2023-06467 - PhD Position F/M Next generation of development environments

Contract type: Fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Function: PhD Position

About the research centre or Inria department

The Inria Rennes - Bretagne Atlantique Centre is one of Inria’s eight centres and has more than thirty research teams. The Inria Center is a major and recognized player in the field of digital sciences. It is at the heart of a rich R&D and innovation ecosystem: highly innovative PMEs, large industrial groups, competitiveness clusters, research and higher education players, laboratories of excellence, technological research institute, etc.

Context

Domain-Specific Languages (DSL) are now omnipresent in the industry and academia. Engineers and scientists are domain experts that handle DSLs to perform task specific to their job. In some cases, it’s a group of people, who are at the good level of abstraction, that stand between domain experts and their engineering problems. Concretely, domain experts use DSLs through dedicated environments (IDE – Integrated Development Environment). In such environments, experts handle DSL models using standard interactive features (e.g. auto-completion, templating, error checking, navigation) and using the concrete syntax of the DSL that can take various forms (e.g. graphical, textual, tabular). Experts use numerous DSLs broadly used in the industry, sometimes without even knowing that they handle a DSL. For example, conceiving an air plane usually involves electricity, resistance, scientific computing schema, models, that follow a specific nomenclature (i.e. the DSL grammar), with a specific representation (i.e. the DSL concrete syntax), with editing environments. Similarly, for conceiving a Web application experts may handle Docker, Git-Lab CI (continuous integration), ANTLR (grammar definition), CSS (style definition), Kubernetes (container orchestration) models/configuration files. All these languages are DSLs that experts use for completing a specific task. If a DSL works by itself, its use may impact other DSL models. For example, an electrician engineer that apply changes on his DSL models may have impacts on DSL models of other experts, such as on heating models. Each of those experts brings their own viewpoint, based on their expertise, for solving the global challenge, developing the system. This phenomenon is known as collective intelligence [1]. Current IDEs hardly support such collective intelligence as it requires novel features to share, communicate, explore, synchronize experts works. Moreover, Such features and the way they are used within a IDE depend on the experts domain. Language engineers, that develop IDEs specifically for DSLs, thus struggle in coding by hand such complex features.

Assignment

Objectives

Challenge 1. Proper DSL Usability

On one side, researchers focus on improving the creation and maintenance process of DSL back-ends to reduce their development cost. On the other side, researchers study how to improve the usability, the interactivity of some DSL front-ends to match new usages. Few research work, however, focus on new techniques for reducing the cost of building usable DSL front-ends [2]. So, language engineers still have to customize the interactivity of DSL environments by hand. Such tasks are costly and may hinder the adoption of DSLs. For example, in our own research work we studied the impact of modern navigation features on one DSL [3]. We coded those features by hand. If we want to bring those features to another DSL we have to re-code them. Researchers need to include interactivity within the creation and maintenance process of DSLs. Those interactive features must go beyond the classical use of mice, keyboards, and standard widgets (buttons, menus) to leverage the advances made by the HCI community. This requires further research work on how to program user interactions: we shown in our recent work [4] that the current UI toolkits still rely on the UI event processing model that exhibits critical flaws for supporting modern interactive features, such as domain-specific undo algorithms, complex user interactions. To summarize, we defined the following research question to address:

RQ1. How to reduce the development cost of usable and highly interactive DSL front-ends?

Challenge 2. Joint and coordinated DSLs usability

A new generation of software systems (for example smart health support, building energy management, or intelligent transportation systems) gives new opportunities for leveraging DSLs. The development of those systems requires expertise in multiple

General Information

- Theme/Domain: Distributed programming and Software engineering
- Software engineering (BAP E)
- Town/city: Rennes
- Inria Center: Centre Inria de l’Université de Rennes
- Starting date: 2023-10-01
- Duration of contract: 3 years
- Deadline to apply: 2023-08-15

Contacts

- Inria Team: DIVERSE
- PhD Supervisor: Blouin Arnaud, arnaud.blouin@inria.fr

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 1,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

*Warning:* you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

Instruction to apply

Please submit online: your resume, cover letter and letters of recommendation eventually.

For more information, please contact arnaud.blouin@inria.fr

Defence Security: This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

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domains. So, different types of experts (e.g. scientists, engineers from different domains) must work in a coordinated manner on various aspects of the system across multiple development phases. Those experts can use DSLs to support their work that focuses on a specific system aspect. The support and integration of DSLs lead to what researchers called the globalization of modeling languages [5], i.e. the use of multiple languages for the coordinated development of diverse aspects of a system. So, while the previous point focuses on the proper interactivity of a DSL, i.e. when a DSL is used alone, in various cases experts use multiple DSLs conjointly. This is what we call the joint and coordinated use of DSLs: such a use of multiple DSLs can lead to a tower of Babel [6] (i.e. a cacophony of DSLs) when the coordination of experts and their DSL models is not achieved correctly. For example the development of air-plane engines involves various experts from different domains: an electrician engineer that apply changes on dedicated DSL models may have impacts on models of an heating engineer; a change in CAD models may impacts material resistance models; when physicians apply changes on their physical models, this may impact system engineers’ models. All those models, made using various DSLs (e.g. Modelica, Simulink) are thus dependent each others: This makes the development process more complex: how domain experts can understand changes that affect their models if those changes come from models out-of-the-scope of their expertise? How experts from different domains can easily iterate on changes to converge to an optimal solution? We consider this problem as a usability issue that affects both development environments and processes, to lead to the following research question.

RQ2. How to improve the usability of using several DSLs conjointly or in coordination?

Main activities
The candidate will work on these two scientific challenges to produce both high level scientific contributions published in top venues, and develop prototypes to assess the contributions.

Skills

Application conditions
We are looking for exceptional and motivated candidates for this 3-year PhD. The candidate must have (or be about to obtain) a master’s or engineering degree in computer science. A mastery of scientific English is necessary. Knowledge of French is not required. Gross monthly salary: around 2050 € (years 1 and 2) then around 2150 €.

Environment
The candidate will work in the DiverSE team, common to IRISA and Inria. The DiverSE team is located in Rennes. DiverSE’s research is in the field of software engineering. The team is actively involved in European, French and industrial projects and is composed of 9 professors/researchers, 20 PhD students, 4 post-docs and 3 engineers. The main supervisors of the thesis will be Arnaud Blouin, and Benoit Combemale. The candidate will enroll in the doctoral school in computer science of the University of Rennes 1.

Benefits package
- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking (90 days per year) and flexible organization of working hours
- Partial payment of insurance costs

Remuneration
Monthly Gross salary:
- 2051 euros for the 1st two years
- 2158 euros on 3rd year