Southern Oregon University
2003 Kieval Lecture Series Talks

Department of Mathematics

Presents

Yves Nievergelt

from

Eastern Washington University

Brief Biography:

Yves Nievergelt completed his diploma in mathematics from the École Polytechnique Fédérale de Lausanne (Switzerland) in December of 1976, then earned a Ph.D. in several complex variables under the guidance of James R. King at the University of Washington in 1984. Since 1985, he has been teaching complex analysis and numerical analysis at Eastern Washington University, where he likes to emphasize the precise connections and mutual influences between real applications and abstract theories in mathematics.

Thursday, May 15 at 10:00 a.m. in Science 118
Methods to Prove the Accuracy of Floating-Point Algorithms.

Digital calculators and computers use fast but inexact "floating-point" arithmetics. Such arithmetics can rely on several bases (binary, octal, decimal, hexadecimal, etc.), and they can offer several rounding options (to the nearest even, truncating, toward infinity, etc.). A strategy for the design of exact or accurate algorithms based on floating-point arithmetics consists of keeping track of the roundoff "error" from each operation. Algorithms to this effect can be short. Their proofs require little beyond high school algebra, but they can be circumvoluted (a hundred times longer than the algorithm they support) and prone to human error: one such algorithm has recently been discovered to enter an infinite loop from some specific data.

Thursday, May 15 at 2:00 p.m. in Science 118
Disasters Attributed to Computer Arithmetic.

Computing machinery - from pocket calculators to desktop workstations and mainframe computers - currently achieve "acceptable" speed only through the use of fast but inexact "floating-point" arithmetics. Such arithmetics produce roundoff errors that can compound so fast as to yield "results" with the wrong sign and the wrong magnitudes after only a few operations, without any warning signal to the unsuspecting user. Consequences have ranged from major embarrassment to complete loss of equipment. How do you know whether the statistics you read in the newspaper have any accuracy?

Friday, May 16 at 9:00 a.m. in Churchill Mulkey Auditorium (CH 230)
Provably Correct Algebraic Algorithms For Fitting Conics to Data.

Several variations of an algorithm based on linear algebra fit conics to data. Such algorithms determine the coefficients of an algebraic equation for the conic that minimizes the sum of the squares of its values at the data points. (In contrast, geometric algorithms minimize distances to the data points.) Versions of such algebraic algorithms based on projective geometry seamlessly allow for "degenerate" conics (double lines), which alleviates rounding errors in extreme cases. Options may include the selection of the type of conic to be fitted, for instance, a parabola, through the imposition of two simultaneous quadratic constraints. The main theoretical basis for such algebraic algorithms is the Singular-Value Decomposition of matrices. A perturbation analysis describes the changes in the fitted conic caused by perturbations of the data.

Friday, May 16 at 3:00 p.m. in Science 118
Provably Correct Geometric Algorithms For Fitting Circles and Spheres to Data.

An algorithm involving only high school algebra and geometry finds the thinnest annulus (or the thinnest spherical shell), including "degenerate" cases with the thinnest strip (or thinnest slab), that contains any finite set of points in the plane (or in space). Applications include archaeology, astronomy, engineering, and particle physics. An alternative algorithm based on projective geometry produces annuli and strips (or shells and slabs) seamlessly, which alleviates rounding errors in extreme cases. Numerical analysis describes the changes in the fitted annuli (or shell) caused by perturbations of the data.