UMR IRISA

Activity Report 2024

Team LOGICA

LOgic, Games, Information, Coordination, and Applications

D4 – Language and Software Engineering

Université de Rennes | rennes | INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES RENNES | cnrs | Inria | Inserm | CentraleSupélec | IMT Atlantique Bretagne-Pays de la Loire École Mines-Télécom | Université Bretagne Sud ubs

1 Team composition

Researchers and faculty

François Bodin, PR University of Rennes
Hervé Marchand, CR Inria
Sophie Pinchinat, PR University of Rennes
François Schwarzentruber, MCF ENS Rennes (until August 2024)
Dylan Bellier (ATER Istic)

Research engineers, technical staff

Benjamin de Zordo, Engineer, CDD, University of Rennes
Marius Garenaux-Gruau, Engineer, CDD, University of Rennes
Laurent Morin, Engineer, University of Rennes
Olivier Martineau, Engineer, CDD, University of Rennes
Corentin Val, Engineer, CDD, University of Rennes
Gaëlle Richet, CDD, University of Rennes
Didier Vojtisek, Engineer, Inria (20%)

PhD students

Mathis Certenais (University of Rennes)
Victorien Desbois (ENS Rennes / NewLogUp)
Yawa Germaine Renate Nyatsikor (University of Rennes)
Alexandre Terefenko (University of Rennes/UMONS)

Administrative assistant

Sophie Maupilé

2 Overall objectives

2.1 Overview

The LOGICA team studies theoretical and practical aspects of *multi-agent systems* (MAS). Viewed abstractly, MAS are systems composed of agents that are autonomous entities deciding by themselves which actions to perform in order to meet their objectives. The notion of MAS is finding a wide range of applications: multi-robot systems (e.g. drones), web services, distributed systems, decentralized control, cyber-physical systems, games, etc. Therefore, an agent could be either a physical entity, a computer program, or a human being. Its behaviour can be cooperative, adversarial, or malicious.

Noticeably, in a MAS, agents may not have perfect information about their environment. As a consequence, agents decisions are taken on the basis of the available information, that changes dynamically due to events occurring over time.

Reasoning about MAS requires their formal modeling and the development of theories. Such theories should support their deployment in practice, by providing guarantees and certification of their proper functioning. This can be achieved by various means: verification (model-checking), automated generation (synthesis), and coordination mechanisms between agents (control/orchestration/choreography/communication). The LOGICA group contributes to the foundations of MAS by developing innovative ideas in these lines. A particular research interest concerns the use of logical approaches where both the models for MAS and the languages for the specification of their properties lead to effective methods.

A part of the team, named Logistica, focuses on data logistics, primarily addressing challenges related to data transport, security, and processing from their source to their final use. This research area falls within the domain of collaborative systems-of-systems, addressing questions such as cybersecurity, federation governance, and workflow management.

This theme concretizes itself in various use cases, such as the integration of exascale computing centers with large-scale scientific instruments (e.g., Sentinel satellites) or data collection chains on mobility. Although scales and data nature vary, the underlying scientific problems remain identical.

Methodologically, Logistica favors an experimental approach based on operational deployments in a multidisciplinary context.

Several projects currently support this research activity, including Exa-AToW, which deals with large-scale workflows, and City-Orchestra, which focuses on metropolitan-scale data federation and sharing.

2.2 Pluridisciplinarity approach and Application domains

- Development of a platform for IoT that allows experiments with data logistics.
- Vulnerability analysis of virtualized networks.
- Information systems risk analysis via attack generation and attack tree design.

- Scientific application in the domain of geophysics and astrophysics.

2.3 Scientific foundations

The team's activities span both theoretical and applied aspects of computer science.

Most of its members work on developing a wide spectrum of ideas and results, in particular in logic, for the analysis of automated reasoning methods in multi-agents systems (MAS): epistemic reasoning, strategic reasoning, dependencies between strategies, synthesis of correct behavior. In most cases, a careful study of the computational complexity of the exhibited problems is conducted. Main research topics are reasoning under uncertainty in MAS, planning problems, strategic reasoning, foundations of attack trees in risk analysis, and automata techniques for system verification and synthesis.

The team also addresses large-scale scientific workflows mixing data and compute related tasks to be deployed in the continuum of IT infrastructures. We define large-scale workflows - also called cross-facility or multi-facility workflows - as portable scientific processes designed to operate across distributed and heterogeneous infrastructures, in order to simplify and automate complex data processing and analysis tasks. Large-scale workflows can be seen as a collaborative system-of-systems, an assembly of independent systems that voluntarily interact to achieve shared objectives. One of the known problems in this context is data logistics, which refers to the process of managing the data flow within a federation, including its collection, storage, transmission, analysis, and security.

3 Scientific achievements

3.1 Formal aspects of Attack Defense Trees

Participants: Sophie Pinchinat, Alexandre Terefenko.

Joint work with Thomas Brihaye.

