behavioural properties, resource-management policies and self-adaptation strategies can be clearly
specify and implement component coordination on a high-level of abstraction, in such a manner that
self-adaptation mechanisms along with appropriate specification languages, allowing designers to
design approach—to be implemented in JavaBIP—which would provide resource management and
one hand, and adaptation policies, on the hand. These models will form the foundation of a rigorous
and analysis of platform capacities and application requirements for various kinds of resources, on
Theoretical work within the project will aim to develop expressive formal models for the specification
with information about resource availability to optimise overall system performance.

Contexte et atouts du poste
The Spirals project-team is conducting research activities in the domains of distributed systems and
software engineering. Spirals aims at introducing more automation in the adaptation mechanisms of
software systems, in particular, transitioning from adaptive systems to self-adaptive systems. For
that, we investigate solutions from several disciplines, such as formal methods, data mining, machine
learning, and distributed algorithms. This contributes to the goal of obtaining eternal distributed
systems. More information can be found on our website https://team.inria.fr/spirals/.

Mission confiée
When building large concurrent systems, one of the key difficulties lies in coordinating component
behaviour and, in particular, management of the access to shared resources of the execution
platform. A simple example consists in managing the memory usage by a set of concurrent
components, such as Camel routes [1]. A Camel route connects a number of data sources to transfer
data among them. The data can be fairly large and may require additional processing. Hence, Camel
routes share and compete for memory. Without additional coordination, simultaneous execution of
several Camel routes can lead to OutOfMemory exceptions, even when each route has been tested
and sized appropriately on its own. Since, in concurrent environments, it is practically infeasible to
envision all possible execution scenarios, synchronization errors can result in race conditions and
deadlocks.

To address this concurrency challenge, we have developed JavaBIP [2]. JavaBIP is a Java adaptation of
the Behavior, Interaction, and Priority (BIP) framework [3], providing two primitive mechanisms for
component coordination: (i) multi-party synchronization of component transitions and (ii)
asynchronous event notifications.

The main goal of this post-doctoral project is to extend JavaBIP with new mechanisms for resource
management and self-adaptation. Indeed, the environment of modern systems is inherently highly
variable. In particular, this is due to interferences among applications sharing common resources and
to the migration, e.g. of cloud applications among computing units. Thus, fluctuations of resource
availability become the norm rather than an exception. Instead of waiting for the resources to
become available, applications adapt their behaviour to the changes in the environment. Mechanisms
representing resource availability and dependencies must be explicitly provided in the design
framework. To enable efficient coordination, components must advertise their resource
requirements to the coordinating engines, which in turn must be able to combine such requirements
with information about resource availability to optimise overall system performance.

Theoretical work within the project will aim to develop expressive formal models for the specification
and analysis of platform capacities and application requirements for various kinds of resources, on
one hand, and adaptation policies, on the hand. These models will form the foundation of a rigorous
design approach—to be implemented in JavaBIP—which would provide resource management and
self-adaptation mechanisms along with appropriate specification languages, allowing designers to
specify and implement component coordination on a high-level of abstraction, in such a manner that
behavioural properties, resource-management policies and self-adaptation strategies can be clearly
stated, combined and enforced.

References


Principales activités

Main activities:

- Scientific research (definition of models, algorithms etc.; proofs)
- Implementation of prototype tools for evaluation of the proposed techniques
- Written presentation of the obtained results through papers and reports
- Oral presentation of the obtained results at scientific conferences
- Participation in the supervision of students at all levels

Additional activities:

- Strengthening of one's scientific network and definition of a career strategy
- Participation in the development of a user community
- Participation in other activities to promote the team's research to broader audiences

Compétences

- Formal methods (in particular semantic models, e.g. finite automata, Labelled Transition Systems and Petri Nets; behavioural equivalences, e.g. trace equivalence and bisimilarity)
- Verification (in particular temporal logics, e.g. LTL and CTL; tools, e.g. nuXmv, mCRL2)
- Knowledge of coordination languages, such as BIP, is a plus
- Proven experience in preparation of scientific documents (including mastery of LaTeX)
- Proven experience in software development (Java, Python)
- Excellent communication skills

Avantages sociaux

- Subsidised catering service
- Partially-reimbursed public transport

Rémunération

Around 31 000 € yearly brutto.