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Operf: Benchmarking the OCaml Compiler

Pierre Chambart¹, Michael Laporte¹, Vincent Bernardoff¹, and
Fabrice Le Fessant^{1,2}

¹OCamlPro, Paris

²INRIA Paris-Rocquencourt

Abstract

We present `operf`, a set of tools to benchmark the OCaml compiler, with both micro-benchmarks, for fast feedback during development, and macro-benchmarks, for results on a larger set of benchmarks.

1 Introduction

Adding optimisations to the compiler is not risk-free. A compiler is a complicated beast and adding some code can introduce complex bugs and increase the maintenance burden. Before considering an optimisation for inclusion, the risk/reward ratio must be carefully evaluated. Currently, there is no way to simply assert the improvement or regression of a change. This is the problem that `operf` intend to solve.

2 Use cases

Benchmarking a compiler means benchmarking programs built with a given compiler. There is nothing really specific to compilers benchmarking compared to a library or a program, but it represents a lot more bookkeeping and maintainance. In particular there is a need for a common an automatable way to compile and execute lot of different applications, recover the results in a similar fashion and compare them, sometimes over a long period of time. For that, `operf` is composed of two packages: `operf-micro` and `operf-macro`.

3 The `operf-macro` Package

The `operf-macro` package is designed to benchmark real applications and accurately account for their running time. It is the part of `operf` that is expected to be used to evaluate compiler changes before integration. The package provides tools to measure the running time, CPU counters (like number of instructions executed), and GC statistics. To recover GC information, we propose a simple standard. If a program does not comply with it, it is still possible to extract some GC information with another tool (cf. our submitted article on `lldb` for OCaml, and the `ocp-gcstats` tool).

Since the evaluation of the compiler needs a representative set of applications, `operf-macro` has been designed to allow developers to easily add new benchmarks, by recording benchmarks in a simple database. We expect that this will allow a majority of open-source released OPAM

Authors' addresses: pierre.chambart at ocamlpro.com, fabrice.le_fessant at inria.fr, vincent.bernardoff at ocamlpro.com

packages to declare their own benchmarks, and thus, to be automatically tested for performance and correctness when a new version of OCaml will be released.

`operf-macro` leverages OPAM to simplify automated bulk testing. It is not strongly tied, but good practices and a few command-line tools makes it as easy as typing one command to test a new compiler version on the world.

4 The `operf-micro` Package

The `operf-micro` package is intended to be used in quick iterations of modification/evaluation of the compiler. A developer can typically add the `operf-micro` command to its makefile invocation to evaluate its changes after every build. The `operf-micro` tool was designed to simply test some small patterns, or algorithms and demonstrate in which cases some optimisation should or should not be triggered. To allow immediate use after the compilation of the compiler, `operf-micro` has as few dependencies as possible. Benchmarks built using its simple API can report their running time, but also the GC statistics and CPU cycles, in a format usable by `operf-macro`.

5 Conclusion

Currently, `operf-micro` and `operf-macro` are distributed with a set of benchmarks, which are used to develop the new `flambda` inliner for OCaml. Those benchmarks were also useful to uncover early bugs during the development of the 4.03.0 branch. Maintaining a test and benchmark suite for a lot of applications on the development branch of OCaml represents quite a lot of work. We think that this work is valuable, and can improve the the confidence of compiler developers in their changes and their impact on real world software. Of course, we hope the original authors will take over the work of maintaining benchmarks for their applications, and we designed the tools with this goal in mind. We wish that `operf` will have a success comparable with OPAM for package developers.