

WHAT ARE THE CHALLENGES OF NEURAL MODELS FOR SENTIMENT ANALYSIS?

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LOOKING FOR PHD STUDENTS

- Project : building transparent and performant neural models for socio-conversational systems
- Looking for PhD students in speech and natural language processing and social computing

WHAT IS SENTIMENT?



- *Sentiment analysis* in English not exactly the same as *Analyse de sentiments* in French
- Sentiment has several senses in English :
 - feeling: *She experiences a sentiment of nostalgia*
 - opinion: *My sentiment is that this project isn't working and we need to rethink it.*
 - exaggerated emotion: *That film has too much sentiment for my taste*
- Sentiment has several - but different - senses in French
 - Impression, feeling: *Dans cette affaire j'ai le sentiment que tu te trompes.*
 - Intention: *C'est une personne qui a de très bon sentiments*
 - Avis, opinion: *Il est difficile de partager le même sentiment que toi sur cette affaire.*

Examples from wordreference

SENTIMENT TERM OR EQUIVALENT IN THE LITERATURE

- Sentiment analysis is used broadly in literature to analyze emotions, opinions, stances, affects, mood, etc.
- Equivalent terms:
 - opinion mining, subjectivity analysis, stance detection, affect sensing, emotion detection, ...
- Study of specific categories
 - Fear (emotions)
 - Hate-speech (an extremely strong dislike: attitude or interpersonal stance)
 - Condescension (attitude or interpersonal stance)
 - Sarcasm detection (interpersonal stance)
 - Likes and dislikes (attitude)

Langlet, C. and Clavel, C. Improving social relationships in face-to-face human-agent interactions: when the agent wants to know user's likes and dislikes, ACL 2015



BUT THEY ARE DIFFERENT PHENOMENA...

- Ex. Scherer's definitions from psychology [Scherer, 2005]
 - **Emotion:** short phenomenon, physiological reaction, appraisal of a major event (stimulus)
 - **Mood:** diffuse non-caused low-intensity long-duration change in subjective feeling
 - **Interpersonal stances:** affective stance toward another person in a specific interaction
 - **Attitudes:** enduring, affectively colored beliefs, dispositions towards objects or persons
 - **Personality traits:** stable personality dispositions and typical behavior tendencies
- PRACTICE: link the following terms to the most relevant phenomenon
 - liking, gloomy, contemptuous, jealous, sad

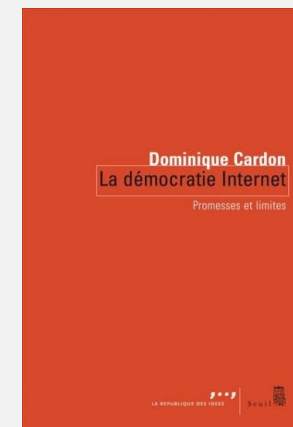
INTRODUCTION TO SENTIMENT ANALYSIS: APPLICATIONS

Social Data analysis

Human-agent interaction (ex: chatbot)

COMPUTATIONAL SOCIAL SCIENCES/ SOCIAL DATA ANALYSIS

- Social data: text data from social network
 - Expressions of the citizens on the web
- Context
 - opportunities for criticism and action via the Internet

