UMR IRISA

Activity Report 2025

Team MALT

MAchine Learning with Temporal Constraints

Joint team with Centre Inria de l'Université de Rennes

D7 – Data and Knowledge Management

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Project-Team MALT

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Keywords

Computer sciences and digital sciences

A3.1.1. – Modeling, representation

A3.1.3. – Distributed data

A3.1.4. – Uncertain data

A3.1.10. – Heterogeneous data

A3.1.11. – Structured data

A3.2.3. – Inference

A3.3. – Data and knowledge analysis

A3.3.1. – On-line analytical processing

A3.3.2. – Data mining

A3.3.3. – Big data analysis

A3.4. – Machine learning and statistics

A3.5.2. – Recommendation systems

A4.8. – Privacy-enhancing technologies

A4.9.1. – Intrusion detection

A5.3. – Image processing and analysis

A5.3.2. – Sparse modeling and image representation

A5.3.3. – Pattern recognition

A5.8. – Natural language processing

A8.1. – Discrete mathematics, combinatorics

A8.2. – Optimization

A8.2.6. – Numerical methods for optimization

A8.12. – Optimal transport

A9.1. – Knowledge

A9.2. – Machine learning

A9.2.1. – Supervised learning

A9.2.2. – Unsupervised learning

A9.2.3. – Reinforcement learning

A9.2.4. – Optimization and learning

A9.2.5. – Bayesian methods

A9.2.6. – Neural networks

A9.2.8. – Deep learning

A9.3. – Signal processing

A9.4. – Natural language processing

A9.6. – Decision support

A9.7. – AI algorithmics

A9.10. – Hybrid approaches for AI

A9.11. – Generative AI

A9.12.1. – Object recognition

A9.12.6. – Object localization

A9.14. – Evaluation of AI models

A9.17. – Cybersecurity and AI

Other research topics and application domains

B1.1. – Biology

B2.6. – Biological and medical imaging

B2.7.2. – Health monitoring systems

B6.6. – Embedded systems

B9. – Society and Knowledge

B9.5.6. – Data science

B9.9. – Ethics

B9.10. – Privacy

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1 Team members, visitors, external collaborators

Research Scientists

- Patrick Bouthemy [INRIA, Emeritus, from Mar 2025, HDR]
- Paul Viallard [INRIA, ISFP, from Mar 2025]

Faculty Members

- Elisa Fromont [Team leader, UNIV RENNES, Professor, from Mar 2025, HDR]
- Romaric Gaudel [UNIV RENNES, Associate Professor, from Mar 2025, HDR]
- Mathieu Lefort [UNIV RENNES, Associate Professor, from Sep 2025, CDD, LRU, HDR]
- Simon Malinowski [UNIV RENNES, Associate Professor, from Mar 2025]
- Romain Tavenard [UNIV RENNES II, Professor, from Mar 2025, HDR]

Post-Doctoral Fellow

- Aurélien Delage [INRIA, Post-Doctoral Fellow, from Sep 2025]

PhD Students

- Noam Bires [UNIV RENNES, with TARAN Team]
- Niels Cobat [UNIV RENNES, with PACAP Team]
- Julianne Guerbette [UNIV RENNES, with LACODAM Team]
- Yasmine Hachani [INRIA, from Mar 2025]
- Carolina Jeronimo De Almeida [GOUV BRESIL, from Mar 2025 until Aug 2025]
- Nouha Karaouli [UNIV RENNES, from Mar 2025]
- G. Charbel Kindji [ORANGE LABS, CIFRE, from Mar 2025]
- Dimitri Lereverend [INRIA, with WIDE Team]
- Youwan Mahe [SIEMENS IND.SOFTWARE, CIFRE, with EMPENN Team]
- Manuel Nkegoum Nzouakeu [ATERMES, CIFRE, with OBELIX Team]
- Ambroise Odonnat [HUAWEI, CIFRE, from Mar 2025]
- Paul Sevellec [STELLANTIS, CIFRE, from Mar 2025, with LACODAM Team]
- Oussama Zaid [ORANGE LABS, CIFRE, from Dec 2025]

Interns and Apprentices

- Youcef Boulfrad [UNIV RENNES, Intern, from Mar 2025 until Aug 2025]
- Florent Cheyron [UNIV RENNES, Intern, from Jun 2025 until Aug 2025]
- Leo Laffeach [UNIV RENNES, Intern, from Mar 2025 until Jun 2025]
- Loane Portier [UNIV RENNES, Apprentice, from Mar 2025]
- Benjamin Wojtecki [ENS Rennes, Intern, from Oct 2025]
- Benjamin Wojtecki [UNIV RENNES, Intern, from May 2025 until Jul 2025]

Administrative Assistant

- Gaelle Tworkowski [INRIA]

Visiting Scientist

- Benjamin Leblanc [Université Laval, Canada, from Nov 2025 until Nov 2025, EA PACTOL]

External Collaborator

- Barbara Pilastre [AMIAD, from May 2025]

2 Overall objectives

The MALT research project is dedicated to incorporating temporal dimensions into machine learning algorithms. It encompasses three primary research directions: **learning from temporal data**, **learning over time**, and **ensuring the trustworthiness of temporal models**.

In the first dimension, MALT plans to tackle the complexities of effectively integrating temporal elements into machine learning models, including the generation of multivariate time series and making early predictions on such data. The second dimension addresses challenges related to adapting to changes in data distribution while considering temporal aspects and facilitating continual or sequential learning. Lastly, our focus in the third dimension is on guaranteeing the reliability, privacy, and transparency of these models.

3 Research program

MALT (MAchine Learning with Temporal constraints) is a joint project-team between Inria (Centre Inria de l'Université de Rennes), Université de Rennes, and Université Rennes 2 hosted at IRISA (Institut de Recherche en Informatique et Systèmes Aléatoires). We aim to develop trustworthy machine learning models that account for time constraints, either in the data or during the learning process.

Machine Learning (ML) is a sub-field of Artificial Intelligence (AI) that explores the construction and study of algorithms that enable machines to learn from data. In ML, the primary purpose of the learned model is to make sense of past data (e.g. by modeling the original data distribution) or make predictions on unseen future data. Different types of machine learning algorithms have emerged over the years depending on the kind of data from which machines learn. In MALT, we are interested in data that exhibits temporal dependencies or machine algorithms that operate with temporal constraints.

