APPLIED MATHEMATICS COLLOQUIUM

The Pochoir Stencil Compiler

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Abstract:
Many high-end scientific applications --- in diverse areas including physics, biology, chemistry, energy, climate, mechanical and electrical engineering, finance, and recreational mathematics --- perform stencil computations in their inner loops. At every time step, a stencil computation updates each point of a d-dimensional grid as a function of itself and its near neighbors. Stencil computations are conceptually simple to implement using nested loops, but looping implementations suffer from poor cache performance. Efficient parallel cache-oblivious stencil algorithms are known which step time nonuniformly across the grid, but ordinary programmers find them difficult to write.

Pochoir provides a domain-specific stencil language embedded in C++ which the Pochoir compiler can translate into high-performing parallel cache-oblivious Cilk Plus code. Pochoir supports general d-dimensional stencils and handles both periodic and aperiodic boundary conditions in one unified algorithm. A host of stencil benchmarks demonstrates that Pochoir outperforms standard parallel-loop implementations on multicore machines, typically running 2-10 times faster and often over 100 times faster than a serial-loop implementation on a modern 12-core computer.

This talk describes joint work with Rezaul Chowdhury of Stony Brook University, Bradley Kuszmaul of MIT CSAIL, Chi-Keung Luk of Intel, and Yuan Tang of Fudan University, China.

Monday October 24, 2011
4:30 PM
Building 2, Room 105
Refreshments are available in Building 2, Room 290
(Math Common Room) between 3:30 – 4:30 PM