We have developed a mathematical setting for attack-defense trees (adts), a classic graphical model to specify attacks and countermeasures. We equip adts with (trace) language semantics allowing to have an original dynamic interpretation of countermeasures. Interestingly, the expressiveness of adts coincides with star-free languages, and the nested countermeasures impact the expressiveness of adts. With an adequate notion of countermeasure-depth, we exhibit a strict hierarchy of the star-free languages that does not coincide with the classic one. Additionally, driven by the use of adts in practice, we address the decision problems of trace membership, non-emptiness, and equivalence, and study their computational complexities parameterized by the countermeasure-depth.

3.2 Logical approaches for games on graph solving

Participants: Sophie Pinchinat.

Joint work with Rylo Ashmore.

Logic and automata have deep connections established in the literature. Many pursuit-evasion games exist with a plethora of analysis. We bridge the two, leveraging logic and automata to find novel results on two pursuit-evasion games. In particular, we use monadic second order logic's connection to (parity) tree automata to provide an additional characterization for the infinite trees which are cat-win in the game of Cat Herding. Our analysis also provides an algorithmic way to decide certain families of infinite trees' outcomes in the game of Cat Herding. Secondly, we use second order finite/Büchi automata's connection with recognizable languages to provide an algorithmic way to identify the existence of protection strategies in the game of firefighting of a given complexity.

3.3 Knowledge representation and reasoning

3.3.1 A Logic for Reasoning about Aggregate-Combine Graph Neural Networks

Participants: François Schwarzentruber.

Joint work with Pierre Nunn, Marco Sälzer and Nicolas Troquard.

We propose a modal logic in which counting modalities appear in linear inequalities. We show that each formula can be transformed into an equivalent graph neural network (GNN). We also show that a broad class of GNNs can be transformed efficiently into a formula, thus significantly improving upon the literature about the logical expressiveness of GNNs. We also show that the satisfiability problem is PSPACE-complete. These results bring together the promise of using standard logical methods for reasoning about GNNs and their properties, particularly in applications such as GNN querying, equivalence checking, etc. We prove that such natural problems can be solved in polynomial space [6].

3.3.2 Qiana: A First-Order Formalism to Quantify over Contexts and Formulas

Participants: François Schwarzentruber.

Joint work with Simon Coumes, Pierre-Henri Paris and Fabian M. Suchanek.

We introduce Qiana, a logic framework for reasoning on formulas that are true only in specific contexts. In Qiana, it is possible to quantify over both formulas and contexts to express, e.g., that "everyone knows everything Alice says". Qiana also permits paraconsistent logics within contexts, so that contexts can contain contradictions. Furthermore, Qiana is based on first-order logic, and is finitely axiomatizable, so that Qiana theories are compatible with pre-existing first-order logic theorem provers [4].

3.3.3 Rhythm Inference Helping Writing Music Scores

Participants: François Schwarzentruber.

We present a new problem called rhythm inference. It consists in inferring the duration of each note and each rest from a partial specification. We then formulate rhythm inference as a constraint satisfaction problem and we use mixed linear programming to solve it. The solution is implemented for a language representing music scores, called abcd. Interestingly, the rhythm is inferred in real-time from partial musical indications [8].

3.4 Analysis and control of Discrete Event Systems

3.4.1 A New Verification Algorithm for Inferencing in Supervisory Control of Discrete-Event Systems

Participants: Hervé Marchand.

Joint work with Laurie Ricker (Mount Allison University, Canada).

We developed a new algorithm to verify inference observability in supervisory control of decentralized discrete-event systems. The algorithm's success relies on the following idea: an inferencing solution exists only when a language contains no inferencing cycles. When there are no cycles, the algorithm computes the smallest upper bound for an inferencing solution [9].

3.4.2 Logic for Opacity - DES To Logic Formalization

Participants: François Pierre, Hervé Marchand, Sophie Pinchinat.

Many researchers have used formal verification to make sure that a system is secure with respect to some properties referring to Integrity, Confidentiality and Availability. Here, we focus on the "confidentiality" side of security, specifically opacity.

Opacity is a security property that is valid if an attacker is not able to infer secret information in a system under a particular observation of the system. In systems where opacity is not valid, the notion of control can be used to obtain it. We thus looked at the links that exist between the supervisory control theory and the First Order Logic (FOL) in order to tackle the opacity control problem. All the various notions necessary to tackle this problem have been translated into first order logic formula on the tree-like structure $Tree$ over the alphabet of the system. In an extra piece of work, we have shown that $Tree$ is an automatic structure, so that all FO-formulas denote regular languages, with an effective automata-based construction.

On the other hand, we showed that the computation of the least supremal language satisfying the opacity condition can be defined in FO(M-LFP) (i.e., monadic least fixed-point logic) leading to fundamental questions regarding the termination of these fix-points computation.

Incidentally, its decidability on the structure $Tree$, as far as we know, is open, which prevents us from making use of this property to answer whether the denoted language is regular. However, we proved that FO(M-LFP) has a strong expressive power, able to capture languages that are not regular.

