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Illinois-Intel Parallelism Center

Distinguished Speaker Series

Stephen Heumann

University of Illinois

The Tasks with Effects Model for Safe Concurrency

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4 - 5 PM CDT

2405 Siebel Center

Abstract

Concurrent programming is difficult, and today's widely-used concurrent programming models provide few safety guarantees, making it easy to write code with subtle errors. Proposed models offering stronger guarantees are often limited in the class of programs that they can express. In this talk, I will present a new concurrent programming model called tasks with effects, which offers strong safety guarantees while still providing the flexibility needed to support the many ways that concurrency is used in complex applications. This model has significantly greater expressivity than previous safe parallel languages, and can support actor-like programs and programs that combine concurrent and parallel components.

The core unit of work in the tasks with effects model is a dynamically-created task. The model's key feature is that each task has programmer-specified effects, and a runtime scheduler is used to ensure that two tasks are run concurrently only if they have non-interfering effects. Through the combination of statically verifying the declared effects of tasks and using an effect-aware runtime scheduler, the tasks with effects model is able to guarantee strong safety properties, including data race freedom and atomicity. It is also possible to statically prove that some programs in this model behave deterministically. I will describe the semantics of the tasks with effects model, as well as an implementation of it in an extended version of Java. I will also discuss an evaluation showing that it can express several programs exhibiting various patterns of concurrency, and that substantial parallel speedups can be achieved.

Bio

Stephen Heumann is a Ph.D. candidate in the department of Computer Science at the University of Illinois at Urbana-Champaign. His research interests include models and techniques for safe parallel programming, and he has worked in the past on the Deterministic Parallel Java project. Before joining UIUC, he received his BS degree in Computer Science from Caltech in 2008.

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