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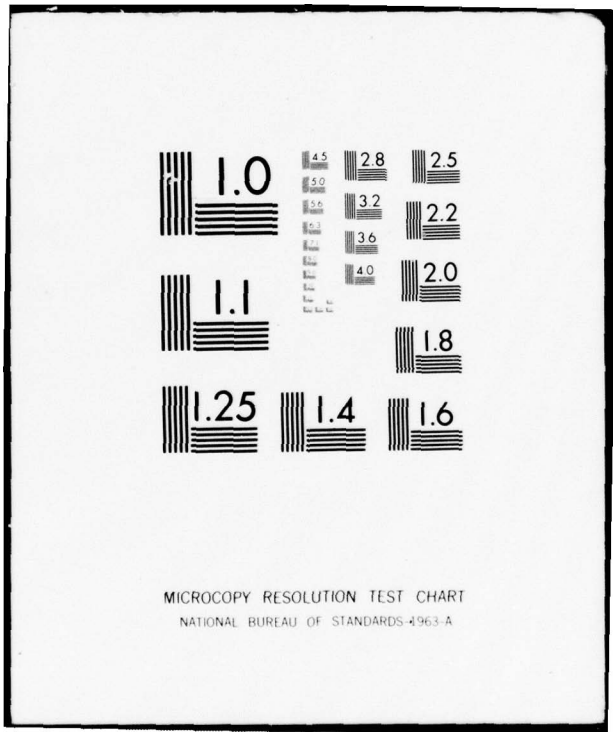
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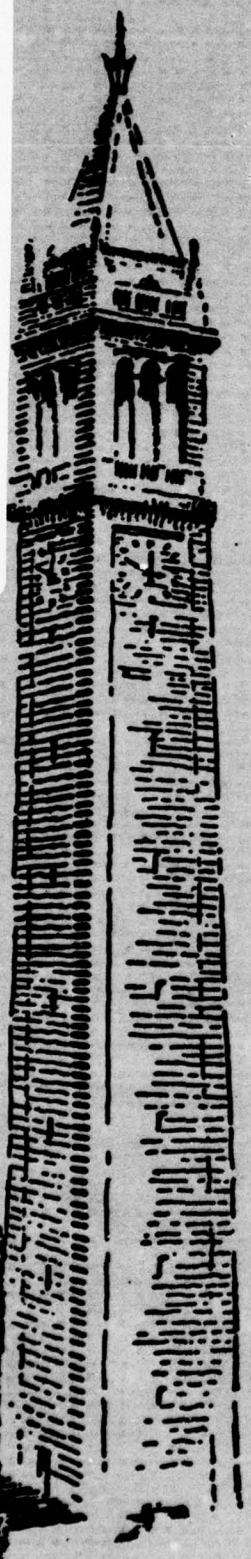

# BIBLIOGRAPHY ON NUMERICAL SOFTWARE

by

B. Einarsson



Memorandum No. UCB/ERL M77/19

25 March 1977





**ELECTRONICS RESEARCH LABORATORY**

**College of Engineering**

**University of California, Berkeley**

# BIBLIOGRAPHY ON NUMERICAL SOFTWARE

by

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Abstract:

This bibliography has been written at the request of the IFIP Working Group on Numerical Software (IFIP WG 2.5), and is intended to serve both members of the working group and others intent on improving numerical software.

It has been divided into twenty-one different areas. Within each area the references are given in alphabetical order by the first author. Some references occur in two or at most three areas. This is especially true for the individual articles in the books of Section 2. For some entries a summary is included; either the original abstract, or a shortened form of the original, or a summary written by the present author.

The aim of the bibliography is to be useful in the production and evaluation of good software for numerical mathematics. However, it does not include references to algorithms in the numerical analysis literature, nor does it include references to individual software products (routines). Section 7 on bibliographies includes many entries not strictly within the scope of the present work. I have tried to get Sections 4 (Numerical Program Libraries), 11 (Transportability), and 16 (Evaluations) as complete as possible, but the other sections are not so well covered, especially as regards matters outside of numerical software.

CONTENTS

History of this Bibliography

A first version of this bibliography, with the title "An Annotated Bibliography on Mathematical Software and Related Topics," was written in 1974 by Eva Edberg and Jan Johansson and was later published in the SIGNUM Newsletter, Vol. 11, No. 2 (August 1976), pp. 9-16, and No. 3 (October 1976), p. 6. That version was produced at Uppsala University, with financial support form the Swedish Institute of Applied Mathematics and the Stockholm Data Center.

At the request of the IFIP Working Group on Numerical Software (IFIP WG 2.5) I started early in 1975 to collect additional material, and with the support of the Swedish National Defense Research Institute, a preliminary version was distributed in May 1976 and a slightly revised version in October 1976.

This version, which is the first version in the form of a formal report, was produced at the Computer Science Division and Electronics Research Laboratory, University of California, Berkeley, California.

It has been discussed by IFIP WG 2.5 to put the bibliography in machine readable form at a later time. Consequently I have chosen not to have the material retyped in a uniform manner and apologize to the reader for any resulting inconvenience.

Acknowledgements

I would like to thank Eva Edberg and Jan Johansson for their excellent original work. I also thank Ed L. Battiste, Fred N. Fritsch, Thos E. Hull, Tapio Niemelä, John R. Rice, and Larry F. Shampine for significant contributions.

My work on the present version has been supported by grants from the Sweden-America Foundation and the National Science Foundation, while the production of the present report has been financed by the Office of Naval Research Contract N00014-76-C-0013. I wish to express my sincere thanks to these three organizations for their support.

I am also very grateful to Professors Elwyn R. Berlekamp, William Kahan, and Beresford N. Parlett for their kind hospitality during my stay at the Computer Science Division of the University of California at Berkeley during the winter quarter of 1977.

Finally, I would like to thank Maj-Britt Kåhre, Agneta Österlund, and Suzanne Briggs for excellent typing of the many entries.

## 1. PROGRAMMING METHODS AND PRINCIPLES


BASILI, Victor R and TURNER, Albert J (1975): Iterative Enhancement: A Practical Technique for Software Development, IEEE Transactions on Software Engineering, Vol SE-1, No. 4, pp. 390-396.

BAUER, F. L.: Software and software engineering, SIAM Review, Vol. 15 (1973), pp. 469-480.

BAUER, F. L.: Programming as an evolutionary process. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976) San Francisco, California. Available from ACM or IEEE, Catalog No.76 CH1125-4C. pp. 223-234.

B.W. Boehm et al,

Characteristics of Software Quality, TRW SOFTWARE SERIES, TRW-SS-73-09, December 1973.

Available free of charge for institutions from TRW Technical Information Center, Mail Station S/1930, One Space Park, Redondo Beach, California 90278, Phone (213) 535-4321.

I would like to recommend a careful study of this long report.

BROOKS, Frederick P.: The mythical man-month, Essays on Software Engineering. Addison-Wesley, Reading, Mass., 1975, $6.50, 195 pp.

BROWN, P J: Programming and Documenting Software Projects, Computing Surveys, Vol 6, No. 4, December 1974, pp. 213-220.

DAVIS, Gordon B and LITECKY Charles R: A Study of Errors, Error-Proneness, and Error Diagnosis in Cobol, Communications of the ACM, Vol 19 No. 1, pp. 33-37. (January 1976).

Göran Fick, Program structures in Fortran when adjustable dimensions are used,including a method to simulate dynamic memory allocation, FOA 2 report C 2556-E5, September 1972 (In English)

FREEMAN, Peter and WASSERMAN, Anthony: Tutorial on software design techniques, IEEE Computer Society Catalog No. 76CH1145-2C, (1976).

GERHARDT, S. L. and YELOWITZ, L.: Observations of fallibility in applications of modern programming methodologies, IEEE Transactions on Software Engineering, Vol. 2 (September 1976), pp. 195-207.

HALSTEAD, Maurice: Elements of software science. Elsevier North-Holland, New York (1977), 160 pp.

HETZEL, William C (Ed) (1973): PROGRAM TEST METHODS
Based on the proceedings of the Computer Program Test Methods Symposium held at the University of North Carolina, Chapel Hill, June 21-23, 1972. Prentice-Hall, Englewood Cliffs.

HILL, I.D.,SCOWEN, R.S.,WICHMANN, B.A., Writing Algorithms in Algol 60, Software-Practice and Experience 5 (1975), pp 229-244.
This report discusses the difficulties of writing procedures and programs in Algol 60 for general use. It also shows how the problems can be alleviated and overcome.

JACKSON, M A: Principles of Program Design. Academic Press, London 1975. £8.80, 299 pp.

KERNIGHAN, B W and PLAUGER, P J (1974): The elements of programming style, Mc Graw Hill, 147 pp.
This book is a study of a large number of "real" programs, each of which provides one or more lessons in style.

KERNIGHAN, Brian W and PLAUGER, P J: Programming Style: Examples and Counterexamples , Computing Surveys, Vol 6, No. 4, December 1974, pp. 303-319.

KERNIGHAN, B W and PLAUGER, P J: Software Tools. Addison-Wesley, Reading, Massachusetts, 1976.

KNUTH, D E (1971): An Empirical Study of FORTRAN Programs, Software 1, pp. 105-133.
Describes an investigation where "ordinary programs" were collected at some computer centers and closely analyzed and judged. Discusses the use of "program profiles", statistics on the rate of use of different types of statements in a program.

LAND, A and POWELL, S (1973): FORTRAN Codes for Mathematical Programming, 249 pp. (Wiley 1973, £4.75)
The authors have realised that as most users are unable to get inside commercially available mathematical programming packages, a large variety of generally inefficient, "home-grown" programs have been developed and also a lot of untested new algorithms have been published. The final chapter deals with problems that may be encountered in either moving the routine onto a new computer or altering the size of problems that may be solved.
Ref: The Computer Journal Vol 18(4), November 1975, p. 354.

McCRACKEN, Daniel D and WEINBERG, Gerald M: How to Write a Readable FORTRAN Program, DATAMATION Vol 18(10), pp. 73-73.
Since you've got to write the program anyway, why not do it in a way that produces documentation as a by-product?

PALME, Jacob: Machine efficiency versus programming efficiency. FOA Report C 10040-M3 (E5), October 1975. Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm 80, Sweden.

PALME, Jacob: Languages for Reliable Software, Datamation, December 1975, pp. 77, 79, 80.

R.S. Scowen, Debugging Computer Programs, A Survey with Special Emphasis on Algol, National Physical Laboratory, NPL Report NAC 21, 2nd Ed, Jan 1973.

WEGNER, Peter: Programming languages - the first 25 years, IFEE Transactions on Computers, Vol. 25 (1976), pp. 1207-1225.

WEINBERG, Gerald M.: The psychology of computer programming, Van Nostrand Reinhold Company, New York (1971), 288 pp.

WEXELBLAT, Richard L.: Maxims for malfeasant designers, or how to design languages to make programming as difficult as possible. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, CA. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 331-336.

B.A. Wichmann, Estimating the Execution Speed of an Algol Program, National Physical Laboratory, NPL Report NAC 38, June 1973.

YOHE, J M: An Overview of Programming Practices, Computing Surveys, Vol 6, No. 4, December 1974, pp. 221-245.

## 2. BOOKS RELATED TO MATHEMATICAL SOFTWARE

BAUER; F L: Software Engineering, Springer-Verlag, Berlin-Heidelberg-New York, 1975.

BRUCKMANN, G; FERSCHL, F and SCHMETTERER, L (Editors): COMPSTAT 1974. Proceedings in Computational Statistics. Physica Verlag, Vienna 1974. DM 48.00.

CNRS (1972): Programming of Numerical Mathematics, Centre National de la Recherche Scientifique, Gordon and Breach, 400 pp.

Contents: The basic forms of error analysis in matrix processes. On condition numbers. Boundary value problems and the algebraic method. Different kinds of arithmetic, their advantages and inconveniences concerning the study of uncertainties. Systematic comparison of algorithms. On test matrices.

COMPUTER SCIENCE AND STATISTICS: Nth Annual Symposium on the Interface. Annual Conference Proceedings, N = 9 was at Harvard University, 1-2 April 1976 and N = 8 was at University of California, Los Angeles, 13-14 February 1975.

COWELL, Wayne R. (ed.): Proceedings of the Software Certification Workshop, Snow Mountain Ranch, Granby, Colorado (27-30 August 1972).

