Proposition de recherche doctorale

Compilation de réseaux de processus de Kahn dans le modèle polyédrique

Mots clés :
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- Unité de recherche : Laboratoire d'Informatique de l'École Normale Supérieure
- Ecole doctorale : École Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal : Divers

Résumé du projet de recherche (Langue 1)

On modern processor architectures (multicores with deep cache hierarchies), parallelization and optimization of computationally-intensive programs have the potential of increasing performance by several orders of magnitude. Starting from naive, algorithmic-level source code, current compilers have a hard time achieving the required transformations to reach such levels of performance. The so-called « polyhedral model » is one of the main research directions to address this challenge. It is dedicated to the optimization and automatic parallelization of regular, loop- and array-centric applications. It is a geometrical representation and transformation model of programs, where the program semantics is captured as affine functions and systems of affine inequalities. This thesis proposes to study and extend the polyhedral model to operate on concurrent programs built of continuous functions defined on unbounded data streams, also known as Kahn process networks. We will then integrate these methods within the GNU Compiler Collection, leveraging an extension of the OpenMP language supporting data-flow concurrency and data streams. The thesis will be partially funded by the TERAFLUX and CARP European Projects. We will consider shared-memory multicore architectures as well as future and emerging manycore designs, including accelerator hardware abstracted through an OpenCL software stack. The this will take place at ENS (45 rue d'Ulm), in the PARKAS INRIA team, and possibly at IRILL (Initiative pour la Recherche et l'Innovation sur le Logiciel Libre, 23 avenue d'Italie), where an activity around the GCC platform is being established. The PhD student will collaborate with two PhD students, Feng Li and Tobias Grosser, and two postdocs, Sven Verdoolaege and Antoniu Pop.

Résumé du projet de recherche (Langue 2)

The goal is to allow programmers to expose dependence, independence and state in a target-independent way, leaving the responsibility to the compiler and runtime system to translate these informations into scalable and efficient parallel execution on a target platform. A formal semantics for static control Kahn networks will be defined, extending the state of the art in concurrent regular processes and cyclo-static data-flow. Emphasis will be put on the support for parametric control and data flow, compositionality of the model (nesting, parallel and functional composition). Algorithms to expose scalable and efficient parallelism for this model will be designed and implemented in generic polyhedral compilation tools.