- Our first obvious research axis aims at exploring how to learn on temporal data and, in particular, time series. Time series data consists of sequential data points collected at regular intervals, each associated with a specific timestamp, portraying particular variable changes over time. Time series that involve multiple variables whose recording is aligned (e.g. different sensors recording multiple views of the same situation) are called multivariate time series. Time series datasets are pervasive across various domains such as finance, meteorology, computer vision (videos), healthcare, and manufacturing. They play a critical role in understanding temporal dependencies, forecasting future trends, and monitoring processes in real time. The temporal nature of these data makes them invaluable for uncovering patterns, anomalies, and trends, essential for decision-making and predictive analytics. While this is clearly not a new research avenue, many problems remain when trying to correctly embed the time aspects in ML models, when trying to solve particular tasks such as early classification or when dealing with multivariate time series, for example, in a generation context.
- The second axis aims to explore how to learn through time. Specifically, our focus lies in scenarios where a machine learning (temporal or not) model is initially trained and subsequently reused at a later stage, encountering potential shifts in data distribution or slight modifications in the task requirements. This involves, for example, the problems of domain adaptation, continual/incremental learning or sequential learning that will all be studied in MALT. Domain adaptation (DA) is a machine learning setting in which the challenge lies in transferring knowledge from a source domain to a target domain,

where the distributions of data may differ. It aims to improve the performance of models on the target domain by leveraging information learned from the source domain while mitigating the effects of domain shift. This adaptation process helps to overcome discrepancies between training and testing data distributions, enhancing the generalization and robustness of machine learning models across diverse real-world scenarios. Continual or incremental learning (CL) refers to a machine learning paradigm where models are trained continuously over time on new data streams or batches of data, without forgetting previously learned information. Unlike traditional batch learning approaches, continual learning systems dynamically adapt to incoming data, updating their parameters or architecture incrementally to incorporate new knowledge while retaining past experiences. This enables models to adapt to changing environments, learn from evolving data distributions, and accumulate knowledge over time, making them suitable for long-term learning tasks where data arrives in a sequential or streaming fashion. Finally, we will explore sequential learning through the use of multi-armed bandit (MAB). In this setting, which is related to CL, the model learns and improves sequentially through trial and error by interacting with an environment and receiving feedback in the form of rewards or penalties based on its actions.

- Our last research axis concerns the trustworthiness of the temporal models (timely learning). Trustworthy AI represents a booming area of research encompassing work on reliability, privacy, fairness, and transparency (and in particular eXplainable Artificial Intelligence (XAI)) of the learned models. MALT predominant expertise lies in XAI, privacy-preserving algorithms and providing theoretical guarantees on the generalisability of the models.

4 Application domains

Most of MALT's research is application-agnostic, meaning that we validate our algorithms using publicly available benchmarks that are best suited to assess our methods. Nevertheless, we recognize the value of engaging in real-world applications through collaborations with industrial or academic partners who are not AI specialists, as such interactions often foster novel perspectives and ideas. Accordingly, we co-supervise students with experts from industry or academia, leveraging their domain expertise to enrich our research. The applications described in this section arise from CIFRE contracts with Orange, Stellantis, Huawei, Atermes, and Siemens, as well as academic collaborations with INRAE and other research teams within Inria.

4.1 Industry & Telecommunication

- **Heterogeneous tabular data generation with deep generative models.** Tabular data generation is paramount when dealing with privacy-sensitive data and with missing values, which are frequent cases in the real (industrial) world and particularly at Orange. It is also used for data augmentation, a pre-processing step often needed when training data-hungry deep learning models (for example to detect anomalies in networks, study customer profiles, ...). The CIFRE PhD of G. Charbel Kindji, funded by Orange, is concerned with this application. We study methods to tackle this problem when the tabular data are heterogeneous (numerical and symbolic) and when new tables should be generated from scratch based on a human prompt.

- **Counterfactual explanations over multivariate time series.** Very complex machine learning models (that are called black-boxes) are often used in critical applications (e.g. self-driving cars). To comply with EU regulations and better understand their systems, many companies, and in particular Stellantis, are interested in developing skills in "explainable AI", a domain which aims at bringing back the human in the decision loop that involves a black box model. The CIFRE PhD of Paul Sevellec, funded by Stellantis, is concerned with this application. We study the particular case of counterfactual explanations on the challenging context of multivariate time-series. This problem is related to the generation of new data that fulfills some human requirements.

- **Analysis and optimization of 3D-printing files through Machine Learning.** In the realm of Additive Manufacturing, and more specifically Fused Filament Fabrication 3D printing, print time estimation and optimization plays a pivotal role. The two main approaches for this task are parametric models

taking as input the 3D description of the model, and analytical models based on G-code. In the context of the PhD of Niels Cobat, we explore the potential of Machine Learning models dedicated to sequences to handle this task.

- **Transfer learning for time series analysis.** In many industrial and scientific domains—such as sensor monitoring, anomaly detection, forecasting or activity recognition—time series data are abundant, while labeled data for each new task or domain remain scarce and costly to obtain. The PhD project of Ambroise Odonnat addresses this challenge by studying and developing transfer learning methods specifically tailored to time series data, with a particular focus on modern sequence models such as Transformers. The work aims to design robust and transferable representations that capture both temporal dependencies and dynamic patterns, enabling knowledge learned from one set of time series to be efficiently reused across different domains, conditions or applications. By bridging theoretical analysis and practical methodologies, the project targets scalable and data-efficient learning solutions for real-world time series applications.

- **Convergence of graph and vector approaches for integrating machine learning predictions into network digital twin simulations** The PhD thesis of Oussama Zaid—in collaboration with Orange—focuses on the convergence of graph-based and vector-based approaches to natively integrate machine learning predictions into digital twin simulations of telecommunications networks, within the context of Orange's digital twin platforms such as Thing'in and network management systems for 5G and fiber infrastructures. The research aims to leverage graph databases and graph machine learning—particularly Graph Neural Networks—to model complex, dynamic network structures, predict traffic and failures, and enable advanced "what-if" simulations to assess the impact of network changes on performance and customer experience. Addressing current limitations where graph learning pipelines are decoupled from database systems, the thesis proposes a hybrid graph–vector database that embeds machine learning capabilities directly into data management. The expected outcome is a prototype supporting multi-model data representation (graphs and embeddings), a unified query language operating across structural and vector spaces, and scalable storage with versioning of data, models, and embeddings, thereby ensuring efficient querying, data governance, incremental learning, and reproducibility over time.

4.2 Embedded Systems

Elisa Fromont is the local coordinator of the ADAPTING ("Architectures adaptatives pour l'intelligence artificielle embarquée") project of the PEPR AI. The ADAPTING project aims at proposing new architectural paradigms adaptable to any AI application and its constraints in terms of precision, energy, latency and reliability. The adaptive architecture will be designed to ensure the flexibility, efficiency, durability and reliability of embedded AI. Within this project, she co-supervises two PhD students and one research apprentice (together with Mathieu Lefort) who respectively started in fall 2024 and 2025 and 2024. Within this project, Simon Malinowski also co-supervises the PhD of Julianne Guerbette with the LACODAM team.

- **Continual learning for time series forecasting in embedded systems.** During her first PhD year, Nouha Karaouli evaluated whether Time Series Foundation Models (TSFMs) would be better suited for continual learning than smaller specific time series models and whether they could meet the resource constraints of embedded systems. She did a systematic study of the "catastrophic forgetting" phenomenon in TSFMs sequentially fine-tuned (FT) on multiple forecasting tasks, evaluating TimesFM-2.0, Chronos-2, and Granite-FlowState-r1 across synthetic and real-world datasets. While FT improves performance on new tasks, it often degrades accuracy on earlier ones. All models exhibit forgetting, though larger models are markedly more robust than smaller ones. Forgetting and adaptability further depend on the gap between pretraining and fine-tuning data distributions. These results expose key limitations in current TSFM design and emphasize the need for continual-learning methods for deployment in non-stationary forecasting settings.

