Offre n°2025-09003

PhD Position F/M Compilation of a DSL based on vectorial circuit to SIMD optimized code

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

Niveau d'expérience souhaité : Jeune diplômé

A propos du centre ou de la direction fonctionnelle

The Inria University of Lille centre, created in 2008, employs 360 people including 305 scientists in 15 research teams. Recognised for its strong involvement in the socio-economic development of the Hauts-De-France region, the Inria University of Lille centre pursues a close relationship with large companies and SMEs. By promoting synergies between researchers and industrialists, Inria participates in the transfer of skills and expertise in digital technologies and provides access to the best European and international research for the benefit of innovation and companies, particularly in the region.

For more than 10 years, the Inria University of Lille centre has been located at the heart of Lille's university and scientific ecosystem, as well as at the heart of Frenchtech, with a technology showroom based on Avenue de Bretagne in Lille, on the EuraTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

Contexte et atouts du poste

Within the framework of a partnership public with LCIS within the scope of ANR SxC.

Streaming data processing is a crucial approach that focuses on traversing data to extract pertinent
information. Applications ranges from network packet manipulation to analysing DNA. Modern data-
processing tools heavily depend on efficient implementations that harness hardware acceleration to
achieve high performance. This acceleration can sometimes be achieved through automatic compilation,
but frequently demands expert developers to craft optimizations by hand.
One critical facet of this optimization process involves SIMD optimization, where data is packed into
chunks and processed with minimal branching in the code, often using bit vector operations. These
optimizations are at the core of numerous well-known software applications, such as regular expression
matching in tools like ripgrep, JSON parsing in libraries like SimdJSON, and even fundamental operations
like string encoding and decoding (Unicode parsing). Developing these optimizations requires a broad
skill set and is a testament to the expertise of programmers worldwide.

Mission confiée

Designing VIR: an intermediate representation of vectorial programs.
During this PhD, we will explore the design and implementation of VIR, an intermediate representation
of vectorial programs heavily influenced by synchronous programming, high-performance compilation
of array languages and vectorial circuits.
The end goal is to have a machine and optimization friendly formal representation of computation
relying heavily on SIMD accelerations.
Some cases studies have already been performed in the context of various experiences, coming from
early-stages internships in which the premises of complete toolchain to evaluate simd solutions has been
designed; or a complete project, vizitig, which proposes simd implementations of programs analyzing
DNA strings.

Principales activités

The core of our specialized language will benefit from these experiences.
In the context of this PhD, the student will:
• make an extensive bibliography of existing approaches for compiling programs into vectorial
code, focusing on intermediate representations to represent parallelism at different abstraction
levels;
• study the specificities of different vectorial targets, especially from the circuit complexity point
of view;
• make different propositions as VIR as intermediaire representation;
• contribute to the compilation stack inside the project, focusing on back-ends.

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 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

Informations générales

- **Thème/Domaine :** Algorithmique, calcul formel et cryptologie
  Calcul Scientifique (BAP E)
- **Ville :** Villeneuve d'Ascq
- **Centre Inria :** Centre Inria de l'Université de Lille
- **Date de prise de fonction souhaitée :** 2025-09-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2025-07-16

Contacts

- **Équipe Inria :** LINKS
- **Directeur de thèse :**
  Paperman Charles / charles.paperman@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'e?orce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

The candidate should ideally be familiar with formal approaches in programming language design,
notably type systems, semantics, and logic. From the practical point of view, a basic experience in
software programming and usage of collaborative tools such than git. This PhD strongly relies on
the fact that practical implementation should have strong theoretical foundations and that further
refinements of the theory should get inspiration from the practical side. We expect the candidate to
agree with this philosophy.

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

Please send your CV and cover letter

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.