Making Different JIT Compilations Dancing to the Same Tune, Acting in the Meta-level

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Context — JIT Compilation

Two major JIT strategies:

Trace-based compilation

PyPy

Method-based compilation

Self

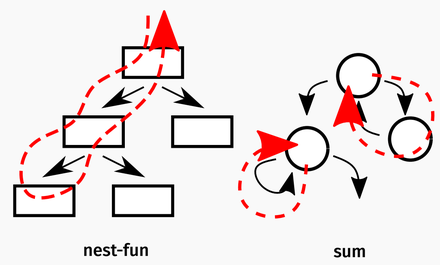
Lua

Problem — Trade-offs between the two

trace-based

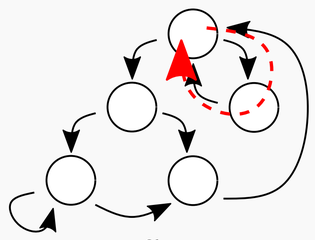
- inline automatically
- convert non-tail rec. call to loop

Good



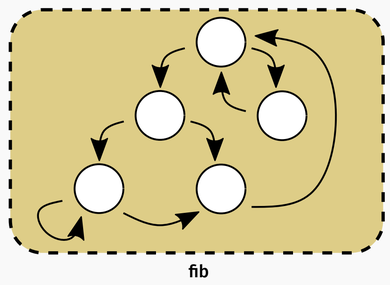
- path-divergence problem[1]

Bad

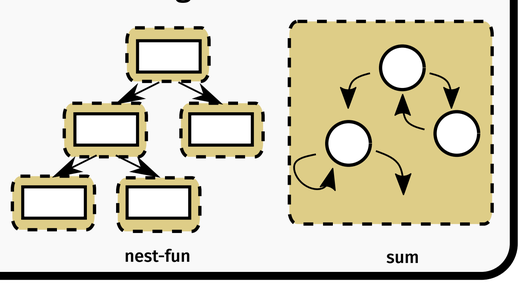


method-based

- able to apply any programs



- need carefully management for inlining



Our Approach

(1) Apply different strategies to different area

(2) Realize as a "meta-JIT compiler framework"

