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THE MICROCOMPUTER AS A TOOL IN NUMERICAL ANALYSIS

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The affordability of microcomputers makes them a practical tool for scientific computations and development of algorithms as well as a dramatic teaching aid. A package of mathematical software called SCRUNCH (1) is available to run in BASIC on moderate sized microcomputers (at least 8K and preferably 16K program space) to aid in the above tasks. SCRUNCH consists of translations of FORTRAN routines taken from three excellent sources:

RKF45 systems of ordinary differential eqns (2)
SIMP adaptive quadrature (3)
FNM minimization of a function of 1 variable (2)
ZEROIN root finder for a function of 1 variable (3)
SPLINE & FNS spline interpolation (2)
DECOMP & SOLVE systems of linear equations (2)
HECOMP & HOLVE overdetermined linear systems (4)
SVD singular value decomposition (2)
SYMEIG symmetric eigensystem (4)

With the growing popularity of using micro and minicomputers to teach structured programming languages such as PASCAL, the addition of this software package and a BASIC interpreter would allow beginning numerical analysis students to get hands on computing experience, avoiding the large computer center in favor of a more personal and self-paced environment.

Although some may complain of the lack of structure in a language like BASIC, the interactive nature of the language allows many more numerical experiments for both the student and experienced programmer than a compile/link/execute cycle. At any time during execution, the program can be interrupted by the user, the values of any variables may be displayed or changed, and the computation can then resume where it left off. The BASIC language is in need of standardization, but when using a microcomputer, the physical portability of the machine in some way compensates. When the author defended SCRUNCH as her masters project at SDSU, she transported the computer in the back seat of her car and plugged it in at State to provide demonstrations of the power that SCRUNCH provides the user.

The microcomputer with its 8-bit word is forced to perform arithmetic in software, although special hardware boards are available from some manufacturers. The system used in developing SCRUNCH is a Z-80 based 32K memory system with North Star BASIC, Disk, and Floating-Point Board. The largest problems this system could handle were a system of 150 ODEs and a 45 by 45 system of linear equations. Following are times for DECOMP and SOLVE on n by n systems using 14-Digit precision arithmetic.

n	time in seconds
5	12
15	47
25	146
35	343
45	655

References:

1. Kris Stewart, Numerical computations on very small machines, Calif. Software, 704 Solana Ave., Albany, CA 94706, 1979 (Source code is available in North Star and CP/M BASIC on diskette.)
2. G. E. Forsythe, M. A. Malcolm, and C. B. Moler, Computer methods for mathematical computations, Prentice-Hall, Inc., 1977.
3. L. F. Shampine and R. C. Allen, Jr., Numerical computing: an introduction, W. B. Saunders, 1973.
4. Cleve B. Moler, Matrix eigenvalue and Least Squares computations, Computer Science Dept. Course Notes, Stanford University, 1974.

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