COWELL, Wayne R.(ed.): Proceedings of the NSF/ERDA Workshop on Portability of Numerical Software, Oak Brook, Illinois, 21-23 June 1976. To be published by Springer-Verlag in the series "Lecture Notes in Computer Science." Contents:

Some Side Effects of Striving for Portability - C. Reinsch

Mathematical Software Transportability Systems - Have the Variations a Theme? - J. Boyle

Aids to Portability within the NAG Project - J. Du Croz, S. J. Hague, and J. L. Siemieniuch

Features for FORTRAN Portability - F. Krogh

The IMSL Fortran Converter: An Approach to Solving Portability Problems - T. Aird

Multiple Program Realizations Using the TAMPR System - K. Dritz

On the Enhancement of Portability within the NAG Project: A Statistical Survey - B. Ford and J. Bentley

The Importance of Standardized Interfaces for Portable Statistical Software - N. Victor and M. Sund

A Study of Portability in Technical and Scientific Computing - I. Dahlstrand

Fortran Poisoning and Antidotes - B. Smith

Semantics of Floating Point Arithmetic and Elementary Functions - T. Hull

Two Numerical Analyst's Views on the Draft Proposed ANS Fortran - C. Lawson and J. Reid

The Production and Testing of Special Function Software in the NAG Library - J. Schonfelder

Portable Special Function Routines - W. Fullerton

Algol 68 as a Language for Numerical Software - M. Delves

Writing the Elementary Function Procedures for the ALGOL 68C Compiler - P. Kemp

Criteria for Transportable Algol Libraries - P. Hemker

Fortran Portability via Models and Tools - S. Brown and A. Hall

PORT - A Portable Mathematical Subroutine Library - P. Fox

Machine Parameters for Numerical Analysis - W. Cody

Machine Requirements for Reliable, Portable Software - T. Dekker

Intermediate Languages: Current Status - W. Waite

DAVIS, Philip J and RABINOWITZ, Philip: Methods of Numerical Integration. Academic Press, New York, 1975, 459 pp. $ 34.50 or £ 16.55.

DIJKSTRA, Edsger W: A Discipline of Programming. Prentice Hall, 1976, 217 pp, $ 14.95.

EVANS, D. J. (Ed.) [1974]: Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press.

Contents:

TRAUB, J. F.: Theory of optimal algorithms, pp. 1 - 12.
WILKINSON, J. H.: Linear algebra algorithms, pp. 17 - 25.
REID, J. K.: Direct methods for sparse matrices, pp. 29 - 47.
EVANS, D. J.: Iterative sparse matrix algorithms, pp. 49 - 83.
MITRA, G.: Sparse inverse in the factored form and maintaining sparsity during simplex iterations, pp. 85 - 97.
DIXON, Valerie A.: Numerical quadrature: a survey of the available algorithms, pp. 105 - 137.
MILLER, G. F.: Algorithms for integral equations, pp. 139 - 147.
EINARSSON, Bo: Testing and evaluation of some subroutines for numerical quadrature, pp. 149 - 157.
GENZ, A. C.: Some extrapolation methods for the numerical calculation of multidimensional integrals, pp. 159 - 172.
WALSH, Joan: Initial and boundary value routines for ordinary differential equations, pp. 177 - 189.
DIXON, L. C. W.: Non-linear optimization: a survey of the state of the art, pp. 193 - 216.
HAYES, J. G.: Algorithms for curve and surface fitting, pp. 219 - 233.
COX, M. G.: A data fitting package for the non-specialist user, pp. 235 - 251.
POWELL, M. J. D.: Piecewise quadratic surface fitting for contour plotting, pp. 253 - 271.
CLENSHAW, C. W.: Rational approximations for special functions, pp. 275 - 284.
SCHONFELDER, J. L.: Special functions in the NAG library, pp. 285 - 300.
SYKES, A.: Applications of on-line techniques to the numerical solution of partial differential equations, pp. 303 - 314.
THOMAS, C. LI.: POTINT - a package for the numerical solution of potential problems in general two-dimensional regions, pp. 315 - 336.
HUTCHINSON, D. and JETSY, P.: A new scheme for interactive numerical computation, pp. 337 - 352.
FORD, B. and HAGUE, S. J.: The organisation of numerical algorithms libraries, pp. 357 - 372.
TAYLOR, D. B., FORD, B. and HAGUE, S. J.: Management practices in the development and distribution of mathematical software with emphasis on computational aids in multi-machine environment, pp. 373 - 382.
PRENTICE, J. A.: The development and maintenance of multi-machine software in the NAG project, pp. 383 - 391.
SMITH, B. T., BOYLE, J. M. and CODY, W. J.: The NATS approach of quality software, pp. 393 - 405.
FLETCHER, R. and HEBDEN, M. D.: Setting up a numerical advisory service, pp. 413 - 421.
LILL, Shirley A.: User documentation for a general numerical library: the NAG approach, pp. 423 - 432.

GEAR, William: Numerical Initial Value Problems in Ordinary Differential Equations. Prentice-Hall, Englewood Cliffs, N.J., 1971, 253 pp, $ 12.95.

GILB, Tom: Software metrics, Winthrop Publishers, Cambridge, Massachusetts (1977).

HETZEL, William C. (Ed) [1973]: PROGRAM TEST METHODS
Based on the proceedings of the Computer Program Test Methods Symposium held at the University of North Carolina, Chapel Hill, June 21-23, 1972. Prentice-Hall, Englewood Cliffs.

Contents:
PART I INTRODUCTION
HETZEL, W. C.: Overview, pp. 3 - 6.
HETZEL, W. C.: A Definitional Framework, pp. 7 - 10.
GRUENBERG, F.: Programming Testing: The Historical Perspective, pp. 11 - 14.

PART II TESTING CONCEPTS
HETZEL, W. C.: Principles of Computer Program Testing, pp. 17 - 28.
PROKOP, J. S.: On Proving the Correctness of Computer Programs, pp. 29 - 37.
PART III DESIGNING PROGRAMS FOR TESTING
VYSSOTSKY, V. A.: Common Sense in Designing Testable Software, pp. 41 - 47.
FREEMAN, P.: Functional Programming Testing and Machine Aids, pp. 49 - 56.
SNOWDON, R. A.: System for the Preparation and Validation of Structured Programs, pp. 57 - 72.

PART IV DESIGNING LANGUAGES FOR TESTING
KOSY, D. K.: Approaches to Improved Program Validation Through Programming Language Design, pp. 75 - 92.
GOOD, D. I. and RAGLAND, L. C.: Nucleus-A Language of Provable Programs, pp. 93 - 117.
PART V TESTING MATHEMATICAL SOFTWARE
CODY, J. W.: The Evaluation of Mathematical Software, pp. 121 - 133.
NG, E. W.: Mathematical Software Testing Activities, pp. 135 - 141.
BRIGHT, H. S. and COLE, I. J.: A Method of Testing Programs for Data Sensitivity, pp. 143 - 162.

PART VI TESTING LARGE SOFTWARE SYSTEMS

SCHERR, A. L.: Developing and Testing a Large Programming System, OS/360 Time Sharing Option, pp. 165 - 180.
BROWN, J. R., DESALVIO, A. J., HEINE, D. E. and PURDY, J. G.: Automated Software Quality Assurance, pp. 181 - 203.
YOUNGBERG, E. P.: A Software Testing Control System, pp. 205 - 222.

PART VII MODELS OF PROGRAM BEHAVIOR

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PART VIII STANDARDS AND MEASUREMENTS OF PROGRAM QUALITY

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KEIRSTEAD, R. E. and PARKER, D. B.: On the Feasibility of Formal Certification, pp. 291 - 301.
DAVIS, R.: Quality Software Can Change the Computer Industry, pp. 303 - 311.

PART IX BIBLIOGRAPHY

IEEE: Proceedings of the International Conference on Reliable Software. Los Angeles, April 22-24, 1975. Sponsored by the IEEE Computer Society and ACM. Published in SIGPLAN Notices. Ref: Datamation 21(6) (1975), pp 93-94. See also IEEE: Transactions on Software Engineering, Special issue on reliable software, June 1975, pp 137-257.

KAHAN, W.: Implementation of algorithms, parts I and II bound together and edited by David Hough as Tech Report 20, Computer Science Department, University of California, Berkeley, 1973. Available from NTIS under DDC AD 769 124/9 GA ($9.50).

LAPIDUS, L. and SCHIESSER, W. E. (eds.): Numerical methods for differential systems, recent developments in algorithms, software, and applications. Academic Press, New York and London (1976), 291 pp., $13.50.

Contents:



LAWSON, Charles L and HANSON, Richard J: Solving Least Squares Problems. Prentice-Hall, Englewood Cliffs, New Jersey, 1974, 340 pp, $ 14.50.

LUKE, Yudell L: Mathematical Functions and Their Approximation. Academic Press, New York 1975.

MILTON, Roy C. and NELDER, John A.: Statistical computation, Academic Press, New York and London (1969).

MRI: Proceedings of the Symposium on Computer Software Engineering, April 20-22, 1976. Volume XXIV of MRI Symposia Series. Polytechnic Institute of New York, MRI Symposium Committee, 333 Jay St., Brooklyn, N.Y. 11201. Price: $ 32.00.

ONLINE: Software Systems Engineering, (proceedings of the European Computing Conference on Software Systems Engineering 1976. Available September 1976).
Reviews developments in techniques and tools for efficient software production and implementation. Topics include System Reliability, Software Testing and Validation, Adaptability and Portability.

Available from: Publications Department, ONLINE, Cleveland Road, Uxbridge, Middlesex UB82DD, England, Price: £32.

RICE, John R. (ed.): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, 1-3 April 1970, published by Academic Press, New York (1971).
Contents:

DICKINSON, A. W., HERBERT, V. P,. PAULS, A. C. and ROSEN, E. M.: The development and maintenance of a technical subprogram library, pp. 141-151.

NEWBERY, A. C. R.: The Boeing Library and Handbook of Mathematical Routines, pp. 153 - 169.
CODY, W. J.: Software for the Elementary Functions, pp. 171 - 186.
KUKI, H.: Mathematical Function Subprograms for Basic System Libraries -Objectives, Constraints and Trade-Off, pp. 187 - 199.
de BOOR, Carl, On Writing an Automatic Integration Algorithm, pp. 201 - 209.

GEAR, C. W.: Experience and Problems with the Software for the Automatic Solution of Ordinary Differential Equations, pp. 211 - 227.
KAHANER, D. K.: Comparison of Numerical Quadrature Formulas, pp. 229 - 259.
SYMES, L. R.: Evaluation of NAPSS Expressions Involving Polyalgorithms, Functions, Recursion, and Untyped Variables, pp. 261 - 274.
BAYER, R.: Toward Computer-Aided Production of Software for Mathematical Programming, pp. 275 - 293.
SAMMET, J. E.: Software for Nonnumerical Mathematics, pp. 295 - 330.
PAYNE, W. H. and LEWIS, T. G.: Continuous Distribution Sampling: Accuracy and Speed, pp. 331 - 345.

LAWSON, C. L.: Applications of Singular Value Analysis, pp. 347 - 356.
PARLETT, B. N. and JOHNSON, O. C.: Numerical Implementation of Variational Methods for Eigenvalue Problems, pp. 357 - 368.
BARTON, D., WILLERS, I. M. and ZAHAR, R. V. M.: Taylor Series Methods for Ordinary Differential Equations-An Evaulation, pp. 369 - 390.
BROWN, K. M. and DENNIS, J. E.: A New Algorithm for Nonlinear Least-Squares Curve Fitting, pp. 391 - 396.

PART THREE: SELECTED MATHEMATICAL SOFTWARE

CLARK, N. W., CODY, W. J. and KUKI, H.: Self-Contained Power Routines, pp. 399 - 415.
de BOOR, Carl, CADR: An Algorithm for Numerical Quadrature, pp. 417 - 449.
RICE, John R.: SQARS - An Algorithm for Least - Squares Approximation, pp. 451 - 476.
FOX, P. A.: DESUB: Integration of a First-Order System of a Ordinary Differential Equations, pp. 477 - 507.

RICE, John R. (ed.): Mathematical Software - Madison, Proceedings of a conference, 28-30 March 1977. To be published by Academic Press.
Preliminary contents:
G. H. Golub, "The block Lanczos method for computing Eigenvalues"
G. W. Stewart, "Research, development, and LINPACK"
M. J. D. Powell, "A technique that gains speed and accuracy in the minimax solution of over-determined linear equations"
G. E. Collins, "Infallible calculation of polynomial zeros to specified precision"
R. E. Barnhill, "Representation and approximation of surfaces"
C. W. Gear, "Simulation: conflicts between real time and software"
D. C. Hoaglin, "Mathematical software and exploratory data analysis"
C. L. Lawson, "Software for $C^1$ surface interpolation"
W. R. Cowell, L. D. Fosdick, "Mathematical software production"
W. S. Brown, "Portability"
I. Babuska, "Computational aspects of the finite element method"
L. F. Shampine, "The art of writing a Runge-Kutta code"
A. Brandt, "Multi-level adaptive techniques for partial differential equations: ideas and software"

SHAMPINE, L F and GORDON, M K: Computer Solution of Ordinary Differential Equations, The Initial Value Problem. W H Freeman and Co, San Francisco 1975.

