History of SACLIB

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SACLIB (symbolic algebraic computation library) is a very large collection of C language programs (more than 900) for computer algebra. The roots of this system go back to 1956, just two years after the commercial programmed computer, the IBM 701 was marketed, and a number of years before the term "computer algebra" had any meaning. In this year the writer began to write a set of programs for performing arithmetic operations on multi-precision integers, and for performing addition and multiplication on polynomials in an arbitrary number of variables with such integers as coefficients. His purpose was to explore Alfred Tarski's quantifier elimination method for the elementary theory of real closed fields (equivalently the elementary theory of the ordered field of the real numbers), [3]. Over the next 10 years, with some interruptions, this set of programs was somewhat augmented and modified to run on newer IBM computers. Also design changes were made. Most notably, whereas the initial design utilized fixed-size arrays, in 1960 the system was redesigned so that integers and polynomials were instead represented as lists.

In 1966 the writer changed his affiliation from IBM to the University of Wisconsin (at Madison) Computer Sciences Department. No IBM computers were operational at the University of Wisconsin, and it was necessary to reprogram the system, which, [1], had acquired the name PM, standing for Polynomial Manipulation. very important decision was made to reprogram the system in a computer-independent manner, using the FORTRAN language. The resulting system was given the name SAC-1 (Symbolic Algebraic Computation, Version 1). The primary reason for choosing FORTRAN was that at that time FORTRAN was the only standardized programming language, and the only one that nearly every computer user was familiar with. During the next few years, with the assistance of several Ph. D. students, the capabilities of the system were rapidly expanded to include such things as polynomial greatest common divisors and resultants, polynomial factorization and polynomial linear algebra, as new algebraic algorithms were devised and studied.

In 1976 SAC-1 began to be transformed into a new System, SAC-2. SAC-2 was programmed in a special programming language called ALDES (ALgorithm DEScription Language) designed by Rüdiger Loos, [2]. Loos also designed and implemented a translator from the ALDES language into a small subset of standard FORTRAN. Most SAC-1 programs were rewritten in ALDES without substantive change. However, whereas SAC-1 programs were written to use a reference count list processing system, SAC-2 programs use a garbage collection system. During the SAC-2 period many new programs were written, most notably for polynomial real and complex root isolation and refinement, for algebraic number arithmetic, and for quantifier elimination.

In 1991, Hoon Hong wrote a translator from ALDES to the C language that was used, together with some human editing, to convert the SAC-2 system from its FORTRAN base to the C language base of the current SACLIB system. The SAC-2 garbage collection system had depended on making the values of list variables accessible to the garbage collector by requiring the programs to explicitly place the values on a special software stack. The SACLIB garbage collector instead obtains such values from the stack that is maintained by the C compiler. Another change was that whereas SAC-2 programs had to simulate recursion since it was not supported by FORTRAN (at least not in 1976, the advent of SAC-2), in SACLIB recursion is supported by the C language. Improvements made to SACLIB since 1991 include faster integer arithmetic, new algorithms for greatest common divisors of polynomials with algebraic number coefficients, faster factorization of univariate polynomials over the integers, and faster polynomial real root isolation using floating point arithmetic with directed rounding.

References

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