Offer #2019-01659

Statistical-oriented predictability of cyber-physical systems

Contract type : Internship

Renewable contract : Yes

Level of qualifications required : Graduate degree or equivalent

Fonction : Internship Research

Level of experience : Recently graduated

Context

What a defibrillator, a car or an airplane have in common? They all share the same property of being a cyber-physical system (CPS). A CPS is an integration of computation with physical processes whose behavior is defined by both cyber and physical parts of the system [1]. An increased pressure is pushing the designers of these systems to make them as autonomous as possible. This pressure is translated at program level by the implementation of smarter algorithms that are tested on the only processors available on the market today: the multicore processors. Indeed, due to the pioneer utilization of multicore processors by the smartphone market as well as the impressive expansion of this later market, the microprocessor industry has evolved towards general purpose processors with complex architectures that are not time predictable. Their lack of time predictability is due to features like several cores, multiple levels of caches and pipelines, speculative branching, communicating through shared memory or/and through a network on chip, etc. While smartphone clients are willing to charge often their phones or to re-boot regularly their applications to compensate for the bad design of the phones on multicore processors, the rest of the CPS industry is facing the open problem of time predictability of programs on multicore processors if they want to provide to their clients applications that are stable and have low-energy consumption.

Unfortunately bounding the execution time of a program on multicore processors is known to be an open problem. For instance, there is no program ensuring the autonomic behavior of an airplane executed on multicore processors today because of the unbounded execution time of the programs on such processors [2].

[1] R. Baheti and H. Gill. Cyber-physical systems. IEEE, 2011

[2] P. Parkinson. Towards avionics safety certification on multi-core processor architectures. TechTime, Elec-

tronics and Technology News, 2016.

Assignment

The queueing model of interest has types of processes: type 1, type 2, $\cdots$, and type N process. The priority increases from type 1 process to type N process, with type 1 process having the lowest priority and type N process the highest priority. Queueing systems with process priorities and queueing systems with process transfers have wide applications in manufacturing, computer networks, telecommunication systems, and vehicle traffic control. Existing works mainly address issues related to system stability, computational algorithm design, optimal scheduling, routing, or performance analysis.

The main motivation for this traineeship is the predictability of cyber-physical systems and especially the execution time on multi-core processors. The first part of the work will be a review of the mathematical literature on this subject. A focus on bounding time and probability of extremal events will be of particular interest. Previous work as [3, 4] may be considered as a starting materiel.

Collaboration :
The recruited person will be in connection with the two supervisors Avner Bar-Hen and Liliana Cucu-Grosjean as well as the members of the Kopernic team.

[3] L. Cucu-Grosjean, L. Santinelli, M. Houston, C. Lo, T. Vardanega, L. Kosmidis, J. Abella, E. Mezzeti, E. Quinones, and F.J. Cazorla. Measurement-based probabilistic timing analysis for multi-path programs. In the 24th Euromicro Conference on Real-time Systems (ECRTS), 2012.

[4] C. Maxim, A. Gogonel, I.-M. Asavoae, M. Asavoae, and L. Cucu-Grosjean. Reproducibility and repre-

sentativity - mandatory properties for the compositionality of measurement-based WCET estimation ap- proaches. In the 9th International Workshop on Compositional Theory and Technology for Real-Time Embedded Systems (CRTS), 2016.

Main activities

Main activities:

- Updating the state of the art;
- Proposition of a new statistical model taking into account the evolution of the execution times;
- Writing a short paper on the achievements of the internship;
- Participating to team meetings and other scientific events.

Skills

Technical skills and level required : MSc level in Statistics

Languages : English required for written English (possibility of lectures within Inria to improve the fluency)

Relational skills : Team working

Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- 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

General Information

- **Theme/Domain :** Embedded and Real-time Systems
  System & Networks (BAP E)
- **Town/city :** Paris
- **Inria Center :** Centre Inria de Paris
- **Starting date :** 2019-09-02
- **Duration of contract :** 4 months
- **Deadline to apply :** 2019-07-06

Contacts

- **Inria Team :** KOPERNIC
- **Recruiter :**
  Cucu Liliana / liliana.cucu@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

Passionate about statistics applied to Computer Science. Ready to work within an International team.

The internship may be continue with a PhD thesis on the same topic, so priority will be given to applicants whishing to prepare a PhD thesis.

 The Inria interns are benefiting of stipends of around 450 euros/month and partially subvention for meals. The internship may start as soon as September 2019 for at least 4 months.

> **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.