opinion on aspect a of entity e ,
- h is the **opinion holder**,
- t is the **opinion posting time**.

Opinion: What to Assess? (1)

- Sentiment analysis (or opinion mining) based on this definition is often called **aspect-based sentiment analysis**.
- When an opinion is only **on the entity as a whole**, the special aspect **GENERAL** is used to denote it. Here, e and a together represent the opinion target.

Opinion: What to Assess? (2)

- In some applications, it **may not be easy to distinguish entity and aspect** or there is **no need** to distinguish them.
- Such cases often occur when people discuss **political** or **social issues**.
 - E.g., *I hate property tax increases*
 - We can treat “**property tax increase**” as a general issue → an entity with the aspect GENERAL.
 - We can regard “**property tax**” as an entity and “**property tax increases**” as one of its aspects to form a hierarchical relationship.
- Whether treating an issue/topic as an aspect or an entity can also depend on the **specific context**.

Opinion Summary (1)

- An opinion from a single opinion holder is usually not sufficient for action.
 - In almost all applications, the user/system needs to analyze opinions from a large number of opinion holders.
- This tells us that some form of summary of opinions is necessary.
- The question is what an opinion summary should be.

Opinion Summary (2)

- An **opinion summary** is just like a multi-document summary because we need to summarize multiple opinion documents, e.g., reviews.
 - It is, however, very different from traditional multi-document summary.
- The core form of opinion summary is called the **aspect-based opinion summary**.

Aspect-based Opinion Summary: Definition

- The **aspect-based opinion summary** about an entity e is of the following form:
 - **GENERAL**: number of opinion holders who are positive about entity e number of opinion holders who are negative about entity e .
 - **Aspect 1**: number of opinion holders who are positive about aspect 1 of entity e number of opinion holders who are negative about aspect 1 of entity e .
 - ...
 - ...
 - **Aspect n** : number of opinion holders who are positive about aspect n of entity e number of opinion holders who are negative about aspect n of entity e .

where GENERAL represents the entity e itself and n is the total number of aspects of e .

Aspect-based Opinion Summary: Example

- To illustrate this form of summary, we summarize a **set of reviews** of a digital camera.

Digital Camera 1:

Aspect: **GENERAL**

Positive: 105 <Individual review sentences>

Negative: 12 <Individual review sentences>

Aspect: **Picture quality**

Positive: 75 <Individual review sentences>

Negative: 42 <Individual review sentences>

Aspect: **Battery life**

Positive: 50 <Individual review sentences>

Negative: 9 <Individual review sentences>

...