SIGMINI/SIGPLAN. Proceedings of the ACM SIGMINI/SIGPLAN Interface Meeting on "Programming Systems in the Small Processor Environment", New Orleans, Louisiana, March 4-6, 1976. SIGPLAN Notices, Vol 11, No. 4, April 1976.

Contains 24 contributions of which some are of interest for numerical software, especially session 2 on portability and session 5 on numerical applications.

SMITH, B.T. et al: Matrix Eigensystem Routines, EISPACK Guide, Second Edition , Lecture Notes in Computer Science, Vol. 6, Springer-Verlag, Berlin-Heidelberg-New York 1976.

WILKINSON, J H and REINSCH, C (1971): Handbook for Automatic Computation, Volume II, Linear Algebra. Springer-Verlag, Berlin-Heidelberg-New York.

WIRTH, Niklaus (1976): Algorithms + Data Structures = Programs. Prentice-Hall, Englewood Cliffs, N.J., 366 pp, $ 14.95.

## 3. STANDARDS

All the ANSI and ISO standards are available through your national standards organization.

American National Standard, Basic FORTRAN, ANSI X3.10-1966, American National Standards Institute

American National Standard, FORTRAN, ANSI X3.9-1966, American National Standards Institute

ANSI: American National Standard Cobol (ANS X3.23-1974). Also adopted as ISO Recommendation R1989.

ANSI X3J3: Draft proposed revised Fortran standard. SIGPLAN Notices, March 1976. (Special issue)
This is the formal document submitted to ANSI X3 for further processing. Several revisions have been made since publication of the draft.

ANSI X3J3: Fortran 77 Full language, Working Document X3J3 76.5 of 1976-11-30. This document makes the draft proposed revised Fortran Standard, published in the March 1976 special issue of SIGPLAN Notices, obsolete.

BSR X3.53 programming language PL/I (draft standard).

BSR X3.60, Programming Language Minimal Basic (draft standard).

BERKELEY, E. C. and BOBROW, D. G. (eds.): The programming language Lisp: its operation and applications, M.I.T. Press, Cambridge, Mass., 1966.

CHAPIN, Ned: Flowcharting With the ANSI Standard: A Tutorial. Computing Surveys, Vol 2, No. 2, June 1970, pp. 119-146.

CLARIFICATION of FORTRAN Standards - Initial Progress. Comm. ACM 12 (1969), pp. 289-294.

CLARIFICATION of FORTRAN Standards - Second Report. Comm ACM 14 (1971), pp. 628-642.

DAHL, O. J. et al.: Simula 67 common base language. Norwegian Computer Center publication S-22, 1971. Adr: Norsk Regnesentral, Forskningsveien 1b, Oslo, Norway.

DAY, A. C., CLARKE, P. A., HILL, D. and REID, J. K.: The proposed new standard for FORTRAN: a critical examination. The Computer Journal, Vol. 19 (1976), pp. 268-271.
This is a critical review of the draft dated 26 September 1975, which has been obsolete for a long time.

ECMA (European Computer Manufacturers' Association), ECMA STANDARD for a Subset of ALGOL 60, Geneva, April 1965.

FELDMAN, S. I.: A Fortranner's lament: comments on the draft proposed ANS Fortran standard. SIGPLAN Notices, Vol. 11, No. 12 (December 1976), pp. 25-34.
Discusses the draft in SIGPLAN Notices, March 1976.

FORD, Brian, REID, J. K. and SMITH, B. T.: Three proposed amendments to the draft proposed ANS Fortran standard. Submitted to SIGNUM Newsletter, September 1976. See also FORWORD, Fortran Development Newsletter, Vol. 2, No. 4 (October 1976), pp. 29-31.

P. A. Fox, A. D. Hall and N. L. Schryer, "The PORT Mathematical Subroutine Library", Computing Science Technical Report No. 47, Bell Laboratories, Murray Hill, New Jersey, September 1976.

GRISWOLD, R. et al.: The Snobol 4 programming language, Second Ed., Prentice-Hall, Englewood Cliffs, 1971.

GROOMS, David W.: Computer software standards (a bibliography with abstracts). National Technical Information Service (June 1976), 92 pp. NTIS/PS-76/0411/9WC.

HANSON, R J; KROGH, F T and LAWSON, C L: A Proposal for Standard Linear Algebra Subprograms. JPL Tech. Mem. 33-660.
The purpose of this report is to propose a set of standard subprograms (modules) for performing many of the elementary operations of numerical linear algebra. The goal is to make it more feasible to produce efficient portable FORTRAN programs in the area of linear algebra.

HINDMARSH, A. C. and BYRNE, G. D.: A proposed ODEPACK calling sequence, UCID-30134, Lawrence Livermore Laboratory, May 1976, 13 pp.
The report contains a proposed list of calling sequence parameters for ordinary differential equation solvers.

IBM System 360 operating system, PL/I(F) language reference manual, IBM Order No. GC28-8201.

IFIP (International Federation for Information Processing), Report on Subset ALGOL 60, Comm. ACM Vol 7 No 10 pp 626-628 1964.

IFIP (International Federation for Information Processing), Report on Input-Output procedures for ALGOL 60, Comm. ACM Vol 7 No 10 pp 628-630 1964.

IFIP WG 2.1: Modified report on the algorithmic language ALGOL 60, The Computer Journal, Vol. 19 (1976), pp. 364-379.
This version is the Naur(1963) Revised Algol 60 Report with the modifications of De Morgan et al. (1976) included.

IFIP WG 2.5: Intrinsic Functions to assist Fortran Portability for Numeric Computation. Manuscript June 28, 1976.

IFIP WG 2.5: Amendments to Draft Proposed ANS FORTRAN, Specifying the Double Precision Complex Data Type. Manuscript June 29, 1976

IFIP WG 2.5: Parameters for Transportable Numerical Software. Manuscript July 1, 1976. Submitted to IFIP for publication.

IFIP WG 2.5: MAP Statement in Fortran to Assist in the Portability of Numerical Software. Manuscript September 10, 1976 (16pp.)

ISO: ISO recommendation R1538, programming language Algol 60, International Organization for Standardization, 1972. (This standard is not recognized by IFIP, at least the first printing was erroneous.)

ISO Recommendation R1539, Programming Language FORTRAN, International Organization for Standardization, 1972

JENSEN, K and WIRTH, N: PASCAL, User Manual and Report. Corrected reprint of the 2nd edition. 167 pp, US $ 8.80. Berlin-Heidelberg-New York: Springer Verlag, 1976.

KAIKOW, Howard: On FORTRAN Standards. SIGNUM Newsletter, Vol 9, No. 3, July 1974, pp. 18-19.

KNUTH, D. E.: The remaining trouble spots in Algol 60, Communications of the ACM, Vol. 10 (1967), pp. 611-617.

LAMPSON, B. W. et al.: Report on the programming language Euclid, SIGPLAN Notices, Vol. 12, No. 2, February 1977, Special issue, 3+79 pp.
This report describes the Euclid language, intended for the expression of system programs which are to be verified. Euclid draws heavily on Pascal.

LARMOUTH, J (1973): Serious FORTRAN, Software Vol 3, pp. 87-107.
Discusses writing of "serious" programs in a scientific environment. It is directed to those who intend to write FORTRAN programs which have more than a transient life. This first part deals with the implications of conforming to the ANSI standard when writing FORTRAN.

LARMOUTH, J (1973): Serious FORTRAN - Part 2, Software Vol 3, pp. 197-225.
The second part of this paper addressed to those who write FORTRAN programs of more than transitory life deals with facilities outside the Standard, optimization, recursion, the design of user interfaces, debugging and program proving.

LAWSON, C L: Proposed Standard Subprograms for Basic Linear Algebraic Operations. SIGNUM Newsletter, Vol 9, No. 2, April 1974, pp. 21-22.

LAWSON, C L; HANSON, R J; KINCAID, D and KROGH, F T: Basic Linear Algebra Subprograms for Fortran Usage. Submitted.

LAWSON, C. and REID, J.: Two numerical analyst's views on the Draft Fortran. See COWELL, Wayne R. (ed.) in section 2, Books related to Numerical Software.

MATHEMATICAL CENTER: An extensive Test Set for ALGOL 68 Compilers has been assembled and comprises 160 programs covering the entire language. Please address requests to: Dick Grune, Mathematical Center, Tweede Boerhaavestraat 49, Amsterdam, The Netherlands.

McILROY, M D (1974): ANS Fortran Charts. Computing Science Technical Report No. 13, Bell Laboratories.

MEISSNER, Loren P: Proposed ANS X3.9 Fortran Language Revision. Special issue of FOR-WORD, Fortran Development Newsletter, Vol 1, No. 6, January 1976, 35 pp.
An easy to read description of the proposed new Fortran.

De MORGAN, R. M., HILL, I. D. and WICHMANN, B. A.: A supplement to the ALGOL 60 revised report. The Computer Journal, Vol. 19 (1976), pp. 276-287 and errata on p. 379. Also in SIGPLAN Notices, Vol. 12, No. 1 (January 1977), pp. 52-66.

MULLER, Mervin E.: Portability standards for software, Proceedings of Computer Science and Statistics, 8th Annual Symposium on the Interface, University of California, Los Angeles (13-14 February 1975), p. 173.

NAG Reference Manual for Internal Project Use. NAG Central Office, Oxford University Computing Laboratory, 7 Banbury Road, Oxford OX2 6NN, England.

NATIONAL Computer Centre Ltd. (1972): Standard FORTRAN Programming Manual, Manchester, England, 152 pp. (2nd edition).
The goal of this publication is to enable programmers already familiar with FORTRAN to write standard (i.e. interchangeable) programs.

NAUR, P. (ed.): Revised report on the algorithmic language ALGOL 60, Comp. Journal, Vol. 5, No. 4 (1963), pp. 349-367.

Numerische Mathematik, Vol. 4 (1963), pp. 420-453.

Communications of the ACM, Vol. 6 (1963), pp. 1-17.

NEEDHAM, Tom: Graphic extensions to the Basic language, Digest of Papers, Comp Con Spring 77, IEEE Catalog No. 77CH1165-0C, pp. 314-317.

PALME, Jacob: Experience from the Standardization of the SIMULA Programming Language. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 405-409.

REID, J K: The use of Fortran for mathematical software, Manuscript 1975-04-15, AERE, Harwell.

REIFER, Donald J (Ed): DIGEST OF PAPERS, The West Coast Fortran Forum, 9 February, 1976.

RYDER, B.G.: The PFORT Verifier, Software-Practice and Experience, Vol. 4 (1974), pp. 359-377.

STEEL, T. B.: Standards for computers and information processing. In "Advances in Computers," Vol. 8, F. L. Alt and M. Rubinoff (eds.), Academic Press, New York, 1967, pp. 103-152.

TRIANCE, J. M.: The significance of the 1974 COBOL standard, The Computer Journal, Vol. 19 (1976), pp. 295-300.

WAGENER, Jerrold L and RALSTON, Anthony: Critique of the Draft proposed Fortran Standard.

Summary in FOR-WORD, Fortran Development Newsletter, Vol 2, No. 3, July 1976, pp 24-26. Full text may be obtained from Wagener at the Computer Science Department, State University of New York, Brockport, New York 14420.

van WIJNGAARDEN, A. et al.: Revised report on the algorithmic language ALGOL 68. Springer-Verlag, Berlin-Heidelberg-New York, February 1976. Also in Acta Informatica, Vol. 5 (1975), pp. 1-236.

## 4. NUMERICAL PROGRAM LIBRARIES

### a) GENERAL ARTICLES

AIRD, T J; BATTISTE, E L; BOSTEN, N E; DARILEK, H J and GREGORY, W C: Name Standardization and Value Specification for Machine Dependent Constants. SIGNUM Newsletter, Vol 9, No. 4, October 1974, pp. 11-13.

BATTISTE, E. L.: The Production of Mathematical Software for a Mass Audience, pp. 121 - 130.

In RICE, John R (Ed): Mathematical Software, Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

BATTISTE, E L: Mathematical Software Patterns. SIGNUM Newsletter, Vol 10, No. 1, January 1975, pp. 17-20.

BATTISTE, E. L., COWELL, W. R. and RICE, J. R.: Tutorial on organized activities and outlets for mathematical software. Audiocasette from ACM 76 National Conference in Houston, Texas. Available from Information Casettes, 645 North Michigan Avenue, Chicago, Illinois 60611.
Contains information on various source types, technical, financial and organizational problems.

BATTISTE, Edward L.: Basic mathematical and statistical software problems, Proceedings of Computer Science and Statistics, 8th Annual Symposium on the Interface, University of California, Los Angeles (13-14 February 1975) p. 162.

