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Task-Based Programming with OmpSs and its extension to create a family of DSLs

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Resumen

OmpSs is a task-based programming model that aims to provide portability and flexibility for sequential codes while the performance is achieved by the dynamic exploitation of the parallelism at task level. OmpSs targets the programming of heterogeneous and multi-core architectures and offers asynchronous parallelism in the execution of the tasks. The main extension of OmpSs, now incorporated in the recent OpenMP 4.0 standard, is the concept of data dependences between tasks. Tasks in OmpSs are annotated with data directionality clauses that specify the data used by it, and how it will be used (read, write or read\&write). This information is used during the execution by the underlying OmpSs runtime to control the synchronization of the different instances of tasks by creating a dependence graph that guarantees the proper order of execution. This mechanism provides a simple way to express the order in which tasks must be executed, without the need of adding explicit synchronization. Additionally, OmpSs syntax offers the flexibility to express that given tasks can be executed on heterogeneous target cores (i.e., regular processors, GPUs, or FPGAs). The runtime is able to schedule and run these tasks, taking care of the required data transfers and synchronizations that are needed. What is more, several implementations can be provided for a given task and the runtime will be able to chose the one best suited one. Also, OmpSs can be nicely combined with MPI to provide a powerful programming model to enhance current MPI applications. Due to its asynchronous nature and look-ahead capabilities, MPI/OmpSs is a promising programming model for future exascale systems, with the potential to exploit unprecedented amounts of parallelism while coping with memory latency, network latency and load imbalance. The talk covers the basics of OmpSs and some recent new developments to support a family of eDSL on top of the compiler and runtime, including an prototype implementation of a Partial Differential Equations DSL and its preliminar results.

Sobre Rosa M. Badia

Rosa M. Badia holds a PhD on Computer Science (1994) from the Technical University of Catalonia (UPC). She is a Scientific Researcher from the Consejo Superior de Investigaciones Científicas (CSIC) and team leader of the Grid Computing and Cluster research group at the Barcelona Supercomputing Center (BSC). She was involved in teaching and research activities at the UPC from 1989 to 2008, where she was an Associated Professor since year 1997. From 1999 to 2005 she was involved in research and development activities at the European Center of Parallelism of Barcelona (CEPBA). Her current research interest are programming models for complex platforms (from multicore, GPUs to Grid/Cloud). The group lead by Dr. Badia has been developing StarSs programming model for more than 10 years, with a high success in adoption by application developers. Currently the group focuses its efforts in two instances of StarSs: OmpSs for heterogenoeus platforms and COMPSs for distributed computing (i.e. Cloud). Dr Badia has published more than 120 papers in international conferences and journals in the topics of her research. She has participated in several European projects, for example BEinGRID, Brein, CoreGRID, OGF-Europe, SIENA, TEXT and VENUS-C, and currently she is participating in the project Severo Ochoa (at Spanish level), TERAFLUX, ASCETIC, The Human Brain Project, EU-Brazil CloudConnect, and TransPlant and it is a member of HiPEAC2 NoE.