

Activity report 2024

**Academy 1 “Networks, Information,
and Digital Society”**

ACADEMY 1 NETWORKS, INFORMATION AND DIGITAL SOCIETY

2024 highlights



Academy 1 "Networks, Information and Digital Society" (RISE) federates over 200 researchers and faculty from 16 research units working on digital science and society. Its objectives are to support the emergence of innovative and ambitious research projects, to encourage transdisciplinary initiatives and to strengthen the outreach of Université Côte d'Azur, both locally and internationally, notably by organizing scientific events and international exchanges for students and researchers.

In 2024, the RISE Academy supported:

- Five research projects under the *Idées 2024* call for expressions of interest (AMI) (€296K)
 - SMA-Sync – A heterogeneous modeling approach for systems biology
 - KG-bot – Large language model-based Interaction with metabolomics knowledge graphs
 - CIIAM - Improving argument mining by synthesizing contextual information
 - GLORIVALS - Global rivalries and firm dynamics in the technology-trade multiplex
 - PRFL - Privacy-preserving and robust federated learning
- Five international doctoral stays under the DocWalker program (€17.5K)
 - Karlsruhe Institute of Technology, Germany
 - Fondazione Bruno Kessler, Italy
 - European Space Agency, Netherlands
 - University of Surrey, United Kingdom
 - Swiss Federal Institute of Technology (ETH Zurich), Switzerland
- Five local scientific events (€13.5K)
 - National Microwave Days
 - Biological Image Processing and Analysis
 - Mons Theoretical Computer Science Days
 - IFIP International Internet of Things Conference
 - What legal approaches are needed to regulate total innovations?
- Two guest researcher stays (€6K)
 - Prof. Tomas Gedeon, Montana State University
 - Ass. Prof. Rich Nguyen, University of Virginia, USA
- Nine Forum Numerica scientific seminars on digital sciences and their impact on society and humanity (€3K).

In addition, the RISE Academy:

- Organized a Research Forum, which gave researchers the opportunity to discuss the progress of research projects supported by the Academy.
- Contributed to the Doctoral Sessions of the DS4H Graduate School - Digital Systems for Humans, attended by close to one hundred students (video).

Examples of projects

GLORIVALS

Investigates whether, and how, companies' invention strategies evolve in response to changes in their imports and exports, which are themselves influenced by structural changes in international dependencies, notably those linked to the growing geopolitical fragmentation of the global economy.



Simone Vannuccini, Faculty member, GREDEG; Flora Bellone, Professor of Economics, GREDEG - Director of the DESPEG Doctoral School



Economics of artificial intelligence and innovation, law, economics, management



Technological innovation, international trade, geopolitics, patents, economic fragmentation

KG-BOT

This project is developing a general-purpose AI chatbot for interactive exploration of knowledge graphs combining natural language and extended language models with a proof of concept in chemistry/metabolomics.



Louis-Félix Nothias (Nice Institute of Chemistry, Université Côte d'Azur); Fabien Gandon (Wimmics Université Côte d'Azur, Inria, CNRS, i3S)



Artificial intelligence, natural language interaction, large language model, knowledge graphs, Earth sciences



Knowledge graphs, chatbot, metabolomics, SPARQL, large language model



Chuan Xu, Researcher and Associate Professor, i3S/Inria



Privacy and robustness in Federated Learning (FL)



Distributed algorithms, privacy, robustness, federated learning

PRFL

This project aims to develop new algorithms to strengthen privacy and security in Federated Learning (FL). It explores the use of compression to improve computational efficiency while ensuring an optimal balance between privacy, robustness and model performance.



Nadia Achiche-Mimouni, associate professor in computer science, i3S CNRS-7271 Laboratory, Université Côte d'Azur DR CNRS, INPHYNI



Chronobiology, circadian rhythms, chronotherapy, circadian desynchronization



Multi-agent systems, heterogeneous formalisms (discrete/continuous), large-scale modeling

SMA-SYNC

This project is developing a multi-agent system to coordinate different modeling formalisms applied to various biological networks (clocks, metabolism or homeostasis) on different scales. The challenge is to achieve large-scale modeling in chronobiology.



FOCUS

High-level linguistic analysis for a better understanding of natural language

Objective

Pre-trained language models, which have been widely adopted in recent years, have played a key role in the progress achieved in the processing and automatic understanding of natural language. However, these models are not always able to capture the full depth of knowledge required for detailed contextual understanding.

A pragmatic analysis of utterances has been developed and automated to fill this gap. It makes deductions based on the wider context: the immediate meaning of a message, but also possible inferences when the literal meaning does not correspond to the situation (who is speaking, to whom, with what intention, in what setting, etc.).

Automation of this analysis is a real challenge, as this linguistic dimension requires complex multimodal knowledge - circumstantial, epistemic, linguistic and social - that is difficult to define and apply. The task involves modeling meaning-making processes comparable to those used by humans.

