2023-06762 - Improving Memory Management in the Linux Kernel

Contract type : Fixed-term contract
Level of qualifications required : Master's or equivalent
Function : Internship Research

Context
Inria is the French national research institute for digital science and technology. World-class research, technological innovation, and entrepreneurial risk are its DNA. In 215 project teams, many of which are shared with major research universities, 3,900 researchers and engineers explore new paths, often in an interdisciplinary manner and in collaboration with industrial partners to meet ambitious challenges.

As a technological institute, Inria supports the diversity of innovation pathways: from open-source software publishing to the creation of technological startups (DeepTech).

Inria Paris is located near Gare de Lyon in Paris. There are opportunities for pursuing a PhD at Inria after the internship.

Assignment
On modern architectures, the performance of memory management in the Linux kernel is intrinsically linked to synchronization and scheduling algorithms. Kernel memory management uses read-write locks which are a performance bottleneck in some applications. The kernel developers have tried to optimize read-write locks with a feature called optimistic spinning, but the approach significantly worsened performance on a MapReduce runtime and it was since partially abandoned [1]. At the same time, in the Linux scheduler, AutoNUMA aims to improve the performance of memory management on Non-Uniform Memory Architectures (NUMA), but the optimizations AutoNUMA uses are very simplistic, and it is unclear they always improve performance. In particular, AutoNUMA only focuses on migrating memory pages, not on replicating them—which has been shown to be worthwhile in previous research [2].

Main activities
As an intern at Inria, you will study the performance bottlenecks induced by synchronization and scheduling on memory management in the Linux kernel. Following this analysis, you will propose optimized synchronization and/or scheduling algorithms that allow for improved scalability, with the objective to publish your findings in top systems conferences such as SOSP, OSDI, USENIX ATC, and EuroSys.

Skills
- Thorough understanding of computer science fundamentals including data structures, algorithms, and complexity analysis
- Good problem-solving skills
- Knowledge and/or experience in systems/low-level programming
- Notions of OS design
- Advanced C programming

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

General Information
- Theme/Domain : Distributed programming and Software engineering
- System & Networks (BAP E)
- Town/city : Paris
- Inria Center : Centre Inria de Paris
- Starting date : 2024-01-15
- Duration of contract : 6 months
- Deadline to apply : 2023-12-31

Contacts
- Inria Team : WHISPER
- Recruiter : Lozi jean-pierre / jean-pierre.lozi@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
Defence Security :
This position is likely to be situated in a restricted area (ZRR), as defined in Décre 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.