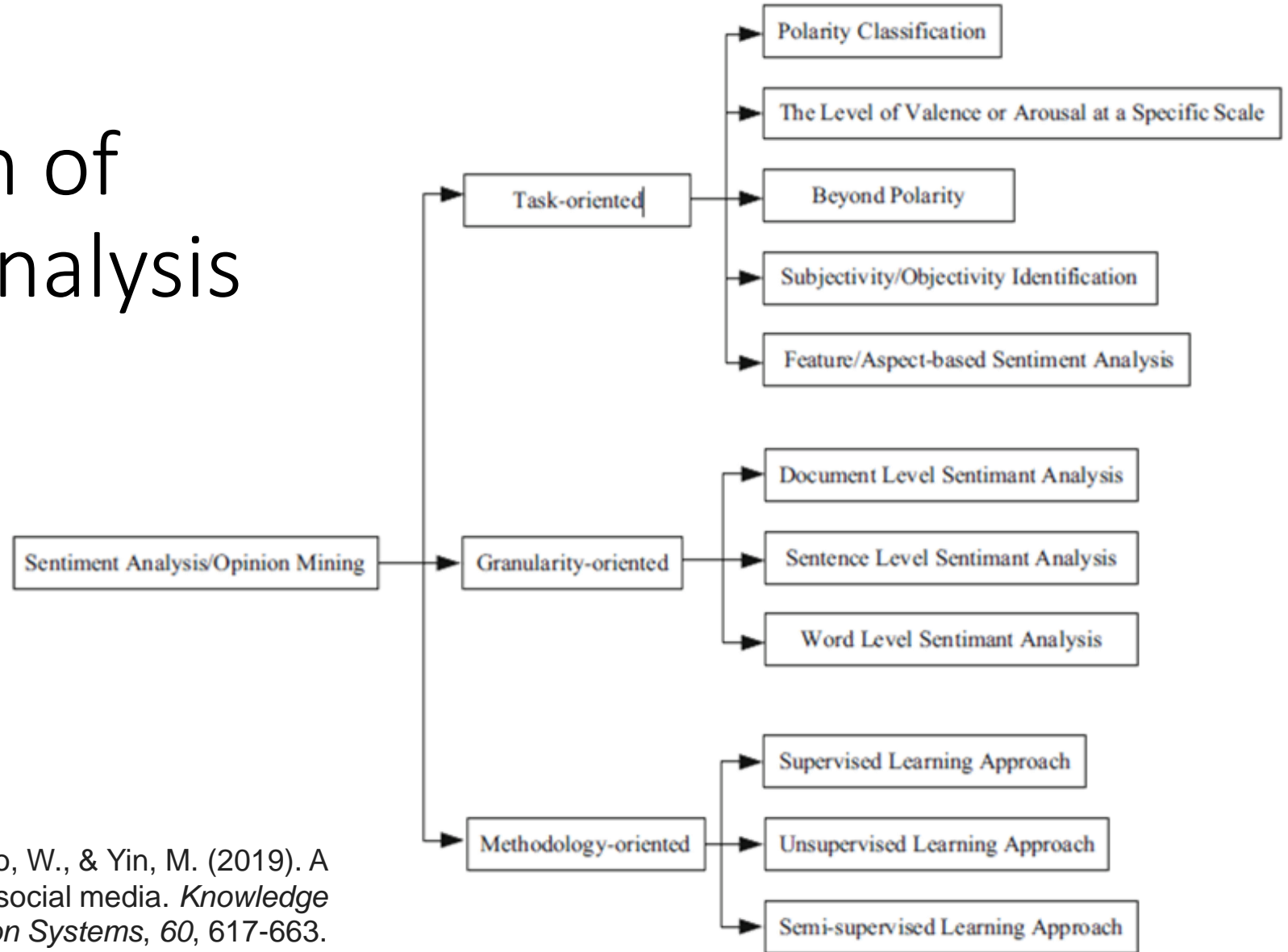
- This is called a **structured summary** in contrast to a traditional text summary of a short document generated from one or multiple long documents.
- In the figure, 105 reviews expressed positive opinions about the camera itself denoted by GENERAL and 12 expressed negative opinions.
- Picture quality and battery life are two camera aspects.
 - Picture quality: 75/42
 - Battery life: 50/9

Aspect-based Opinion Summary: Aggregation

- In an **application**, the number counts is often replaced by **percentages**.
- The quantitative perspective is especially important in practice.
- For example, 20% of the people positive about a product is very different from 80% of the people positive about the product.

Sentiment Analysis Tasks

A Possible Classification of Sentiment Analysis Tasks



From: Yue, L., Chen, W., Li, X., Zuo, W., & Yin, M. (2019). A survey of sentiment analysis in social media. *Knowledge and Information Systems*, 60, 617-663.

Task-oriented SA: Polarity (1)

- Basic research of sentiment analysis is **polarity classification**, which explores whether the expressed opinion in a document or a sentence, on a certain feature or aspect of a target, is **positive**, **negative**, or **neutral**.
- Sentiment classification can usually be seen as a **two-class (binary) classification problem**. In this type of research, sentiment analysis is essentially a **text classification problem**, in which **feature selection** has important effects on the performance of classification algorithm.
 - In **text classification**, feature selection techniques are used for simplifying the models to make them easier to be interpreted, reducing training times, and enhancing generalization by overcoming the problem of overfitting.
 - In **sentiment classification**, feature words should be sentiment words that indicate a certain polarity, which needs to process more complex semantics.

Task-oriented SA: Polarity (2)

- Researchers studied the **several types of features** and found that using unigrams features gets better performance compared to other different feature selection strategies.
 - Two machine learning methods on sentiment classification task do not perform as well as on traditional text classification task.
 - Like traditional classification task, the key to sentiment classification task is also selecting effective features.

