PhD Position F/M Data placement in heterogeneous memory levels

Contract type: Fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Function: PhD Position

Context

Position Overview:
This role represents a collaborative opportunity between two Inria teams: CAMUS and STORM.

It is related to the NUMPEX PEPR Exasoft project (https://numpex.org/fr/) and will allow interacting with the partners of the project.

Location:
The selected candidate will be positioned within the CAMUS team, based in Illkirch Graffenstaden, within the ICube laboratory.

Team Focus:
- CAMUS Team: Specializes in compilation and high-performance computing. The team currently comprises 4 postdoctoral researchers/engineers, 9 PhD students, and 8 permanent researchers.

The research conducted in this position will aim to bridge the gap between task-based runtime system, high-performance computing (HPC) programming and its applications.

Assignment

Task-based programming has proven to be very effective in implementing high-performance applications on heterogeneous architectures. With this method, programmers describe their algorithms as tasks and their dependencies. Additionally, programmers inform the runtime system about the data being used. As a result, the runtime system can move the data across different memory nodes. Moreover, the scheduler (an internal component of the runtime system) decides where the various tasks will be executed, and the data will be moved accordingly.

The objective of the project is to imagine and implement advanced strategies to decide where the data should be moved when there is a choice. These strategies will have to predict where the data will be used (which is related to the scheduling policies) and when they will be used. It will require a deep knowledge of the hardware bus/network and latency/throughput.

Key aspects of the research include:
- Create semi-automatic strategies: In the first step, we will create strategies that will be potentially guided by the users.
- Create automatic strategies: In the second step, we will improve the strategies to make them autonomous.
- Benchmark on different architectures: We will continuously run benchmarks to measure and quantify the improvement of our contributions.

This research project is part of the national initiative PEPR NUMPEX, the French Exascale program that aims at designing and developing the software components that will equip future exascale machines. NumPEx will deliver Exascale-grade numerical methods, software, and training, allowing France to remain a leader in the field. It will contribute to bridging the gap between cutting-edge software development and application domains to prepare major scientific and industrial application codes to fully exploit the capabilities of these machines. Application domains of the NumPEx program include, but are not limited to, weather forecasting and climate, aeronautics, automotive, astrophysics, high energy physics, material science, energy production and management, biology, and health.

Main activities
Main activities:
- Imagine new methods to decide where the data should be placed/moved
- Implement high performance code
- Run benchmark
- Participate to conference and publish the work done

Skills

Technical Skills and Proficiency Required:
- Knowledge of parallelization approaches
- Proficient in CUDA programming and experienced in implementing high-performance computing (HPC) applications.
- Familiarity with HPC environments and compilation processes.

Programming Languages:
- C (mandatory), C++
- CUDA

Interpersonal Skills:
- Capable of collaborative teamwork as well as independent work.

Additional Valued Qualities:
- Creativity.

The applicant must have a MS degree or equivalent.

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

2100 € gross/month the 1st year

General Information

- Theme/Domain: Distributed and High Performance Computing
- Town/city: Illkirch-Graffenstaden
- Inria Center: Centre Inria de l'Université de Lorraine
- Starting date: 2024-10-01
- Duration of contract: 3 years
- Deadline to apply: 2024-08-10

Contacts

- Inria Team: CAMUS
- PhD Supervisor: Bramas Bérenger / Berenger.Bramas@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.
The keys to success

The ideal candidate will possess:

- A passion for solving complex algorithmic challenges, with the ability to deliver robust and efficient solutions.
- An enthusiasm for understanding the work of others and proposing innovative improvements.
- The ability to clearly explain methodologies, operational functions, and contribute to scientific publications.

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.