Proposal — *Meta-hybrid JIT Compiler Framework*

Virtual Machine Generation

language designer

lang. designer builds with the framework

Meta-interpreter

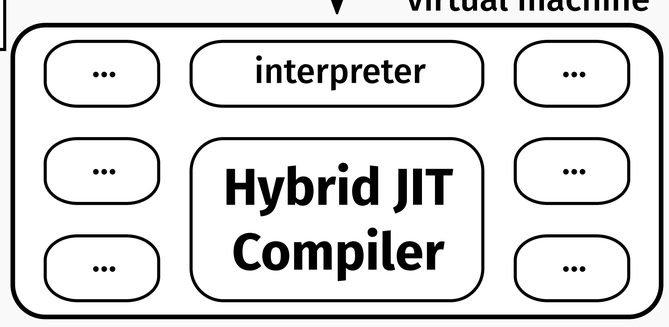
it is based on the MinCaml[3] compiler

follows RPython[2]'s architecture

BacCaml

generate

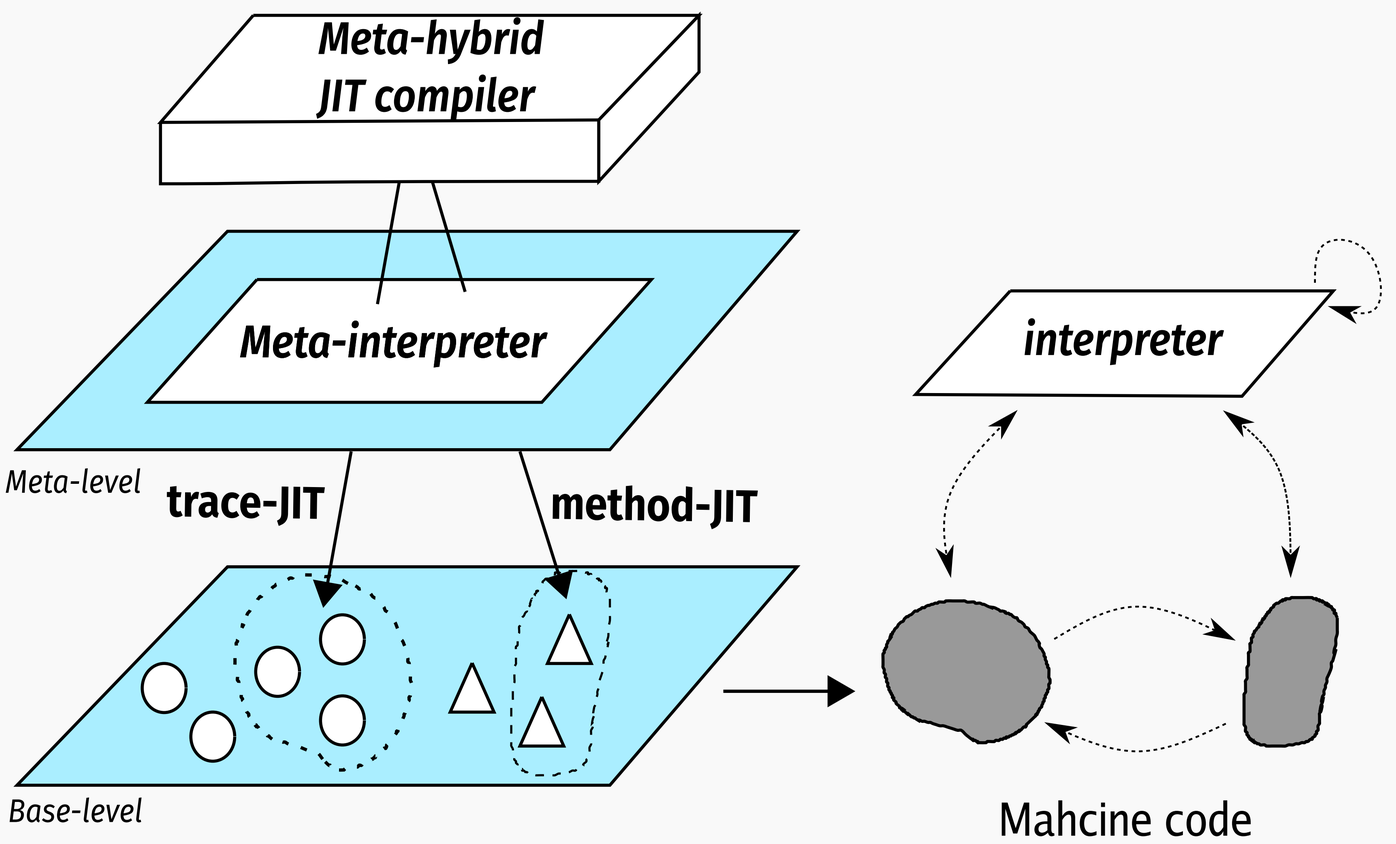
virtual machine



Execution

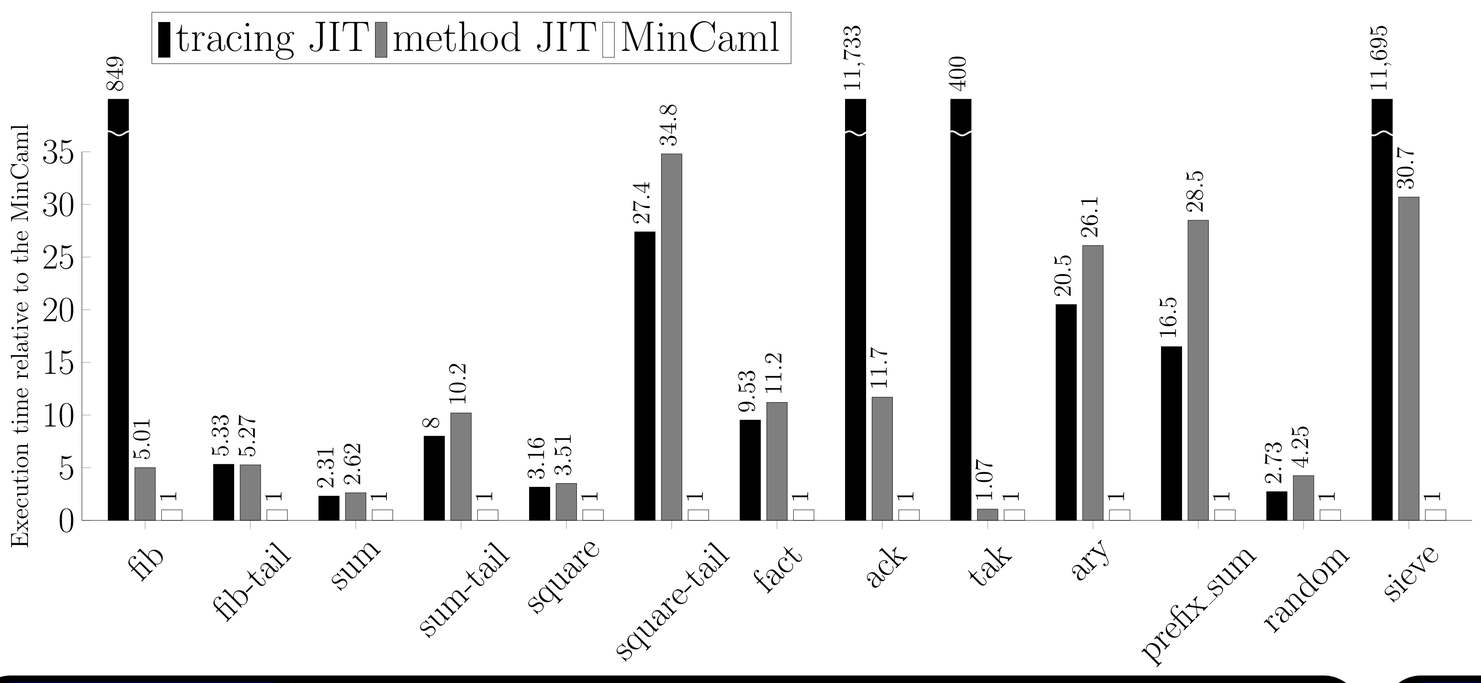
(Meta) JIT Compilation

Runtime

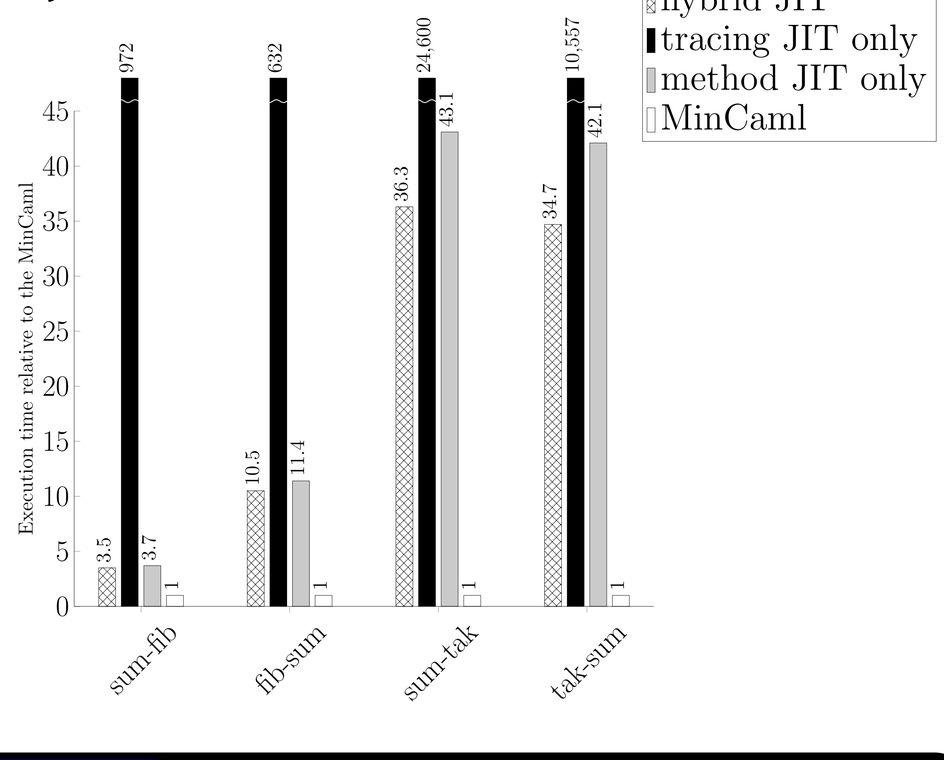


Result

Standalone JIT Microbenchmark:



Hybrid JIT Microbenchmark:



Future work

- Add optimizations for resulting traces
- Investigate profiling scheme for automatically selecting a suitable JIT strategy
- Apply our approach for RPython

References

[1] Huang Ruochen, Hidehiko Masuhara, and Tomoyuki Aotani. 2016. "Improving Sequential Performance of Erlang Based on a Meta-Tracing Just-In-Time Compiler." In International Symposium on Trends in Functional Programming, 44–58.

[2] Bolz Carl Friedrich, Antonio Cuni, Maciej Fijalkowski, and Armin Rigo. 2009. "Tracing the Meta-Level: PyPy's Tracing JIT Compiler." In Proceedings of the 4th Workshop on the Implementation, Compilation, Optimization of Object-Oriented Languages and Programming Systems, 18–25.

[3] Sumii Eijiro. 2005. "MinCaml: A Simple and Efficient Compiler for a Minimal Functional Language." In Proceedings of the 2005 Workshop on Functional and Declarative Programming in Education, 27–38.