Communication Lower Bounds for Programs that Access Arrays

Nick Knight, UC Berkeley

April 24, 2013

In a previous seminar talk (2/15/12), we described a generalization of the communication lower bound theory for 3-nested-loop-like algorithms. The new theory yields a lower bound on data movement for any computer program that accesses arrays via affine functions of the loop indices. We review our recent results regarding practical computation of this lower bound. The decidability of one formulation of the problem implies a positive solution to Hilbert's 10th Problem over the rationals (a longstanding open problem). But despite the possible undecidability, a useful approximation can still be obtained. More recently, we have devised another formulation of the problem that leads to an effective algorithm. Having established this machinery for computing lower bounds, we now consider the related problem of attaining these bounds, i.e., constructing optimal algorithms. We sketch our current directions.

This is joint work with M. Christ, J. Demmel, T. Scanlon, and K. Yelick (UCB Math and CS depts).