Meven Lennon-Bertrand

Post-doctoral researcher – University of Cambridge

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Academic Positions

Research Associate
Principal Investigator: Neel Krishnaswami

📅 Nov. 2022—…   📍 University of Cambridge

PhD Student
Supervised by Nicolas Tabareau

📅 Sep. 2019—Sep. 2022   📍 Gallinette team, Université de Nantes

Research intern Feb.—Jul. 2019.

Research Intern
Supervised by Jurriaan Rot

📅 Jan.—Jul. 2017   📍 Radboud Universiteit Nijmegen

Coalgebraic Determinization of Alternating Automata.

Research Intern
Supervised by Hugo Herbelin

📅 Jun.—Jul. 2016   📍 PPS team, Université Paris 7

Compilation of Dependent Pattern-Matching without Axiom K.

Main Research Contributions

💬 Conference Articles

- Laurent et al., *Definitional Functoriality for Dependent (Sub)Types* (ESOP 2024)
- Adjedj et al., *Martin-Löf à la Coq* (CPP 2024)
- Maillard et al., *A Reasonably Gradual Type Theory* (ICFP 2022)
- Lennon-Bertrand, *Complete Bidirectional Typing for the Calculus of Inductive Constructions* (ITP 2021)

📄 Journal Articles

- Sozeau et al., *Correct and Complete Type Checking and Certified Erasure for Coq, in Coq* (JACM 2024, to appear)
- Lennon-Bertrand et al., *Gradualizing the Calculus of Inductive Constructions* (TOPLAS 2022)

⚙️ Formalisations

- METACOQ (contributor)
- LOGREL-COQ (leader)

Interests

Proof Assistants   Logic
Dependent Types   Bidirectional Typing
Formalisation of Mathematics

Education

Master 2 (Computer Science)

📅 2018—2019   📍 ENS de Lyon

Master 2 (Mathematics)
Preparation to the Agrégation, received 10th

📅 2017—2018   📍 ENS de Lyon

Master 1 (Mathematical Foundations of Computer Science)

📅 2016—2017   📍 Nijmegen, Erasmus exchange

Bachelors (Comp. Sc. & Mathematics)
Double Bachelor

📅 2015—2016   📍 ENS de Lyon

Teaching and Outreach

Co-Lecturer: Proof Assistants

📅 2024   📍 University of Cambridge

Lecturer: Denotational Semantics

📅 2023, 2024   📍 University of Cambridge

Teaching Assistant: Maths & CS

📅 2019—2022   📍 Université de Nantes

Science Popularisation: CHantiers Arts, Sciences et Technologies

📅 2019–2022   📍 Lycée Michelet, Nantes

1. Past Research

Topic

My research is at the intersection between mathematics, computer science and logic, in the field of proof assistants. These software tools aim at helping their users in writing, manipulating and checking mathematical proofs. They both help in getting a very high degree of confidence in the validity of the mechanized proof, but also give access to many software tools to create, analyse and maintain such mechanized proofs. The proof assistants I am particularly interested in are those based on type theory and the Curry-Howard correspondance, in particular the Coq proof assistant.

I try to make these tools both more expressive and safer, often by building on concepts and ideas coming for programming language theory.

Main Theoretical Results

Subtyping & definitional functoriality

📄 [LLM24]   👥 Théo Laurent, Kenji Maillard

We study the addition of extra equations to depedent type theory, corresponding to fuctoriality of type formers. Based on these, we present a form of structural subtyping well-suited for dependent types, and the equivalence of its implicit and explicit presentations.

Formalised logical relations in Coq

📄 [Adj+24]   👥 A. Adjedj, K. Maillard, L. Pujet, P.-M. Pédrot

We formalised, in Coq, a proof of normalisation based on logical relations, improving a previous proof in Agda [AÖV17] on multiple points: weaker meta-theory and richer object language, proof of decidability of typing using bidirectional typing, and executable type-checker.

Gradualization of the Calculus of Inductive Constructions

📄 [Len+22; Mai+22]   👥 Kenji Maillard, Nicolas Tabareau, Éric Tanter

We built an extension of the Calculus of Inductive Constructions, the type system behind Coq, to feature a form of dynamic typing, following ideas from the gradual typing research area. This open the way to incorporate the flexibility offered by dynamic typing in proof assistants.

Bidirectional Calculus of Inductive Constructions

📄 [Len21; SLF22; Soz+24]

I gave a precise bidirectional presentation for the Calculus of Inductive Constructions, showed in Coq its equivalence with the standard presentation, and built on this to certify the correctness of MetaCoq's type-checker with respect to its specification. This work also led to the discovery and fix of a bug in the type-checker of Coq.

Software Development: Formalisation Projects

🌐 MetaCoq

📅 2020-...   👥 The MetaCoq team

This large collaborative project aims at formalizing Coq in Coq itself, and to allow manipulating Coq terms in Coq in order to develop certified meta-programming tools. I mainly contribute to the theoretical aspect, and currently my largest addition is the formalisation of my work on bidirectional typing, in order to prove the correctness of the type-checking algorithm implemented as part of the project.

