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 Hauts-de-France 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.

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

Context

One of the key problems in the domain of cloud computing is the correct management of (re)configurations. Indeed, cloud applications are complex concurrent software systems that are further subject to the constraints imposed by the underlying cloud platforms. They must be capable of self-adaptation while ensuring correctness in spite of subtle dependences both among the software components, and between components and the resources provided by the platforms.

One approach to (re)configuration in the cloud consists in modelling cloud platforms as dynamic software product lines (DSPSLs). The SALOON framework allows automatic generation of configuration files and scripts for cloud platforms from the combination of domain- and application-specific constraints on the required resources. This is achieved by establishing a mapping between a cloud knowledge model, which formally defines all the concepts relevant to the cloud domain (e.g. Virtual Machine, Language, Location, RAM), and an extended cloud feature model, which describes the features that can be made available for the particular cloud platform to configure (e.g. the Heroku cloud environment comprising an optional Load Balancer and between 1 and 3 mandatory Dyno features, each annotated with the required RAM size).

This approach is further extended to define dynamic reconfiguration plans. They observe that systems should evolve through a safe migration path between configurations, considering the dynamic constraints that determine the allowed transitions between configurations in addition to the static constraints of a variability model. To address this issue, they introduce reconfiguration operations allowing the description of multiple alternative reconfiguration paths, together with their associated costs. Temporal constraints governing when and how a new configuration can be reached using these operations, can then be encoded as State/Event Linear Temporal Logic (SE-LTL) formulae, which are then used to synthesise the appropriate reconfiguration plans. At present, the above reconfiguration plans are generated as statically defined scripts, which have to be executed manually.

Host laboratory

Spirals (Self-adaptation for distributed services and large software systems) is a project-team at Inria Lille – Nord Europe research centre. Its research program focuses on defining self-adaptive distributed software services and systems. In particular, one of the two key properties that it targets is self-optimisation, i.e. the capability of systems to continuously reason about themselves and to take appropriate decisions and actions on the optimisations they can apply to improve their usage of the available resources. In order to provide this capability, Spirals is conducting a study of mechanisms for monitoring, taking decisions, and automatically reconfiguring software at run-time and at various scales.

Mission confiée

Proposed research project

The goal of this research project is to design a novel framework for safedynamic reconfiguration of cloud applications by integrating into the platform software and extending the coordination mechanisms proposed by JavaBIP. To this end, this project will proceed in three steps.

The first step will consist in designing and implementing a model transformation tool that, based on an extended cloud feature model and a set of additional constraints, will automatically generate a JavaBIP model. Interfaced with an application, this JavaBIP model will be used at runtime to monitor the application and platform state. It will intercept reconfiguration requests and enforce the constraints ensuring that all intermediate configurations are safe.

The second step will consist in applying existing verification techniques for early detection of configuration problems such as deadlocks (reconfiguration cannot proceed) and livelocks (reconfiguration can proceed but the target configuration cannot be attained from the current one). Beyond detecting such problems, additional monitoring techniques could be applied to avoid them whenever possible.

The third step will consist in designing additional components and interfaces to be plugged into the JavaBIP model developed in step 1 so as to guide the reconfiguration process ensuring liveness and...
In order to provide flexibility to the designers and maintainers of cloud applications and platforms, we are planning to include several options, such as 1) statically precomputed reconfiguration plans; 2) techniques inspired by simulated annealing, consisting of the alternation of random disturbances with periods of settling down aiming at the globally optimal configuration through a sequence of locally optimal ones; and 3) on-line constraintsolving.

**Principales activités**
- Research
- Preparation and submission of publications
- Communication
- Experimentation and validation
- State of the art review

**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**
- Partial reimbursement of public transport costs
- Subsidized meals
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Access to vocational training
- Possibility of French courses
- Social, cultural and sports events and activities

**Rémunération**
1st and 2nd year: 1 982€ Gross monthly salary (before taxes)
3rd year: 2085€ gross monthly salary (before taxes)