Leveraging the Runtime Environment for Feedback-Driven Computing

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To execute computer programs more efficiently, managed runtime environments rely on feedback about the program's execution. For example, the just-in-time (JIT) compiler of the managed runtime environment profiles the program's execution and uses that profile to speculatively optimize the program. To demonstrate this, I describe an advanced JIT inlining algorithm, and I show several concrete examples of how execution feedback and speculation make the compiled code more efficient. While the approach of speculatively optimizing the program based on the execution feedback has been immensely successful for code optimizations in JIT compilers, the runtime environment does not expose this execution feedback to user programs. This means that user programs can neither encode JIT-compiler optimizations, nor reason about the properties of their own execution. Despite the popular notion that the runtime's internals should be hidden from the users, I hypothesize that exposing the execution feedback to user programs is remarkably useful. To motivate this, I describe a data structure optimization, called path-caching, which was manually applied to concurrent hash tries. I then show the performance improvements of the path-caching optimization, and I explain how this optimization can be generalized using the execution feedback. The approach of speculatively adapting the program to its execution properties is applicable to other domains, such as graph processing and memory management. However, exposing the execution feedback and runtime facilities to user programs will result in a style of programming that is inherently unsafe. I conclude by discussing how exposing this feedback influences the programming language design, and how safety properties of high-level programs can be retained through the use of type systems.

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IST Austria Campus Mondi Seminar Room 2, Central Building

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