Offre n°2025-08850

PhD Position F/M Coordinating multiple autonomic feedback loop managers in the Cloud/Edge computing

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : CDD

Niveau de diplôme exigé : Bac + 5 ou équivalent

Fonction : Doctorant

A propos du centre ou de la direction fonctionnelle

The Centre Inria de l'Université de Grenoble groups together almost 600 people in 24 research teams and 9 research support departments.

Staff is present on three campuses in Grenoble, in close collaboration with other research and higher education institutions (Université Grenoble Alpes, CNRS, CEA, INRAE, …), but also with key economic players in the area.

The Centre Inria de l'Université Grenoble Alpes is active in the fields of high-performance computing, verification and embedded systems, modeling of the environment at multiple levels, and data science and artificial intelligence. The center is a top-level scientific institute with an extensive network of international collaborations in Europe and the rest of the world.

Contexte et atouts du poste

co-advised by Eric Rutten (Ctrl-A, Grenoble), INRIA, and Thomas Ledoux (Stack, Nantes), IMT Atlantique

Within the framework of a partnership of collaboration between 2 Inria teams: Ctrl-A and Stack, funded by the Taranis project in the PEPR Cloud.

Mission confiée

Orchestration is a process that consists of managing dynamically and automatically computing resources in the Cloud/Edge, applications and services in order to satisfy final users.

Autonomic management and orchestration of distributed systems use feedback control loops [IBM03] that react to perceived variations (events or values in the system and its environment) by deciding upon reconfigurations (hardware and/or software). These reconfigurations are then implemented through basic actions in the system's API.

Feedback loops can manage a variety of objectives, of different natures (e.g., self-optimization, self-configuration, self-protection, etc.). They deal with different dimensions: quantitative, temporal, logical, etc. and rely upon diverse decision techniques (control theory, scheduling, constraints resolution, learning, etc.). The general challenge is the design of autonomic managers that can handle this complexity.

This research topic considers the necessity to coordinate multiple autonomic loops, interdependent or in parallel, to face the co-existence of multiple problems in real-world complex architectures.

Principales activités

The approach consists of exploring novel compositions of controllers and decision techniques, exploiting their complementarities, and applying them to concrete resource management problems that can benefit from them.

Compositions of loops will be studied at the level of software architectures of autonomic managers, exploring coordination mechanisms with a "black box" vision via mechanisms of vote or consensus, or "white box" with more internal integration (e.g., control and constraints), or "grey box" at intermediary levels of integration.

Particularly interesting compositions concern:

- the coordination of infrastructure and application managers, specified separately, for reasons of separation of concerns, and considering that development teams are distinct. Typically, applications can have running modes that sollicit resources in different ways, and which can be exploited when reconfiguration is required ([Alvares13], [Serrano16], [Mokhtari24], [Moghaddam22]).
- the composition of managers for deployment (typically based on constraints resolution), taking into account the dynamic aspects of the variations they are reacting to (typically speed or acceleration of evolutions).
- beyond the previous point, the composition and coordination of deployment managers (or even scheduling) with managers using Control Theory [Rutten18] for the regulation of system values such as the number of servers or power consumption.

For scheduling-related topics, the work can be done in cooperation with another topic in the Taranis project, on control and scheduling.

Experimental validation “in vivo” will concentrate on the SLICES-FR (https://slices-fr.eu/) platform, a research infrastructure covering the whole continuum IoT/networks/edge/cloud, with a particular attention for reproducibility. Another path of experimentation will consider simulation, like the Batsim environment (https://batsim.frama.io/).

Références

[IBM03] J. O. Kephart and D. M. Chess, “The vision of autonomic computing” in Computer, vol. 36, no. 1, pp. 41-50, Jan. 2003
[Alvares13] F. Alvares de Oliveira, T. Ledoux and R. Sharrock, “A Framework for the Coordination of Multiple Autonomic Managers in Cloud Environments” in IEEE 7th International Conference on Self-Adaptive and Self-Organizing Systems, Philadelphia, PA, USA, 2013
[Moghaddam22] Mahyar Tourchi Moghaddam, Eric Rutten, Guillaume Giraud, “Hierarchical Control for Self-adaptive IoT Systems A Constraint Programming-Based Adaptation Approach” in HICSS 2022 – Hawaii International Conference on System Sciences, Jan 2022, Hawaii, United States.
[Serrano16] Damián Serrano, Sara Bouchenak, Yousri Kouki, Frederico Alvares de Oliveira Jr., Thomas Ledoux, Jonathan Lejeune, Julien Sopena, Luciana Arantes, and Pierre Sens. “SLA guarantees for cloud services”, Future Generation Computer Systems, Pages 233-246, Volume 54, 2016.
[Mokhtari24] Anas Mokhtari, Baptiste Jonglez, Thomas Ledoux. Towards Digital Sustainability: Involving Cloud Users as Key Players. IC2E 2024 - 12th IEEE International Conference on Cloud Engineering, Sep. 2024, Paphos, Cyprus.
[Rutten18] Eric Rutten, Nicolas Marchand, Daniel Simon. Feedback Control as MAPE-K loop in Autonomic Computing. Software Engineering for Self-Adaptive

Systems III. Assurances., 9640, Springer, pp.349-373, 2018, LNCS.

Compétences

The PhD candidate must have:

- a MSc degree in Computer science.
- Excellent skills in programming languages, software engineering
- Knowledge in the domains of Cloud infrastructures, autonomic computing, control techniques.
- Good organizational and communication skills.
- Relational skills: curiosity, autonomy and social capabilities.

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 (90 days / year) and flexible organization of working hours**
- **Social, cultural and sports events and activities**
- **Access to vocational training**
- **Social security coverage under conditions**

Rémunération

2200 euros gross salary /month

Informations générales

- **Thème/Domaine :** Systèmes distribués et intergiciels
  Ingénierie logicielle (BAP E)
- **Ville :** Grenoble
- **Centre Inria :** Centre Inria de l'Université Grenoble Alpes

- **Date de prise de fonction souhaitée :** 2025-10-01
- **Durée de contrat :** 3 ans
- **Date limite pour postuler :** 2025-07-11

Contacts

- **Équipe Inria :** CTRL-A
- **Directeur de thèse :**
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A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 start-up. L'institut s'e?orce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

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.

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.