Table 3 The candidate features for sentiment classification

Feature types	Descriptions	Examples
Terms and their frequency	Frequency counts of individual words and their n-grams	TF-IDF weighting scheme
Part of speech	As important indicators of opinions, adjectives are treated as special features	–
Sentiment words and phrases	Words that are used to express negative or positive sentiments	Positive sentiment words such as good, wonderful, and amazing Negative sentiment words such as bad, poor, and terrible Nouns such as rubbish, junk, and crap Verbs such as hate and love
Rules and opinions	Individual sentiment words with implied sentiments or compound expressions and their orientations determined by domain knowledge	Compositional semantics
Sentiment shifters	Expressions that could change the sentiment orientations	Negation words of the most common type of sentiment shifters such as not, never, none, nobody, nowhere, neither, and cannot Modal auxiliary verbs such as would, should, could, might, must, and ought Words such as fail, omit, neglect, less Sarcasm often changes orientations
Syntactic dependency	Features with word dependency generated from parsing or dependency trees	–

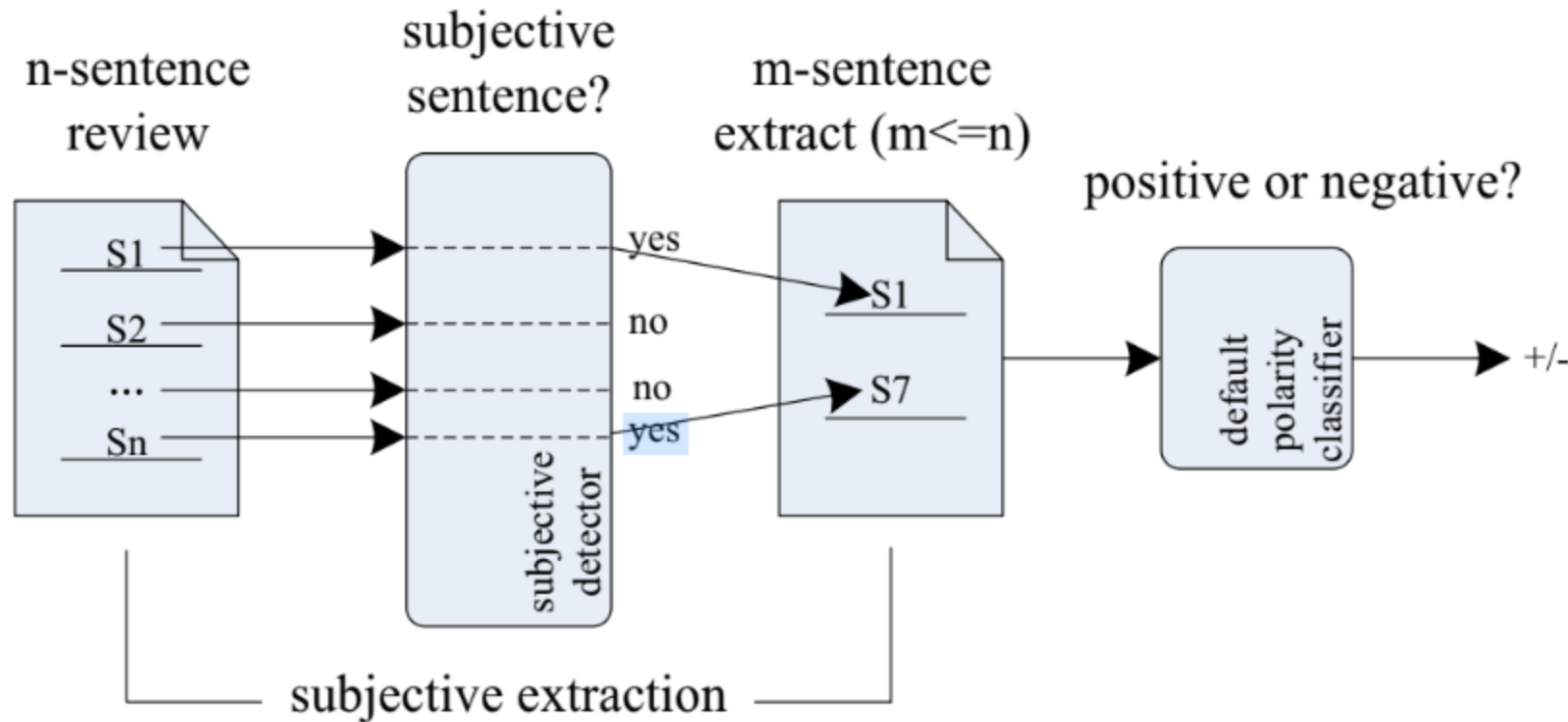
Task-oriented SA: Valence and Arousal

- **Valence**: Refers to the positivity or negativity of an emotion. It ranges from highly negative to highly positive.
- **Arousal**: Represents the level of excitement or calmness associated with an emotion. It ranges from low arousal (calm) to high arousal (excited).
- The **Valence-Arousal-Dominance** (VAD) model is a psychological framework that aims to represent and measure the three fundamental dimensions of emotional experience: **valence**, **arousal**, and **dominance**.
 - **Dominance**: Indicates the level of control or influence associated with an emotion.
 - It ranges from low dominance (submissive) to high dominance (dominant).