Method

Drawing on cutting-edge techniques in text generation and prompting, such as formulating instructions or examples in natural language to guide models such as ChatGPT, this project aims to overcome the limitations of current methods, notably by addressing cultural variations and implicit messages. To address this issue, the range of stimuli needs to be enlarged to teach language models how to reason by combining both the knowledge required to construct the overall meaning and the processes involved in creating this meaning. A concrete example would be the transcription of grammatically encoded cues, social signals and elements related to beliefs, desires and intentions, as described in speech act theories. This need for contextualization is particularly crucial in automatic language processing tasks sensitive to subjectivity such as sentiment analysis or hate speech detection. For example, depending on the context, aggressive content can be perceived as either implicit, subtle, or apparently neutral. The challenge, then, is to use this abstract information to build an explicit contextual framework for each utterance, and thus enable language models to gain a finer, more nuanced understanding of interactions.

This project aims to develop techniques for automatically constructing contextual frameworks that capture the multimodal dimensions of communication, in order to improve the understanding of natural language utterances.



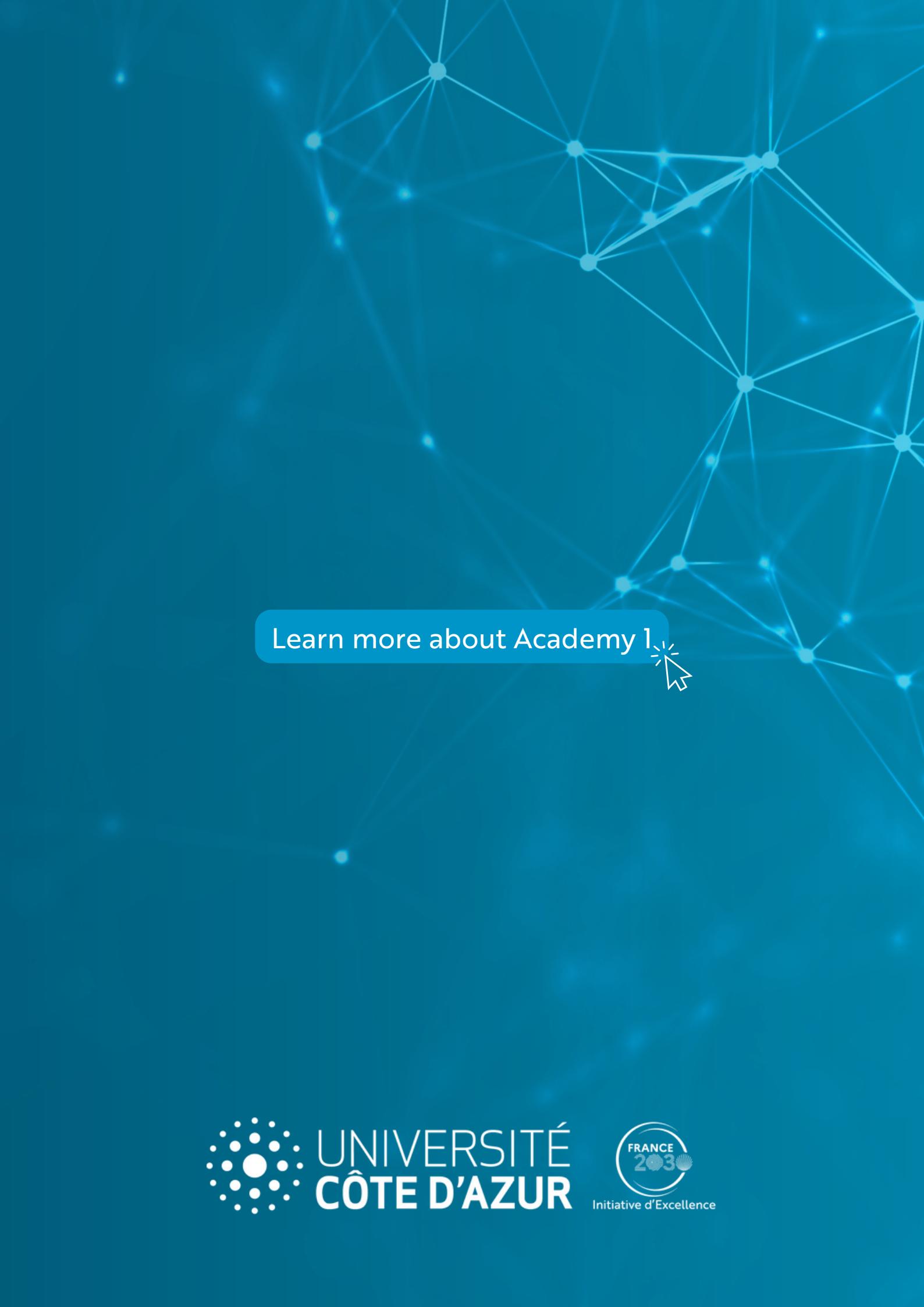
Anais Ollagnier,
assistant professor,
i3S laboratory



Machine learning
and natural
language
processing (NLP)



Machine learning, natural language
processing (NLP), detection of
cyberbullying, high-level linguistic
analysis, dialogue modeling



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