Meanwhile, we proved that the language is regular in the specific case where the attacker is blind (i.e., the observation relation of the attacker is the equal length relation).

3.5 Multi-agent system analysis and algorithms

3.5.1 An Efficient Modular Algorithm for Connected Multi-Agent Path Finding

Participants: François Schwarzentruber, Victorien Desbois.

Joint work with Ocan Sankur.

We present a new algorithm for solving the connected multi-agent path finding problem (connected MAPF), which consists in finding paths for a set of agents that avoid collisions but also ensure connectivity between agents during the mission. Our algorithm is based on heuristic search. It combines ODrM, a well known algorithm without connectivity constraints, and an efficient but incomplete solver for the connected MAPF from the literature. We present a formal analysis of the termination and completeness of our algorithm, and present an experimental evaluation, showing a significant improvement over the state of the art [5].

3.5.2 Plan Logic

Participants: Dylan Bellier, Sophie Pinchinat.

Joint work with Fabio Mogavero and Massimo Benerecett.

When reasoning about games, one is often interested in verifying more intricate strategic properties than the mere existence of a winning strategy for a given coalition. Several languages, among which the very expressive Strategy Logic (SL), have been proposed that explicitly quantify over strategies in order to express and verify such properties. However, quantifying over strategies poses serious issues: not only does this lead to a non-elementary model-checking problem, but the classic Tarskian semantics is not fully adequate, both from a conceptual and practical viewpoint, since it does not guarantee the realisability of the strategies involved.

In collaboration with Fabio Mogavero and Massimo Benerecetti (Università degli Studi di Napoli Federico II, Italy), we follow a different approach and introduce Plan Logic (PL), a logic that takes plans, i.e., sequences of actions, as first-class citizens instead of strategies. Since plans are much simpler objects than strategies, it becomes easier to enforce realisability. In this setting, we can recover strategic reasoning by means of a compositional hyperteams semantics, inspired by the well-known team semantics. We show that the Conjunctive-Goal and Disjunctive-Goal fragments of SL are captured

by PL, with an effective polynomial translation. This result relies on the definition of a suitable game-theoretic semantics for the two fragments. We also investigate the model-checking problem for PL. For the full prenex fragment, the problem is shown to be fixed-parameter-tractable: it is polynomial in the size of the model, when the formula is fixed, and 2-ExpTime-complete in the size of the formula. For the Conjunctive-Goal and Disjunctive-Goal fragments of PL this result can be improved to match the optimal polynomial complexity in the size of the model, regardless of the size of the formula [2].

3.5.3 Dylan Bellier's PhD defense

Participants: Dylan Bellier, Sophie Pinchinat.

Strategy Logic (SL) has been introduced by Chatterjee, Henzinger and Piterman as a logic to reason about strategies. This powerful setting can express complex strategic notions, like the existence of a Nash equilibrium in a game or the existence of a defensive strategy. However this expressiveness comes with a price, as the associated model-checking problem has a non-elementary complexity and the satisfiability problem is undecidable. A careful analysis links this high complexity with the monolithic nature of strategy quantifiers in SL, where strategies are the first class citizens of the logic. Consequently, in a formula, a quantified strategy depends on the entirety of all strategies quantified before, which includes counter-factual and future decisions. This monolithic aspect of SL-quantifiers prevents from enforcing strategies to depend only on the history of the current play, and may lead to solutions with unrealizable strategies (i.e. strategies that cannot be implemented). It is therefore reasonable to investigate new semantics/new logics that guarantee the realizability of strategies, and ideally reduce decision problem complexities.

In our work, we took inspiration from logics with so-called team semantics, that rely on a team (a set of assignments) instead of a single assignment. Formally, a team satisfies an atomic formula if every assignment in the team satisfies said formula. Teams are convenient objects to represent all possible situations – so that the team semantics captures imperfect information. They also enable to express constraints on the quantified variable values. For instance, the property "the value of a variable x depends only on the value of another variable y" is characterized by teams in which every two assignments giving the same value to y, also give the same value to x. However, logics with team semantics generally lead to undeterminacy (there are formulas neither true nor false) because dependency constraints apply only to variables with the same quantifier-type (either existential or universal).

The core idea of our work is to replace team semantics by hyperteam semantics, where a hyperteam is a set of teams. This approach enables to express dependence in a compositional manner with symmetric treatment of existential and universal quantifiers. For a start, we successfully apply the approach to several logical settings – first, to first-order-like languages by designing Alternating Dependence/Independence Friendly Logic (ADIF), and second to Quantified Propositional Temporal Logic (QPTL). Next, we adapt hyperteam semantics to strategic reasoning by considering plans (sequences of actions), objects that are much simpler than strategies, as first-class citizens of the logic.

