

Matrix Computations & Scientific Computing Seminar

Organizer: James Demmel & Ming Gu

Wednesday, 11:10AM–12:00PM, 380 Soda Hall

Feb. 12 **Ming Gu**, UCB

Tradeoffs between synchronization, communication, and work in parallel schedules

Any parallel schedule of an algorithm incurs three basic costs: synchronization, data movement, and computational cost. The execution time of such a schedule is governed by the most expensive execution path within schedule. In this talk, I will present a lower bounds on the cost of any schedule for a class of algorithms with certain dependency expansion properties. Our main theorem demonstrates a trade-off of latency cost with data movement as well as computational cost, parameterized by expansion growth functions of the dependency graph. We will then apply the theorem to a number of applications with lattice dependency structure, which have polynomial expansion growth. Our machinery allows us to derive novel lower bounds for Gaussian elimination, the Floyd-Warshall all-pairs shortest-paths algorithm, and Krylov subspace methods on stencils. Lastly, I will demonstrate the limits of the scheduling lower-bound methodology, by presenting an alternate all-pairs shortest-paths algorithm due to Tiskin, which has lower costs than any possible schedule of the Floyd-Warshall algorithm.

This work was done jointly with Erin Carson, Nicholas Knight, and James Demmel.