- **Trustworthy AI hardware architectures.** The goal of Noam Birès's PhD thesis is to study the impact of hardware faults not only on the AI decisions, but also on algorithms developed to explain AI (XAI) models. The objective is to make AI-HW reliable by understanding how hardware faults (due

to variability, aging, external perturbations) can impact AI and XAI decisions and how to mitigate those impacts efficiently. The final goal is to enable the transparency of the AI-HW by designing self-explainable, trustworthy, reliable, and real-time verifiable AI hardware accelerators, capable of performing self-test, self-diagnosis, and self-correction.

- **Monitoring Federated Systems with XAI.** Loane Portier is an apprentice in the AI Master of University of Rennes. Federated Learning (FL) enables collaborative model training across decentralized data sources, but heterogeneous client distributions can lead to local drifts or adversarial behaviors that are difficult to detect with conventional metrics. In his first apprentice year (M1), he studied a method that leverages SHAP (SHapley Additive exPlanations) to monitor the evolution of feature contributions in both local and global models during training.

4.3 Defense

- **Object detection from few multispectral examples.** This project, developed during the thesis of Manuel Nkegoum, aims at providing robust deep-learning-based methods to detect objects in outdoor environments using multispectral images under a low supervision context. The developed methods are expected to learn from few labeled examples at training time and be able to detect scarcely-observed objects in prediction. In case of very few object labels (even no label) being available, the model to be developed should be capable of discovering unknown novel objects from the observed scene.

- **Local search for multi-armed bandit problems.** Multi-armed bandits is the paradigm to design algorithms which simultaneously learn from the data they have collected and act (and therefore collect data) based on what they have learned. While being important for many aplications, such algorithms prove to be inefficient when confronted to combinatorial optimization problems. To remove this limit, we are developing bandit algorithms dedicated to combinatorial problems which can be solved through local search. This project is currently supported by a funding from a collaboration between Inria and DGA-AID to foster reasearch subjects which are of interest to both the army and the industry.

4.4 Agriculture

- **Deep learning-based analysis of the early development of bovine embryos from videomicroscopy.** The PhD of Yasmine Hachani (collaboration with the Sairpico team and INRAE) focuses on designing deep learning methods for the comparison and classification of videos of embryos produced in vitro (PIV). These automatic methods are eagerly awaited by biologists in order to broaden the potential of fundamental and applied research in this field, and to help improve results and reproductive performance in breeding. The problem posed is multifaceted. First of all, the images acquired by microscopy are complex in nature: they are low-contrast, noisy, contain transparency effects, and movements are difficult to characterize. The categorization of in vitro fertilized embryos, in terms of the quality of their development, is based on a continuum of classes, rather than distinct ones. Furthermore, the need is to obtain reliable classification at the earliest possible stage, i.e. 3 days post-gamete contact, from a video of 300 images, with images acquired every 15 minutes. Finally, while classification can be supervised, we have only a limited amount of data (a few hundred videos) for deep learning purposes, especially as class characterization can only be achieved by observing a video in its entirety.

4.5 Medicine

- **On multimodal segmentation of chronic stroke lesions.** Since fall 2024, Elisa Fromont is the co-supervisor of Youwan Mahé with the EMPENN Inria team. Post-stroke MRI not only delineates focal lesions but also reveals secondary structural changes, such as atrophy and ventricular enlargement. These abnormalities, increasingly recognised as imaging biomarkers of recovery and outcome, remain poorly captured by supervised segmentation methods. In this thesis, we adapt state-of-the-art generative methods to this particular medical context to better detect and segment these anomalies.

5 Social and environmental responsibility

5.1 Footprint of research activities

There are two main axes that characterize the bulk of MALT's environmental impact: work trips, and computing resources utilisation.

- **Work trips.** Whenever possible, we prefer using train rather than plane for national and European travels. Most of us continue to submit papers to international conferences outside of Europe but if a paper gets accepted into such conference, we prioritize sending the first author (PhD student). Outside of conferences, for national events (seminars, PhD juries, etc.), videoconference is increasingly used, which helps to reduce the overall carbon footprint of the community.

- **Utilisation of computing resources.** The discontinuation of Igrida services and the transition towards Grid'5000 and Jean Zay has reduced our access to easily available computation resources. It adds friction to making experiments, but has a positive effect on energy consumption, as we are now using national infrastructures that benefit from even better sharing between users than Igrida (which was already heavily used).

5.2 Impact of research results

We estimate that the research work can have actual impact in three different ways:

- In the short/medium term, a significant part of our research work is conducted in collaboration with companies, through CIFRE PhDs. Hence, the addressed research problems concern an important challenge for the company, and the solutions proposed are evaluated on their relevance to tackle this challenge.

- In the long term, the team has a fundamental line of work on trustworthy and interpretable machine learning. Given the increasing use of machine learning solutions in most areas of human activity, work on interpretability is of utmost societal importance, as it will help in designing more useful and also more acceptable machine learning approaches. This will require a sustained effort from the community: MALT is taking part in this effort with an important number of contributions in this area.

6 Highlights of the year

- **MALT was created in March 2025!** Note that MALT is a spinoff of the LACODAM team.

- We had the pleasure to follow the PhD defense of G. Charbel Kindji.

- The start of the project team is supported by 3 projects:

  - A national one, the DATES ANR project, which is at the core of our research axes;
  - An exploratory one, the AEx HYPE project, to expolore research questions on the link between optimization and multi-armed bandits;
  - An international one, the associate team PACTOL with Université Laval (Québec, Canada), which is about the link between PAC-Bayesian approaches and multi-armed bandits.

- Elisa Fromont and Paul Viallard (along with Edwige Cyffers and Michaël Perrot) take the leadership of the SSFAM (Société Savante Francophone d'Apprentissage Machine).

7 Latest software developments, platforms, open data

7.1 Latest software developments

7.1.1 tslearn

Keywords: Machine learning, Time Series, Forecasting

Functional Description: tslearn is a Python package that provides machine learning tools for the analysis of time series.

URL: https://tslearn.readthedocs.io/en/stable/

Contact: Romain Tavenard

8 New results

8.1 Learn on temporal data

Participants: Patrick Bouthemy, Élisa Fromont, Romaric Gaudel, Nouha Karaouli, Paul Sévellec, Yasmine Hachani.

Remark about the "Participants" boxes: we compiled syntactically the list of co-authors of the papers that make the "New Results" of the year, for each section. It obviously does not mean that other members of the team do not work on the topics listed, the correct meaning is that they did not have a publication on that topic this year.