Aside of our contributions on hyperteam semantics for various logics, we develop a setting with a new kind of games with delays between player actions, that generalizes Delay Games, and that offers another way to express dependencies between strategies in multi-player games.

4 Software development

4.1 Risk analysis in information systems: ATSyRA platform

Participants: Sophie Pinchinat, Didier Vojtisek.

Joint work with Maxime Audinot, Laurent Collet (head), William Ragot of the SYA Digital company from Rennes.

We keep on with the ATSyRA platform development (`http://atsyra2.irisa.fr/`) to address the risk analysis of information systems, on top of previous analysis tools for physical systems.

Most of our research code is being made available through `http://atsyra2.irisa.fr/`. The software functionalities are essentially the specification of an information system, reachability analysis with scenario synthesis, and an attack tree design assistant tool with correctness criteria checking of the specified attack trees via model checking techniques.

This year, the software development is performed in the context of an industrial collaboration with the start-up SYA Digital from Rennes.

5 Contracts and collaborations

5.1 National Initiatives

5.1.1 RagARenn

Participants: Laurent Morin, François Bodin, Corentin Val, Benjamin de Zordo.

Since March 2024, the University of Rennes has launched an experimentation with generative AI called "RAGaRenn", with the goal of co-constructing a framework for the use of this technology with all of the university's staff. Our team LOGICA has been at the core of the technical design and implementation of the infrastructure supporting this initiative. We have also supported its deployment on the trusted local infrastructure Eskemm Data, the university's datacenter in Brittany dedicated to the ESR. The aim is to precisely dimension the necessary resources, estimate its direct carbon impact, and better understand the specific and relevant uses in a professional context.

The experimentation is still ongoing at `https://ragarenn.eskemm-numerique.fr/` and has gained national visibility. Following its successful presentation in summer 2024, the project now has two main objectives. First, upgrading the infrastructure to allow the University's IT services (DSI) to take over its support. Second, pooling usage around

generative AI and avoid the under-utilization of digital infrastructures, particularly servers. This is the goal of the Ilaas project, a new federation of higher education institutions (University of Lille, Reims Champagne Ardennes, Paris-I Panthéon-Sorbonne, Rennes, and CentraleSupélec) aiming to move towards more digital sobriety. RagARenn was one of the starting point for the creation of the Ilaas project. This project received funding from the DGRI (Direction Générale de la Recherche et de l'Innovation).

5.1.2 PEPR Numpex/Exa-AToW Architectures and Tools for Large-Scale Workflows

Participants: François Bodin, Mathis Certenais, Marius Garenaux, Olivier Martineau, Laurent Morin, Gaëlle Richet.

- Project type: PEPR
- Dates: 2022–2028
- PI institution: University of Rennes
- Other partners: CEA, CNRS, Inria

The deployment of exascale supercomputers meets the increasing demand for computational capacity in numerical models. Concurrently, there's an exponential growth in data volume from large scientific instruments, the Internet of Things (IoT), and numerical simulations (e.g., CMIP 6). In this scenario, designing scientific applications necessitates the consideration of distributed processing chains across data centers, processing/computation infrastructures, and scientists' labs (e.g., through large-scale workflows).

These infrastructures are often managed by different administrative authorities and are technically heterogeneous. This poses a challenge in implementing data logistics and orchestrating processing/computation at such a scale. Data logistics must adhere to several constraints:

1. Comply with the infrastructure's storage limitations.
2. Account for the capabilities (including topology, latency, and transfer protocols) of communication networks and computing infrastructures.
3. Maintain overarching security.
4. Reduce energy consumption.
5. Streamline the writing, deployment, and debugging of applications.

Thus, the implementation of these logistics is a multi-criteria optimization challenge within collaborative systems-of-systems. Key aspects of these logistics include the traceability of operations and adherence to the FAIR policy for all scientific data. Incorporating metadata - related to data or processes - in analyzing constraints and logistical solutions is crucial.

More at `https://numpex.org/`

In order to implement the FAIR principle in Exa-AToW we have set up two plateforms:

Documentation: `https://exatow.fenix.rudi-univ-rennes1.fr/`

Codes: `https://gricad-gitlab.univ-grenoble-alpes.fr/exa-atow`

These platforms aim at providing access to Exa-AToW results as well as work in progress.

5.1.3 Breizh Decarbonated Mobility

Participants: François Bodin, Olivier Martineau, Laurent Morin, Marius Garenaux.

- Project type: Feder / Brittany Region
- Dates: 2021–2024
- PI institution: Setur
- Other partners: University of Rennes (Irisa, Crem), RatpDev

Transportation is a major source of greenhouse gas emissions. Optimizing transport and promoting sustainable mobility can help reduce these emissions. This requires understanding the decision-making patterns of users regarding modes of transport, through the collection of personal and contextual data.

