UNIVERSITY OF ALBERTA
DEPARTMENT OF COMPUTING SCIENCE

CMPUT 566
Algebraic and Symbolic Computation
(Fall, 1998)

Instructor : Stan Cabay, GSB 609, Ph. 3895

Primary Reference: K.O. Geddes, S.R. Czapor and G. Labahn, *Algorithms for Computer Algebra,* Kluwer Academic Publishers, Boston, 1992.

Description of course: Algebraic and symbolic systems are used primarily for the transformation of mathematical expressions. The goal is to provide exact, closed form, solutions to problems.

The primary intent of the course is the description and analysis of fundamental algorithms used by algebraic computer systems. The lectures also discuss current problems and recent developments in the area.

Course Content:

(1) Representation and data structures
- integers
- polynomials and rational expressions
- power series
- algebraic and transcendental functions

(2) Transformation of Representations
- Chinese remainder and interpolation algorithms
- fast Fourier transform
- Pade' fractions
- Hensel Constructs

(3) Classical and fast integer and polynomial arithmetic
(4) Greatest common divisor algorithms
(5) Factorization
(6) Exact solution of systems of linear equations over a ring
(7) Analytical integration
(8) Simplification of expressions

The students are expected to gain familiarity with one algebraic language (e.g., MAPLE), in addition to completing a number of assignments, which constitute 40% of the course grade. 40% of the course grade is based on a research-oriented course project and 20% on a class presentation.

The most crucial pre-requisite for the course is a background in abstract algebra, particularly, in ring theory.

References:

(1) K.O. Geddes, S.R. Czapor and G. Labahn, *Algorithms for Computer Algebra,* Kluwer Academic Publishers, Boston, 1992.

(2) D. Knuth, *Seminumerical Algorithms: Volume II*, Addison-Wesley, 1981.

(3) J. Lipson, *Elements of Algebra and Algebrsic Computing*, Addison- Wesley, 1981. (particularly the last few chapters)

(4) J.H. Davenport, Y. Siret and E. Tournier, Editors, *Computer Algebra: Systems and Algorithms for Algebraic Computation,* Academic Press, San Diego, 1988.

(5) J. Della Dora and J. Fitch, Editors, *Computer Algebra and Parallelism,* Academic Press, San Diego, 1989.

(6) E. Kaltofen and S.M. Watt, Editors, *Computers and Mathematics,* Springer-Verlag, New York, 1989.

(7) A.G. Akritas, *Elements of Computer Algebra with Applications,* John Wiley and Sons, New York, 1989.

(8) R. Grossman, *Symbolic Computation: Applications to Scientific Computing,* SIAM, 1989.

(9) R. Zippel, *Effective Polynomial Computation,* Kluwer Academic Publishers, Boston, 1993.

(10) D. Bini and V. Pan, *Polynomial and Matrix Computation: Volumne 1, Fundamental Algorithms,* Birkhäuser, Boston, 1994.

(11) All proceedings from *SYMSAC* and *EUROSAM* conferences, 1967-1997.