During the year, we have proposed several advancements in temporal learning. In time series forecasting, we demonstrated that foundation models exhibit inherent limitations for time series data due to domain-dependent zero-shot capabilities, revealing that fine-tuned models often fail to deliver consistent performance gains over dedicated architectures despite their larger parameter counts (see [25]). For multivariate time series classification, we introduced **CFE4MTS**, a generation-based counterfactual explanation framework that produces interpretable, plausible counterfactuals aligned with target class distributions, significantly outperforming state-of-the-art methods across real-world datasets (see [23]). Additionally, we uncovered critical privacy risks in fine-grained electrical consumption data, showing that even degraded time series (e.g., rounded to 100W) can re-identify over **40%** of households using just 7 consecutive measurements, with uniqueness rates persisting at concerning levels even under severe data degradation (see [12]). In videomicroscopy, we introduced **CLEmbryo** to identify the developmental stages of embryos from 2D time-lapse image sequences. This model leverages supervised contrastive learning with focal loss and the lightweight 3D neural network CSN-50 as encoder (see [29]).

8.2 Learn through time

Participants: Ambroise Odonnat, Romain Tavenard.

During the year, we advanced the "Learn through time" initiative by introducing four key contributions. First, we proposed *Zero-shot Model-based Reinforcement Learning using Large Language Models* [15] to enable LLMs in predicting continuous dynamics via Disentangled In-Context Learning (DICL). Second, we developed **PAWL** [17], an efficient algorithm for exact partial Wasserstein distances on the line, and its differentiable extension for high-dimensional settings [24]. Third, we released **SKADA-Bench** [10], a comprehensive benchmark for evaluating unsupervised domain adaptation across diverse modalities. Finally, we introduced *Leveraging Gradients for Unsupervised Accuracy Estimation under Distribution Shift* [13], a technique that uses gradient magnitudes to predict test accuracy under distribution shifts and significantly outperforms state-of-the-art methods.

8.3 Trustworthy AI

Participants: Élisa Fromont, Romaric Gaudel, G. Charbel Kindji, Dimitri Lerévérend, Paul Sévellec, Paul Viallard.

During the year, we have proposed Zip-DL, a privacy-aware decentralized learning algorithm that achieves **35%** higher membership-inference attack resilience compared to baseline methods while maintaining up to **59%** higher accuracy under the same threat model, as demonstrated by [16]. Concurrently, to address analytical variability in fMRI processing, we released the HCP Multi-Pipeline dataset comprising **1,080** participants' statistic maps across **24** pipelines and developed a style transfer framework using GANs and diffusion models to enhance reproducibility, as detailed in [8] and [18]. In the realm of data integrity, we advanced synthetic tabular data detection by introducing cross-table baseline detectors and robust schema-adaptive methods [26], demonstrating the challenge of *in-the-wild* detection across diverse table structures. Additionally, we established a PAC-Bayesian framework linking flat minima to generalization, showing their positive influence via gradient-based bounds that avoid dimension-dependent dependencies [19]; extended counterfactual explanations for multivariate time series classification through plausible generation techniques, [23]; and quantified privacy risks in fine-grained electrical consumption data, revealing that **90%** of households can be re-identified from **5** consecutive measurements—a critical insight for smart grid privacy—[12].

8.4 Applications

Participants: Patrick Bouthemy, Élisa Fromont, Romaric Gaudel, G. Charbel Kindji, Youwan Mahé, Ambroise Odonnat, Paul Sévellec, Simon Malinowski, Erwan Vincent.

During the year, we have proposed significant advancements across medical imaging, tabular data processing, and foundational machine learning techniques. In medical imaging, we developed a deep learning framework for multi-modal MRI segmentation of sub-acute and chronic stroke lesions, achieving a mean Dice score of 0.74 for dual-modality (T1-w + FLAIR) ensembles on internal datasets—demonstrating that integrating FLAIR data and ensemble strategies significantly improves small/medium lesion quantification [7]. Concurrently, we introduced the HCP Multi-Pipeline dataset to investigate analytical variability in fMRI, providing 1,080 participants' statistic maps across 24 pipelines for rigorous analysis of processing inconsistencies [8]. To address reproducibility challenges, we further proposed a style transfer approach leveraging GANs and Diffusion Models to convert fMRI statistic maps across pipelines, enabling effective data augmentation for neuroimaging studies [18]. In tabular data processing, we conducted the first comprehensive benchmark of 16 diverse datasets, revealing that diffusion-based generative models consistently outperform alternatives after dataset-specific tuning—while highlighting the challenges of cross-table synthetic data detection under schema variability [9, 26, 20]. Additionally, we developed the supervised model **CLEmbryo** for cell stage classification of animal embryos in videomicroscopy, which outperforms state-of-the-art methods on both our in-house Bovine ECS dataset and the publicly available NYU Mouse Embryos dataset [29]; extended our understanding of optimization pathways through a circuit-based curriculum for efficient learning [22]; and developed plausible counterfactual explanations for multivariate time series classification [23]. Finally, we demonstrated that gradient-based signal analysis (via cross-entropy loss gradients) provides robust test accuracy estimation under distribution shift, outperforming existing methods in diverse scenarios [13]. These contributions collectively advance robustness in medical data, scalable tabular generation, and interpretable AI systems for real-world deployment. In [14], we have developed a methodology that is able to identify impact factors for buses commercial speed analysis. Machine learning and data analysis techniques are used to quantify the impact of many different features on the commercial speed of buses. The most important features can then be used within machine learning frameworks in order to predict the commercial speed of buses on different roads.

9 Bilateral contracts and grants with industry

9.1 Bilateral contracts with industry

- **ORANGE - Univ. Rennes (2023-2025)**

  Participants: Elisa Fromont, G. Charbel Kindji.

  Contract amount: 45k€ + Phd Salary

  Context. Tabular data generation is paramount when dealing with privacy-sensitive data and with missing values, which are frequent cases in the real (industrial) world and particularly at Orange. It is also used for data augmentation, a pre-processing step often needed when training data-hungry deep learning models (for example to detect anomalies in networks, study customer profiles, ...).

  Objective. We study methods to tackle heterogeneous tabular data generation with deep generative models. We are particularly interested in problems where the tabular data are heterogeneous (numerical and symbolic) and when new tables should be generated from scratch based on a human prompt.

  Additional remarks. This is the doctoral contract for the PhD of Charbel Kindji who defended his PhD December 18 2025 (Thèse CIFRE).

- **Stellantis - Univ. Rennes (2024-2026) with LACODAM Team**

  Participants: Elisa Fromont, Romaric Gaudel, Paul Sevellec.

  Contract amount: 70k€ + Phd Salary

  Context. This project is a collaboration with Stellantis and focuses on the development of interpretable machine learning models for multivariate time series data. Utilizing a range of sensors integrated within vehicles, these models are designed to make real-time decisions. Providing drivers with clear explanations of these decisions is a key aspect. We specifically concentrate on counterfactual explanations, which not only clarify why a particular decision was made but also illustrate how alternative scenarios might have led to different outcomes.

  Objective. Current approaches providing counterfactual explanations for time series models are limited to univariate time series. In this project, we aim to develop approaches to handle multivariate time series, which requires capturing the correlations between the series.

  Additional remarks. This is the doctoral contract for the PhD of Paul Sévellec (Thèse CIFRE), which is co-advised with Laurence Rozé from LACODAM Team.