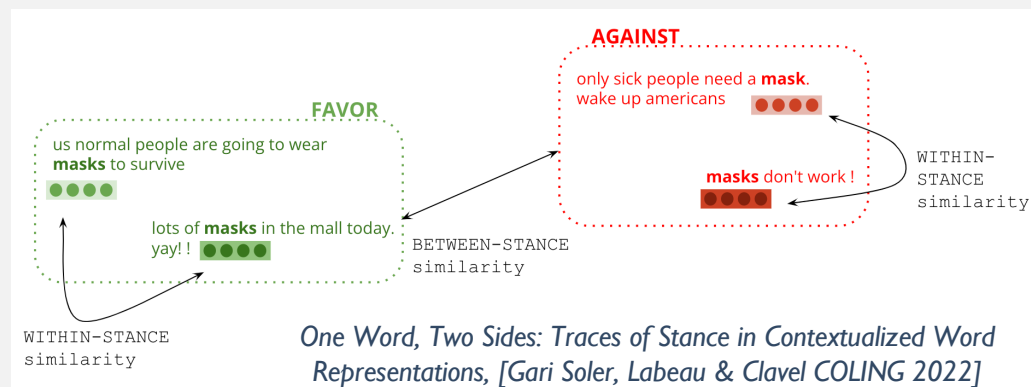


SOCIAL DATA ANALYSIS : APPLICATIONS

- Analysis of **social networks**
 - Detection of misinformation, cyberbullying, hate speech, etc.
 - Analysis of societal trends (e.g. environmental engagement)
 - Analysis of citizens' opinions on candidates in elections/
Evaluation of the success of communication campaign
- Analysis of **movie/product/restaurant reviews**
 - Analysis of the opinions of Internet users on a product
 - Analysis of the e-reputation of a brand, a product
 - Identify target clients / recommendation systems

EXAMPLES OF OUR RESEARCH FOR COMPUTATIONAL SOCIAL SCIENCES

Automatic analysis of stances
(in favor/against vaccinations)
on twitter



Automatic analysis of fallacies
Chaire ANR NoRDF



Context

Fallacies - erroneous or invalid ways of reasoning - play a significant role in spreading **fake news** and **propaganda**. Their **automated detection and classification** is vital yet challenging due to subjectivity and the lack of unified approaches.

A fictional example of the False Dilemma fallacy

[Helwe, Paris, Calamai, Suchanek & Clavel, NAACL 2024 to appear]

COMPUTATIONAL SOCIAL SCIENCES

- 2 fields/2 types of methodologies
 - Sociology:
 - qualitative / manual / sociological analysis of small corpora selected to form a panel of studies
 - Computer science :
 - development of automatic large corpus analysis methods

HUMAN-AGENT INTERACTION

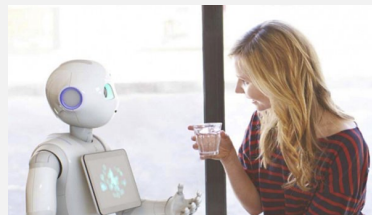
- **Analyze** and **reproduce** human behaviors to interact socially with humans

Virtual characters
(Embodied Conversational
Agents)



[GRETA Platform, Pelachaud]

Robots

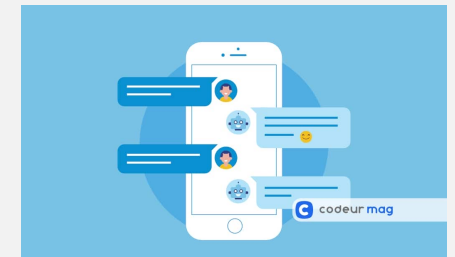


[Softbank robotics]

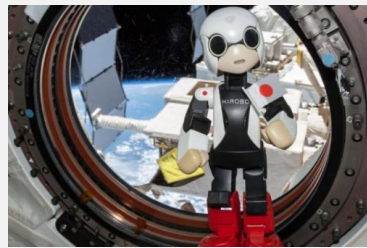
Vocal assistants
(google home, siri)



Chatbots

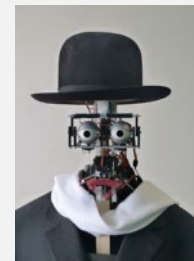


APPLICATIONS OF SENTIMENT ANALYSIS IN CONVERSATIONAL SYSTEMS



Astronomy

Kirobo: the Japanese robot who left 18 months in space to keep an astronaut company



Arts

Berenson: Art lover robot at Quai Branly discuss the criteria for aesthetic appreciation with visitors



Customer relationship management

Agents work of Buckmore and colleagues combines these



Figure 1. SimSensei, the Virtual Human Interviewer

Health

(agent for motivational interviews or psychotherapy session) Ex: SimSei

APPLICATIONS OF SENTIMENT ANALYSIS IN CONVERSATIONAL SYSTEMS

Education : Robots as learning partners

Global aim: build intelligent autonomous social robots that can promote children's learning (for example in computational thinking) by assisting teachers through complementary activities

Machine learning models for the automatic analysis of child's self-confidence

H2020 Marie Skłodowska-Curie Innovative Training Network ANIMATAS

[QTrobot](#)

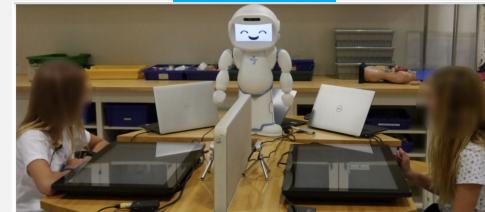


Figure 1: The JUSThink activity setup.



