Offer #2024-07749

PhD Position F/M Certification of automated theorem provers for higher-order logic (F/M)

Contract type : Fixed-term contract

Level of qualifications required : Graduate degree or equivalent

Fonction : PhD Position

About the research centre or Inria department

The Inria Saclay-Île-de-France Research Centre was established in 2008. It has developed as part of the Saclay site in partnership with **Paris-Saclay University** and with the **Institut Polytechnique de Paris** .

The centre has **39 project teams** , 27 of which operate jointly with Paris-Saclay University and the Institut Polytechnique de Paris; Its activities occupy over 600 people, scientists and research and innovation support staff, including 44 different nationalities.

Context

Automated theorem provers (ATPs) are tools that attempt to fully automatically prove a given conjecture from a set of assumptions. Such systems are based on a logic in which the reasoning problems are formulated using a machine readable input syntax. A calculus for said logic then provides the deduction rules that are implemented to form inferences from the assumptions. The step by step derivation of the conjecture from the assumptions through the application of the inference rules then represents a proof produced by such systems.
ATPs have a wide and extending field of applications, including software and hardware verification, mathematics, philosophy and artificial intelligence. It is thus important to be able to trust that any statement provable with a given system is indeed a logical consequence of the provided assumptions, a property known as soundness. The generated proofs can be lengthy and the reasoning usually does not follow human intuition, which can make the correctness of proofs hard to check for human readers. In practice, established provers have nevertheless gained the trust of the community by consistently performing reliably over long term usage and in numerous applications and tests. Such empirical verification is however not sufficient to ensure that the results of the systems will always be trustworthy. This is where formal verification comes into play. There are different possible techniques to warrant the correctness of the produced proofs: One might for instance look at the provers themselves and verify their implementation. The complexity of this task however makes checking individual proofs an attractive alternative. To this end, a trace containing details about all of the steps taken in the individual proofs produced by ATPs can be used to check the inferences and thereby verify the correctness.

Assignment

The aim of the thesis will be the development of a tool that verifies Leo-III proofs using the Dedukti framework. More specifically, the reasoning that takes place after the transformation of the formulas to CNF will be the focus here since the transformation of formulas containing existential quantification involves skolemization. While this preserves satisfiability, which is sufficient for the purpose of deriving the empty clause from the negated conjecture and thus showing provability, equivalence is not maintained. The use of the other inference rules can however be verified when both the applied inference rules and the steps of the proof are encoded in LambdaPi Syntax. If necessary, the output produced by Leo-III will be extended if additional information will be needed for the translation of the proof certificate. This approach might however be limited to proofs that Leo-III did not cooperate with external system for since such cooperations can cause gaps in proofs. The first step will be the successful implementation of the translation-tool for only a subset of the inference rules and for monomorphic HOL. This will then be extend later on, if time will permit it.

Main activities

https://adum.fr/as/ed/voirproposition.pl?matricule_prop=56527

Skills

Familiarity with logic and functional programming.

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Remuneration

Gross salary 2.100 euros/mois

General Information

- **Theme/Domain :** Proofs and Verification
  Scientific computing (BAP E)
- **Town/city :** GIF SUR YVETTE
- **Inria Center :** Centre Inria de Saclay
- **Starting date :** 2024-10-01
- **Duration of contract :** 3 years
- **Deadline to apply :** 2024-09-30

Contacts

- **Inria Team :** DEDUCTEAM
- **PhD Supervisor :**
  Blanqui Frederic / Frederic.Blanqui@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

Warning : you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST).Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

Recruitment Policy :
As part of its diversity policy, all Inria positions are accessible to people with disabilities.