The BMDec project focuses on urban and peri-urban home-to-work mobility. It is a multidisciplinary initiative bringing together the SETUR consultancy, the LOGICA research team from IRISA, CREM, UrbanThink, and RatpDev. The project is funded by the Brittany Region and is part of the activities of the Chair of Mobility in a Sustainable City of the Rennes 1 Foundation. The project aims to analyze user behavior to encourage a reduction in greenhouse gas emissions and to integrate these behaviors into decision-support tools. Thus, the BMDec project relies on the creation of a panel of users who are questioned daily about their modes of transportation.

The project consists of two main components. The first involves the collection and analysis of data related to user behavior. The second aims to design a decision-support system based on machine learning (ML) to generate a model of user behavior.

More at `https://project.inria.fr/bmdec/fr/`

5.1.4 Rennes Urban Data Interface (RUDI)

Participants: François Bodin, Olivier Martineau, Laurent Morin.

- Project type: UIA
- Dates: 2019–2023
- PI institution: Rennes Métropole
- Other partners: University of Rennes, Lego/UBS, Fing, Ouishare, Keolis Rennes, Enedis Bretagne, GRDF, Audiar, Tiriad, Ouest-France

RUDI is proposing an original approach for aligning technical architecture with governance principles. The articulation of both dimensions is especially important when the considered data perimeter includes open data, sensitive data and personal data. Indeed, the technical architecture may or may not allow to implement the governance induced protocols, data protection, responsibilities tracking, data management, etc.

The main contribution of the Logica's team to RUDI is the producer node. The RUDI Producer Node groups all the modules required for the deployment of fully managable RUDI producer Node as defined in RUDI Open-Data project.

The purpose of a RUDI producer node is to provide the technology able to store and manage the metadata and data (media) of the datasets owned by a particular contributor in the open-data RUDI federation. This software was designed with the following principles:

- It proposes a reference implementation of the standard RUDI API.
- It is able to publish the metadata of datasets to the main Rennes-Métropole RUDI platform (rudi.bzh)
- It is completely independent, and can be used as a standalone OpenData platform.
- It is modular and relies and a set of micro-services.
- Its is only based on free and open-source technologies and release under an open-source license.

RUDI is still active and in a deployment phase.

More at `rudi.bzh`

5.1.5 City Orchestra

Participants: François Bodin, Marius Garenaux, Olivier Martineau, Laurent Morin, Gaëlle Richet.

- Project type: PIA
- Dates: 2022–2026
- PI institution: Rennes Métropole
- Other partners: Brest Métropole, Région Bretagne, Conseil Départemental d'Ille et Vilaine, Ekitia, SIB, Air Breizh, Syndicat Départemental d'énergie des Côtes d'Armor, Université de Rennes, Centre Scientifique et Technique du Bâtiment, Institut Agro, Université de Rennes 2, Kereval, Someware, WI6Labs, AmpliSIM, Alkante.

The climate emergency and the need to ensure a socially just ecological transition of our territories have placed greater expectations on the effectiveness of public policies and their intervention mechanisms, on the reliability of the tools and data needed to track territorial trajectories and anticipate future developments, on the guarantee of easy access to multi-source, up-to-date and reliable data.

Building on a trajectory during which they have developed a palette of tools and competencies for data management in support of public policies, Rennes Métropole and its partners propose to lead a territorial project, City Orchestra, based on four pillars and bringing together Breton collectivities (Region Brittany, Brest Métropole, Ille-et-Vilaine Departmental Council, Côtes d'Armor Departmental Energy Syndicate) and local data actors (expert companies, research laboratories and GIPs) around a shared project in support of ecological transition.

In this project, Logistica is involved in the Orchestration workpackage regarding the data logistics aspects.

5.1.6 Epistemic reinforcement learning (epiRL)

Participants: François Schwarzentruber.

- Project type: ANR
- Dates: 2023–2027
- PI institution: ENS Rennes
- Other partners: University of Toulouse, University of Caen-Normandie, DAVI

EpiRL project aims at investigating the combination of epistemic planning and reinforcement learning (RL), by proposing new algorithms that are efficient, adaptive, and capable of computing decisions relying on theory of knowledge and belief. We expect from this approach an efficiency in the generation of epistemic plans, while decisions made by RL algorithms will be explainable. Moreover, the algorithms of EpiRL will be tested and evaluated within a real application that exploits autonomous agents. The project will address the weaknesses of both epistemic planning and RL: on the one hand, existing epistemic planning algorithms are costly, do not adapt to the environment, and concepts are hand-crafted and are not learned; on the other hand, in reinforcement learning, agents adapt to their environments but are unable to reason about beliefs of other agents. The newly developed algorithms will combine the strengths of both fields. We propose four workpackages:

1. Study representations of states
2. Develop RL algorithms
3. Study representations of policies
4. Validating our algorithms with our industrial partner DAVI. In particular, we aim at developing a debunking chatbot whose use case will apply to raising awareness about environmental issues.

More at `http://epirl.irisa.fr/`

5.1.7 Extreme Computing Lab for Astronomical Telescopes (ECLAT)

Participants: François Bodin, Mathis Certenais, Laurent Morin.