- **ATERMES - Univ. Rennes (2024-2027) with OBELIX Team**

  Participants: Élisa Fromont, Manuel Nkegoum.

  Contract amount: 0€ (for MALT Team) + Phd Salary

  Objective. This project aims at providing robust deep-learning-based methods to detect objects in outdoor environments using multispectral images under a low supervision context. The developed

methods are expected to learn from few labeled examples at training time and be able to detect scarcely-observed objects in prediction. In case of very few object labels (even no label) being available, the model to be developed should be capable of discovering unknown novel objects from the observed scene.

Additional remarks. This is the CIFRE PhD of Manuel Nkegoum with Atermes (Thèse CIFRE). There is an agreement with the Obelix team to freely use part of the 60k€ contract as was done conversely in the previous PhD with the same parties.

- **SIEMENS - Univ. Rennes (2025-2028) with EMPENN Team**

  Participants: Elisa Fromont, Youwan Mahé.

  Contract amount: 12k€ (for MALT Team)+ Phd Salary

  Context. Stroke is a major health issue globally, causing severe brain damage due to disrupted blood supply. Medical imaging, especially MRI, is crucial for assessing stroke localization and extent.

  Objective. Objective. Our goal in this project, is to improve the detection and delineation of chronic stroke lesions from multimodal data using deep learning, helping clinicians plan better treatment and rehabilitation programs.

  Additional remarks. This is the CIFRE PhD of Youwan Mahé with Siemens (Thèse CIFRE). The total contract with Siemens is 50k€ but this amount is divided between the CHU of Rennes, the Empenn team and the MALT team.

- **HUAWEI - Univ. Rennes II (2025-2028) with OBELIX Team**

  Participants: Romain Tavenard, Ambroise Odonnat.

  Contract amount: 90k€ (for MALT Team, shared with OBELIX team in practice)+ Phd Salary

  Objective. Our goal in this project is to understand how Transformer architectures are impacted by distribution shift so as to be able to better adapt pre-trained models on target distributions.

  Additional remarks. This is the CIFRE PhD of Ambroise Odonnat with Huawei (Thèse CIFRE). There is an agreement with the Obelix team to freely share the 90k€ contract, though this contract is hosted on the Université de Rennes II - MALT side.

- **ORANGE - Univ. Rennes (2025-2028)**

  Participants: Romaric Gaudel, Oussama Zaid.

  Contract amount: 39k€ + Phd Salary

  Objective. In this project we develop a hybrid graph–vector database that natively integrates machine learning, particularly graph neural networks. Its main use-case is telecom network digital twins, aiming at efficient prediction, simulation, and data governance for complex and evolving networks.

  Additional remarks. This is the CIFRE PhD of Oussama Zaid with Orange (Thèse CIFRE).

10 Partnerships and cooperations

10.1 International initiatives

10.1.1 Inria associate team not involved in an IIL or an international program

EA PACTOL

Participants: Paul Viallard, Romaric Gaudel.

Title: Novel PAC Theoretical Guarantees Of Machine Learning Models

Partner Institution: Université Laval / Electrical Engineering and Computer Engineering, Canada

Date/Duration: 3 years (2025-2027)

Additionnal info/keywords: Machine learning and statistics, Machine learning, Data science

Budget: 30k€ (Inria)
This associate team project seeks to advance our understanding of statistical machine learning theory by deriving theoretical guarantees for model performance, known as PAC (Probably Approximately Correct) guarantees. These PAC guarantees bound a notion of quality for the model by a term named complexity measure to estimate the quality of the model in practice. In order to obtain new complexity measures, the primary objective is to develop a novel theory of PAC guarantees that is distinct from existing uniform-convergence-based and PAC-Bayesian bounds. This theory will specifically upper-bound the generalization gap, a key notion of model quality. During the reporting year, the project enabled the funding of two research visits (one by Paul Viallard and one by Romaric Gaudel) and provided partial financial support for the research visit of Benjamin Leblanc from Université Laval.

10.1.2 STIC/MATH/CLIMAT AmSud projects

Projet STIC AmSud-GIMMD

Participants: Simon Malinowski.

Title: Graph-based Analysis and Understanding of Image, Video and Multimedia Data

Partner Institution(s):

- PUC MINAS, Brésil
- UNICAMP, Brésil
- Universidade de la Republica, Uruguay
- Université Gustave Eiffel, France

Date/Duration: from January 2024 to December 2025

Additionnal info/keywords: Main challenges adressed:

- Graph-based image and video segmentation
- hierarchical feature extraction for data classification
- temporal graph processing and classification
- graph-based image and video inpainting

10.2 International research visitors

10.2.1 Visits of international scientists

Other international visits to the team

Benjamin Leblanc

Status PhD

Institution of origin: Université Laval

Country: Québec, Canada

Dates: 2 weeks in November 2025

Context of the visit: Joint work with Paul Viallard on PAC-Bayes and fairness

Mobility program/type of mobility: Associate team PACTOL

10.2.2 Visits to international teams

Research stays abroad

Dimitri Lerévérend

Visited institution: EPFL

Country: Switzerland

Dates: 04/05/25 - 31/07/25

Context of the visit: Start a new research project with the Team SACS at EPFL: design, theoretically analyze, and test a distributed learning algorithm that transmits only a subset of its model to each neighbor.

Mobility program/type of mobility: research stay partially funded by Aide à la mobilité internationale sortante des doctorants 2025 du Collège doctoral de Bretagne (2.8 k€)

Simon Malinowski

Visited institution: PUC MINAS

Country: Brazil

Dates: 11/02/25 - 27/05/25

Context of the visit: Supervision of Carolina Jeronimo and research visit, both in the context of the Stic-Amsud GIMMD project.

Mobility program/type of mobility: Research stay

Paul Viallard and Romaric Gaudel

Visited institution: Université Laval

Country: Québec, Canada

Dates: October 2025

Context of the visit: Kickoff of the associate team PACTOL.

Mobility program/type of mobility: Associate team PACTOL

10.3 National initiatives

- **DGA-AID : Local search for multi-armed bandit problems - Inria**

  Participants: Romaric Gaudel, Elisa Fromont, Paul Viallard, Aurélien Delage.

  Budget: 130k€ (Inria)

  This project aims at proposing multi-armed bandit algorithms dedicated to combinatorial problems which can be solved through local search. It is funding by through a collaboration between Inria and DGA-AID to foster reasearch subjects which interest either the army or the industry. The fund mainly covers a 2-years postdoc position.

- **PEPR IA ADAPTING - Univ. Rennes (2024-2028)**

  Participants: Elisa Fromont, Nouha Karaouli, Noam Bires, Loane Portier, Simon Malinowski, Julianne Guerbette.

  Budget: 3×(14,5k€ + PhD Salary)

  AdaptING explores new models, computing paradigms (i.e., beyond the Von Neumann architecture), hybrid architectures (i.e., beyond MPSoC – System-on-Chip), and emerging technologies through various initiatives aimed at making AI more efficient, sustainable, and trustworthy. While the project encompasses hardware advancements, our contributions in LACODAM will focus on the algorithmic level. In particular, we will design new resource-efficient incremental learning algorithms that can run on embedded systems with their associated resource and privacy constraints. We will also investigate post-hoc explanation methods for federated learning systems as a way to monitor the trustworthiness of such systems. Federated learning will often be at the center of the project as a practical learning paradigm suited for embedded systems.

