2019-01991 - Post-Doctoral Research Visit
F/M Interactive Verification of Synchronous Programming Languages

Type de contrat : CDD de la fonction publique
Contrat renouvelable : Oui
Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Post-Doctorant
Niveau d’expérience souhaité : jusqu’à 3 ans

Contexte et atouts du poste

The FidelIR project, for “Fidelity in Reactive Systems Design and Compilation”, is funded by a French government “Young Researcher” grant (ANRJCJC). Its goal is to extend the Vélus verified Lustre compiler with state machines and techniques for interactively verifying models. The grant includes funding for national and international travel to participate in workshops and conferences.

Lustre is a synchronous language closely related to the industrial Scade tool which supports Model-Based Development (MBD) of critical embedded control software. It’s a programming language with a formal semantics for block-diagram specifications. The Vélus compiler is developed in OCaml and the Coq Interactive Theorem Prover (ITP). It successively transforms source programs into the Clight language used by CompCert. The overall correctness theorem states that the stream-based semantics of the source program is preserved by the generated assembly code. Vélus is developed in the Inria PARKAS team located at the École normale supérieure in the heart of Paris. Development is led by [Timothy Bourke](https://www.lark.org) and involves collaboration with experts in synchronous languages (Marc Pouzet), verified compilation (Xavier Leroy) and automatic verification (Cesare Tinelli).

Mission confiée

Work on Vélus has to date focused on verified compilation. This postdoctoral position would involve developing techniques and tools for interactively verifying Lustre programs within Coq. That is, making it possible to load a Lustre program into Coq, to state invariants, and to prove that the program satisfies them. The compiler correctness theorem guarantees that such invariants also hold of the generated code. While interactive frameworks exist for imperative languages, like the Verified Software Toolchain and Isabelle/SIMPL, and model checkers exist for synchronous languages, like kind 2 and Les, there are relatively few results on the interactive verification of languages for model-based development. We believe that ITPs provide an ideal environment for decomposing verification goals, safely mixing results from model-checkers and specialized tactics, and transferring properties of the model to generated executables.

The postdoctoral researcher will collaborate closely with other team members to develop techniques and tools for interactively verifying Lustre programs in the context of the Vélus project. Please see the Vélus website for scientific references. This work will involve mastering the existing semantic models, proposing verification techniques, implementing plugins and tactics in the Coq ITP, and working on case-studies to guide and evaluate the approach. Results will be communicated to international workshops, conferences, and journals.

The initial contract is for one year, but solid progress on research goals would open other opportunities.

Principales activités

1. Master relevant background knowledge on synchronous languages and the state-of-the-art in interactive program verification by reading books and research articles.
2. Experiment with small examples in the Coq ITP to understand the problem and potential solutions.
3. Propose verification techniques and implement them as Coq plugins and tactics.
4. Evaluate the techniques and implementations on one or more larger case studies.
5. Document the results in technical reports and scientific articles.

Additional activities:

1. Participate in workshops and team activities.
2. (Optional) Teach at the L3 and masters level.

Compétences

Technical skills and level required:

- Strong expertise in one or more programming languages (ideally a strongly typed functional language like OCaml, SML, or Haskell).
- Some experience with Interactive Theorem Proving or a very strong motivation to become a specialist.

Languages: French or English.

Avantages

- Thème/Domaine : Preuves et vériﬁcation
- Ville : Paris
- Centre Inria : CRI de Paris
- Date de prise de fonction souhaitée : 2020-01-01
- Durée de contrat : 1 an
- Date limite pour postuler : 2019-10-31

Informations générales

A propos d’Inria

Inria, the institute of national research dedicated to sciences of the digital, promotes excellence scientific and the transfer for avoir le plus grand impact. It emploie 2400 personnes. Ses 200 équipes-projets agiles, in general communes with des partenaires académiques, impliquent plus de 300 scientifiques for relever the deﬁs des sciences informatiques et mathématiques, souvent à l’interface d’autres disciplines. Inria travaille de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L’institut s’efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l’économie.

L’essentiel pour réussir

You are passionate (but not fanatic) about functional languages and interactive proof assistants. You are not (just) interested in the theory of logic, but really motivated to apply it to real-world problems. Tenacity and a taste for simplicity are essential character traits for this work.

You have completed, or will soon complete, a PhD in computer science, computer engineering, or mathematics with a strong emphasis on formal methods, verification, programming language semantics, or computer-assisted logic. You already have some experience with interactive theorem proving, but may not (yet) be an expert. Ideally, you have already contributed to software projects or publications.

Knowledge of Lustre, Scade, or Model-Based Development is not essential.

Consignes pour postuler

Sécurité défense : Ce poste est susceptible d’être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L’autorisation d’accès à une zone est délivrée par le chef d’établissement, après avis ministériel favorable, tel que défini dans l’arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l’annulation du recrutement.
- 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

Politique de recrutement:
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d’autres canaux n’est pas garanti.