Dinkar, T., Vasilescu, I., Pelachaud, C., & Clavel, C. How confident are you? Exploring the role of fillers in the automatic prediction of a speaker's confidence. ICASSP 2020

INTERACTIVE SYSTEMS: APPLICATIONS

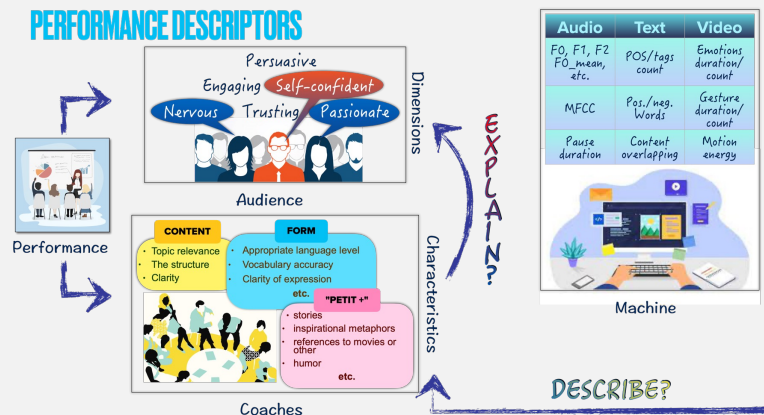
Public speaking training systems : **ANR (National Project) Revitalise**

Global aim: virtual environment with a virtual audience for public speaking training



©Chollet et al., 2014

Our work: Machine learning models for the automatic analysis of persuasiveness from speech,
Explainable approaches to give feedback



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Barkar, A., Chollet, M., Biancardi, B., & Clavel, C. (2023). *Insights Into the Importance of Linguistic Textual Features on the Persuasiveness of Public Speaking*. ICMI

