

Internship offer (5-6 months): Cooperative task scheduling and synchronization

1 Institute

Inria

2 Description of the institute

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, more than 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).

3 Topic

Synchronization primitives such as barriers and locks are the building blocks of multithreaded applications on multicore architectures: improving their performance has an impact on the performance and scalability of the majority of today's applications [1]. Meanwhile, the Linux scheduler must solve a complex problem that has both a temporal and a spatial dimension: it has to make very fast decisions at a high frequency in order to decide when and where to place each thread—and has been shown to perform poorly at this task [2]. On modern architectures with a large number of cores, the overhead of synchronization is often a significant bottleneck. While previous research heavily focused on improving the performance of synchronization primitives in multithreaded applications, it was conducted in isolation from research on scheduling algorithms, as the scheduler traditionally considers applications as black boxes, including the synchronization code they use.

We would like to design new synchronization and scheduling algorithms that cooperate to improve the performance of multithreaded applications. As an example, it was shown that when the scheduler is unable to ensure work conservation, some threads are slowed down, and this results in all threads being slowed down when barriers are involved [2]. Making the scheduler aware of stragglers would make it possible to mitigate the problem by e.g., placing them on high-frequency cores or on cores that do not execute concurrent hyperthreads, in order to make them reach barriers faster.

As an intern at Inria, you will research this idea, with the objective to publish the results in top systems conferences such as SOSP, OSDI, USENIX ATC, and EuroSys.

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

4 Required 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

5 Contact

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Bibliography

- [1] Tudor David, Rachid Guerraoui, Vasileios Trigonakis. Everything you always wanted to know about synchronization but were afraid to ask. Symposium on Operating Systems Principles (SOSP) 2013.
<https://dl.acm.org/doi/pdf/10.1145/2517349.2522714>
- [2] Jean-Pierre Lozi, Baptiste Lepers, Justin Funston, Fabien Gaud, Vivien Quéma, and Alexandra Fedorova. The Linux scheduler: a decade of wasted cores. European Conference on Computer Systems (EuroSys) 2016.
<https://dl.acm.org/doi/abs/10.1145/2901318.2901326>