Compiler Infrastructure for Efficient Implementation of Functional Languages on Java Virtual Machine

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Abstract:

For cross-platform execution and development as well as its enormous collection of libraries and tools, Java Virtual Machine (JVM) has become an attractive platform for compiler writers and it hosts many different programming languages. These languages, however, may follow programming language paradigms that are completely different from the imperative object oriented programming which JVM was originally designed for. This fact leads to many difficulties and compromises compiler writers and language users need to face to overcome limitations of JVM. The most popular family of non-imperative languages on JVM are functional languages. Functional programming has strong foundations in formal logic. In particular, the second-order (polymorphic) lambda calculus is the basis of the majority of statically typed functional languages and its variations are used as intermediate representations in their compilers. This talk will present a new representation of closures in JVM and overview a formalized type-directed translation of the polymorphic lambda calculus to Java using this representation. This new compilation technique opens up possibilities for language-specific optimizations. The talk will show how it can be used to efficiently overcome a notorious issue of current generations of JVM and some other virtual machines: the lack of support for tail calls. Thus, idiomatic functional programming constructs, which rely on tail calls, can be achieved seamlessly with a uniform closure representation, low execution time overhead, and constant memory overhead. The implementation of this technique in our research compiler will be presented as well as its experimental evaluation. In comparison with other techniques used in mature functional language compilers on JVM, it achieves a better performance. Finally, the talk will outline some future directions for the research compiler, language implementations on top of this compiler and new optimizations within the described compilation technique.

About the Speaker:

Tomas Tauber is a full-time PhD student at the Department of Computer Science, the University of Hong Kong. His supervisors are Prof. Cho-Li Wang and Dr. Bruno C. d. S. Oliveira. His research interests are design and implementation of programming languages and compiler optimizations.