SENTIMENT ANALYSIS – TASKS

TEXT ANALYSIS : TASKS

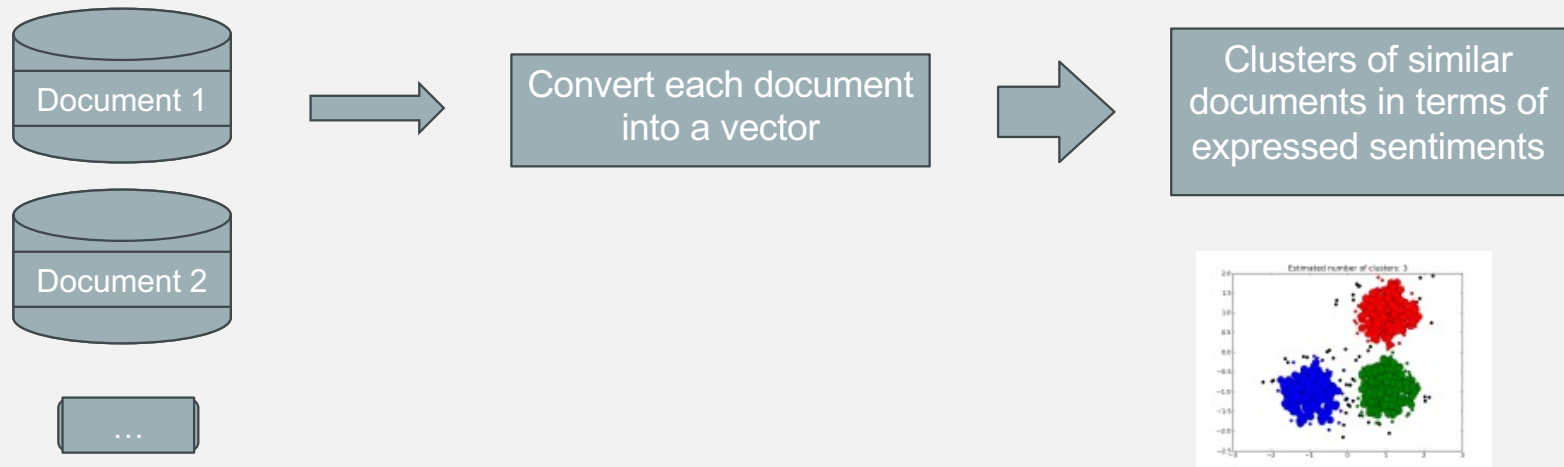
1/ Text clustering

2/ Text classification

3/ Labelling words

I/TEXT CLUSTERING FOR SENTIMENT ANALYSIS

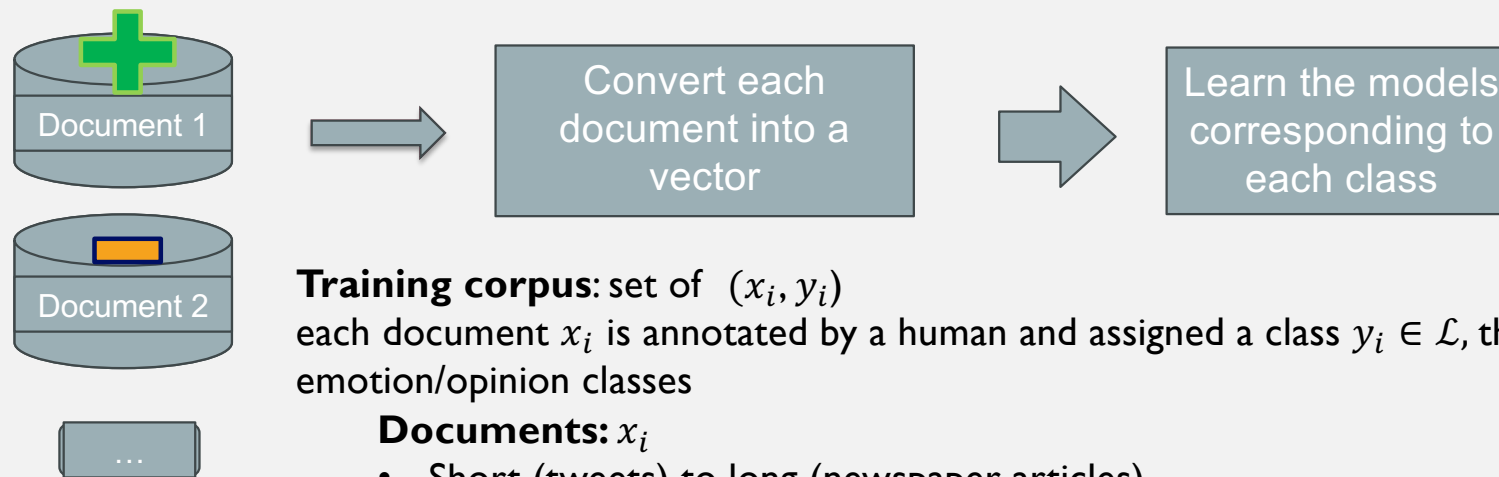
Unsupervised learning : no labelling based on human expertise



Documents within a cluster must be as close as possible / Documents in different clusters should be the least similar possible
in terms of sentiments (make up of the data so that the text vectors encode information on sentiments)

2/SENTIMENT CLASSIFICATION

- Supervised learning : Learning the classes (emotions, opinions, etc.)



Training corpus: set of (x_i, y_i)

each document x_i is annotated by a human and assigned a class $y_i \in \mathcal{L}$, the set of possible emotion/opinion classes

Documents: x_i

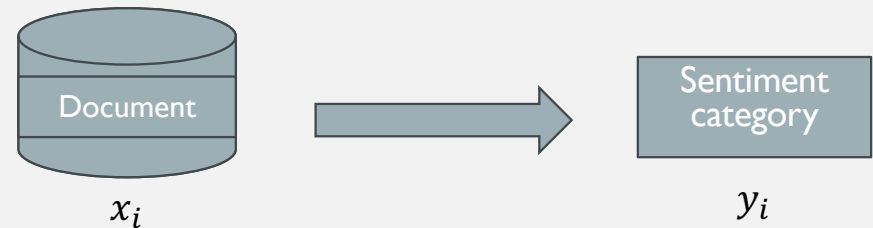
- Short (tweets) to long (newspaper articles)
- Monologues (presentation) or dialogues (call-centres, chats)

Sentiment categories: \mathcal{L}

- Ex. Movie reviews: the score attributed by a user (1 to 5) or positive vs. negative
- Label set \mathcal{L} depending on the application: frustration, satisfaction, fear, etc.

