

PhD position on Non-Classical Logical Reasoning and Large Language Models
Institut de Recherche en Informatique de Toulouse (IRIT)
Toulouse University
France

The PhD thesis will be carried out as part of the project entitled “Designing Artificial Reasoners for Communication” (DesiRes), which started in January 2026 and will end in December 2029. The PhD will start in September 2026 and will be funded by a three-year contract.

Description of the research project

The DesiRes project aims to overcome the reasoning limitations of Large Language Models (LLMs) by pursuing two main objectives: (i) developing a toolbox of languages, logic-based models, and algorithms to equip a conversational agent with advanced capabilities in theory of mind, planning, causal reasoning, ethical reasoning, and explanation; and (ii) integrating these components with an LLM.

The project is both theoretical and practical, ranging from conceptual and formal analysis—addressing proof-theoretic and complexity aspects of the proposed languages and algorithms—to the implementation of solutions that combine logic-based reasoning, planning, and argumentation with LLMs in a conversational agent, and their evaluation with real end-users.

In addition, the project will compare these novel approaches with state-of-the-art LLM reasoning enhancement techniques, such as Chain-of-Thought, across several dimensions, including persuasiveness, reasoning efficiency, transparency, and user acceptability.

The project focuses in particular on non-classical logics, including modal and epistemic logic, dynamic logic, deontic logic, logics for causal reasoning, and counterfactual logics, as well as their integration. On the automated reasoning side, it relies on algorithms for model checking and satisfiability checking for these logics.

The PhD thesis will specifically focus on developing an integrated logical framework combining epistemic logic, causal reasoning, and argumentation, aimed at equipping an artificial agent with advanced theory-of-mind, explanatory, and argumentative capabilities. Reasoning and planning algorithms based on this framework will be developed during the thesis, and an architecture integrating them with an LLM will be proposed.

Candidate profile

The ideal candidate should have a strong background in computer science and/or mathematics and strong programming experience. A Master’s degree in Computer Science, Mathematics or Logic is required. On the theoretical side, familiarity with logic is expected. On the practical side, experience with functional programming (ideally Haskell) and knowledge of transformer architectures is desirable.

PhD supervisor

The thesis will be supervised by Emiliano Lorini, CNRS Senior Researcher at the Institut de Recherche en Informatique de Toulouse (IRIT) and Jean-Guy Maily, associate professor at IRIT. More information is available at:

<https://www.irit.fr/~Emiliano.Lorini>

<https://www.irit.fr/~Jean-Guy.Maily/>

How to apply

Please send the following documents to Emiliano.Lorini@irit.fr and Jean-Guy.Maily@irit.fr

- A detailed CV
- A motivation letter
- Transcripts of your Bachelor's and Master's degrees

Including samples of research publications and reference letters is encouraged.

APPLICATION DEADLINE FOR FULL CONSIDERATION: May 15th 2026