  We currently supervise three PhD students funded by the PEPR IA ADAPTING.

- **ANR DATES - Univ. Rennes (2025-2029)**

  Participants: Romain Tavenard, Romaric Gaudel, Elisa Fromont.

  Budget: 238k€

  DATeS focuses on developing data-efficient machine learning methods for time-dependent data that can generalize across varying conditions, environments, or application domains. Its application context lies in real-world settings where temporal data are continuously collected—such as industrial systems, monitoring infrastructures, or complex cyber-physical systems—but where annotated data are scarce or heterogeneous. The project addresses the challenge of distribution shifts and domain changes by designing learning frameworks that can adapt knowledge learned from one context to another. By combining methodological advances with practical use cases, it aims to improve the robustness, reliability, and scalability of time-series–based decision systems. Overall, the project targets impactful applications where adaptive and transferable temporal models can significantly reduce deployment costs and improve operational performance. DATeS is a joint PRCE project with Univ. Jean Monnet (St Etienne) and ERICSSON R&D.

- **P16** - Inria (2025-2026)

Participants: Romain Tavenard.

Budget: Engineer Salary

The tslearn library that is developped in the team is backed by a P16 Inria project through the funding of the engineer contract of Guillaume Charavel.

- **AEx HYPE: HYPErparameter-Free Optimization Algorithms by Online Self-Tuning - Inria (2025-2028)**

Participants: Paul Viallard, Romaric Gaudel.

Budget: 146k€ (Inria)

This project lies at the intersection of statistical learning theory and mathematical optimization, both central topics in machine learning. Indeed, optimization algorithms are the backbone of machine learning methods, enabling us to automatically find a model (i.e. a mathematical function) from data to perform a desired task. However, running these optimization algorithms requires setting certain hyperparameters that influence their execution, and identifying optimal values for them can be time-consuming. Therefore, the goal of this project is to develop novel optimization algorithms capable of adaptively tuning all their hyperparameters during execution. The funding provides support for a three-year PhD position.

10.4 Regional initiatives

- **AIS fund for 3D-printing time prediction**

Participants: Romaric Gaudel.

Budget: 25k€ (Rennes Métropole: Allocation d'Insatallation Scientifique)

This fund pays for a GPU card used for research on improving 3D printing. The 3D printing research axis emerged within the IRISA laboratory in 2021, led by Damien Hardy and Fabrice Lamarche, and is still in the process of consolidation. As part of this emerging research axis, Damien Hardy, Romaric Gaudel, and Niels Cobat work at optimizing G-code using AI methods, in particular neural networks for sequence modeling, and this research track benefits from the funded GPU.

Romaric AIS

11 Dissemination

11.1 Promoting scientific activities

11.1.1 Scientific events: organisation

General chair, scientific chair

- Romain Tavenard and Ambroise Odonnat Neurips have co-organized the workshop Recent Advances in Time Series Foundation Models (BERT2S) at NeurIPS in San Jose, USA.
- Romain Tavenard and Simon Malinowski have co-organized the workshop Advanced Analytics and Learning on Temporal Data (AALTD) at ECMLPLKDD in Porto, Portugal.
- Elisa Fromont is the scientific chair of the AI week 2025 in Rennes.

11.1.2 Scientific events: selection

Member of the conference program committees

- Paul Viallard: NeurIPS'25 (A*), AAAI'26 (A*), PPML @ EurIPS'25, AIMLAI @ ECML/PKDD'25, CAp'25,
- Romaric Gaudel: NeurIPS'25 (A*), AISTATS'26 (A)

11.1.3 Journal

Reviewer - reviewing activities

- Romain Tavenard has reviewed for the TMLR journal.

11.1.4 Invited talks

- Paul Viallard presented a tutorial entitled "How to Make Use of Learning Theory to Learn Efficient ML Models: From PAC-Bayesian Generalization Bounds to (Self-Bounding) Learning Algorithms" with Emilie Morvant (University Jean Monnet of Saint-Etienne) at the COLT'25 (A*) conference.
- Paul Viallard gave a seminar at Université Laval, Québec, Canada.
- Mathieu Lefort gave a seminar at ISIR, Paris.
- Romain Tavenard gave a seminar at Withings, Paris.

11.1.5 Leadership within the scientific community

- Paul Viallard served as a representative of the SequoIA AI cluster at Mila for the first edition of the Franco-Canadian Dialogue on Artificial Intelligence, jointly organized by Inria, CIFAR, and Mila.
- Elisa Fromont is a member of the board of GDR RADIA.

11.1.6 Scientific expertise

- Patrick Bouthemy was head of the HCERES committee that evaluated the LIRIS (Laboratoire d'InfoRmatique en Image et Systèmes d'information), is member of the Selection and Validation Committee of the Images & Réseaux competitivity cluster.
- Romaric Gaudel was member of the HCERES committee that evaluated IRIT (Institut de Recherche en Informatique de Toulouse).
- Romaric Gaudel was reviewer for the ANR agency (review of one final project)
- Romaric Gaudel was member of the PhD-award commity of SSFAM association.
- Romaric Gaudel was member of the PhD-fund commity of cluster-IA PostGenAI@Paris.
- Romaric Gaudel was member of jury for assistant professor position at univ. Paris Dauphine, AgroParisTech (Paris), Ecole Centrale Mediterannée (Marseille).
- Elisa Fromont is a member of an OECD Network of Experts on AI "Expert Group on AI Risk & Accountability"
- Elisa Fromont was president of the PhD award committee of AFRIF (french society in Pattern Reconition) and was a member of the PhD award committee of AFIA (french society in Artificial Intelligence).
- Elisa Fromont is a member of the scientific council of the MathNum dept of Inrae (3 days of meeting and scientific evaluations every years)

- Elisa Fromont was a member of the scientific council of the SSFAM (french society in Machine Learning).
- Elisa Fromont was head of the D7 Data and Knowledge Management department at IRISA until June 2025 (work: 1/2 day per month + HCERES eval). Now Romain Tavenard is the new head of the department.
- Elisa Fromont was president of the PhD award committee of AFRIF (french society in Pattern Reconition) and was a member of the PhD award committee of AFIA (french society in Artificial Intelligence).

11.1.7 Research administration

- Patrick Bouthemy serves as Research Integrity Officer for Inria (since July 2025), is member of the executive board of Excellence Lab CominLabs, is member of the steering board of the NeurInfo platform.
- Elisa Fromont is co-head of the gender equality committee at IRISA and gender equality liaison for the CNRS.
- Romaric Gaudel is elected member of the board of the laboratory IRISA.