BENSON, A. and EVANS, D. J.: Mathematical software. Software 71, D. J. Evans (ed.),Transcripta Books (1972), pp. 35-44.

BISH, D R B and COOPER, J R A: Guide to the NPL Algorithms Library. NPL Report NAC 64, February 1976. Division of Numerical Analysis and Computing, National Physical Laboratory, Teddington, England.

BOYLE, J. M. et al [1972]: NATS, A Collaborative Effort to Certify and Disseminate Mathematical Software, Proceedings, ACM Conference, pp. 630 - 635.
Probably the best overview of principles and ideas behind the National Activity to Test Software.

CARVER, M B (1974): FORSIM: A FORTRAN Package for the Automated Solution of Coupled Partial and/or Ordinary Differential Equation Systems, User's Manual. AECL-4844, November 1974.

E. CATE, A. ERISMAN, P. LU and R. SOUTHALL - Boeing Page 272
A User Oriented Multi-Level Math Library

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

CODY, W J (1974): The Construction of Numerical Subroutine-Libraries, SIAM Review 16(1), pp. 36-46.

CODY, William J.: Robustness in mathematical software, Proceedings of the 9th Interface Symposium on Computer Science and Statistics, Harvard University (1-2 April 1976), p. 76.

COWELL, Wayne R and FOSDICK, Lloyd D: A Program for Development of High Quality Mathematical Software. University of Colorado, Department of Computer Science, Boulder, Colorado 80309. Report CU-CS-079-75, Sept. 1975.

DICKINSON, A. W., HERBERT, V. P., PAULS, A. C. and ROSEN, E. M.: The Development and Maintenance of a Technical Subprogram Library, pp. 141 - 151.
In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

CHARLES DUNHAM - University of Western Ontario Page 214
Development and Publication of Numerical Algorithms -218

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

EINARSSON, Bo: Översikt av existerande programbibliotek (inom numerisk analys) (in Swedish). (A Review of Existing General Program Libraries (for Numerical Analysis)) ITM Working Paper No. 10 (1973).
Contains a description of the most usual program libraries with comments on availability, economical conditions and reliability. An addendum from March 1974 is also available from ITM.

ERBLOM, Håkan (1973): Matematisk programvara; problem och möjligheter (in Swedish) (Mathematical software; problems and possibilities), Ref: DATA No. 6
Concentrates on the role of the computer centre in distributing mathematical software. Contains a review of the Stanford study of FORTRAN programs by Knuth.

FADEN, Ben R (Ed) (1971): Computer programs directory. CCM Information Corp., New York, 399 pp.
This book is intended to serve as a unified program library catalog for the unit members within the Joint User Group of the ACM. The book can be important in efforts to develop industry-wide standards for program documentation, because there are already standards in force within the individual units.
The directory contains two main sections: a program description section and a subject index. About 1000 programs from 11 units are listed, the most recent additions having been made in late 1970.
The 1974 edition is available from Macmillan Information, 866 Third Avenue, New York.

FORD, Brian: The Nottingham Algorithms Group (NAG) Project. SIGNUM Newsletter, Vol 8, No. 2, April 1973, pp. 16-21.

FORD, B and HAGUE, S J: The organisation of numerical algorithms libraries, pp. 357-372.
In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

FORD, B and SAYERS, D K: Developing a Single Numerical Algorithms Library for Different Machine Ranges. ACM Transactions on Mathematical Software, Vol 2, No. 2, June 1976, pp 115-131.

FOX, P: PORT - a portable mathematical subroutine library. See COWELL, Wayne R. (ed.) in section 2, Books related to Numerical Software.

FRANCE, James W.: The BMD and BMDP series of statistical computer programs. Communications of the ACM, Vol. 19, (October 1976), pp. 570-576.

FRITSCH, F. N.: Construction of mathematical software, part 1: general design. UCID-30050, part 1. Lawrence Livermore Laboratory, August 1972, 34 pp.

GEPNER, Herbert L.: User ratings of software packages, Datamation (December 1976), pp. 108-133.
More detailed results are available as "User Ratings of Proprietary Software" for $12 from Datapro Research Corporation, 1805 Underwood Boulevard, Delran, New Jersey 08075.

M. A. HENNELL - University of Liverpool Page 269
The Design and Implementation of an Algol 68 Numerical Algorithms Library for NAG

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

INTERNATIONAL COMPUTER PROGRAMS Inc: Software Directory.
1119 Keystone Way, Carmel, Indiana 46032.
More than 3,000 proprietary software products produced by more than 800 vendors are described in the latest semiannual, two-volume ICP Software Directory. The first volume (338 pp.) is on systems software, and the second (614 pp.) covers applications software. There are over 2,000 product updates in this version, plus 600 new product listings. Price: $100/yr. by subscription, or $60 for two volumes on a one-time basis.

JOHNSON, O G: IMSL's Ideas on Subroutine Library Problems.
SIGNUM Newsletter, Vol 6, No. 3, November 1971, pp. 10-12.

NEWBERY, A. C. R.: The Boeing Library and Handbook of Mathematical Routines, pp. 153 - 169.

In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

PILKEY, W; SACZALSKI, K and SCHAEFFER, H: Structural Mechanics Computer Programs, Surveys, Assessments, and Availability. University Press of Virginia, Charlottesville, 1975, 1100 pp., Price: $20.

POOL, J. C. T.: Mathematical software in the network environment. Argonne National Laboratory (1976), 22 pp. CONF-760550-2 (available from NTIS).

PRENTICE, J. A.: The development and maintenance of multi-machine software in the NAG project, pp. 383 - 391.
In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

RICE, John R.: The Distribution and Sources of Mathematical Software, pp. 13 - 25.
RICE, John R.: The Challenge for Mathematical Software, pp. 27 - 41.
In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

RICE, J. R.: The algorithm selection problem, in Advances in Computers, Vol. 15, Yovits and Rubinoff (eds.), Academic Press, New York (1976) pp. 65-118.

RICE, John R.: Software for numerical computation. Report CSD-TR214, January 1977, Mathematical Sciences, Purdue University. Article to appear in the book: Research Directions in Software Technology.

RICHARDSON, M G and HAYES, S J: The Design and Implementation of the NAG Master Library File System. SOFTWARE - Practice & Experience (1976). In Press.

SCHECHINER, O; SCHMID, F and ZELLE, K: Algorithmen Programme Programmpakete, Institut für Stadtforschung, Währinger-strasse 6-8, A-1090 Wien. Verlag Jugend & Volk, Wien (Schilling 800) A Catalog of more than 3000 subroutines from journals, research centers, and computer manufacturers.

**SMITH, B. T., BOYLE, J. M. and CODY, W. J.: The NATS approach of quality software, pp. 393 - 405.**

In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

SMITH, B.T. et al: Matrix Eigensystem Routines, EISPACK Guide, Second Edition , Lecture Notes in Computer Science, Vol. 6, Springer-Verlag, Berlin-Heidelberg-New York 1976.

STETTER, Hans J: Some Aspects of Numerical Software. IFIP WG 2.5 Position Paper, January 13-16, 1975, Oxford University, 5 pp.

**TAYLOR, D. B., FORD, B. and HAGUE, S. J.: Management practices in the development and distribution of mathematical software with emphasis on computational aids in multi-machine environment, pp. 373 - 382.**

In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

**TRAUB, J. F.: High Quality Portable Numerical Mathematics Software, pp. 131 - 139.**

In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

WAITE, W M: Hints on Distributing Portable Software. Software Practice and Experience, Vol 5, pp. 295-308 (1975).

WHITEMAN, J R (1975): A Bibliography for Finite Elements. 202 pp. Academic Press, London.
The present work cites almost all the significant papers on advances in the mathematical theory; reports on applications; covers such topics as classical analysis, functional analysis, approximation theory, fluids and diffusion; lists finite element packages.
Ref: Inst. Maths. Applics, Vol 16(1), 1975.

ZIELKE, G: ALGOL-Katalog Matrizenrechnung. München-Wien: R. Oldenbourg Verlag. 1972. DM 32.-, 148 pp.
A catalog of more than 400 published Algol procedures for matrix problems, with comments on accuracy and usefulness.

4. NUMERICAL PROGRAM LIBRARIES

b) SOME COMMERCIAL NUMERICAL LIBRARIES (available at cost)

1. IMSL is a mathematical and statistical subroutine library in Fortran, available for IBM 360/370, Xerox, UNIVAC 1100, Honeywell-Bull 600/6000, DEC System-10, CDC 6600/7600/ CYBER 70/170, Burroughs 6700/7700

It is used at five hundred computer centers. New release each year as announced. Further information from International Mathematical & Statistical Libraries, Inc., 7500 Bellaire Boulevard, Sixth Floor, GNB Building, Houston, Texas 77036. Tel. (713) 772-1927.

2. NAG is a British subroutine library, available in both Fortran and Algol 60. An Algol 68 version is being developed. Versionsexist for IBM 360/370, CDC 6600/7600, CYBER 70/170, Burroughs 5700/6700/7700, UNIVAC 1100, PRIME, DEC System 10 and various ICL computers. It is used extensively in British Universities and is now being made available internationally. Further information from the NAG Central Office. 7 Banbury Road, Oxford OX2 6NN, England. Tel (0865) 511245.
New release each year as announced. Work is in progress on a version for GEC computers.

Ref. Bulletin of the Institute of Mathematics and its Applications, Nov 1972, SIGNUM Newsletter, Vol. 8, No. 2 (April 1973), pp. 16-21, and in "Software for Numerical Mathematics", Ed. by D.J. Evans, Academic Press, London 1974.

3. The PORT Mathematical Subroutine Library is a rather recent software product from Bell Laboratories, Murray Hill, New Jersey 07974. It has been written with particular emphasis on portability, which is achieved by careful language specification and specifying computer classes by means of predefined machine constants. The library has been described by Phyllis Fox, see references in section 2, COWELL, Wayne R (Editor) with entry FOX and section 4a. The library has been tested extensively on IBM and Honeywell.

Information on availability is given in the SIGNUM Newsletter, Vol. 11, No. 2 (August 1976), p. 8.

P. A. Fox, A. D. Hall and N. L. Schryer, "The PORT Mathematical Subroutine Library", Computing Science Technical Report No. 47, Bell Laboratories, Murray Hill, New Jersey, September 1976.

4. SL-Math is a numerical program library available as a Program Product from IBM. The source code, written in Fortran, contains routines for sparse matrices. Ref. IBM System/360 and System/370, IBM 1130 and IBM 1800, Subroutine Library-Mathematics, User's Guide SH 12-5300-0, and Subroutine Library Mathematics, General Information GH 12-5103-0, (1971).

A version in PL/1 is called PL-Math, but does not contain the sparse routines.

5. BOEING has developed a large numerical program library for use on CDC computers. A description is in A.C.R. Newbery, "The Boeing Library and Handbook of Mathematical Routines", in "Mathematical Software", Ed. by John R. Rice, Academic Press, New York 1971, pp. 153-169.

Further information from Control Data. This library is now considered almost obsolete.

4. NUMERICAL PROGRAM LIBRARIES

c) SOME NON-COMMERCIAL NUMERICAL LIBRARIES

1. SSP. This old and well-known Fortran library from IBM is available on most computers. It is considered to be out-of-date but still used. There also exists a PL/1 version (The only known non-commercial PL/1 library?) Ref. System/360 Scientific Subroutine Package, Version III, Programmer's Manual GH 20-0205-3 with Technical Newsletter N 20-1944.

2. MATH-PACK. Univac has a Fortran library similar to SSP. Most other computer manufacturers also have similar libraries.

3. CNRS. A collection "Procedures Algol en Analyse Numérique" has been issued by Centre National de la Recherche Scientifique, Service des Publications, Ventes 15, Quai Anatole-France, Paris 7.

4. HARWELL. The United Kingdom Atomic Energy Authority Research Group at Harwell has a large Fortran library, that is being used also at many other centers. Further information is available from Mr S. Marlow, Building 8.9, AERE, Harwell, Oxfordshire OX11 ORA. See also the report AERE-R 7477, A catalogue of Subroutines.

   The original version is for IBM 360/370. The library is specially strong in optimization and sparse matrices.

5. NPL. The National Physical Laboratory has a large library of routines which aims to cover most numerical processes widely required in the scientific disciplines. The Algorithms are coded in Algol 60 and Standard Fortran although some may be available in one language only. The highest degree of machine and compiler independence has been aimed at. There is one document for each algorithm for each available language. Routines may be supplied individually.

The library is based upon expertise accumulated by numerical analysts at NPL through years of research and problem solving. These analysts may be consulted upon most numerical problems and usually provide advice and assistance in the early stages of use of an algorithm. Material is continually added to the library as a result of research effort at NPL.

