Matrix Computations & Scientific Computing Seminar

Organizer(s): James Demmel, Ming Gu & Beresford Parlett

Wednesday, 11:00am–12:00pm, 380 Soda

Oct. 21 **Prof. Jim Demmel**, UC Berkeley

Minimizing Communication in Linear Algebra

Algorithms have two kinds of costs: arithmetic and communication, by which we mean moving data either between levels of a memory hierarchy (in the sequential case) or between processors over a network (in the parallel case). Communication costs can already exceed arithmetic costs by orders of magnitude, and the gap is growing exponentially over time, so our goal is to design linear algebra algorithms that minimize communication. First, we show how to extend known communication lower bounds for $O(n^3)$ dense matrix multiplication to all direct linear algebra, i.e. for solving linear systems, least squares problems, eigenproblems and the SVD, for dense or sparse matrices, and for sequential or parallel machines. We also describe dense algorithms that attain these lower bounds; some implementations attain large speed ups over conventional algorithms. Second, we show how to minimize communication in Krylov-subspace methods for solving sparse linear system and eigenproblems, and again demonstrate new algorithms with significant speedups.