11.2 Teaching - Supervision - Juries - Educational and pedagogical outreach

11.2.1 Teaching

- Elisa Fromont is Professor at University of Rennes. She taught 96h in 2024-2025 mainly at Master level. She is responsible for the AI Master of the University of Rennes.
- Romain Tavenard is Professor at University of Rennes 2. He taught 200h in 2024-2025 mainly in the MIASH program. He is responsible for the Master of Statistics of UR2.
- Romaric Gaudel is associate professor at University of Rennes. He taught 200h in 2024-2025. He is responsible for the 2nd year (M2) of the Master of AI. He is responsible for the following courses at ISTIC (Univ. Rennes): "discover AI" (L2), "Machine Learning" (M1 SIF) Data analysis and probabilistic modeling (M2 SIF), a course on recommender systems (M2 Miage & IET), a course on information retrieval and natural language processing (M2 Miage).
- Simon Malinowski is associate professor at University of Rennes. He taught taught 250h in 2024-2025. He is responsible for the Master EIT data science and the 2nd year of the MIAGE master.
- Mathieu Lefort is an associate professor at University of Rennes since September 2025. He teaches a full service. He is responsible for a course on reinforcement learning in the Master of AI.

Other major responsibilities

- Elisa Fromont is the scientific director of the CMA IA TIARe (3.5 M€ training project). She spends on average 1/2 days per week on this project: creation of new training programs (e.g. AI Master), scientific mediation, development of the continuous learning program, datalab, recruitments, ...
- Elisa Fromont is elected (college A) at the research council ("commission recherche") of Université de Rennes. As such, she is a member of the academic council (CAC) of the University and a member of the HDR Committee of the University. This activity takes about a day per month.
- Romain Tavenard is elected (college A) at the research council ("commission recherche") of Université de Rennes 2. As such, he is a member of the academic council (CAC) of the University of Rennes 2.

11.2.2 Supervision

Apprentice

- Loane Portier (2025-2026, Univ. Rennes, Elisa Fromont, Yasmine Hachani) "Post-hoc Explanations for Federated Learning Systems"

Bachelor Students

- Florent Cheyron (3 months, Univ. Rennes, Barbara Pilastre, Elisa Fromont) "Anomaly detection on temporal graphs"
- Benjamin Wojtecki (3 months, ENS Rennes, Paul Viallard, Romaric Gaudel) "Parameter-free Optimization Algorithms Using Contextual Bandits"

Master Students

- Youcef Boulfrad (5 months, ENSAI, Paul Viallard, Romaric Gaudel) "Parameter-free Optimization Algorithms Using Contextual Bandits"
- Léo Laffeach (5 months, Univ. Rennes, Romaric Gaudel, Romain Tavenard) "Extension of Dynamic Time Warping (DTW) to Continuous-Time: Theoretical Foundations and Applications"

PhD Students

- Ahmed Abdourahmane Mahamoud (2024-2027, Univ. Rennes, Simon Malinowski) "Simulation de personnages virtuels basée sur l'imitation des interactions", PEPR Ensemble
- Hind Atbir (2024-2027, Univ. Jean Monnet, Paul Viallard) with Laboratoire Hubert Curien and MALICE Team "Learning fair and robust kernel-based models with generalization guarantees"
- Nadir Bendoukha (2024-2025, Univ. Lyon 1, Mathieu Lefort) with LIRIS laboratory and Institut Pascal "Equivariant multimodal self-supervised learning"
- Axel Bessy (2024-2027, Univ. Lyon 1, Mathieu Lefort) with LIRIS laboratory and ATOS "Multimodal fusion of medical imaging for diagnosis support: towad a general model"
- Noam Bires (2025-2028, Univ. Rennes, Elisa Fromont) with TARAN Team "Architectures matérielles d'IA fiables"
- Niels Cobat (2024-2027, Univ. Rennes, Romaric Gaudel) with PACAP Team "Analyse et optimisation des fichiers d'impression 3D à l'aide de méthodes d'apprentissage automatique"
- Télio Dupuis (2025-2028, Univ. Grenoble Alpes, Mathieu Lefort) with Univ Lyon 1 "Deep active self-supervised sensorimotor learning of manipulable object representations"
- Julianne Guerbette (2025-2028, Univ. Rennes, Simon Malinowski) with LACODAM team "Continual Neuro-symbolic Learning of Knowledge Graph Embeddings"
- Yasmine Hachani (2023-2026, Inria, Elisa Fromont, Patrick Bouthemy) "Deep learning analysis of the dynamics of early bovine embryo development using video microscopy"
- Carolina Jeronimo de Almeida (2022-2026, Gouvernement Brésil, Simon Malinowski) "Analysis of time series graphs"
- Nouha Karaouli (2025-2028, Univ. Rennes, Elisa Fromont) "Incremental Deep Learning for Embedded Systems"
- Charbel Kindji (2022-2025, OrangeLabs, Elisa Fromont) "Synthetic Tabular Data: Generation and Detection"
- Julien Lefebvre (2024-2027, Univ. Lyon 1, Mathieu Lefort) with LIRIS laboratory "Continual unsupervised learning"

- Dimitri Lerévérend (2023-2026, Inria, Romaric Gaudel) with WIDE Team "Privacy Preserving Decentralized Through Model Fragmentation"

- Youwan Mahé (2025-2028, Siemens, Elisa Fromont) with EMPENN Team "Anomaly detection and segmentation for the characterization of post-stroke recovery"

- Manuel Nkegoum Nzouakeu (2024-2027, ATERMES, Elisa Fromont) with OBELIX Team "Object Detection from Few Multispectral Examples"

- Ambroise Odonnat (2024-2027, Huawei, Romain Tavenard) with OBELIX Team "Apprentissage par transfert pour les séries temporelles"

- Nathan Salazar (2024-2027, Univ. Lyon 1, Mathieu Lefort) with LIRIS laboratory "Towards a fundation model of human movements for analysis and synthesis of body actions and expressions"

- Paul Sevellec (2023-2026, Stellantis, Romaric Gaudel, Elisa Fromont) with LACODAM Team "Explanations of multivariate time series using counterfactuals"

- Pierre-Elliott Thiboud (2022-2025, Univ. Lyon 1, Mathieu Lefort) with Creatis laboratory and Previa Medical "Structure and explanibility of artificial neural networks for health - application to sepsis prevention"

- Erwan Vincent (2022-2025, Univ Rennes, Simon Malinowski) "Apprentissage automatique pour l'analyse et la prédiction de la qualité de service des transports de bus urbains", Thèse CIFRE avec Keolis Rennes

- Oussama Zaid (2025-2028, OrangeLabs, Romaric Gaudel) "Convergence of graph and vector approaches to integrate machine learning predictions into network digital twin simulation"

Post docs

- Aurélien Delage (2025-2026), Inria, Romaric Gaudel "Local search for multi-armed bandit problems"

- Nicolas Jaquelin (2025-2027, Univ. Lyon 1, Mathieu Lefort) with Neovision "Generic augmentations for self-supervised learning"

ATER

- Louis Bagot (2025-2026, Univ. Lyon 1, Mathieu Lefort) "Exploration with goal conditionned reinforcement learning"

11.2.3 Juries

- Elisa Fromont was involved in the following PhD juries: Hugo Laurençon, 15/01 Paris (committee member); Romain Ilbert, 16/05 Paris (reviewer); Franck-Anaël MBiaya 12/09 Orléans (committee member); Ricky Walsh, 17/10 Rennes (committee member, president); Charbel Kindji, 18/12 Rennes (co-supervisor).

