that coherence theorems for a lambda-calculus with monads can be achieved through rewriting. The second line of work is the study of languages allowing the use of monads, e.g. Haskell. We expect still open.

Coherence theorems. However, this field is relatively young and many connexions between algebra, higher-dimensional algebraic structures, allowing for the study of fine invariants of those, and show applications to algebra (for instance, the celebrated Knuth-Bendix algorithm was first developed in order to study the theory of groups). While investigating these, deep connections with category theory were found and given rise to higher-dimensional rewriting theory, which is able to deal with higher-dimensional algebraic structures, allowing for the study of fine invariants of those, and show coherence theorems. However, this field is relatively young and many connexions between algebra, rewriting and computational models remain to be studied. In particular, linear rewriting, i.e. rewriting on formal sums of terms, is still not well understood in this context, and would have applications to probabilistic and quantum programming languages, as well as in logical foundations of programming such as linear logic.

Assignment

The first aim of the post-doc is, broadly speaking, to explore and develop topics where algebra, rewriting, and programming meet. We propose two concrete axes of work, but other are possible.

The second aim of the post-doc is to foster interactions between teams of Inria and LIX. The post-doc will indeed work in collaboration with Beniamino Accattoli, from the Parsifal Inria team, and Samuel Mimram, from the Cosynus LIX team. Roughly speaking, Accattoli covers the functional programming part, Mimram the algebraic one, and both have their background in rewriting theory.

Main activities

We propose two directions of work, one based on tools from linear algebra and one on tools from category theory. Of course, the interaction between algebra, functional programming and rewriting goes well beyond these two topics, and candidates interested in other connections are also welcome.

The first line of work is the rewriting study of the algebraic lambda-calculus, which is an extension of lambda-calculus with linear combinations of programs, and it is at the foundations of probabilistic and quantum functional programming languages. This framework, introduced by Vaux in 2009, has already attracted considerable research, because of its rewriting subtleties, but many questions are still open.

The second line of work is the study of languages allowing the use of monads, e.g. Haskell. We expect that coherence theorems for a lambda-calculus with monads can be achieved through rewriting.
techniques, from which one can expect to automate the insertion of coercions, made from monad
morphisms. This would lead to a practical improvement of state-of-the-art languages (the compiler
would automatically insert code, thus simplifying the work of the programmer) which would be
theoretically be shown to be sound (the coherence theorem would ensure that no arbitrary decision is
taken by the compiler).

Skills
The successful candidate will have a background in linear algebra or category theory. Knowledge of
basic rewriting theory is also expected, while expertise in functional programming is less essential.

Benefits package
- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Remuneration
Monthly gross salary: 2653 euros