Dataflow Models of Computation for Programming Heterogeneous Multicores

Jeronimo Castrillon, Karol Desnos, Andrés Goens, Christian Menard

Abstract The hardware complexity of modern integrated circuits keeps increasing at a steady pace. Heterogeneous Multi-Processor Systems-on-Chips (MPSoCs) integrate general purpose processing elements, domain-specific processors, dedicated hardware accelerators, reconfigurable logic, as well as complex memory hierarchies and interconnect. While offering unprecedented computational power and energy efficiency, MPSoCs are notoriously difficult to program. This chapter presents Models of Computation (MoCs) as an appealing alternative to traditional programming methodologies to harness the full capacities of modern MPSoCs. By raising the level of abstraction, MoCs make it possible to specify complex systems with little knowledge of the target architecture. The properties of MoCs make it possible for tools to automatically generate efficient implementations for heterogeneous MPSoCs, relieving developers from time consuming manual exploration. This chapter focuses on a specific MoC family called dataflow MoCs. Dataflow MoCs represent systems as graphs of computational entities and communication channels. This graph-based system specification enables intuitive description of parallelism, and supports many analysis and optimization techniques for deriving safe and highly efficient implementations on MPSoCs.

Jeronimo Castrillon and Christian Menard
Chair for Compiler Construction, TU Dresden, Helmholtzstr. 18, 01069 Dresden, Germany. e-mail: name.lastname@tu-dresden.de

Karol Desnos
Univ Rennes, INSA Rennes, CNRS, IETR-UMR6164, 20, Avenue des buttes de Coësmes, 35708 Rennes, France e-mail: karol.desnos@insa-rennes.fr

Andrés Goens
School of Informatics, the University of Edinburgh, 10 Crichton Street, Edinburgh, United Kingdom. e-mail: andres.goens@ed.ac.uk. The work was carried out while at the Chair for Compiler Construction, TU Dresden.

Acknowledgements

This work was funded in part by the German Federal Ministry of Education and Research (BMBF) through the E4C project (16ME0426K), by the BMBF project 6G-life hub (16KISK001K), by the German Research Foundation (DFG) through TraceSymm (366764507), by the Studienstiftung des Deutschen Volkes, by the CERBERO (Cross-layer modEl-based fRamework for multi-oBjective dEsign of Reconfigurable systems in unceRtain hybRid envirOnments) Horizon 2020 Project, by the European Union Commission under Grant 732105, and by the French Agence Nationale de la Recherche under grant ANR-20-CE46-0001 (DARK-ERA project).

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