Hybrid CPU-GPU cores for heterogeneous multi-core processors

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We propose to generalize the SIMT execution model of GPUs to general-purpose processors, and use it to design new CPU-GPU hybrid cores. These hybrid cores will form the building blocks of heterogeneous architectures mixing CPU-like cores and GPU-like cores that all share the same instruction set and programming model. The SIMT model used on some GPUs binds together threads of parallel applications so they perform the same instruction at the same time, in order to execute their instructions on energy-efficient SIMD units. Unfortunately, current GPU architectures lack the flexibility to work with standard instruction sets like x86 or ARM. Their implementation of SIMT requires special instruction sets with control-flow reconvergence annotations, and they do not support complex control flow like exceptions, context switches and thread migration. We will see how we can overcome all of these limitations and extend the SIMT model to conventional instruction sets using a PC-based instruction fetch policy. In addition, this solution enables key improvements that were not possible in the traditional SIMD model, such as simultaneous execution of divergent paths. It also opens the way for a whole spectrum of new architectures, hybrids of latency-oriented superscalar processors and throughput-oriented SIMT GPUs.

PGAS models and programming languages:
current panorama, influence on standard tools
in parallel programming

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PGAS programming languages and models exist since some time. Their primary goal was to propose an alternative standard model for parallel programming as a replacement of MPI and OpenMP. No PGAS model currently emerges, particularly on recent parallel machines that include accelerators. Nevertheless, existing PGAS implementations keep improving their efficiency. At the same time, a tendency focuses on the interoperability with MPI, OpenMP and other standard tools. Also, some effort is done to incorporate PGAS concepts in non-PGAS programming models. We will present an overview on the current PGAS environment, existing tools and their use.

Tuesday, November 10th 9:30 AM (coffee offered, talks at 10 AM)
Maison de la Simulation, Digiteo building (565), room 33

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