SENTIMENT CLASSIFICATION

- Binary classification
 - ex: $y_i \in \{positive, negative\}$
- **Multi-class** classification
 - ex: $y_i \in \{fear, anger, joy, disgust, sadness\}$
- **Multi-label** classification
 - ex: $y_i = (l_1, l_2, l_3)$ with $l_1, l_2, l_3 \in \{set\ of\ hashtags\}$ (prediction of the set of hashtags of a tweet : (#party #FRIDAY #fail))
- Regression task
 - ex: emotional intensity $y_i \in [0; 5]$



LABELLING SENTIMENT-RELATED WORDS

« Je suis **satisfait** des contacts que j'ai eus avec le service client **mais pas** des tarifs pratiqués »

- Task#1 - multi-label classification — x_i : document; $y_i = (l_1, l_2, l_3)$
 - **Sentiment: satisfaction or dissatisfaction?**
 - **Topics: contact and price**
- Task#2 - fine-grained analysis — x_i : word; ; $y_i \in \{\text{speaker, satisfaction, contact, etc.}\}$
 - Retrieve sentiment-related units
 - And **link** sentiment to their **targets** and **sources**
 - **Satisfaction** of the **speaker** towards *contact*
 - **Dissatisfaction** of the **speaker** towards *price*

Also known as **Aspect-based sentiment analysis (ABSA)**

LABELLING SENTIMENT-RELATED WORDS: B.I.O. LABELS

x_i : word; y_i = B.I.O. tag

B - beginning of a span

I - inside a span

O - out of a span (indicates the token doesn't belong to any span)

Ex : OTE (Opinion Target Extraction), retrieve target spans using BIO annotations

OTE (Opinion Target Extraction), with BIO annotations

The	O
onion	B-TARGET
rings	I-TARGET
are	O
great	O
,	O
and	O
the	O
sushi	B-TARGET
very	O
tasty	O
...	

(figure from Agerri, R. and Rigau, G., 2019. Language independent sequence labelling for opinion target extraction. Artificial Intelligence, 268, pp.85-95.)

LINK SENTIMENT TO THEIR TARGETS AND SOURCES

- When target/sentiment/source spans are retrieved, we need then to link them
- Underlying theoretical model : systemic functional linguistics
 - Appraisal theory [Martin and White, 2005]:
 - an appraisal expression is a **source** who **evaluates** a **target** -> 3 components.
 - Je suis satisfait des contacts
 - Source analysis: Je
 - Target analysis: *contact*
 - Evaluation: positive

Linguistics can help !

OVERVIEW OF SENTIMENT ANALYSIS METHODS

From the simplest to the most complex/opaque ones

I / RULE-BASED

- Retrieve words and linguistic/syntactic patterns featuring the class
- Class knowledge explicitly modelled
- Ex1: advanced search criteria using advanced regular expressions to retrieve sentiment expressions

*(manque|~negation-patt|(il/#NEG/y/avoir/~negation-patt))/(#PREP_DE)?/ (conseil|contact|~services-lex)**



Class

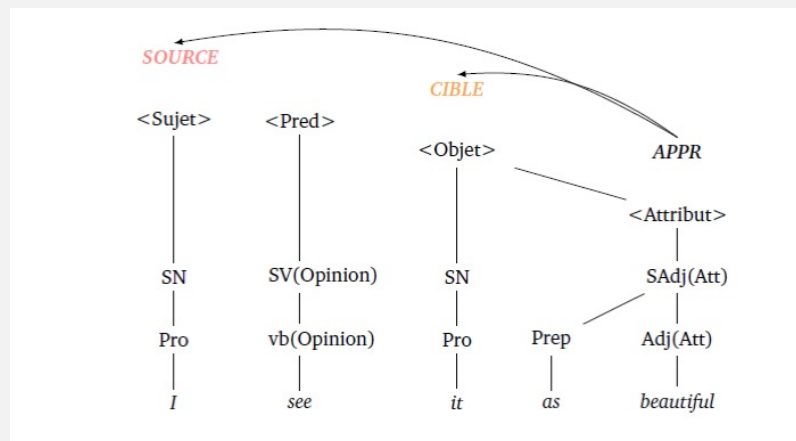
Dissatisfaction

Pattern retrieving for example « manque de conseils » or « il n'y a pas eu de contact » and assigning the text « dissatisfaction » class

