



Offer #2020-02326

Post-Doctoral Research Visit F/M Abstractions for causal analysis and explanations in concurrent programs

Contract type : Fixed-term contract

Level of qualifications required : PhD or equivalent

Fonction : Post-Doctoral Research Visit

About the research centre or Inria department

Inria the French national institute for research in computer science and control, is dedicated to fundamental and applied research in information and communication science and technology (ICST). Inria has a workforce of 3,800 people working throughout its eight research centers established in seven regions of France.

Grenoble is the capital city of the French Alps. Combining the urban life-style of southern France with a unique mountain setting, it is ideally situated for outdoor activities. The Grenoble area is today an important centre of industry and science (second largest in France). Dedicated to an ambitious policy in the arts, the city is host to numerous cultural institutions. With 60,000 students (including 6,000 foreign students), Grenoble is the third largest student area in France.

Context

The postdoc will collaborate with Jérôme Feret (Antique team, INRIA Paris) and Gregor Gössler (Spades team, INRIA Grenoble).

Important information concerning the COVID-19 epidemic: in case the rules by the French government and Inria related to the epidemic make it impossible for the candidate to physically start the position at Inria Grenoble, the position will start with teleworking.

Assignment

Within the ANR project "DCore - Causal Debugging for Concurrent Systems" we are looking for a highly motivated postdoctoral researcher. The first goal of the project is to investigate the use of abstractions for the construction of causal explanations. During the last couple of years, several approaches have been proposed to construct, from the execution of a system violating an expected property P , concise explanations why P was violated, and which components or events caused this violation, see e.g. [JRS04,BBD+12,DF+12,FMN15,GLM15,GS15]. However, these approaches either were limited to small systems, or used ad-hoc approximations to make them scale. The goal of the DCore project is to develop and implement causal analysis for a full-fledged programming language, in order to answer questions of the form "what would have been the outcome if component A had satisfied its specification?" or "which component faults were necessary to entail the observed effect?".

We are therefore interested in developing abstractions that "compose well" with causal analyses, and understanding precisely how explanations found on the abstraction relate to explanations on the concrete system. It is worth noting that the presence of abstraction, which inherently comes with some induction and extrapolation processes, completely recasts the issue of reasoning about causality. Causal traces do no longer describe only potential scenarios in the concrete semantics, but also mix some approximation steps coming from the computation of the abstraction itself. Causal explanation is then intertwined with the issue of alarm diagnosis [R05], and not all explanations are replayable counterexamples: they may contain some steps witnessing some lack of accuracy in the analysis. Vice versa, a research question to be addressed is how to define causal analyses that have a well understood behavior under abstraction. The second goal of the project is to implement and validate the theoretical developments as part of a causal debugger for a full-fledged programming language, such as Java with actors, or Erlang.

References:

[BBD+12] I. Beer, S. Ben-David, H. Chockler, A. Orni, and R.J. Trefler. Explaining counterexamples using causality. *FMSD* 40(1), pp. 12-40, 2012.

[DF+12] V. Danos, J. Feret, W. Fontana, R. Harmer, J. Hayman, J. Krivine, C. Thompson-Walsh, and G. Winskel: Graphs, Rewriting and Pathway Reconstruction for Rule-Based Models. *Proc. FSTTCS 2012, LIPICS* 18, 2012.

[FMN15] T. Ferrère, O. Maler, D. Nickovic: Trace Diagnostics Using Temporal Implicants. Proc. ATVA 2015: [241-258, 2015](#).

[GLM15] G. Gössler and D. Le Métayer: A general framework for blaming in component-based systems. Sci. Comput. Program. 113(3):[223-235, 2015](#).

[GS15] G. Gössler and J.-B. Stefani: Fault Ascription in Concurrent Systems. Proc. TGC'15, LNCS 9533, 2015.

[JRS04] H. Jin, K. Ravi, and F. Somenzi: Fate and free will in error traces. STTT 6(2):[102-116, 2004](#).

[R05] X. Rival. Abstract Dependences for Alarm Diagnosis. Proc. APLAS 2005, LNCS [3780, 347-363, 2005](#).

Main activities

Main activities :

- Study existing work on abstract interpretation, fault diagnosis, and causal analysis.
- Propose abstraction techniques and causal analyses for concurrent programs that "compose well", in the sense that the result of causal analysis on an abstraction of the program has a well-understood interpretation for the concrete program.
- Implement the results as part of a causal debugger for a programming language, such as Java with actors, or Erlang.

Additional activities :

- Present the results at conferences and workshops.
- Participate in project meetings.

Skills

Candidates should have a good background in formal methods. Good programming skills are also required.

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

Salary: 2 653 € gross/month before income taxes.

General Information

- **Theme/Domain** : Proofs and Verification
- **Town/city** : Grenoble or Paris
- **Inria Center** : [Centre Inria de l'Université Grenoble Alpes](#)
- **Starting date** : 2020-10-01
- **Duration of contract** : 2 years
- **Deadline to apply** : 2020-11-30

Contacts

- **Inria Team** : [SPADES](#)
- **Recruiter** :
Goessler Gregor / gregor.goessler@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 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.