Dear Professors Andreas Nuyts and Dominique Devriese,

I am Yee-Jian Tan, an second-year Master's student at the MPRI (Parisian Masters of Research in Computer Science), in France. I am writing to express my enthusiastic interest in the PhD position on implementing Multimodal Type Theory in Agda. I am passionate about Type Theory for its ability to formalise mathematical proofs, and I am motivated to design and implement a proof assistant that is both logically consistent and expressive. In the rest of this letter, I would like to demonstrate some of my previous projects, which involve functional programming, Type Theory, and correctness of metatheory of proof assistants, that are relevant to the PhD offered.

Between May and August 2024, I completed my Master's Year 1 (M1) internship with Yannick Forster at the Cambium team in INRIA Paris, working on the project "Towards Formalizing the Guard Checker of Coq", which was awarded an Honourable Mention (Mention de Félicitations) from École Polytechnique for L3/M1 internships. The guard checker of Coq is the part of Coq's kernel that checks for the termination of recursive functions in Coq, which is crucial for Coq's soundness as a proof assistant. In this project, I implemented the guard checker of Coq in the Coq proof assistant and documented its features and behaviours in my report. I presented the project publicly twice, once as an invited speaker at the Workshop on the Guard Condition of Coq, held on 3 June by the RECIPROG project in Nantes, France; as well as during the Coq Workshop 2024, affiliated with ITP 2024 in Tbilisi, Georgia.

In 2022, I worked on formalizing the Modules system of Coq in MetaCoq during my undergraduate internship with Nicolas Tabareau. Together with co-supervisors Martin Henz and Yue Yang, I wrote my bachelor's thesis on the same topic, which received an A grade from the National University of Singapore, thus completing a dual bachelor's degree in Computer Science and Mathematics with Highest Distinction.

During the first two semesters of my Master's Year 1 in 2023-24, I studied the categorical formalization of type theory via Category with Families under the supervision of Ambrus Kaposi. This project culminated in a small formalization of a less-dependent version of Category with Families in Agda, akin to Steve Awodey's Natural Models.

Besides, among the courses I studied in M1, INF551 Computational Logic, taught by Samuel Mimram, was the most relevant to my research interests. I was awarded full marks (20/20) in this course, where I implemented, for the final project, a dependent type-checker / proof-assistant supporting Dependent Function types, Equality types, and Natural Number types. I am currently taking courses on Proof Assistants (2.7.2), Foundations of Proof Systems (2.7.1), Models of Programming Languages (2.2), and Functional Programming (2.4) in the MPRI M2 programme. In addition, I am also taking the Category Theory and Proof Theory courses in the Master's in Mathematical Logic and Foundations of Computer Science (LMFI).

Outside of the implementation of Guard Checker in my M1 internship and a Type Checker during a course in M1, I have also implemented a compiler from a Python

sublanguage to X86_64 assembly, in OCaml, all of which contributes to my functional programming experience. Additionally, having worked theoretically with the metatheory of proof assistants makes me understand better the complications of designing and implementing a consistent and decidable type checker. I believe these experiences make me a great fit for the PhD project you have proposed, and I eagerly look forward to working with you on the topic.

Thank you very much for considering my application, and I look forward to your favorable response.

Warmest regards,
Yee-Jian Tan
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