Task-oriented SA: Subjectivity or Objectivity (1)

- The task of allocating a given text (usually a sentence) into one of two categories: **subjective** or **objective**.
- Sometimes, it can be **more difficult than polarity classification** problem.
 - For example, the **subjectivity of words or phrases usually depends on the context**, but an objective chapter such as a news article may quote people's opinions which are subjective sentences.
 - It could be **helpful to remove objective sentences** from a document before classifying its sentiment polarity.

Task-oriented SA: Subjectivity or Objectivity (2)



Task-oriented SA: Subjectivity or Objectivity (2)

I watched a really good movie yesterday during bad weather. It made me happy.

Subjective?

Objective?

Mixed?

Task-oriented SA: Beyond Polarity

- The goal of researches in the area of **fine-grained opinion analysis** is to identify subjective expressions in text, along with their associated sources and targets.
- More specifically, fine-grained opinion analysis aims to identify types of opinion entities such as **opinion holders, opinion expressions, opinion targets, aspects of a target, opinion sources**.

Task-oriented SA: Feature or Aspect-based (1)

- In the context of sentiment analysis, **aspect extraction** is different from entity extraction.
 - A feature or an aspect is an attribute or a component of an entity.
- This problem involves **subproblems** such as:
 - Identifying **relevant entities**.
 - Extracting their **features** or **aspects**.
 - Determining whether an **opinion expressed on each aspect** or feature is positive, negative, or neutral.

Task-oriented SA:

Feature or Aspect-based (2)

- When people comment on different aspects of an entity, the **words** that they use **usually converge** together.
 - Find **frequently used nouns** and consider them as significant.
 - Quite simple method, but actually **effective**.
- Basically, aspect-based analysis needs to **find explicit aspect expressions**, which usually are **nouns** and **noun phrases** from the text of given domain.
 - These nouns and phrases can be identified by a **Part-of-Speech tagger** (PoS tagger).

Sentiment Analysis Challenges

Challenges in Sentiment Analysis

- Sentiment at different **text granularities**.
- Sentiment of the **writer, reader, and other opinion holders**.
- Sentiment towards **aspects** of an entity.
- Detecting **affect** and **emotions**.
- **Negated** expressions.
- Phrases with **degree adverbs, intensifiers, and modals**.
- Sentiment in **figurative expressions**.
- Sentiment of **social media content**.

Ambiguity in Natural Language

- Ambiguities in natural language arise due to the inherent complexity, richness, and context-dependent nature of human communication.

I made her duck

How many meanings?

Ambiguity in Natural Language

- Ambiguities in natural language arise due to the inherent complexity, richness, and context-dependent nature of human communication.

I made her duck

- Q1a: What did you cook for Mary last night?
- A1a: I made her duck (I cooked a duck for her)

Ambiguity in Natural Language

- Ambiguities in natural language arise due to the inherent complexity, richness, and context-dependent nature of human communication.

I made her duck

- Q1b: What did you cook for Mary last night?
- A1b: I made her duck (I cooked the duck that belongs to her)

Ambiguity in Natural Language

- Ambiguities in natural language arise due to the inherent complexity, richness, and context-dependent nature of human communication.

I made her duck

- Q2: Did you tell Mary to watch her head?
- A2: I made her duck (*I caused her to quickly lower her head/body*)

Ambiguity in Natural Language

- Ambiguities in natural language arise due to the inherent complexity, richness, and context-dependent nature of human communication.

I made her duck

- Q3: What animal did you turn Mary into?
- A3: I made her duck
(I put a spell on her and turned her into a duck)

Ambiguity in Natural Language

- Syntactic ambiguity
- Semantic ambiguity
- Pragmatic ambiguity
- Emotional ambiguity

Syntactic Ambiguity

- **Syntactic ambiguity** occurs when a sentence or phrase can be parsed in multiple ways due to the structure of the language, leading to different possible interpretations.

