Offer #2023-06987

PhD Position F/M Auto Parallelization and Optimizations for Dynamic Languages

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 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 EuratTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

Assignment

Data science requires support from programming languages to ease the development of efficient applications manipulating large datasets. Dynamic languages such as Pharo or Python boost developer productivity thanks to their support for the run-compile-test cycle and high level tools for development (refactoring, testing, debugging). Specific libraries such as PolyMath, NumPy, SciPy provide optimizations for such programs.

However, the overall performance of such programs requires a deep understanding of the application, the libraries used, the virtual machine implementation and the hardware it executes on. Indeed, different libraries may require different data memory layout to achieve better performance and the virtual machine should detect and use optimization opportunities (e.g. AOT JIT generating SIMD code).

This PhD aims to explore dynamic detection of optimization opportunities for processing large datasets, incorporating state-of-the-art optimizations. The focus includes loop optimizations, vectorized instructions, multi-core parallelization, GPU execution, and more. The goal is to seamlessly support deoptimization for debugging while maintaining transparency for developers. Such optimizations are crucial for creating mobile and power-efficient applications based on large datasets. In scenarios where minimizing power consumption is paramount, optimized execution plays a pivotal role in achieving this goal.

The work will be prototyped on the Pharo infrastructure, a widely used platform in both industrial and academic settings.

Bibliography


Main activities

In general terms, the plan for the development of the work includes the following tasks:

1. Study of existing optimizations to select the ones applicable to large datasets

2. Experiment with a selection of optimizations to show improvements in large dataset processing scenarios. These optimizations are applied in manually selected hot spots.

3. Studying the required information to detect the hot spots where to implement the selected optimizations.

4. Experiment with dynamic code profiling to automatically detect these hot spots.

5. Study and experiment with the data and transformations required to provide transparent data inspection and debugging of optimized large dataset hot spots.

The PhD student will work at the CERI 5N of IMT Nord Europe and the Evref Team at Centre Inria de l'Université de Lille.

Skills

Technical
- C, Pharo,
- Assembly is a plus
- computer architecture is a plus
- agile development, testing

Languages
- english
- technical scientific written english
- french is a plus

Human relationships
- good communication skills
- individual and team work
- good humour

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 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

2,082 gross per month for the first two years, then €2,190 gross per month for the third year.

General Information

- **Theme/Domain**: Distributed programming and Software engineering
  - Software engineering (BAP E)
- **Town/city**: Villeneuve d’Ascq
- **Inria Center**: Centre Inria de l’Université de Lille
- **Starting date**: 2024-09-01
- **Duration of contract**: 3 years
- **Deadline to apply**: 2024-01-20

Contacts

- **Inria Team**: EVREF
- **PhD Supervisor**: Ducasse Stephane / Stephane.Ducasse@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

CV + Cover Letter

**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.