- Project type: Common Lab
- Dates: 2024–
- PI institution: Rennes Métropole
- Other partners: CNRS, Inria, Eviden, the Observatoire de la Côte dâAzur, the Observatoire de Paris.

ECLAT is a national collaborative laboratory focused on High-Performance Computing (HPC) and Artificial Intelligence (AI) for astronomical tools. As part of France's contribution to the Square Kilometer Array Observatory (SKAO), ECLAT aims to foster strong partnerships and large-scale projects at both national and European levels. It unites the efforts of sixteen labs and teams from CNRS, Inria, Eviden, the Observatoire de la Côte dâAzur, and the Observatoire de Paris, bringing together computer scientists and astrophysicists to co-design and develop future cyber-physical systems for astronomy.

The main contribution of LOGICA team to ECLAT is the study and deployment of the DDF Pipeline, a radio astronomy data processing tool and one of the SKA processing pipeline's precursors, as a use case for data logistics and large-scale workflows deployment.

Main activities :

- study of existing data processing pipelines ;
- experiments on HPC machines ;
- deployment of data logistics framework for cross-facility scientific workflows in the context of PEPR Numpex/Exa-AToW, e.g. Ephemeral Buffers (EB) ;
- rewriting of existing pipelines into workflow representation such as, but not restricted to, the Common Workflow Language (CWL) ;
- workflow simulation and optimization methods to improve the orchestration of multiple processing pipelines on distributed architectures.

More at `https://eclat-lab.fr/en/`

5.1.8 Efril: Negative Tourism Impact Study

Participants: François Bodin, Laurent Morin.

- Project type: Pluridisciplinary research
- Dates: 2024–
- PI institution: USB

- Other partners: Irisa, St Armel (56).

This work explores the interest in combining participatory science and digital tools to measure and sustainably manage tourist tensions. Applied to the commune of Saint-Armel (56), this approach aims to address resident annoyance towards tourism by co-constructing solutions with local inhabitants.

This study uses the BMDec platform to collect the information. It is performed in collaboration with the LEGO lab, University of South Brittany (`https://www.labo-lego.fr/`).

More details are available here: `https://project.inria.fr/efril56/`.

5.2 Collaborations

- Hervé Marchand: Mount Allison University, Canada (Laurie Ricker). This collaboration focused on the problem of *Decentralized control* of discrete event systems as well as *the opacity control problem*.
- Dylan Bellier & Sophie Pinchinat: Università degli Studi di Napoli Federico II (Massimo Benerecetti & Fabio Mogavero) on logic for expressing dependences in strategic reasoning.
- Sophie Pinchinat has developed a collaboration with Memorial University of Newfoundlands (Canada) to work on logical approaches to solve games on graphs. She has hosted Rylo Ashmore for three months (with an ingoing international mobility for doctoral researchers 2024 from Rennes Metropole), and is now working on publications on the obtained scientific results.

6 Dissemination

6.1 Promoting scientific activities

6.1.1 Scientific Events Organisation

Member of the Organizing Committees Sophie Pinchinat has organized the annual event of the Groupe de Travail Data, Automata, Algebra, & Logic du GDR Informatique et Mathématiques (`https://daal.labri.fr/`) with 62 participants.

6.1.2 Scientific Events Selection

Steering Committees

- Hervé Marchand:
  - President of the Steering Committee of MSR (conférence sur la modélisation des systèmes réactifs);
- Sophie Pinchinat has entered the Steering Committee of the International Symposium on Temporal Representation and Reasoning (TIME).

Chair of Conference Program Committees

- François Schwarzentruber:
  - JIAF-JFPDA 2024

Member of Conference Program Committees

- Hervé Marchand:
  - Wodes'2024 (International Workshop on Discrete Event Systems).
- Sophie Pinchinat:
  - JFIA 2024
  - Highlights 2024
  - ATVA 2024
- François Schwarzentruber:
  - IJCAI 2024
  - AAAI 2024
  - AAMAS 2024
  - ECAI 2024

Reviewer

- Hervé Marchand was reviewer for Wodes'2024, CDC'2024,ACC 2024,ATVA'2024.
- Dylan Bellier was reviewer for AAMAS'2024, ATVA'2024
- Sophie Pinchinat has reported on a long article for the journal Software ans System Modeling (Springer).
- Sophie Pinchinat has reported on a long article for Theoretical Computer Science.
- Sophie Pinchinat has reported on the PhD thesis of Alessandro Burigana from the Free University of Bolzen-Bolzano.

6.1.3 Journal

Member of the Editorial Boards

- Hervé Marchand is Associate Editor of the Journal Discrete event dynamical systems - Theory and applications.

Reviewer - Reviewing Activities

- Hervé Marchand was reviewer for Discrete event dynamical systems - Theory and applications, IEEE Transaction Automatic and Control, Automatica.

