Matrix Computations and Scientific Computing Seminar

Organizer: Jim Demmel and Ming Gu

Wednesday, 12:00–1:00 pm, 380 Soda Hall

Oct 14 **David H. Bailey**, LBNL

Discovery of large Poisson polynomials using the MPFUN-MPFR arbitrary precision software

In previous studies of lattice sums arising from the Poisson equation of mathematical physics, the present authors and two colleagues found that in the basic two-dimensional case, where the arguments x and y are rational, the lattice sum $\phi_2(x, y) = 1/\pi * \log A$, where A is *algebraic*. After computing high-precision numerical values of these sums and applying a multipair PSLQ integer detection algorithm, we obtained the explicit minimal polynomials for the algebraic numbers A in several cases. Based on these computations, Jason Kimberley conjectured a number-theoretic formula for the degree of these polynomials.

The earlier work was hampered by the enormous cost and complexity of these computations. In this study, we have employed the new MPFUN-MPFR arbitrary precision floating-point package and a parallel three-level multipair PSLQ integer relation program, which together resulted in a speedup of up to 130X over the software used in the earlier studies. As a result, we have been able to substantially extend our previous results, confirming that Kimberley's formula holds for significantly larger arguments. These computations required up to 51,000-digit precision, which, as far as we are aware, is the highest level of precision ever employed for a significant and successful integer relation detection.