MicroJIT: A Lightweight Just-in-Time Compiler to Improve Startup Times

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Outline

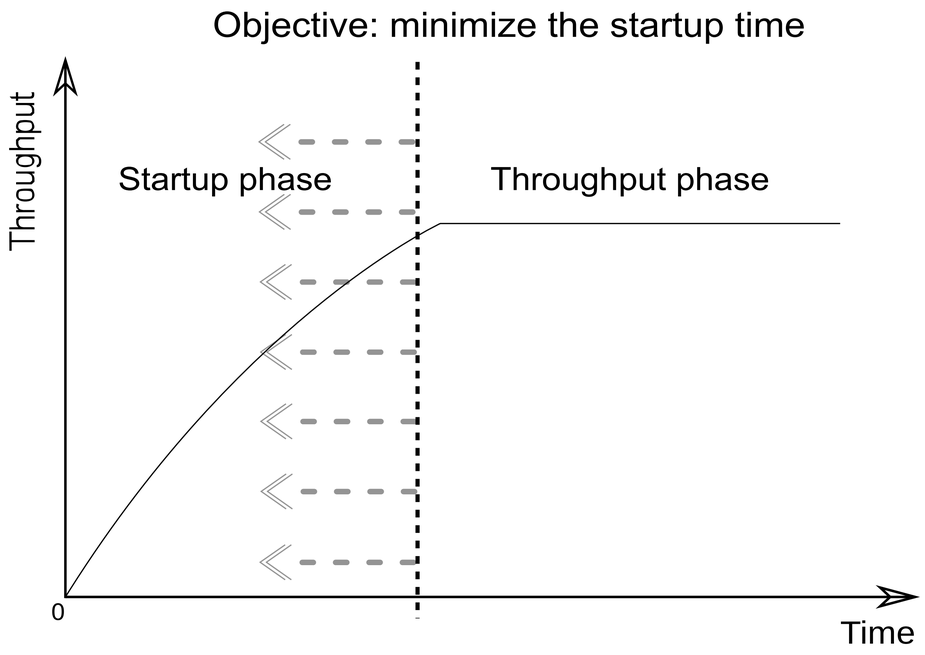
The startup phase of an application represents a tiny fraction of the total runtime, but it is considered, nevertheless, a critical phase for both client and server environments.
We are investigating whether using two different Just-in-Time (JIT) compilers in the same JVM can improve startup time. In our approach the lightweight JIT system (i.e. MicroJIT) performs an initial, low-optimized, but fast compilation while, at a later time, the standard JIT recompiles Java bytecodes with better, but more expensive, optimizations.

Motivation

- The time spent in the startup phase must be minimized to allow the application to reach the throughput phase as quickly as possible.
- JIT produces highly optimized native code but with a cost in time and computation.
- Investigate if using a lightweight JIT system can improve startup time.

Other techniques

- *Ahead-of-Time compilation (AOT)* uses code compiled before the start of the JVM, usually saved from a previous execution.
- *Offline profiling* saves profiling information between JVM runs. The information is used by JIT to optimize the compilation of Java methods.
- *Multilevel JIT systems* allow for compilation tuning for better (slower) or worse (faster) optimization.



Design

We are porting MicroJIT, a lightweight JIT system, originally developed for JAVA ME, to IBM J9 (Java 8).

MicroJIT differs from the standard JIT:
- Single pass synchronous compilation (no intermediate language).
- Small footprint.
- Template-based code generation.
- Works on the same stack structure (Java stack) used by the Interpreter (i.e. no stack transitions).
- Can give up anytime to the VM to interpret even a single bytecode.
- Only a small subset of optimizations.
- Uses the same interface with the VM as the standard JIT.

JIT/VM interface

The JIT system must cooperate with the VM to perform operations that change the state of the application or the state of the JVM: object allocation, read/write barriers, synchronization, method invocation, Java stack “management”.

Compilation criteria

MicroJIT compilation is triggered by the VM when a method is interpreted *n* times (default: hundreds).
Standard JIT recompiles the method depending on different criteria:
- Counting: if method is executed *m* times (default: thousands).
- Profiling information: standard JIT requires profiling information to generate highly optimized native code.