- Dylan Bellier was reviewer for Frontiers, Information and Computation, Logical Methods in Computer Science

6.1.4 Invited Talks

- Sophie Pinchinat has been invited to present her work on under Imperfect Information at the workshop on Logic at the Interface: Modal Logic and AI, 11–12 July 2024, Université de Montpellier, France (`https://sites.google.com/view/modlogai2024/home`)

- Sophie Pinchinat was invited talk at TIME 2024 (31st International Symposium on Temporal Representation and Reasoning) Oct. 28-30, 2024, Montpellier, France

6.1.5 Scientific Expertise

- Sophie Pinchinat has been a member of the Profile Committee for academic position calls at Université Libre de Bruxelles, with a focus on parity gender.

- Sophie Pinchinat served as an expert to support the European DeMythif.AI Université Paris-Saclay program. DeMythif.AI is an international doctoral training and career development program funded as a Marie Sklodowska-Curie Action under the call Horizon-MSCA-Cofund-2022. She had to evaluate and report on 8 applications.

- Sophie Pinchinat reported on candidates for professorship promotion at Télécom Paris, École d'Ingénieur de l'Institut Mines Télécom et de l'Institut Polytechnique de Paris.

6.1.6 Research Administration

- Hervé Marchand was in the committee hiring for an assistant professor position (4099 ECN/LS2N STR) at l'Ecole Centrale de Nantes.

- Sophie Pinchinat has participated to recruitment committees:

  - 2024 27PR0679 Université de Franche Comté
  - 2024 27PR1514 Université d'Artois
  - 2024 27MCF1351 Aix Marseille Université

6.2 Teaching, supervision

6.2.1 Teaching

For researchers, all activities are given. For professors and assistant professors, only courses at the M. Sc. level are listed.

- Hervé Marchand: L1 Informatique et électronique: Découverte Informatique : 30h eq TD.
- Sophie Pinchinat: Advance Algorithmics, 10h, M1 informatique.
- Sophie Pinchinat: Méthodes et Vérification Formelle par Automates, 24h, M1 SIF (Science Informatique), ISTIC, Université de Rennes 1/ENS Rennes, France.
- Sophie Pinchinat: Automatic Structures and their Logical theory, 5h, Australian National University à Canberra (Australie).
- François Schwarzentruber: Complexity theory, 20h, M1 SIF (Science Informatique), ISTIC, Université de Rennes 1/ENS Rennes, France.
- François Schwarzentruber: Logic, 14h, Préparation à l'agrégation d'informatique, ISTIC, Université de Rennes 1/ENS Rennes, France.
- Dylan Bellier: Méthodes et Vérification Formelle par Automates, 21h, M1 SIF (Science Informatique), ISTIC, Université de Rennes 1/ENS Rennes, France.

6.2.2 Supervision

- PhD: Dylan Bellier was supervised by Sophie Pinchinat on the topic of logic-based mathematical settings to specify and handle dependencies of agent strategies in decision making systems. He has defended his PhD on November 4, 2024 with the following PhD committee: Fan YANG (F), Assistant Professor, Department of Philosophy and Religious Studies, Utrecht University, Martin Zimmermann (H), Associate Professor, Aalborg University, Erich Grädel (H), Professeur à Mathematische Grundlagen der Informatik, RWTH Aachen, Patricia Bouyer, Directrice de recherche, Laboratoire Méthodes Formelles, Université Paris-Saclay, CNRS, ENS Paris-Saclay, Natasha Alechina (F), Associate Professor, Information and computing sciences, Utrecht University, Juha Kontinen (H), Professor, University Helsinki, Sophie Pinchinat (F), Professeure, Université de Rennes/IRISA, François Schwarzentruber (H), Maître de Conférence ENS Rennes.
- PhD in progress: Mathis Certenais co-supervised by François Bodin on the topic "Collaborative System of Systems for Scientific Data Logistics".
- PhD in progress: Alexandre Terefenko co-supervised by Sophie Pinchinat (with Thomas Brihaye (Université de Mons, Belgium) on the topic "Foundations of Attack-Defense Trees with Dynamic Semantics". This PhD is in “co-tutelle” between University of Rennes and University of Mons.

- PhD in progress: Victorien Desbois, co-supervised by Cédric Pelois (NewLogUp), Ocan Sankur (CNRS, IRISA) and François Schwarzentruber on the topic "Rescheduling in traffics". This CIFRE PhD is between ENS Rennes and the company NewLogUp.
- PhD in progress: Thibaut Le Marre, co-supervised by Jilles Dibangoye (University of Groningen), Ocan Sankur (CNRS, IRISA) and François Schwarzentruber on the topic "epistemic reinforcement learning". This PhD is funded by the ANR EpiRL project ANR-22-CE23- 0029.
- François Pierre (M2, Univ Rennes): Logic for Opacity - DES To Logic Formalization (Hervé Marchand, Sophie Pinchinat)
- Mathieu Huc (L3, Univ Rennes): Opacity property for system confidentiality: focus on various state-baseddefinitions and their unification in a setting of formal language (Hervé Marchand)
- Tudwall Creze (L3, Univ Rennes): Syntax-based vs. Semantic-based assumptions for DEL-based Epistemic planning (Sophie Pinchinat)
- Alan Le Brech (L3 SIF, Univ Rennes/ENS): Expressiveness of Second-order Finite Automata (Sophie Pinchinat)

