

## CSc 80040 - Topics in Algorithm Analysis and Scientific and Engineering Computing - Algebraic and Numerical Computation

### ! Professor Victor Pan

The seminar studies most effective methods in the fields of symbolic and numerical computing. The recent focus was on the advances based on symbolic-numerical techniques that merge the methods in both fields. This relatively recent direction has been highly recognized by now, but fresh research topics are still abundant. The study in the seminar has lead many students to many publications and PhD Theses

(20 Theses have been defended in the last 9 years in the PhD programs in Computer Science and Mathematics, two of them in the Spring of 2007 and one in February of 2008.) The students who prefer just learning are also warmly welcome. The subjects in the seminar can be partly adjusted to the students' interests and background.

Recently covered subjects include:

- a) Various areas of matrix computations, in particular solving large linear systems of equations and computing the eigenvalues and eigenvectors of a matrix. Extensions and applications to computations in algebra and geometry.
- b) Structured (e.g., Toeplitz, Hankel, Cauchy, Pick, and semi-separable) matrices. They are omnipresent in modern computations in sciences, engineering and signal and image processing as well as in many areas of math. They are closely related to the fundamental algebraic computations with polynomials and rational functions.
- c) Solving a polynomial equation, which was the central and most influential problem in math for four millennia and remains highly important in computer algebra. Some extensions to the fundamentals of the solution of systems of multivariate polynomial equations have been studied.
- d) Polynomial and rational interpolation.
- e) Algebraic techniques for coding and cryptography.
- f) Fast and certified computation of the sign of the determinant, with applications to some fundamental geometric computations.

The seminar resumes with new topics every semester.

Background knowledge is welcome but is not a prerequisite because the students are divided into the entry level group and the advanced group. The instructor usually meets separately for two hours per week with each group. The entry level students eventually join the group of advanced students.

Survey and research papers are supplied as handouts. Some relevant papers are available at the instructor's homepage at <http://comet.lehman.cuny.edu/vpan/> and some as his Tech Reports at the CS Dept. in the Graduate Center. The students can also use the texts published by the instructor and available in the GC library.

The Computer Science students are encouraged to implement new algorithms presented at the seminar, and the Math students to solve the relevant open problems in math. The successful work becomes part of the theses, is supported by the instructor's grants, and is published in journals and refereed conference proceedings.