A guide to the library will be supplied free of charge upon application to: Dr. J.R.A. Cooper, Division of Numerical Analysis and Computing, National Physical Laboratory. Teddington, Middlesex TW11 OLW.

6. NATS. National Activity to Test Software is a United States project managed by the Applied Mathematics Division of the Argonne National Laboratory in cooperation with universities in North America and Europe. So far the eigensystem package EISPACK and the special functions package FUNPACK are available for all main U.S. computers.

   Further information from Burton S. Garbow, Applied Mathematics Division, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, Illinois 60439.

   EISPACK is available for IBM 360/370, CDC 6600/7600, UNIVAC 1100, DEC System-10, Honeywell 600/6000 and Burroughs 6700.

   FUNPACK is avaiable for IBM 360/370, CDC 6600/7600 and UNIVAC 1100.

Ref. Garbow, B.S.: EISPACK - A Package of Matrix Eigensystem Routines, Computer Physics Communications, Vol. 7, No. 4, (April 1974), pp. 179-184.

Smith, B.T., et al: Matrix Eigensystem Routines-EISPACK Guide, Lecture Notes in Computer Science, Volume 6, Second Edition, Springer-Verlag, Berlin-Heidelberg - New York, 1976.

7. JPL. The Jet Propulsion Laboratory in Pasadena, California has a private library, described in Report 1846-23; Rev. A, February 1, 1975. This report is an excellent example of how a private library ought to be documented and presented to its local users.

8. NUMAL.
On request of the Academic Computing Centre of Amsterdam (SARA) the Mathematical Centre adapted and extended its library of numerical procedures for use with the CD CYBER 70 System, the resulting library called "NUMAL" (" NUM" ERICAL PROCEDURES IN "AL"GOL 60).

The aim of NUMAL is to provide a high level numerical library for Algol 60 Programmers. The library contains a set of validated numerical procedures together with supporting documentation. Except for a small number of double precision arithmetic routines all the source texts are written in Algol 60 and they are to a high degree independent of the computer/compiler used.

The library is now in use by several scientific computer centers in the Netherlands. Full reference documentation (ca. 800 pages) is distributed to subscribers. Once a year additions and improvements are released.

Ref. Mathematical Centre report NW8/76: NUMAL, a library of numerical procedures in ALGOL 60. Index and KWIC-index (3rd edition).

Further information from Stichting Mathematisch Centrum, 2e Boerhaavestraat 49, Amsterdam-1005, The Netherlands.

9. CERN. The "Centre Européenne pour la Recherche Nucléaire" in Geneva has one of the largest subroutine libraries in Europe. It is intended for the CDC 6600/7600 series, but mappings exist to other systems, including UNIVAC 1100. Some routines are very machine dependent. The library is classified according to SHARE and contains three categories

   a) numerical routines
   b) data manipulation routines
   c) nuclear physics applications

   Further information from Program Librarian, CERN, Div. [illegible], CH-1211 Geneva 23, Switzerland.

10. CPC (Computer Physics Communications Program Library). Computer programs in Physics are being collected at the Queen's University of Belfast and are announced in the Computer Physics Communications, see Volume 1 (1970), pp. 473-476 and Volume 10 (1975), p. 203. The current indexes of the contents of the program library as well as the programs are available from the C.P.C. Program Library, School of Physics and Applied Mathematics, Queen's University, Belfast BT7 1NN, Northern Ireland.

11. ANL. The Argonne Code Center is responsible for operating a computer software and data exchange and information center under U.S. Energy Research and Development Administration. Registered Installations receive a copy of the Program Abstracts, ANL 7411. A nominal fee is required for non-ERDA installations. Information is available from:

Argonne Code Center
Argonne National Laboratory
9700 South Cass Avenue
ARGONNE, Illinois 60439.

12. CACM. Collected algorithms from ACM is a collection of the algorithms published in the Communications of the ACM and ACM Transactions on Mathematical Software. The 1976 Index is published in Communications of the ACM, Vol. 19 (1976), p. 696. Further information from ACM.

## 5. CLASSIFICATION

A keyword index, as well as a revised classification scheme, is being developed for the Collected Algorithms from ACM.


BOLSTAD, John: A Proposed Classification Scheme for Computer Program Libraries. SIGNUM Newsletter Vol 10, No. 2-3, November 1975, pp. 32-39.

CODY, William J: Letter to Professor Lloyd D Fosdick Dec 3, 1974, regarding the proposed Bolstad Classification scheme (3 pp.).

FORD, Brian: Classification of Numerical Algorithm Libraries. Manuscript 9 January 1975, Oxford University (2 pp.)

FOSDICK, Lloyd D: Indexing system for algorithms based on key words and phrases. Draft, June 10, 1975.

IBM Systems Reference Library, Catalog of Programs for IBM System/360, GC 20-1619.
Contains three different classification systems, of which the one for Type III and IV Programs is being used widely.

KLAUS, Roland L: Short Communications. A Numbering scheme for a computer programming library. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 435-437.

KROGH, Fred T.: A classification scheme for computer program libraries. Jet Propulsion Laboratory, Section 366, Computing Memorandum No. 413, revised 7 September 1976, 12 pp.

## 6. DOCUMENTATION


BANKS, D., PERCIVAL, I. C. and WILSON, J. McB. [1972]: Stirling FORDOC 01. A Set of Documentation Conventions for FORTRAN Packages and Routines, Computer Physics Communications Vol 3, pp. 180 - 196.
Documentation conventions for FORTRAN are urgently needed to provide for better understanding and communication of packages and routines. The required properties of these conventiones are defined, and a descriptive list of documentation conventions entitled "Stirling FORDOC 01", in use at the University of Stirling is presented in the appendix.

FRANZÉN, Margareta; HOLM, Gunnar; OHLSON, Kjell: Dokumentation av Datorprogram vid FOA (Documentation of Computer Programs at FOA). FOA Report A 0003, October 1975. Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm, Sweden.

FRITSCH, F. N. and HAUSMAN, R. F.: On the documentation of computer programs, UCID-30043, March 1972, Lawrence Livermore Laboratory, 16 pp.
*Contains suggested format* for computer program documentation (7 pp.), programming suggestions (5 pp.), and testing principles (1 p.).

GENTLEMAN, W M: More on Publishing Programs. SICNUM Newsletter Vol 3, No. 3 (October 1968), 2 pp.

HOAGLIN, David C: Some Remarks on Implementing and Documenting Random Number Generators. In the proceedings of "Computer Science and Statistics: 8th Annual Symposium on the Interface, 1975", pp 213-216. (13-14 February 1975), University of California, Los Angeles.

INSTRUCTIONS TO AUTHORS (second revision). Computer Physics Communications 11 (1976), pp ix-xiv.

Shirley A. Lill, User documentation for a general numerical library: the NAG approach, pp. 423-432 of D.J. Evans (Ed.), Software for Numerical Mathematics, Proceedings of the Loughborough University Conference of the Institute of Mathematics and its Applications held in April 1973, Academic Press, London 1974.

LOZIER, W. E., MAXIMON, L. C. and SADOWSKI, W. L.: Documentation of Mathematical Function Routines.
This paper concerns what kind of documentation that a program should have for the purpose of certification and validation by an independent tester, for example a reviewer for an algorithm journal.

NAG Reference Manual for Internal Project Use. NAG Central Office, 7 Banbury Road, Oxford OX2 6NN, England.

NEWMAN, N and LANG, T: Documentation for Computer Users. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 321-326.

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K. A. REDISH - McMaster University
Tree Structures for a Program Library Index

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

ROBERTS, K. V.: The Publication of Scientific FORTRAN Programs, Computer Physics Communications, Vol 1, pp. 1 - 9. [1969]
This article outlines some general principles which appear to be necessary if an international literature of published scientific programs is to be successfully established. Programming conventions are suggested for FORTRAN, together with several automatic documentation tools which have already been tried out and found useful.

R.S. Scowen, D.Allin, A.L. Hillman, M. Shimell, SOAP - A program which documents and edits ALGOL 60 programs, Computing Journal, Vol. 14, No 2 pp 133-135 (1971).

SCOWEN, R. S. and LAWRENCE, A. R.: Some experiments in improving program documentation. In "International Computing Symposium 1973," A. Günther, et al. (eds.), North-Holland/American Elsevier, Amsterdam (1974), pp. 55-58.

## 7. BIBLIOGRAPHIES

ACR: Quarterly bibliography of computers and data processing, a subject/author index to computer literature. Published by Applied Computer Research, P. O. Box 9280, Phoenix, Arizona 85068.

ANNUAL BIBLIOGRAPHY OF COMPUTER ORIENTED BOOKS. Computing Newsletter, Box 7345, Colorado Springs, Colorado 80933.

This bibliography contains more than 1000 entries. Price: $ 4 ($ 5 if invoice required).

BARNARD, David and THOMPSON, David: An annotated bibliography on computer program engineering, University of Toronto, Toronto, Canada, 100 pp. Available as R76-264 from IEEE Repository.

Fritz Bierbaum,

Intervall-Mathematik, Eine Literaturübersicht, Interner Bericht Nr. 74/2 und 75/3, UNIVERSITÄT KARLSRUHE, Institut für Praktische Mathematik, D-75 Karlsruhe 1, Englerstrasse 2, Postfach 6380, Germany.

B. W. Boehm et al,

Characteristics of Software Quality, TRW SOFTWARE SERIES, TRW-SS-73-09, December 1973. (Section 6 is a nine page annotated bibliography).

Available free of charge for institutions from TRW Technical Information Center, Mail Station S/1930, One Space Park, Redondo Beach, California 90278, Phone (213) 535-4321.

BOEHM, Barry W.: Software engineering, IEEE Transactions on Computers, Vol. 25 (1976), pp. 1226-1241.
Survey with extensive bibliography.

CARPENTER, John A.: KWIC index for numerical algebra. ORNL/CSD-18, December 1976, 136 pp.
Supplement 1 to ORNL-4778 revision, see Householder below.

CARTER, Ciel: Guide to reference sources in the computer sciences. Macmillan Information, New York, 1974, 237 pp. $25.
Some 900 basic information sources have been given a critical evaluation. The sources are listed in ten categories. The author has written a critical review for each entry.
Ref: Computing Reviews 16 No. 28333 and 28475.

COMPUTER PHYSICS COMMUNICATIONS: Cumulative Indexes, Vols. 1-10, 1976 (82 pp.)

Elise de Doncker and Robert Piessens,

A bibliography on automatic integration.

Journal of Computational and Applied Mathematics, Vol. 2, No. 4 (1976), pp. 273-280.

EDBERG, Eva and JOHANSSON, Jan: An annotated bibliography on mathematical software and related topics, Institute of Applied Mathematics (ITM), Box 5073, S-102 42 Stockholm 5, Sweden. Version 2.0 (December 1974), 20 pp. Reprinted in SIGNUM Newsletter, Vol. 11, No. 2 (August 1976), pp. 9-16, and No. 3 (October 1976), p. 6.

FORSYTHE, George E: Recent References on Solving Elliptic Partial Differential Equations by Finite Differences or Finite Elements. SIGNUM Newsletter Vol 6, No. 1, January 1971, pp. 32-56.

FREDRIKSSON, Billy and MACKERLE, Jaroslav: Structural Mechanics Finite Element Computer Programs, Surveys and Availability. Report LiTH-IKP-R-054, September 1975 (200 SwCr). Department of Mechanical Engineering, Division of Solid Mechanics, Linköping University, Institute of Technology, S-581 83 Linköping, Sweden.

Myron Ginsberg, Bibliography 36.

A Guide to the literature of Modern Numerical Mathematics. Computing Reviews, February 1975, pp. 83-97.

GIRARD, E and RAULT, J-C: L'etude des methodes de test et d'evaluation de la fiabilité du logiciel (Study of test methods and evaluation of software reliability). Report SCAS 74.589, May 1974, in French, 89 pp. and a bibliography with 1556 items. THOMSON-CSF, DIB, 33 Rue de Vouillé, F-75724 Paris.

GROOMS, David W:

Computer software reliability. A bibliography with abstracts. NTIS/PS-75/486. National Technical Information Service (1975), 98 pp.

GROOMS, David W.: Symbolic programming (a bibliography with abstracts). National Technical Information Service (May 1976), NTIS/PS-76/0121/4WC.

GROOMS, David W.: Computer software maintenance (a bibliography with abstracts). National Technical Information Service (May 1976). NTIS/PS-76/0322/8WC.

GROOMS, David W.: Computer software transferability and portability (a bibliography with abstracts). National Technical Information Service (May 1976), 46 pp. NTIS/PS-76/0388/9WC.

GROOMS, David W.: Computer software standards (a bibliography with abstracts). National Technical Information Service (June 1976), 92 pp. NTIS/PS-76/0411/9WC.

GROOMS, David W.: Programming language design (a bibliography with abstracts). Available as NTIS/PS-76/0747/6WC. 144 pp. (September 1976).

