
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

The Inria Lille - Nord Europe Research Centre was founded in 2008 and employs a staff of 360, including 300 scientists working in sixteen research teams. Recognised for its outstanding contribution to the socio-economic development of the Nord - Pas-de-Calais Region, the Inria Lille - Nord Europe Research Centre undertakes research in the field of computer science in collaboration with a range of academic, institutional and industrial partners.

Contexte et atouts du poste

Modern software systems are inherently concurrent. They consist of components running simultaneously and sharing resources provided by the execution platform. For instance, embedded control software in various domains, ranging from household robots to operation of smart power grids to on-board satellite software, commonly comprises, in addition to components responsible for taking the control decisions, a set of components driving the operation of sensing and actuation devices. These components interact through buses, shared memories and message buffers, leading to resource contention and potential deadlocks compromising mission- and safety-critical operations. Similar problems are observed in various kinds of software system: workflow management, integration software, as well as cloud computing platforms and applications, which are the main application domain of this proposal. Components of cloud applications interact through cloud resources such as virtual machines, virtual networks, virtual storage, application servers, database managers, middleware services, etc. Thereby, cloud resource sharing can lead to cloud resource contention, potential deadlocks, and operational faults.

Essentially, any software entity that goes beyond simply computing a certain function, necessarily has to interact and share resources with other such entities. Correct coordination of access to resources among concurrent software entities is fundamental to ensuring that they satisfy user and system requirements avoiding operational faults and deadlock situations. This proposal targets the correct coordination of access to cloud resources among concurrent cloud application entities.

In the domain of multi-cloud computing, Spirals researchers study both platform (re)configuration and application design. Both aspects involve complex concurrent software systems, which must be capable of self-adaptation while ensuring correctness in spite of subtle dependencies both among the software components, and between components and the resources provided by the execution platforms. Thus, this proposal targets the design of cloud applications, which are both correct-by-construction and self-adaptive, using formal methods.

Mission confiée

The OCCIware modelling framework provides a means for specifying the behaviour associated to OCCI entities as a Finite State Machine (FSM). Although such FSMS can be used to monitor and coordinate the behaviour of the corresponding entities, no such mechanisms are currently available. The first step of the project will consist in extending OCCIware with coordination capabilities using JavaBIP [5], an open-source Java implementation [2] of the BIP (Behaviour-Interaction-Priority) framework [6] for the coordination of concurrent components, relying on annotations, component APIs and external specification files.
Currently, FSM specifications in OCCIware are available for elements of the cloud infrastructure such as virtual machines/networks/storages and of the cloud application such as databases, etc. This allows, in particular, to guide cloud application deployment wrt. available cloud resources. Once the application is deployed, there is little control of its resource use and requirements. In order to safely manage these at runtime allowing the applications to dynamically adapt their behaviour to the changes in cloud resource availability, FSM specifications of these applications must also be provided. The second step of the project will consist in defining an easy-to-learn intuitive domain-specific language (DSL) to allow developers to provide these specifications and integrating them into the overall model of the cloud system.

In order to ensure acceptance of the project results by software developers, one has to minimise the effort, which they must put into providing additional specifications. The third step of the project will consist in developing algorithms and infrastructure for learning an FSM model of a cloud application by interacting with it and observing its execution traces [3].

Partnership and collaboration
The results of this research project, i.e. 1) the integration of JavaBIP into OCCIware, 2) the DSL to specify cloud application self-adaptiveness, 3) learning algorithms and infrastructure, will be validated against cloud applications provided by three of Spirals partners: XScalibur, Scalaic and Orange Lab. XScalibur is a spin-off company originating from Spirals, which develops and markets the Multi-Cloud Studio - a product based on the OCCIware framework - for automation and administration of virtualised resources provided by heterogeneous cloud computing platforms. Scalaic, a regional cloud architect and operator, is our partner in the CIRRUS joint-team. Our partner Orange Labs will bring us applications from the domain of Network Virtualisation Functions (NVF), which consists in the cloudification of network functions.

References

Principales activités
* M0-M6: State of the art on the correct coordination of concurrent cloud resources and cloud applications.
  Milestone 1: Submission of this SotA to a top level review (e.g. ACM Computing Surveys).
* M6-M12: Integration of JavaBIP inside OCCIware (i.e. first step), and validation against partner’s applications.
  Milestone 2: Submission of an international conference paper (e.g. IEEE CLOUD).
* M12-M18: Design and implementation of the cloud application self-adaptiveness specification language (i.e. second step), and validation against partner’s applications.
  Milestone 3: Submission of an international conference paper (e.g. COORDINATION).
* M18-M24: Design and implementation of learning algorithms and infrastructure (i.e. third step), and validation against partner’s applications.
  Milestone 4: Submission of an international conference paper (e.g. ICML).
* M24-M30: Integration of the three steps, and validation against partner’s applications.
  Milestone 5: Submission of a top level review article (e.g. IEEE TCC).
  Milestone 6: PhD thesis defence.

Compétences
The following skills are required for this project:
* Knowledge of cloud computing
* Basics of formal methods (e.g. automata, predicate logics)
* Proficiency in the Java programming language
* Speak and write in English fluently

The following skills are not required, but could constitute a plus:
* Advanced knowledge of formal methods (e.g. temporal logics)
* Constraint programming

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)
* Access to vocational training
* Social security coverage

Rémunération
1st and 2nd year : 1593.50€ Net monthly salary (after taxes)
3rd year : 1676.37€ Net monthly salary (after taxes)