



Offre n°2024-07562

PhD Position F/M Scalable Translation Validation for High-Performance Computing and Machine Learning

Type de contrat : Fixed-term contract

Niveau de diplôme exigé : Graduate degree or equivalent

Fonction : PhD Position

A propos du centre ou de la direction fonctionnelle

The Inria research centre in Lyon is the 9th Inria research centre, formally created in January 2022. It brings together approximately 300 people in 16 research teams and research support services.

Its staff are distributed at this stage on 2 campuses: in Villeurbanne La Doua (Centre / INSA Lyon / UCBL) on the one hand, and Lyon Gerland (ENS de Lyon) on the other.

The Lyon centre is active in the fields of software, distributed and high-performance computing, embedded systems, quantum computing and privacy in the digital world, but also in digital health and computational biology.

Contexte et atouts du poste

The PhD thesis will be held at **Ecole Normale Supérieure** (ENS-Lyon), in **Lyon, France**. ENS-Lyon is one of the top public universities in France and its ranked among the best universities in the world ([QS world university ranking: 184](#)).

The PhD student will be an employee of Inria, the French National Research Institute of Research in Computer Science which covers a wide spectrum of research

in Computer Science.

This PhD thesis is within a **collaboration framework** between **Inria Lyon** and **Iowa State University (USA)**.

Mission confiée

The overall objective of this PhD thesis is to investigate **translation validation** of programs with **reductions** and compile-time **data allocation**. In particular, the PhD student will address the following points.

- **Verifying reductions.** Many reduction transformation exist (factorization, semantic tiling, reduction parallelization). How to formalize them in unified way? How to support the composition with loop transformations? How that formalization might be produced by the compiler? Finally, how to check it in a scalable way? The *polyhedral model* provides a formalization of some of these transformations which enables solver-based checking. A reduction-compliant extension could be investigated.
- **Verifying data allocation.** The same questions arise for compile-time data allocation required by automatic parallelization (array privatisation, array contraction, struct/array permutation, etc) and will be investigated as well. In particular the framework of *linear intra-array allocation* and *affine inter-array allocation* could help to find a relevant formulation.
- **Scalability.** If possible, a first direct solver approach will be proposed for simple cases. Then, the scalability will be addressed to handle real-life HPC programs. How to parallelize the whole process? How to reduce the overall complexity? A trace-based solution could also be investigated.
- **Validation.** The approach will be validated on HPC benchmarks.

Principales activités

The PhD student will conduct original researches on the topic described above. The expected outcome includes:

- **Verification algorithms and correctness proofs**
- **Effective implementation in C++**
- **Successful benchmarking using Iowa State's compiler**

Activities includes, but are not limited to: bibliographical synthesis, research, proof writing, software implementation, presentation of results at conferences, attending research schools, etc.

Compétences

Technical skills and level required : Notions in compilers, parallelism and program analysis. Experience with C++.

Languages : Fluent english reading, writing and speaking

Relational skills : Excellent

Avantages

- 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 (90 days / year) 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
- Complementary health insurance under conditions

Rémunération

1st and 2nd year: 2 100 euros gross salary /month

3rd year: 2 190 euros gross salary / month

Informations générales

- **Thème/Domaine :** Architecture, Languages and Compilation
Scientific computing (BAP E)
- **Ville :** Lyon
- **Centre Inria :** [Centre Inria de Lyon](#)
- **Date de prise de fonction souhaitée :** 2025-09-01
- **Durée de contrat :** 3 years
- **Date limite pour postuler :** 2025-06-30

Contacts

- **Équipe Inria :** [CASH](#)

- **Directeur de thèse :**
Alias Christophe / christophe.alias@inria.fr

A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 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

The PhD student will have excellent communication skills as well as full fluency in english (writing, reading, speaking). A willingness to learn French is a plus, but it is not mandatory.

He/she will have to overcome challenges in program analysis, compilation, proof writing, C++ implementation and written/spoken communication. A master thesis in a connex field is a real asset.

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.

Consignes pour postuler

Defence security: This position is likely to be assigned to a restricted area (ZRR), as defined in decree no. 2011-1425 relating to the protection of the nation's scientific and technical potential (PPST). Authorisation to access a zone is issued by the head of the establishment, following a favourable ministerial opinion, as defined in the decree of 03 July 2012 relating to the PPST. An unfavourable ministerial opinion for a post assigned to a ZRR would result in the recruitment being cancelled.

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.

Politique de recrutement :

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