- Romain Tavenard was involved in the following PhD juries: Theo Gnassounou (Paris), Thibaut Germain (Paris).

- Romaric Gaudel was involved in the following PhD jury: Charles-Maxime Gauriat, 23/06 Toulouse (reviewer).

- Elisa Fromont was involved in the following HDR juries: Nicolas Audebert, 20/05 Paris (reviewer); Charlotte Laclau, 24/11 Paris (reviewer).

11.2.4 Educational and pedagogical outreach

- Elisa Fromont made an introduction to artificial intelligence for Rennes city councillors.
- Elisa Fromont presented her job in **5** classes within the 1 scientifique, 1 classe : chiche ! program.
- Romaric Gaudel presented his job in **1** class within the 1 scientifique, 1 classe : chiche ! program.
- Elisa Fromont presented talked about AI for secondary school students in **3** classes. She was also involved in JFMI days and two training days for teachers. She was an Invited expert at the West Data Festival for a session on "women and AI" for bachelor students.
- Paul Viallard gave a presentation to a class at Lycée Colbert in Lorient, as part of the CMA TIARe initiative.

11.3 Popularization

11.3.1 Specific official responsibilities in science outreach structures

Elisa Fromont, as the scientific director of the CMA TIARe initiative coordinate a science communicator, Elsa Denichou, working for the project.

11.3.2 Productions (articles, videos, podcasts, serious games, ...)

Elisa Fromont did a conference (in French) at l'Espace des sciences "50 d'IA, et apres ?", Rennes. : video here.

11.3.3 Participation in Live events

- Paul Viallard participated in the various Inria dissemination stands organized for the "Semaine de la Science" at Champs Libres.
- Paul Viallard gave a talk at a "Pint of Science"' event entitled "How does an AI learn?".
- Mathieu Lefort participated to the exposition Intelligences 2.0 organised during the "Fête de la science" at Lyon 1 library.
- Elisa Fromont participated in the following events: Panellist at the University of Rennes EPE seminar on "IAG et son impact sur les métiers", Ouest France, Rennes; Opening conference (in French) of the academic year for staff (3h) for ENSCR "Acculturation à l'IA", PNRV Rennes; Opening conference (in French) of the academic year for staff (1h30) for the La Fontaine des Eaux high school, "IA, de quoi parle-t-on ?", Dinan; Panelist at l'Espace des sciences "IA : la révolution Homme-machine", Rennes; Conference (in French) at Le Kiosque "Introduction à l'Intelligence Artificielle " dans le cadre de la fête de la science, Chantepie. Panellist (in French) at Les 9èmes Assises départementales de la Recherche et de l'Innovation, Saint-Brieuc.
- Romaric Gaudel was part of a round table "Enseignement supérieur et IA", organized during the annual conference of AIR project at Rennes.
- Romaric Gaudel was part of a round table "Le devenir de la programmation avec ou sans IA" during the day "IA génératives : serveurs et services associés" organized by Univ. Rennes.

11.3.4 Others science outreach relevant activities

Elisa Fromont co-organized a training day (in French) for high and secondary school teachers on "Stereotypes in Computer Science", Je peux pas, j'ai informatique !.

12 Scientific production

12.1 Major publications

[1] S. Biswas, D. Frey, R. Gaudel, A.-M. Kermarrec, D. Lerévérend, R. Pires, R. Sharma and F. Taïani. 'Low-Cost Privacy-Preserving Decentralized Learning'. In: *Proceedings on Privacy Enhancing Technologies Symposium*. Privacy Enhancing Technologies Symposium. Vol. 2025. 3. Washinghton DC, United States, July 2025, pp. 451–474. DOI: 10.56553/popets-2025-0108. URL: https://hal.science/hal-04993586.

[2] L. Chapel and R. Tavenard. 'One for all and all for one: Efficient Computation of Partial Wasserstein Distances on the Line'. In: *Proceedings of the International Conference on Learning Representations*. International Conference on Learning Representations. Singapore, Singapore, 24th Apr. 2025. URL: https://hal.science/hal-04928469.

[3] L. Chapel, R. Tavenard and S. Vaiter. 'Differentiable Generalized Sliced Wasserstein Plans'. In: NeurIPS 2025 - 39th Annual Conference on Neural Information Processing Systems. San Diego, United States, 2025, pp. 1–20. DOI: 10.48550/arXiv.2505.22049. URL: https://hal.science/hal-05345011.

[4] G. Kindji, L. M. Rojas-Barahona, E. Fromont and T. Urvoy. 'Tabular Data Generation Models: An In-Depth Survey and Performance Benchmarks with Extensive Tuning'. In: *Neurocomputing* 658 (Dec. 2025), p. 131655. DOI: 10.1016/j.neucom.2025.131655. URL: https://hal.science/hal-04612244.

[5] P. Sevellec, E. Fromont, R. Gaudel, L. Rozé and M. Sammarco. 'Plausible Conditional Generation-based Counterfactual Explanations for Multivariate Times Series Classification'. In: *Proceedings of the 28th European Conference on Artificial Intelligence, IOS Press*. ECAI 2025 - European Conference on Artificial Intelligence. Bologna, Italy, 25th Oct. 2025. URL: https://hal.science/hal-04928456.

[6] A. Voyez, T. Allard, G. Avoine, P. Cauchois, E. Fromont and M. Simonin. 'The Privacy Cost of Fine-Grained Electrical Consumption Data'. In: *Scientific Reports* 15.17391 (19th May 2025), pp. 1–8. DOI: 10.1038/s41598-024-78285-7. URL: https://hal.science/hal-03833605.

12.2 Publications of the year

International journals

[7] A. Di Matteo, Y. Mahé, S. s. Leplaideur, I. Bonan, E. Bannier and F. Galassi. 'Deep Learning and Multi-Modal MRI for the Segmentation of Sub-Acute and Chronic Stroke Lesions'. In: *Pattern Recognition Letters* 199 (14th Nov. 2025), pp. 225–231. DOI: 10.1016/j.patrec.2025.11.017. URL: https://inria.hal.science/hal-04647365 (cit. on p. 12).

[8] E. Germani, E. Fromont, P. Maurel and C. Maumet. 'HCP Multi-Pipeline: a derived dataset to investigate analytical variability in fMRI'. In: *Scientific Data* 12.1 (2025), p. 940. DOI: 10.1038/s41597-025-05247-7. URL: https://inserm.hal.science/inserm-04356768 (cit. on p. 12).

[9] G. Kindji, L. M. Rojas-Barahona, E. Fromont and T. Urvoy. 'Tabular Data Generation Models: An In-Depth Survey and Performance Benchmarks with Extensive Tuning'. In: *Neurocomputing* 658 (Dec. 2025), p. 131655. DOI: 10.1016/j.neucom.2025.131655. URL: https://hal.science/hal-04612244 (cit. on p. 12).

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