GROOMS, David W.: Automatic programming (a bibliography with abstracts). Available as NTIS/PS-76/0748/4WC. 56 pp. (September 1976).

GROOMS, David W.: Integration of partial differential equations (a bibliography with abstracts). National Technical Information Service (October 1976), 152 pp. NTIS/PS-76/0791/4WC.

GROOMS, David W.: Integration of nonlinear differential equations (a bibliography with abstracts). NTIS/PS-76/0932/4WC, National Technical Information Service (November 1976).

William C. Hetzel (Editor),

PROGRAM TEST METHODS, Based on the proceedings of the Computer Program Test Methods Symposium held at the University of North Carolina, Chapel Hill, June 21-23, 1972. Prentice-Hall, Englewood Cliffs, 1973.

Part IX, Bibliography, is an extensive annotated bibliography, pp. 313-348.

HOUSEHOLDER, A. S.: KWIC index for numerical algebra, ORNL-4778 revision, June 1975, 627 pp.

This listing combines, updates, and otherwise augments all previously issued volumes. The intention has been to list recent literature and selected older classics that have a possible interest for those working in this branch of numerical analysis.

See also the supplement by Carpenter. Both reports are available from the National Technical Information Service at the prices $13.60 and $6, respectively.

INFOTECH: A Bibliography of Computing. Infotech Information Ltd, Nicholson House, Maidenhead, Berkshire, England, 1974.

International Computer Bibliography, published by the National Computer Centre, Manchester, England, in cooperation with Stichting Het Nederlands Studiecentrum voor Administratieve Automatisering, Amsterdam, Holland (1968), 327 pp.

Loren P. Meissner,

Structured Fortran Bibliography (I),

FOR-WORD, Fortran Development Newsletter, No. 2, 24 March 1975.

(Loren P. Meissner (50-B 3239), Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720).

MEISSNER, Loren P.

Structured Fortran Preprocessor Survey. (Preprocessor update)

FOR-WORD, Fortran Development Newsletter, Vol. 2, No. 1, pp. 4-5.

Loren P. Meissner,

Fortran Bibliography.

FORWORD, Fortran Development Newsletter, No. 4, August 1975, p. 7.

Edward F. Miller, Jr.,

Document List, Program Validation Project, GENERAL RESEARCH CORPORATION, 5383 Hollister Avenue, P.O. Box 3587, Santa Barbara, California 93105.

MISURI, Giorgio: Survey of Existing Programming Aids. SIGPLAN Notices, Vol 11, No. 8, August 1976, pp 38-41, (33 refs).

NTIS: Weekly government abstracts: Computers, Control and Information Theory.

PIESSENS, Robert: A bibliography on numerical inversion of the Laplace transform and applications. Journal of Computational and Applied Mathematics, Vol 1, No. 2, 1975, pp. 115-128.

PIESSENS, R. and DANG, N. D. P.: A bibliography on numerical inversion of the Laplace transform and applications: a supplement. Journal of Computational and Applied Mathematics, Vol. 2, No. 3, (1976), pp. 225-228.

William G. Poole, Jr. and Robert G. Voigt, Bibliography 35.

Numerical Algorithms for Parallel and Vector Computers: An Annotated Bibliography. Computing Reviews, October 1974, pp. 379-388.

RAND CORPORATION: A bibliography of selected Rand publications, Computing Technology, The Rand Corporation, Santa Monica, California, SB-1036 (January 1972), 106 pp.

RHEINBOLDT, Werner C: Non-linear Systems of Equations. SIGNUM Newsletter Vol 4, No. 1 (January 1969), pp. 15-21.

P.L.J. van Rooij and F. Schurer,

A bibliography on spline functions. II.

T.H.-Report 73-WSK-01, January 1973, Department of Mathematics, Technological University Eindhoven, P.O. Box 513, Eindhoven, The Netherlands.

SAMMET, Jean E.: Roster of programming languages for 1974-75, Communications of the ACM, Vol. 19 (1976), pp. 655-669.

SCHUCANY, W. R., MINTON, P. D. and SHANNON, B. S., Jr. [1972]: A survey of Statistical Packages, Computing Surveys 4(2), pp. 65 - 79.
This survey of 37 existing packages does not include a real evaluation.

TRW: Index to Publications in Print, TRW SOFTWARE SERIES, TRW-SS-Index (cf. Boehm above for address)

ULERY, Dana L; KHALIL, Hatem M: Selected Bibliography on Languages for Numerical Linear Algebra. SIGNUM Newsletter Vol 7 No. 2, July 1972, pp. 18-21.

USOW, Karl H: Certification Bibliography. SIGNUM Newsletter Vol 4, No. 3 (October 1969), pp. 16-18 and Vol 5, No. 2 (August 1970), pp. 14-15.

WHITEMAN, J R: A Bibliography for Finite Elements. Academic Press, London 1975. 202 pp., £3.50/$9.25.
The present work cites almost all the significant papers on advances in the mathematical theory; reports on applications; covers such topics as classical analysis, functional analysis, approximation theory, fluids and diffusion; lists finite element packages.

YOUDEN, W. W.: Computer literature bibliography (Vol. 1, 1946-1963, and Vol. 2, 1964-1967), National Bureau of Standards Miscellaneous Publication 266, 31 March 1965, and Special Publication 309, December 1968, 463 and 381 pp.

## 8. DESIRABLE LANGUAGE FEATURES FOR NUMERICAL PROGRAMMING

GANNON, J. D. and HORNING, J. J.: Language design for programming reliability, IEEE Transactions Software Engineering, Vol. 1, No. 2 (1975) pp. 179-191.

GEAR, C. W.: What do we need in programming languages for mathematical software? Department of Computer Science, University of Illinois at Urbana-Champaign, Report UIUCDCS-R-74-652, 1974, 26 pp.

HULL, T. E. and HOFBAUER, J. J.: Language facilities for numerical computation, 1974, 18 pp. See also in Rice, John R. (ed.): Mathematical software II, Informal Proceedings of a conference, Purdue University, 29-31 May 1974. (pp. 1 - 18)

WEXELBLAT, Richard L.: Maxims for malfeasant designers, or how to design languages to make programming as difficult as possible. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, CA. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 331-336.

> As the title implies, this article contains undesirable language features for numerical programming.

## 9. COMMUNICATION LANGUAGES

W. MORVEN GENTLEMAN - University of Waterloo — Page 303
Interface between Numerical Analysis and Symbolic Computation

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

RICE, John R: NAPSS-like Systems, Problems and Prospects. In "Proceedings of The National Computer Conference 1973, AFIPS, pp 43-47.

Page 302

JOE THAMES - PROSE, Inc.
PROSE, A Very High Level General Purpose Language

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

WAITE, W: Intermediate Languages - Current Status. See COWELL, Wayne R (Editor) in section 2, Books related to Numerical Software.

## 10. FORTRAN DIALECTS

ALCOA, Aluminium Company of America: Tests of Standard Fortran. Tests programs which facilitate the checking of standard Fortran compilers, developed as ALCOA Engineering Standard 32.6.7.1 - May, 1972, are available from

Dr T J Williams
Purdue Laboratory for Applied Industrial Control
Purdue University
West Lafayette
Indiana 47907

The charge for the card deck is US $20 plus postage (for 15 pounds).
Note: This package can be considered as the opposite of PFORT, which checks the program, and not the compiler.

ARNBORG, Stefan: Konvertering av Datorprogram från IBM S/360 till DEC-10 (Conversion of Computer Programs from IBM S/360 to DEC System 10) (in Swedish). FOA Report C 20086, January 1976. Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm, Sweden.

BULUT, Necdet; HALSTEAD, M H and BAYER, Rudolf: Experimental validation of a structural property of FORTRAN algorithms. Proceedings of the ACM 1974 Annual Conference, San Diego, California, November 1974, ACM, New York, 1974, pp. 207-211. Ref: Computing Reviews Vol 16 (07), July 1975, review No. 28533.

CHUNG-PHILLIPS, Alice and ROSEN, R W: A note on dynamic data storage in FORTRAN IV. The Computer Journal, Vol 18(4), November 1975, pp. 342-343.

COOK, Margaret M.: FORTRAN compiler validation system (1977). Version 1.0. The U. S. Navy has already in July 1976 issued a compiler validation system for the intersection of ANS X3.9-1966 Fortran and the proposed new Fortran. It is not known whether the Navy will update according to the changes in the proposed standard. The system is available as AD-A030 209/1WC: "Population File" on Magnetic Tape, AD-A030 210/9WC: User's Guide, 48 pp., AD-A030 211/7WC: Detailed Test Specifications, 246 pp.

EINARSSON, Bo: Remark on Algorithm 443. Comm. ACM, Vol 17 (1974), p 225.

EINARSSON, Bo: Remark on Algorithm 24, Regarding a Very Common Violation of the Fortran Standard. Computing, Vol 16 (1976), pp 291-292.

FRANZÉN, Margareta; JANZON, Krister; KÖNBERG, Eva: Avvikelser från Standard FORTRAN - När, Var, Hur på FOA (Deviations from Standard FORTRAN - When, Why and How at FOA). FOA Report C 20083, December 1975. Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-10450 Stockholm, Sweden.

GARY, John: A macro preprocessor for a Fortran dialect. Technical Report No. CU-CS-054-74, Department of Computer Science, University of Colorado, Boulder, Colorado 80309 (1974).

GARY, John: A vector language for the solution of PDE problems. Technical Report No. CU-CS-068-75, Department of Computer Science, University of Colorado, Boulder, Colorado 80309 (1976).

GEAR, C W: Outline of Possible WG 2.5 Activities in a Fortran Language Survey. Manuscript November 15, 1974, 4 pp.

Eva Könberg and Ingemar Widegren, Fortran Dialects - A selection, FOA 1 report C 1500-M4, February 1973 (In English).

Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-10450 Stockholm, Sweden.

KORNCOFF, Alan R. and GOODSPEED, Charles H.: SAGES: system aiding the generation of engineering software. SIGPLAN Notices, Vol. 11, No. 12, December 1976, pp. 56-73.
A Fortran-based expanded language.

LYON, G. and STILLMAN, R. B.: A Fortran analyzer, NBS Note 849, National Bureau of Standards (1974) 23 pp.

LYON, G. and STILLMAN, R. B.: Simple transforms for instrumenting Fortran decks, Software-Practice and Experience, Vol. 5 (1975), pp. 347-358.

RYDER, B.G.: The PFORT Verifier, Software-Practice and Experience, Vol. 4 (1974), pp. 359-377.

SALE, A. H. J.: The classification of Fortran statements, Computer Journal, Vol. 14, No. 1 (1971), pp. 10-12.

SCHNECK, P. B. and ANGEL, E.: A Fortran to Fortran optimizing compiler, Computer Journal, Vol. 16, No. 4 (1973), pp. 322-330.

WHITTEN, Douglas E and deMAINE, Paul A D: A Machine and Configuration Independent Fortran: Portable Fortran (PFortran). IEEE Transactions on Software Engineering, Vol SE-1, No. 1, March 1975, pp. 111-124.

11. TRANSPORTABILITY

T. AIRD, E. BATTISTE and W. GREGORY - IMSL, Inc. Page 278
Portability of Mathematical Software Coded in an ANSI Based Fortran

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

AIRD, T. J.: The FORTRAN converter-user's guide, International Mathematical and Statistical Libraries, Inc., Houston, Texas (1976).

AIRD, T. J., BATTISTE, E. L. AND GREGORY, W. C.: Portability of mathematical software coded in Fortran, ACM Transactions Math Software, Vol. 3, to appear.

ARNBORG, Stefan: Konvertering av Datorprogram från IBM S/360 till DEC-10 (Conversion of Computer Programs from IBM S/360 to DEC System 10) (In Swedish). FOA Report C 20086, January 1976. Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm, Sweden.

ATKINS, M S: Problems of program portability, paper presented at IUCC Computer Science Colloquium, University College of Swansea, September 1974.

Boyle, J.M., "Portability problems and solutions in NATS", Proceedings of the Software Certification Workshop, (W.R. Cowell, editor), Argonne National Laboratory, 1973, 80-89.

Boyle, J.M. and Dritz, K.W., "An automated programming system to facilitate the development of quality mathematical software",

In: Information Processing 74, Proceedings of the IFIP Congress 74, Ed. by J.L. Rosenfeld, North-Holland, Amsterdam 1974. Pp. 542-546.

Brown, P.J., Macro Processors and Techniques for Portable Software, John Wiley & Sons, 1974.

BROWN, P. J. (ed.): Software portability, an advanced course. Cambridge University Press, Cambridge, 1977, 336 pp., $14.95.
Concentrates on technical and legal problems surrounding programs and structuring data.

BUHLER, R: Supporting P-STAT on 7 types of computers, Proc. Compstat Conf., Vienna University Computer Centre, September 1974.