This work allowed detecting and fixing a bug in the kernel of Coq. MetaCoq's certified type-checker serves as a basis for the certified compilers CertiCoq – from Coq to CompCert's Clight – and ConCert – to Elm, Rust and smart contract languages.

LogRel-Coq

📅 2022-...   👥 A. Adjedj, K. Maillard, P.-M. Pédrot, L. Pujet

   This project formalises, in Coq, proofs by logical relations of difficult meta-theoretic proper-
ties of dependent type systems, in particular normalisation. It is complementary to MetaCoq,
in the sense that the latter concentrates on obtaining a certified type-checker for a system that
is as close as possible to "real" Coq, but admits normalisation. Instead, LogRel-Coq currently
works on a simpler language, but avoids any form of axiom.

 Coq-PartialFun

📅 2023-...   👥 Théo Winterhalter, Kenji Maillard

   Support library for the definition of non-structurally recursive functions.

 AutoSubst 2

📅 2023-...   👥 Adrian Dapprich, Yannick Forster, Kathrin Stark

   Code generator dedicated to syntax with binders.

2. Research Activity

Supervised students

Arthur Adjedj – Subtyping in Dependent Type Theory
ENS Paris-Saclay long research internship

📅 Oct. 2024 – Aug. 2025

Robin Jourde – Understanding the η Law for Functions in CIC
Master 2 internship

📅 Jan. – Jul. 2023   👥 Co-supervised with Nicolas Tabareau

Matthew Sirman – A Normalisation by Evaluation Implementation of a Type Theory with Observational Equality
Undergraduate final dissertation (4th year)

📅 Nov. 2022 – May 2023   👥 Co-supervised with Neel Krishnaswami

   Matthew was distinguished as the best student in Part III CS, in part for his dissertation.

Research Visits & Invited Seminars

Formalisation of Mathematics with Interactive Theorem Provers
📅 Nov. 7 2024   📍 Faculty of Mathematics, Cambridge

Big Specification Workshop
📅 17 Oct. 2024   📍 Newton Institute, Cambridge

OASIS Seminar
📅 10 May 2024   📍 University of Oxford

Kathrin Stark & Dependable Systems Group
📅 4 – 8 Mar. 2024   📍 Heriot-Watt University

Deducteam Seminar
📅 14 Dec. 2023   📍 Université Paris-Saclay

Proofs and Algorithms Seminar

📅 12 Dec. 2023   📍 LIX, École Polytechnique

PPS Seminar & Formath Seminar

📅 7 & 11 Dec. 2023   📍 PPS, Université Paris Cité

Meta-programming, Quoting, and Modalities in Type Theory Workshop

📅 16 – 20 Oct. 2023   📍 Université de Nantes

Conor McBride & Mathematically Structured Programming Group

📅 26 – 30 Jun. 2023   📍 University of Strathclyde

CHoCoLa Seminar

📅 Jan. 2023   📍 ENS de Lyon

LoVE Team Seminar

📅 Dec. 2022   📍 Université Sorbonne Paris Nord

Andrej Bauer & Faculty of Mathematics and Physics Foundations Seminar

📅 9 – 13 May 2022   📍 University of Ljubljana

Academic and Community Service

SANDWICH Seminar (organiser)

📅 2024-…   👥 University of Cambridge

Internal seminar of the CLASH group.

Normalisation by Evaluation Reading Group (organiser)

📅 2023-2024   👥 University of Cambridge

Reviewing

- CPP 2025 subreviewer
- CSL 2025 subreviewer
- Types 2024, program committee
- ICFP 2022, artefact evaluation committee

Proof Assistants Stack Exchange

📅 2022-…

This website aims to answer questions around proof assistants in a community-based manner. I am in the top 5 most reputable users, and a moderator.

Elected Student Representative

📅 2017-2018   📍 ENS de Lyon

3. Publications

My publications by default list authors in alphabetical order. Some depart from this and use the first author position to highlight key contribution to a project, either the main technical

investigator, generally a junior researcher [Mai+22; Len+22; SLF22; LK23; LLM24] – despite some of them apparently respecting alphabetical order – or the project lead [Soz+24].

Journal

[Soz+24] Correct and Complete Type Checking and Certified Erasure for Coq, in Coq
2024 Matthieu Sozeau, Yannick Forster, Meven Lennon-Bertrand, Jakob Botsch Nielsen, Nicolas Tabareau and Théo Winterhalter. *Journal of the ACM* (to appear).

[Len+22] Gradualizing the Calculus of Inductive Constructions
2022 Meven Lennon-Bertrand, Kenji Maillard, Nicolas Tabareau and Éric Tanter. *ACM Transactions on Programming Languages and Systems*.

Conference

[LLM24] Definitional Functoriality for Dependent (Sub)Types
2024 Théo Laurent, Meven Lennon-Bertrand and Kenji Maillard. *33rd European Symposium on Programming, ESOP 2024*.

