

2019-01331 - PhD Position F/M Abstractions for causal analysis and explanations in concurrent programs

Type de contrat : CDD de la fonction publique
Niveau de diplôme exigé : Bac + 5 ou équivalent
Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

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.

Contexte et atouts du poste

The PhD thesis will be co-advised by Jérôme Feret (Antique team, INRIA Paris) and Gregor Gössler (Spades team, INRIA Grenoble).

Mission confiée

Within the ANR project "DCore - Causal Debugging for Concurrent Systems" we are looking for a highly motivated PhD student. The first goal of the thesis 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 counter-examples: 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 thesis 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.

A description of the thesis subject is available at <https://team.inria.fr/spades/phd-thesis-abstractions-for-causal-analysis-and-explanations/>

References:

- [BBD+12] I. Beer, S. Ben-David, H. Chockler, A. Orni, and R.J. Treffer. 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.

Principales activités

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.

Informations générales

- **Thème/Domaine** : Preuves et vérification
- **Ville** : Montbonnot
- **Centre Inria** : CRI Grenoble - Rhône-Alpes
- **Date de prise de fonction souhaitée** : 2019-10-01
- **Durée de contrat** : 3 ans
- **Date limite pour postuler** : 2019-11-30

Contacts

- **Equipe Inria** : SPADES
- **Directeur de thèse** :
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A propos d'Inria

Inria, l'institut national de recherche dédié aux sciences du numérique, promeut l'excellence scientifique et le transfert pour avoir le plus grand impact. Il emploie 2400 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3000 scientifiques pour relever les défis des sciences informatiques et mathématiques, souvent à l'interface d'autres disciplines. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 160 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

Consignes pour postuler

Sécurité défense :

Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :

Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

- 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.

Compétences

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

Avantages

- 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

Rémunération

Salary: 1982€ gross/month for 1st and 2nd year. 2085€ gross/month for 3rd year.

Monthly salary after taxes : around 1596,05€ for 1st and 2nd year. 1678,99€ for 3rd year. (medical insurance included).