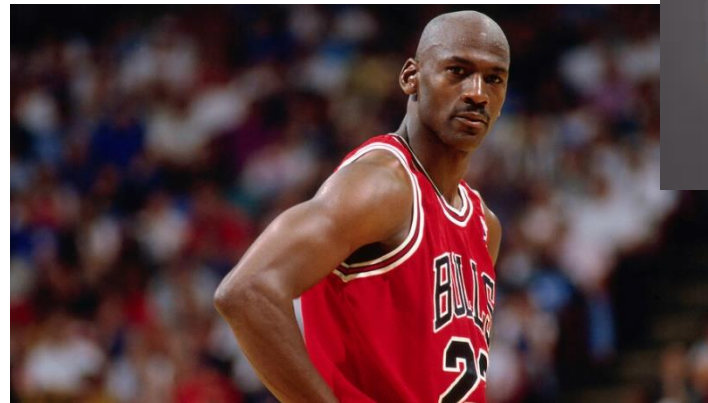
They ate pizza with
anchovies



Creative Commons Attribution-NonCommercial 2.5
James Constable, 2010

Semantic Ambiguity

- **Polysemy**: e.g., «chief»
 - The chief of Italy is a woman
 - The chief reason for the delay was the weather
- **Named entities**: e.g., «Michael Jordan». He is ...
 - ... a professor at Berkeley
 - ... a former basketball player.
- **Object/color**: e.g., cherry.
 - Your cherry coat



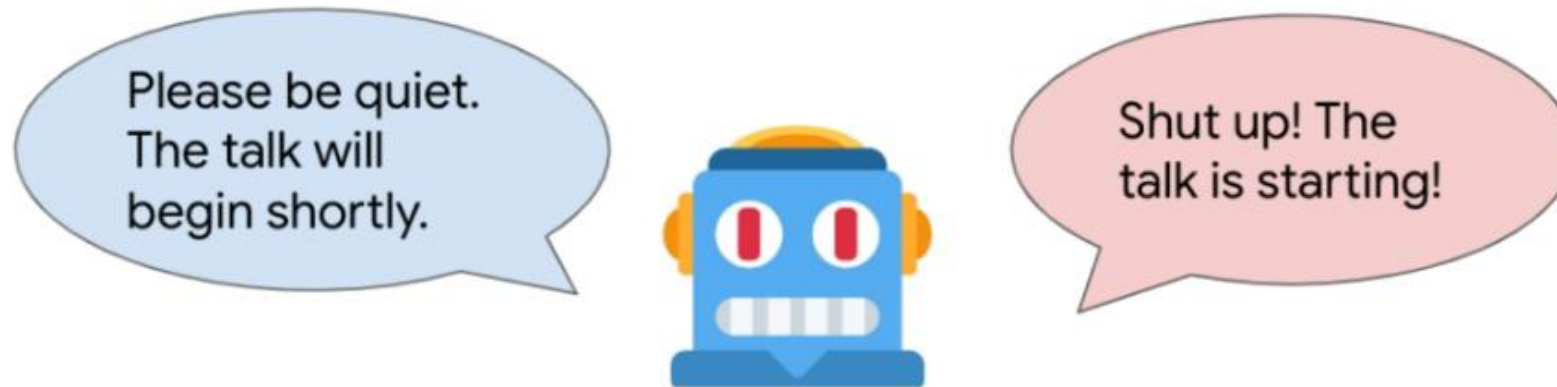
Pragmatic Ambiguity

- **Pragmatic ambiguity:** it arises from the nuances of meaning, implications or specific contexts of a communication.
 - Not from the grammatical structure or literal semantics of words.
- Do you know what time it is?
 - One actually wants to know what the time is.
 - One expresses anger about someone being late for an appointment.



Emotional Ambiguity (1)

- Not only can one lexical form have different meanings (semantic ambiguity), but **the same meaning can be expressed in different forms** (with different emotions).



Emotional Ambiguity (2)

- The **same expression** can be interpreted with its signification or with its opposite meaning than, for example, the **irony** used.



Today is Marco Viviani's lecture
on Sentiment Analysis, can't wait

can't wait! 😊

can't wait... 😞

