The strategy of the Centre is to develop an internationally renowned centre of excellence with a significant impact on the City of Lille and its surrounding area. It works to achieve this by pursuing a range of ambitious research projects in such fields of computer science as the intelligence of data and adaptive software systems. Building on the synergies between research and industry, Inria is a major contributor to skills and technology transfer in the field of computer science.

Contexte et atouts du poste

Modern software systems are inherently concurrent. They consist of components running simultaneously, executing 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. 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.

The work on multi-cloud application design is structured around OCClware [1] - a model-driven cloud resource management framework [7] based on the Open Cloud Computing Interface (OCCI) standard, providing a unique and unified framework to manage OCCI artefacts (documents, specifications, models, code and tools) and, at the same time, representing a factory to build domain-specific modeling frameworks for cloud computing, where each framework targets a specific cloud domain, such as infrastructure management, container management, application management, elasticity management, etc.

Mission confiée

The OCClware 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 OCClware with coordination capabilities using JavaBIP [5], an open-source Java implementation [2] of the BIP (Behaviour-Interaction-Priority) framework [4, 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 w.r.t. 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 availabilities, 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, Scalair 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. Scalair, 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 TEC).

**Compétences**

The following skills are required for this project:

* Knowledge of cloud computing
* Basic 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: 1675.37€ Net monthly salary (after taxes)