BUHLER, Roald: P-STAT portability, Proceedings of Computer Science and Statistics, 8th Annual Symposium on the Interface, University of California, Los Angeles (13-14 February 1975) pp 165-172.

BUHLER, Roald: Some portability issues affecting the P-Stat system, Proceedings of the 9th Interface Symposium on Computer Science and Statistics, Harvard University (1-2 April 1976), p. 93.

Control Data 6400/6500/6600 Computer Systems FORTRAN Reference Manual,

60174900, Control Data Corporation, 1969.

COWELL, Wayne R (Editor): Proceedings of the NSF/ERDA Workshop on Portability of Numerical Software. See section 2, Books related to Mathematical Software, for complete reference.

DAHLSTRAND, Ingemar: Portabilitet inom teknisk-vetenskaplig ADB (Portability in scientific computations) (In Swedish). STU-rapport 74-4022, Lund University Computer Center, Sölvegatan 18, S-223 62 Lund, Sweden (March 1976).

DAHLSTRAND, Ingemar: A Study of Portability in Technical and Scientific Computing. DATA (The Scandinavian Computer Journal), issue 7/8 (1976), pp 47-52.

Fleiss, J.E., et al, "Programming for transferability", RADC-TR-72-234,

International Computer Systems, Inc., 1972.

FORD, Brian and SMITH, Brian T: Transportable Mathematical Software - A Substitute for Portable Mathematical Software. IFIP WG 2.5 Position Paper, January 13-16, Oxford University (16 pp.). (1975)

FORD, B and SAYERS, D K: Developing a single Numerical Algorithms Library for Different Machine Ranges. ACM Transactions on Mathematical Software, Vol 2, No. 2, June 1976, pp 115-121.

P. A. Fox, A. D. Hall and N. L. Schryer, "The PORT Mathematical Subroutine Library", Computing Science Technical Report No. 47, Bell Laboratories, Murray Hill, New Jersey, September 1976.

**GROOMS, David W.: Computer software transferability and portability (a bibliography with abstracts). National Technical Information Service (May 1976), 46 pp. NTIS/PS-76/0388/9WC.**

HAGUE, Stephen J and FORD, Brian: Portability - Prediction and Correction. Software-Practice and Experience, Vol 6, No. 1, January-March 1976, pp. 61-69.

Summary

We consider the attainment of portability through the sucessive refinements of an initial coding attempt. This may be seen as prediction followed by correction. Recent attention has been given to the mechanical selection of software variants stored in a single composite file. We conclude that, under some circumstances, it is also necessary to consider the updating of the file as well as extraction from it.

Hanson, R.J., Krogh, F.T., and Lawson, C.L., "A proposal for standard linear algebra subprograms", Technical Memorandum No. 33-660, Jet Propulsion Laboratory, 1973.

IFIP WG 2.5: MAP Statement in Fortran to Assist in the Portability of Numerical Software. Manuscript September 10, 1976 (16pp.)

Krogh, F.T., "A language to simplify maintenance of software which has many versions", Computing Memorandum No. 360, Jet Propulsion Laboratory, April 18, 1974.

Krogh, F.T., "A method for simplifying the maintenance of software which consists of many versions", Technical Memorandum No. 314, Jet Propulsion Laboratory, 1972.

MULLER, Mervin E.: Portability standards for software, Proceedings of Computer Science and Statistics, 8th Annual Symposium on the Interface, University of California, Los Angeles (13-14 February 1975), p. 173.

Prentice, J.A.: "The development and maintenance of multi-machine software in the NAG project", Software for Numerical Mathematics (D. Evans, editor), Academic Press, New York, 1973, pp 383-391.

RAMAMOORTHY, C F and JAHANIAN, P: Formalizing the Specification of Target Machines: A Methodology to Enhance Software Transportability. Ref: Proceedings of the "Polytechnic Institute of New York-MRI Symposium on Computer Software Engineering", April 20-22, 1976.

Redish, K.A., and Ward, W., "Environment inquiries for numerical analysis", SIGNUM Newsletter, 6(1)1971, 10-15.

ROSE, Lawrence L. and HELLERMAN, Herbert: Portable character processing in Fortran and fixed integer environments, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 176-185.

Ryder, B.G., "The FORTRAN verifier: User's guide", Computing Science Technical Report #12, Bell Telephone Laboratories, 1973, Revised 1975.

Ryder, B.G., "The PFORT verifier", Software Practice and Experience, 4(4)1974, 359-377.

SABIN, M A: Portability - Some Experiences with FORTRAN. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 393-396.

SCHNEIDER, Ben Ross: Travels in Computerland, or, Incompatibilities and Interfaces. Addison-Wesley 1974.

A book on an outsider's perspective on the world of computing.

STRÖM, Torsten: GIPZ - A Portable Program Package for Simple Graphics. FOA report C 20125-D8 (July 1976), (In English).

GIPZ is a program package in FORTRAN for simple graphics e.g. simple line drawings and data display. It provides very high level subroutines and has been designed and written with portability in mind. This manual describes the design of the system and a user's detailed view of it. Program listings are not included.

Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm 80, Sweden.

Tsiang, G.S., Peterson, D.C., and Price, J.F., "FORTRAN language standardization study", Technical Report D180-14226-1, The Boeing Company, 1972.

WARREN, J.: Software portability, Stanford University Digital Systems Laboratory, Technical Note No. 48 (September 1974).

WARREN, Jim C., Jr.: Software portability, a survey of approaches and problems. Comp Con Spring 75, Digest of Papers, San Francisco, 25-27 February 1975, pp. 253-256. Available from IEEE.
Has extensive bibliography.

## 12. AIDS FOR SOFTWARE GENERATION AND EVALUATION


ALLEN, F. E. and COCKE, J.: Graph-theoretic constructs for program flow analysis, IBM Report RC 3923, IBM, Yorktown Heights (1972). 65 pp.

ALLEN, F E and COCKE, J: A Program Data Flow Analysis Procedure. Comm. ACM Vol 19, No. 3, March 1976. pp. 137-147.

ANDERSON, S. E. and SHORT, G. E.: A study of automated aids for secure systems, TRW-SS-74-06, TRW Systems Group, Redondo Beach (1974), 61 pp.

Stefan Arnborg, Strukturerad induktion och strukturerad programmering - praktiska och opraktiska metoder för programvalidering (Structured induction and structured *programming* - Practical and impractical methods for program validation) FOA P report C 8402-M3 (E5), May 1974 (In Swedish)

The report gives a summary of formal and informal program validation techniques and structured programming methods. A number of applications are described and a discussion of the relevance of described ideas is included.

Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm, Sweden.

BARTH, Donald E: RENBR - The FORTRAN Renumbering Program. Digital Equipment Computer Users Society, Maynard, Mass., USA. (DECUS No. 10-130b).

BAYER, R.: Toward Computer-Aided Production of Software for Mathematical Programming, pp. 275 - 293.
In RICE, John R (Ed): Mathematical Software. Based on the *proceedings of the Mathematical Software Symposium* held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

BELFORD, P C and TAYLOR, D S: Specification Verification. A Key to Improving Software Reliability. Ref: Proceedings of the "Polytechnic Institute of New York-MRI Symposium on Computer Software Engineering", April 20-22, 1976.

BENSON, Jeoffrey P. and MELTON, Richard A.: A laboratory for the development and evaluation of BMD software quality enhancement techniques, Proceedings of the 2nd International Conference on Software Engineering, 13-15 October 1976, San Francisco, pp. 106-109. Available from ACM and IEEE, Catalog No. 76CH1125-4C.

BOEHM, B W: Some steps toward formal and automated aids to software requirements. analysis and design.
This paper describes a formalism for requirements analysis and design which includes a porperties-oriented formalism for requirements traceability, consistency, and completeness checking, the Requirements/Properties Matrix, and a process- oriented formalism similar to others in being hierarchial and working with black-box descriptions of modules. An initial manual version of the technique has worked successfully in two small-to-medium software projects. It is now being extended to handle large software projects in a semiautomated fashion.
This paper has appeared in the PROCEEDINGS of the IFIP Congress 74, Stockholm, Sweden, August 1974, Information Processing 74, Ed. by Jack L Rosenfeld, North-Holland Publishing Company, Amsterdam 1974. Pp. 192-197. Report TRW-SS-74-02.

BOEHM, Barry W; McCLEAN, Robert K and URFRIG, D B: Some Experience with Automated Aids to the Design of Large-Scale Reliable Software. IEEE Transactions on Software Engineering, Vol SE-1, No. 1, March 1975. Pp. 125-133.

BOEHM, B W; McCLEAN, R K; and URFRIG, D B: Some Experience with Automated Aids to the Design of Large-Scale Reliable Software. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 105-113.

Boyer, Robert S.; Elspas, Bernard; Levtt, Karl N. "Select--A System for Testing and Debugging Programs by Symbolic Execution." (Preliminary copy) Stanford Research Institute.

BOYLE, J. M. and DRITZ, K. W. [1974]: An Automated Programming System to Facilitate the Development of Quality Mathematical Software. pp. 542 - 546 of Information Processing 74, Proceedings of IFIP Congress 74 in Stockholm, August 5-10, 1974. Ed. by Jack L. Rosenfeld, North-Holland Publishing Company, Amsterdam.

BOYLE, J. and MATZ, M.: Automating multiple program realizations. Argonne National Laboratory (1976), 67 pp. CONF-760471-1 (available from NTIS).
Ref: Proceedings of the "Polytechnic Institute of New York-MRI Symposium on Computer Software Engineering", April 20-22, 1976.

BROWN, J R: Practical applications of automated software tools. September 1972, 8 pp, 6 references. Proceedings of the September 1972 WESCON. Report TRW-SS-72-05.

BROWN, J. R. and HOFFMAN, R. H. [1972]: Evaluating the Effectiveness of Software Verification - Practical Experience with an Automated Tool, Proceedings of AFIPS 1972 Fall Joint Comp. Conf. Vol 41, Part I, pp. 181 - 190.

An account of some experiences with FLOW for debugging and testing large FORTRAN programs for the IBM System/360. FLOW gives information about number of executions of selected statements, number of calls to subroutines, tracing of execution and execution time for each subroutine.

Also available as Report TRW-SS-72-08. (December 1972)

CHRISTIANSEN, J P and ROBERTS, K V: OLYMPUS - a standard control and utility package for initial value Fortran programs. Computer Physics Communications 7 (1974), pp 245-270.

CHU, Yaohan: Introducing a software design language, Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No.76 CH1125-4C. pp. 297-304.

CLARKE, Lori: A system to generate test data and symbolically execute programs, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 215-222.

DOLOTTA, T. A. and MASHEY, J. R.: An introduction to the programmer's workbench, Proceedings of the 2nd International Conference on Software Engineering, 13-15 October 1976, San Francisco, pp. 164-168. Available from ACM and IEEE, Catalog No. 76CH1125-4C. (Additional papers on the Workbench appears on pp. 169-199.)

FAIRLEY, Richard E: An Experimental Program-Testing Facility. IEEE Transactions on Software Engineering, Vol SE-1, No. 4, December 1975, pp 350-357.

FOSDICK, L D: BRNANL, A Fortran program to identify basic blocks in Fortran programs. Report CU-CS-040-74, March 1974. Department of Computer Science, University of Colorado, Boulder, Colorado.

L. FOSDICK and L. OSTERWEIL - University of Colorado Page 108
Automated Input/Output Variable Classification as an -129
Aid to Validation of Fortran Programs

In: Rice, John R.
*Mathematical Software II*, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

FOSDICK, L D and OSTERWEIL, L J: DAVE - A Fortran Program Analysis System. Proceedings of Computer Science and Statistics: 8th Annual Symposium on the Interface, February 13, 14 (1975), University of California, Los Angeles, California, pp 329-335.

FOSDICK, Lloyd D. and OSTERWEIL, Leon J.: Validation and global optimization of programs. Proceedings of the 4th Texas Conference on Computing Systems, Texas (November 1975).

FOSDICK, Lloyd D. and OSTERWEIL, Leon J.: Data flow analysis in software reliability, Computing Surveys, Vol. 8 (1976), pp. 305-330.

FOSDICK, Lloyd D. and OSTERWEIL, Leon J.: The detection of anomalous interprocedural data flow. Proceedings of the 2nd Internation Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 624-628.

FOSDICK, Lloyd D. and OSTERWEIL, Leon J.: The detection of anomalous interprocedural data flow. Technical Report No. CU-CS-090-76, Department of Computer Science, University of Colorado, Boulder, Colorado 80309 (1976).

FOSDICK, Lloyd D. et al.: POLISH,A Fortran program to edit Fortran programs. Technical Report No. CU-CS-050-76, Department of Computer Science, University of Colorado, Boulder, Colorado 80309 (revised)(1976).
This editing program gives a systematic layout of the program and renumbers the statement numbers. It is written in ANS Fortran.