[Adj+24] Martin-Löf *à la* Coq
2024 Arthur Adjedj, Meven Lennon-Bertrand, Kenji Maillard, Pierre-Marie Pédrot and Loïc Pujet. *Proceedings of the 13th ACM SIGPLAN International Conference on Certified Programs and Proofs* (distinguished paper).

[Mai+22] A Reasonably Gradual Type Theory
2022 Kenji Maillard, Meven Lennon-Bertrand, Nicolas Tabareau and Éric Tanter. *International Conference on Functional Programming*.

[Len21] Complete Bidirectional Typing for the Calculus of Inductive Constructions
2021 Meven Lennon-Bertrand. *12th International Conference on Interactive Theorem Proving*.

Peer-reviewed workshops

[Len24] Towards a certified proof assistant kernel
2024 Lennon-Bertrand. *Meeting of the Working Group 6 of the European Research Network on Formal Proofs* (invited talk).

[LK23] Decidable Type-Checking for Bidirectional Martin-Löf Type Theory
2023 Meven Lennon-Bertrand and Neel Krishnaswami. *29th International Conference on Types for Proofs and Programs*.

[Mai+23] Engineering logical relations for MLTT in Coq
2023 Kenji Maillard, Arthur Adjedj, Meven Lennon-Bertrand and Loïc Pujet. *29th International Conference on Types for Proofs and Programs*.

[Len22a] Equivalence between Typed and Untyped Algorithmic Conversions
2022 Meven Lennon-Bertrand. *28th International Conference on Types for Proofs and Programs*.

[Len22b] À bas l'η – Coq's troublesome η-conversion
2022 Meven Lennon-Bertrand. *1st Workshop on the Implementation of Type Systems*.

[SLF22] The Curious Case of Case: Correct & Efficient Representation of Case Analysis in Coq and MetaCoq
2022 Matthieu Sozeau, Meven Lennon-Bertrand and Yannick Forster. *1st Workshop on the Implementation of Type Systems*.

Publication in open archives

[BR18] Coalgebraic Determinization of Alternating Automata
2018 Meven Bertrand and Jurriaan Rot. *arXiv*, DOI: 10.48550/ARXIV.1804.02546

4. Teaching and Science Outreach

Co-Lecturer: Denotational Semantics

📅 Fall 2024 📍 University of Cambridge

With Thomas Bauereiss, we co-lecture a course on proof assistants for 4th year students. I am in charge of the Coq half of the course.

Lecturer: Denotational Semantics

📅 Fall 2023, Fall 2024 📍 University of Cambridge

For the second year in a row, I lecture the Denotational Semantics course for 3rd year students.

Teaching Assistant (64 hrs/year)

📅 Sep. 2019—Jun. 2022 📍 Université de Nantes

During my PhD, I also worked as a teaching assistant. I taught various levels (1st to 3rd Bachelor years), themes (mathematics, applied and fundamental computer science), formats (lectures, exercise and computer sessions), and publics (specialists and non-specialists).

CHantiers Arts, Sciences et Technologies

📅 2019–2022 📍 Théâtre Athénor & Lycée Professionnel Michelet, Nantes

Together with math researcher Bertrand Michel and theatre authors Rémi Checchetto and Sylvain Renard, we collaborated with a vocational high-school teachers to build workshops for their students around the theme of "Artificial Intelligence", in a broad sense. I implemented activities directly inspired by the *Computer Science Unplugged* project, and designed some of my own. These workshops culminated in an exhibition, created by the students.

Séminaire de la Détente Mathématique

📅 2018—2019 📍 Maison des Mathématiques et de l'Informatique, Lyon

A weekly seminar, aimed at being "relaxed" and accessible to both students and faculty, with talks often on unusual or fun topics. Many students would give their first seminar talk there. I organized the seminar with a team of students, and spoke there.

Category Theory Course

📅 Sept 2018 – Jan 2019 📍 ENS de Lyon

During my Master 2, I co-organized with a fellow student a category theory course for students of the ENS de Lyon. Although it was not integrated to the official curriculum, we kept it as close as possible to a proper lecture: it lasted for a semester of a 2-hour lecture per week, with a few dozen students, and we covered a large part of Awodey's *Category theory*.

Thesis

Defended at Université de Nantes, on June 24, 2022. Prepared in the Inria team Gallinette, affiliated to the Laboratoire des Sciences du Numérique de Nantes.

Chair of the Jury

Christine Paulin-Mohring (Professeure des Universités, Université Paris Sud)

PhD Advisor

Nicolas Tabareau (Directeur de Recherche, Inria Rennes)

Rapporteurs

Neel Krishnaswami (Associate Professor, University of Cambridge)
Conor McBride (Reader, University of Strathclyde)

Examiners

Jesper Cockx (Assistant Professor, TU Delft)
Herman Geuvers (Professor, Radboud University Nijmegen)
Hugo Herbelin (Directeur de Recherche, Inria Paris)
Assia Mahboubi (Directrice de Recherche, Inria Rennes)

Invited Member

Matthieu Sozeau (Chargé de Recherche, Inria Rennes)