Postoctoral position

Decentralization of distributed systems reconfiguration by using constraint programming

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1 Introduction

This position is funded by the ANR SeMaFoR (Self Management of Fog Ressources) project which intends to model, design and develop a decentralized solution for self-management of Fog resources in a generic way. The Fog computing is one of the new decentralized paradigm of utility computing (the Edge could also be mentioned) that overcomes the limitations of the centralized Cloud computing by leveraging smaller resources closer to the end-users and to the data sources. Hence, the Fog computing is adapted to latency-critical applications and systems (e.g., 5G, autonomous cars, virtual reality).

However, handling a pool of geo-distributed heterogeneous resources is challenging and the usual operating systems of the Cloud (e.g., OpenStack) are not easily adaptable to this purpose. The heart of SeMaFoR is to tackle Fog resources by the means of a set of autonomous controllers, one for each area of the pool, where areas could be geographical or logical. This set of controllers collaborate to manage in an efficient manner the set of shared resources.

An autonomous controller follows an infinite loop, often referred as the MAPE-K model, that continuously monitors the area (i.e., the set of resources, applications and systems), take decisions on which new state to reach according to the current situation, and then plan and execute a reconfiguration plan according to the current and desired state.

2 Mission

The selected candidate for this position will work on the collaboration of multiple controllers when building a reconfiguration plan. Indeed, if each area knows its desired state, the reconfiguration plan is in practice not fully decoupled from other areas that may use services or resources hosted by different areas, thus requiring coordination.

In recent work, we have designed a new reconfiguration model and language, namely Concerto, that enhances the safety and efficiency of a reconfiguration [1, 2]. Thanks to its formal specification, we have been able to automatically synthesize correct reconfiguration plans from a partial desired state. We have used SMT solvers to this purpose [4]. However, this work has considered a centralized synthesis of a reconfiguration plan.

The selected candidate will contribute to the decentralization of a reconfiguration plan synthe-

sis. In particular, the candidate will study the use of constraint programming[1] and distributed constraint satisfaction problems (DCSP) [3]. The selected candidate will also actively participate to the SeMaFoR project meetings and will collaborate with the partners of the project.

3 Expected skills

The position requires the following skills: (1) a PhD in computer science in one of the following fields: distributed systems and Cloud computing, software engineering, constraint programming, SAT or SMT solvers; (2) a taste for programming and experimenting; (3) good communication skills; and (4) a good level of English.

4 Additional information

The postdoctoral researcher will sign an 18-month contract at IMT Atlantique. The work will take place at the Nantes campus of IMT Atlantique (West of France, only 2 hours from Paris by train), with participation in the SeMaFoR project events (e.g., meetings in Paris). The candidate will be a member of the STACK research group (`http://stack.inria.fr/`). The main advisor is Hélène Coullon from the Stack team, but the candidate will be co-supervised bu Charles Prud'homme from the TASC team, expert in constraint programming. Both teams are part of the LS2N laboratory of Nantes, and the DAPI department of IMT Atlantique. The annual salary of the postdoc candidate is 34,400€, including complete health insurance and other social benefits provided by the French state. By subtracting taxes, the net salary is estimated to 2,326€. The offers open in April 2022 with a deadline in August 2022 for application. Please contact : Helene Coullon <helene.coullon@imt-atlantique.fr>; Charles Prud'homme <charles.prudhomme@imt-atlantique.fr>.

References

[1] Maverick Chardet, Hélène Coullon, and Christian Pérez. Predictable Efficiency for Reconfiguration of Service-Oriented Systems with Concerto. In *CCGrid 2020 : 20th IEEE/ACM International Symposium on Cluster, Cloud and Internet Computing*, Melbourne, Australia, May 2020. IEEE.

[2] Maverick Chardet, Hélène Coullon, and Simon Robillard. Toward Safe and Efficient Reconfiguration with Concerto. *Science of Computer Programming*, 203:1–31, March 2021.

[3] Ferdinando Fioretto, Enrico Pontelli, and William Yeoh. Distributed constraint optimization problems and applications: A survey. *CoRR*, abs/1602.06347, 2016.

[4] Simon Robillard and Hélène Coullon. SMT-Based Planning Synthesis for DistributedSystem Reconfigurations. In *International Conference on Fundamental Approaches to Software Engineering (FASE)*, Munich, Germany, April 2022.

[1] `https://choco-solver.org/`