OpenJIT*: An Open-Ended, Reflective JIT Compile Framework for Java

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Abstract. OpenJIT is an open-ended, reflective JIT compiler framework for Java being researched and developed in a joint project by Tokyo Instistute of Technology and Fujitsu Laboratories Limited. Although in general self-descriptive systems have been studied in various contexts such as reflection and interpreter/compiler bootstrapping, OpenJIT is a first system we know to date that offers a stable, full-fledged Java JIT compiler that plugs into existing monolithic JVMs, and offer competitive performance to JITs typically written in C or C++. This is in contrast to previous work where compilation did not occur in the execution phase, customized VMs being developed ground-up, performance not competing with existing optimizing JIT compilers, and/or only a subset of the Java language being supported. The main contributions of this paper are, 1) we propose an architecture for a reflective JIT compiler on a monolithic VM, and identify the technical challenges as well as the techniques employed, 2) We define an API that adds to the existing JIT compiler APIs in "classic" JVM to allow reflective JITs to be constructed, 3) We show detailed benchmarks of run-time behavior of OpenJIT to demonstrate that, while being competitive with existing JITs the time- and space-overheads of compiler metaobjects that exist in the heap are small and manageable, and 4) we demonstrate how reflective JITs could be useful class- or application specific customization and optimization by providing an important reflective "hook" into a Java system. Being an object-oriented compiler framework, OpenJIT can be configured to be small and portable or fully-fledged optimizing compiler framework in the spirit of SUIF. It is fully JCK compliant, and runs all large Java applications we have tested to date including HotJava. We are currently distributing OpenJIT for free to foster further research into advanced compiler optimization, compile-time reflection, advanced run-time support for languages, as well as other areas such as embedded computing, metacomputing, and ubiquitous computing.

* http://www.openjit.org/