

**Title: Two Complexity Results from Convex Optimization:
Matrix Definiteness Certified and
Valiant's Determinants Symmetricized**

Speaker:

Professor Erich Kaltofen
North Carolina State University

Date: Monday, 19 December 2011

Time: 11:00 am

Venue: Room 603, Chow Yei Ching Building

Abstract:

Convex optimization and the related sum-of-squares approach has yielded several theoretical problems in computational linear algebra that are quite meaningful on their own. We will discuss two:

First, we will provide certificates for the positive semidefiniteness of an n by n integer matrix that can be verified by a Monte Carlo randomized algorithm in $n^{2+o(1)} \log \text{norm}(A)^{1+o(1)}$ bit time. Such certificates constitute efficient sum-of-squares proofs for polynomial inequalities. This is joint work with Michael Nehring and B. David Saunders [ISSAC 2011].

Second, we will discuss Valiant's 1979 result on the universality of the determinant for algebraic formulas. Linear matrix inequalities (LMIs) from semidefinite programming restrict Valiant's theorem to symmetric matrix pencils. We will explain how Valiant's approach leads to symmetric determinantal representations with dimension $O(s)$ of even weakly skew circuit of size s over any field of characteristic $\neq 2$. This is joint work with Bruno Grenet, Pascal Koiran and Natacha Portier [STACS 2011]. Amazingly, such representations are impossible for the formula $x*y+z$ over any field of characteristic 2.

Biography of the speaker:

Erich Kaltofen received both his M.S. degree in Computer Science in 1979 and his

Ph.D. degree in Computer Science in 1982 from Rensselaer Polytechnic Institute. He was an Assistant Professor of Computer Science at the University of Toronto and an Assistant, Associate, and full Professor at Rensselaer Polytechnic Institute. Since 1996 he is a Professor of Mathematics at North Carolina State University. He has held visiting positions at Tektronix in 1985, the Mathematical Sciences Research Institute in Berkeley in 1985 and 2000, the University of Toronto in 1991, the Ecole Normale Supérieure in Lyon in 2005 and the Massachusetts Institute of Technology in 2006.

Kaltofen's current interests in the symbolic computation discipline are hybrid symbolic/numeric algorithms, efficient algorithms for linear and polynomial algebra, algebraic complexity theory, and generic programming techniques for algorithm implementation. He is a founding member of the LinBox project [<http://www.linalg.org>].

Kaltofen was the Chair of ACM's Special Interest Group on Symbolic & Algebraic Manipulation 1993 - 95. He serves as associate editor on several journals on symbolic computation. From 1985 - 87 he held an IBM Faculty Development Award. From 1990 - 91 he was an ACM National Lecturer. In 2009 Kaltofen was selected an ACM Fellow.

He has edited 4 books, including the Computer Algebra Handbook in 2002, published over 140 research articles, and has developed symbolic computation software in Lisp and C++ and contributed to commercial symbolic computation software. According to Microsoft Academic Search, Kaltofen is a top-ranked author: http://academic.research.microsoft.com/CSDirectory/Author_category_22.htm

Organizer: Dr. G. Chesi