**TASK: SENTIMENT
classification**

I / RULE-BASED

- Ex2. rules relying on the syntactic structure of sentences for both text or word labelling

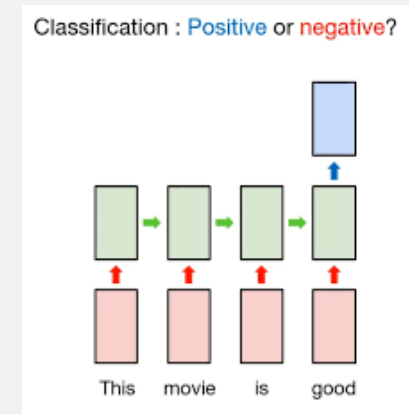
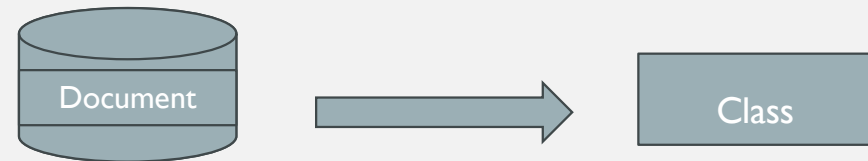


TASK: labelling words
Identify source/target/appraisal
expression and link them

2/ MACHINE/DEEP LEARNING

- **Task : text Classification**

- Logistic regression
- Multi-Layer Perceptron,
- Support Vector Machine
- Convolutional Neural networks
- Recurrent neural networks in a **many-to-one** configuration,
- Possible to be trained in an end-to-end fashion



From :
https://goodboychan.github.io/python/deep_learning/tensorflow-keras/2020/12/06/01-RNN-Many-to-one.html

2/MACHINE/DEEP LEARNING

- **Task : labelling words**
 - Hidden-Markov Models, Conditional Random Fields,
 - Recurrent Neural Networks, in a **many-to-many** configuration with for example BIO annotations
 - etc.

« Je suis satisfait des contacts »

B-S /B-E I-E / B-T I-T

Source/Evaluation/Target

Alex B-PER

is O

going O

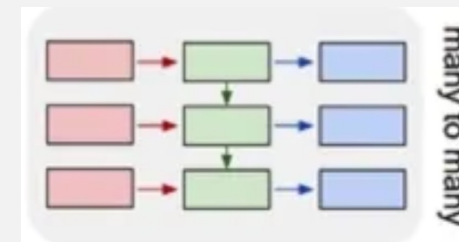
to O

Los B-LOC

Angeles I-LOC

in O

California B-LOC



RULE-BASED VS. ML

RULE BASED

- **linguistic expertise (high)** required to manually build and maintain rule-based system.
- Requires a small development **corpus**
- **Accuracy:** lower
- **Interoperability** : new rules for new data (low)
- **Transparency:** explicit decision process

MACHINE LEARNING

- **linguistic expertise (lower but still there)** required to build the annotated data for machine learning supervision,
- Requires an annotated training **corpus**. Sometimes a large one!
- **Accuracy:** higher
- **interoperability** : now higher with transfer learning
- **Transparency:** more (random forest) or less (deep learning architectures)

And recently....

GENERATIVE AI MODELS WITH PROMPTING

- Generative AI models: models capable of generating texts
- Transform text classification task into a task of generating an answer to a question over a context
- Prompt: question over a context
 - Question : Is this sentence positive or negative ?
 - Context : A stirring, funny and finally transporting re-imagining of Beauty and the Beast and 1930s horror film.

- Answer : positive

McCann, Bryan, et al. "The natural language decathlon : Multitask learning as question answering." (2018).

- For more information on prompting methods

From Pre-train, Prompt, and Predict: A Systematic Survey of Prompting Methods in Natural Language Processing, <https://arxiv.org/pdf/2107.13586v1.pdf>