6.2.3 Juries

- Hervé Marchand was an examinor of the HDR of Léonardo Brenner, "Contributions à la modélisation, la simulation et l'analyse de systèmes déterministes et stochastiques par approches événementielles", Université de Reims Champagne-Ardenne, July 2024.
- Hervé Marchand was a reviewer of the PhD of Nour Elhouda SOUID, "Supervision de l'opacité des systèmes à événements discrets", Université Sorbonne Paris Nord, December 2024.

7 Bibliography

Books and Monographs

[1] *Actes des 18es Journées d'Intelligence Artificielle Fondamentale et des 19es Journées Francophones sur la Planification, la Décision et l'Apprentissage pour la conduite de systèmes*, Association Française pour l'Intelligence Artificielle, July 2024, `https://hal.science/hal-04620491`.

Publications in Conferences and Workshops

[2] D. Bellier, M. Benerecetti, F. Mogavero, S. Pinchinat, "Plan Logic", *in: 44th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2024)*, Schloss Dagstuhl–Leibniz-Zentrum für Informatik, p. 9–1, 2024.

[3] T. Brihaye, S. Pinchinat, A. Terefenko, "Semantics of Attack-Defense Trees for Dynamic Countermeasures and a New Hierarchy of Star-Free Languages", *in : LATIN 2024: Theoretical Informatics - 16th Latin American Symposium, Puerto Varas, Chile, March 18-22, 2024, Proceedings, Part II*, J. A. Soto, A. Wiese (editors), *Lecture Notes in Computer Science*, *14579*, Springer, p. 257–271, 2024, https://doi.org/10.1007/978-3-031-55601-2_17.

[4] S. Coumes, P. Paris, F. Schwarzentruber, F. M. Suchanek, "Qiana: A First-Order Formalism to Quantify over Contexts and Formulas", *in : Proceedings of the 21st International Conference on Principles of Knowledge Representation and Reasoning, KR 2024, Hanoi, Vietnam. November 2-8, 2024*, P. Marquis, M. Ortiz, M. Pagnucco (editors), 2024, https://doi.org/10.24963/kr.2024/28.

[5] V. Desbois, O. Sankur, F. Schwarzentruber, "An Efficient Modular Algorithm for Connected Multi-Agent Path Finding", *in : ECAI 2024 - 27th European Conference on Artificial Intelligence*, p. 1–11, Santiago de Compostela, Spain, October 2024, https://hal.science/hal-04650916.

[6] P. Nunn, M. Salzer, N. Troquard, F. Schwarzentruber, "A Logic for Reasoning about Aggregate-Combine Graph Neural Networks", *in : Proceedings of the 33rd International Joint Conference on Artificial Intelligence, IJCAI 2024, Jeju, South Korea, 3-9 August 2024*, ijcai.org, 2024.

[7] S. Pinchinat, "Strategic Reasoning Under Imperfect Information with Synchronous Semantics (Invited Talk)", *in : 31st International Symposium on Temporal Representation and Reasoning, TIME 2024, October 28-30, 2024, Montpellier, France*, P. Sala, M. Sioutis, F. Wang (editors), *LIPIcs*, *318*, Schloss Dagstuhl - Leibniz-Zentrum für Informatik, p. 2:1–2:2, 2024, https://doi.org/10.4230/LIPIcs.TIME.2024.2.

[8] F. Schwarzentruber, "Rhythm Inference Helping Writing Music Scores", *in : Proceedings of the 33rd International Joint Conference on Artificial Intelligence, IJCAI 2024, Jeju, South Korea, 3-9 August 2024*, ijcai.org, 2024.

[9] C. K. Sharpe, S. Yoon, L. S. L. Ricker, H. Marchand, "A New Verification Algorithm for Inferencing in Supervisory Control of Discrete-Event Systems", *in : 17th Ifac Workshop on Discrete Event Systems*, Rio De Janeiro, Brazil, April 2024, https://inria.hal.science/hal-04581576.

Internal Reports

[10] E. Bannier, S. Castellan, S. Derrien, F. Galassi, L. Garnier, L. Hoyet, A. l'Azou, N. Lahaye, M. J.-M. Macé, O. Martineau, A. Masson, T. Maugey, B. Ninassi, E. Rohou, M. Simonin, F. Taïani, "Réduire les émissions GES de nos déplacements professionnels : Une Démarche collaborative à l'IRISA/Inria", *research report*, Groupe de travail " missions " IRISA / Centre Inria de l'Université de Rennes, March 2024, https://univ-rennes.hal.science/hal-04506138.