Internship offer for Master 2 students or final year computer engineering students - 2021

Proposing a DSL for the generation of code, tests and OpenAPI descriptor

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Location: Inria Rennes - Bretagne Atlantique or remotely due to the COVID-19 situation

Salary: legal amount of 3.90€ / hour, full time (Gratification de stage)

Duration: up to 6 months

Keywords.

Domain-Specific Language (DSL), Application Programming Interface (API), Test-Driven Development (TDD), code generation, OpenAPI descriptor

Context and Problem.

Developing services and exposing them through APIs is now a common and popular task in the digital world. Thousands of APIs are available, which makes using them complex and overwhelming. The standard OpenAPI [1] aims to overcome this issue by proposing a common manner of describing APIs and making them readable and understandable by both humans and computers. However, even with strong recommendations, developers lack discipline when it comes to respecting such standards and writing OpenAPI specifications. Therefore, the notion of hypermedia [4] which carries the information on how to use an API ends up being implicit. Instead of writing proper OpenAPI documentations and in order to specify the user story of an API, some efforts have been shifted in the industry towards Test-Driven Development (TDD), which is a programming technique that consists in writing tests first, and then writing the code of the application. However, TDD is a tedious and slow process since developers have to imagine the interface's endpoints, write the test code, and run the tests before writing the code

eventually. Moreover, when adopting a TDD approach, many design choices should be abstracted in order to avoid premature commitment to implementation details, e.g. whether using REST or RPC.
This gives rise to the following research question: **"How from the test cases description, are we able to automatically generate a part of the OpenAPI descriptor?"**

Objectives.

The objective of this internship is to **propose a high-level domain-specific language (DSL) to reason on the API, define the interaction between the APIs in a micro-services context, and generate the API code and tests.** This DSL will encapsulate the notion of hypermedia such as the sequence of requests expected by the API.
Based on the review of the literature, the first step is to elaborate, by relying on TDD examples, the required features of the DSL to express high-level test cases scenarios. These features are among others:

a. expressing the pre-conditions (*e.g.* Resources managed by the service),
b. expressing the behavior (*e.g.* HTTP requests),
c. expressing the expected post-conditions (*e.g.* assertions on results of the requests).

Then, the student is expected to implement a textual DSL, its syntax, its semantics, and the required tools to generate the API code and tests [2,3]. A graphical DSL might be also proposed to graphically define test case scenarios in a block-like manner.
The proposed DSL must be evaluated on existing applications such as TousAntiCovid.
The final objective is to generate, from the DSL, OpenAPI descriptors such as Swagger. These descriptors make the API user-friendly and help define a semantic mapping between various APIs.

We have funding for a PhD position after this internship, in case the candidate is interested and has achieved encouraging results during his/her internship.

Required skills.

- Ability to work autonomously
- Strong skills in object-oriented programming
- Writing and speaking in English since the DiverSE team host foreign researchers
- Knowledge in model-driven engineering approach

To apply to this position, please send us an email with the following documents:

- A CV detailing your educational path and experience
- A motivation letter
- A transcript of your grades during the last five years (Bachelor + Master or Software Engineering diploma)

Environment.

The candidate will work at Inria in the DiverSE team. Inria is the French national institute for research in computer science. There are 8 Inria research centres located throughout France, hosting more than 200 research teams. The DiverSE team is located in Rennes. DiverSE's research is in the area of software engineering. The team is actively involved in European, French and industrial projects and is composed of 9 faculty members, 20 PhD students, 2 post-docs and 4 engineers. The candidate will work in the context of one of the main topics currently explored in the team, involving various professors and students.

References.

[1] OpenAPI specifications version 3.0.3.
[2] Daniel Perelman, Sumit Gulwani, Dan Grossman, and Peter Provost. 2014. Test-driven synthesis. *SIGPLAN Not.* 49, 6 (June 2014), 408–418. DOI:https://doi.org/10.1145/2666356.2594297
[3] Lennart C.L. Kats, Rob Vermaas, and Eelco Visser. 2011. Testing domain-specific languages. In *Proceedings of the ACM international conference companion on Object oriented programming systems languages and applications companion* (*OOPSLA '11*). Association for Computing Machinery, New York, NY, USA, 25–26. DOI:https://doi.org/10.1145/2048147.2048160
[4] A Description of Hypermedia APIs, Chris Fidao.