GIBSON, C G and RAILING, L R: Verification guidelines. August 1971, 57 pp., 30 references. Report TRW-SS-71-04.

GINSBERG, Myron and FRAILEY, Dennis J: The design and use of a portable system for testing the arithmetic behavior of mathematical software. The 1975 International Conference on Reliable Software.

**FDS: A FORTRAN Debugging System Overview and Installer's Guide**
Andrew D. Hall
FDS is a comprehensive debugging system designed for use with Honeywell Series 600/6000 FORTRAN IV. The main features include a symbolic post-mortem dump, an interactive debugging system, and an automatic subprogram measurement system. All facilities may be used in either the batch or the timesharing environments of GCOS. This paper gives a brief overview of the capabilities and implementation of FDS and provides instructions for installing the system in GCOS release SR-F.

Computing Science Technical Report No. 29, Bell Laboratories, Murray Hill, New Jersey, May 1975.


HENDERSON, P and SNOWDEN, R A: Some design criteria for program development tools. University of Newcastle, MRM-53, August 1973.

HEUERMANN, C. A., MYERS, G. J. and WINTERTON, J. H.: Automated test and verification, IBM Tech. Disclosure Bulletin, Vol. 17, No. 7 (1974), pp. 2030-2031.

HEUERMANN, C. A., MYERS, G. J. and WINTERTON, J. H.: Automated test with interface verification simulation, IBM Tech. Disclosure Bulletin, Vol. 17 No. 7 (1974), pp. 2032-2033.

HEUERMANN, C. A., MYERS, G. J. and WINTERTON, J. H.: Verification of test case output, IBM Tech. Disclosure Bulletin, Vol. 17, No. 7 (1974), pp. 2034-2035.

HITACHI Ltd, Tokyo: Fortran Analyzer. FORTRAN IV (93 percent), ASSEMBLER (7 percent) 10,887 source statements. IBM 370. COS-02510 Price: Program ¥970.00/Documentation ¥9.50.

HODGES, B. C. and RYAN, J. P.: A system for automatic software evaluation, Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 617-623.

Francis E. Holberton and Eilzabeth G. Parker, "NBS FORTRAN Test Programs", Institute for Computer Sciences and Technology, National Bureau of Standards, Gaithersberg, Maryland, October 1974. See SIGPLAN Notices, August 1975, pp. 7-8.

M.H. Hughes, K.V. Roberts, and P.D. Roberts, OLYMPUS and Preprocessor Package for an IBM 370/165. Computer Physics Communications, Vol. 9, No. 1, (1975), pp. 51-58.

HUGHES, M H; ROBERTS, K V and LISTER, G G: OLYMPUS Control and Utility Package for the CDC 6500. Computer Physics Communications 10 (1975), pp. 167-181.



THOMAS E. HULL - University of Toronto
Language Facilities for Numerical Computation

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

IEEE: Proceedings of the Workshop "Currently Available Program Testing Tools: Technology and Experience". Los Angeles, April 24-25, 1975. Arranged by the IEEE Computer Society Technical Committee on Software Engineering.

INGALLS, D. H. H.: FETE--a Fortran execution time estimator, STAN-CS-71-204, Stanford University (1971), 10 pp.

IRVINE, C. A. and BRACKETT, John W.: Automated software engineering through structured data management, IEEE Transactions on Software Engineering, Vol. 3 (1977), pp. 34-40.
SEF is a system designed to support the development of well-engineered software. It provides support for an integrated collection of subsystems.

JESSOP, W. H. et al.: ATLAS, an automated software testing system, Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 629-635.

JET PROPULSION LAB, California Institute of Technology, Pasadena: Structured Programming-to-Fortran Translator: SFTRAN. SFTRAN 680 cards, UNIVAC 1100, NPO-13602. Price: Program $380.00/Documentation $9.00. Ref: Computer Program Abstracts Vol 7 (2), July 15, 1975.

KENNEDY, K. W.: Node listing applied to data flow analysis, Conference record of the 2nd ACM Symposium on Principles of Programming Languages, ACM, New York (1975), pp. 10-21.

KERNIGHAN, Brian W: RATFOR - A Preprocessor for a Rational Fortran. Software-Practice and Experience, Vol 5 (4), 1975, pp. 395-406.

Summary
Although Fortran is not a pleasant language to use, it does have the advantages of universality and (usually) relative efficiency. The RATFOR language attempts to conceal the main deficiencies of Fortran while retaining its desirable qualities, by providing decent control flow statements and some 'syntactic sugar'. RATFOR is implemented as a preprocessor which translates this language into Fortran.

**KNOBE, Bruce and YUVAL, Gideon: Compilers should indent, BIT, Vol. 16 (1976), pp. 340-343.**

**KORNCOFF, Alan R. and GOODSPEED, Charles H.: SAGES: system aiding the generation of engineering software. SIGPLAN Notices, Vol. 11, No. 12, (December 1976), pp. 56-73.**

FRED T. KROGH - Jet Propulsion Laboratory Page 285
A Language to Simplify Maintenance of Software which has Many Versions

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

Also available as Computing Memorandum No. 360, JPL (Section 914).

LANCASTER, Ronald L and SCHNEIDER, Victor B: Quick Compiler Construction Using Uniform Code Generators. Software-Practice and Experience, Vol 6, No. 1, 1976, pp. 83-91.

This paper describes our experience in using a common set of code generating subroutines as the basis for compilers of ALGOL W, ALGOL 60 and subsets of PL/I and COBOL. The advantages of using a common set of primitives for implementing more than one compiler include: (1) greatly reduced effort to implement additional languages; (2) simplified maintenance of the generated compilers; (3) standardized diagnostic messages for all compilers implemented using this system; and (4) simplified documentation of the compilers.

LAWSON, C L (Ed): Workshop on Fortran Preprocessors for Numerical Software. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

LIPOW, M: Estimation of software package residual errors. November 1972, 13 pp., 2 references.

A method for estimating the number of errors remaining in a software package is proposed and analyzed. It is based upon a scheme proposed by H D Mills of IBM, in which a set of known errors is "seeded" into the software. A specified number of tests in conducted, each test capable of finding one of the indigeneous or unknown errors, or one of the seeded errors with the same probability, or of finding no error. Report TRW-SS-72-09.

LYON, Gordon and STILLMAN, Rona B: Simple Transforms for Instrumenting FORTRAN Decks. Software-Practice and Experience, Vol 5 (4), 1975, pp. 347-358.

Summary

A recent revival of interest in measuring program execution behaviour has led to a number of distinct approaches. Arguments are given for a fairly simple method of modifying FORTRAN source code to collect frequency counts. No symbol table is necessary and only a single reserved name is introduced into the source.

MILLER, Webb: Software for Roundoff Analysis. ACM Transactions on Mathematical Software, Vol 1, No. 2, June 1975, pp.108-128.

MISURI, Giorgio: Survey of Existing Programming Aids. SIGPLAN Notices, Vol 11, No. 8, August 1976, pp 38-41, (33 refs).

OCHIMIZU, K, TOYODA, J. and TANAKA, K.: On a construction method of systems for detecting logical errors in programs, Systems-Computers-Controls, Vol. 5, No. 2 (1974), pp. 88-96.

Osterweil, L. and Fosdick, Ll.D. [1974]: Automated Input/Output Variable Classification as an Aid to Validation of FORTRAN Programs, University of Colorado, Report CU-CS-037-74.

Certain types of errors in the coding of FORTRAN programs can be detected by careful analysis of the input/output usage of the variables in the program. Algorithms are presented which employ depth-first searching techniques to verify whether input uses and output uses are improperly interspersed. These algorithms can also be used to determine the input and output parameters for entire subprograms. This capability extends the usefulness of these verification techniques, and can also be used in the attempts to automate documentation production.

Osterweil, Leon J and Fosdick, L.D., "Data Flow Analysis as an Aid in Documentation, Assertion Generation, Validation, and Error Detection." Report 55 (September 1974) Dept. of Computer Science, University of Colorado, Boulder, CO.

OSTERWEIL, Leon J. and FOSDICK, Lloyd D.: DAVE--a validation, error detection and documentation system for Fortran programs, Software-Practice and Experience, Vol. 6 (1976), pp. 473-486.

OSTERWEIL, Leon J. and FOSDICK, Lloyd D.: Some experience with DAVE--a Fortran program analyzer. Technical Report No. CU-CS-088-76, Department of Computer Science, University of Colorado, Boulder, Colorado 80309 (1976).

PALME, Jacob: Putting Statistics into a Simula Program. FOA Report C 10030, July 1975. Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm, Sweden.

PANZL, David J.: Test procedures: a new approach to software verification. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 477-485.

PETERSON, Norman D: Cobol Generation of Source Programs and Reports. Software-Practice and Experience, Vol 6, 1976, pp. 117-131.

PETRAVIC, M; PETRAVIC, L G K and ROBERTS, K V: Automatic production of programs for solving partial differential equations by finite difference methods. Computer Physics Communications 4 (1972), pp 82-88.

Program evaluator and tester--PET, M2085074, MacDonnell Douglas Automation Company (1974), 35 pp.

RAMAMOORTHY, C V, MEEKER, R J and TURNER, J: Design and construction of an automated software evaluation system. In Proceedings of the 1973 IEEE Symposium of Computer Software Reliability, pp 28-37.

RAMAMOORTHY, C. V. and HO, S. F.: FORTRAN automated code evaluation system, Electronics Research Laboratory, University of California, Berkeley, Memo ERL-M466 (July 1974).

RAMAMOORTHY, C V and HO, Siu-Bun F: Testing Large Software with Automated Software Evaluation Systems. IEEE Transactions on Software Engineering, Vol SE-1, No. 1, March 1975. Pp. 46-58.

RAMAMOORTHY, C V and HO, S F: Testing Large Software with Automated Software Evaluation Systems. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 382-394.

RAMAMOORTHY, C V; KIM, K H and CHEN, W T: Optimal Placement of Software Monitors Aiding Systematic Testing. IEEE Transactions on Software Engineering, Vol SE-1, No. 4, December 1975, pp. 403-411.

RAMAMOORTHY, C. V. et al.: The status and structure of software testing procedures, Digest of Papers, Comp Con Spring 77, IEEE Catalog No. 77CH1165-OC, pp. 367-369.

REIFER, Donald J.: Automated Aids for Reliable Software. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 131-142. Also in SIGPLAN Notices, Vol. 10, No. 6 (1975), pp. 131-142.

ROBERTS, K V: An introduction to the OLYMPUS system. Computer Physics Communications 7 (1974), pp 237-244.

ROCKWELL International Corp., Canoga Park, California, Space Div.: Indices and cross references from computer readable text. PLI 97 source statements, IBM 360, MSC-19423. Price: Program/Documentation $ 50.00.
This program was developed to provide indices and cross reference tables from computer readable texts. The program will produce an index on selected words or phrases. The program will search the text and reference all occurrences of the specific words or phrases used as search keys. This program was configured to process administrative terminal service (ATS) generated texts. The program will operate with time share option (TSO) or on batch processing computers. Ref: Computer Program Abstracts Vol 7(3) 1975.

ROY, Patrick: Linear flowchart generator for a structured language. SIGPLAN Notices, Vol. 11, No. 11, November 1976, pp. 58-64.

RUBEY, Raymond J: Quantitative Aspects of Software Validation. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 246-251.

RUBEY, R. J., DANA, J. A. and BICHE, P. W.: Quantitative aspects of software validation, IEEE Transactions Software Engineering, Vol. 1, No. (1975), pp. 150-155.

RUSSELL, E. C. and ESTRIN, G.: Measurement based automatic analysis of Fortran programs, AFIPS Conference Proceedings, SJCC (1969), pp. 723-732

RYDER, B.G.: The PFORT Verifier, Software-Practice and Experience, Vol. 4 (1974), pp. 359-377.

**The PFORT Verifier: User's Guide**
B. G. Ryder and A. D. Hall
The PFORT Verifier is a program which checks a FORTRAN program for adherence to PFORT, a portable subset of ANS FORTRAN. It diagnoses errors in inter-program-unit communication and COMMON usage which compilers often miss. The Verifier itself is written in PFORT and can easily be installed on a variety of computers. This paper describes the use of the Verifier and presents the portable subset in considerable detail. This is a revised version of Computing Science Technical Report #12, May 1973.

Computing Science Reports, Room 2C-576, Bell Laboratories, Murray Hill, New Jersey 07974:

SADOWSKI, W. L. and LOZIER, D. W.: A Unified Standards Approach to Algorithm Testing, pp. 277 - 290.

In HETZEL, William C (Ed): Program Test Methods. Based on the proceedings of the Computer Program Test Methods Symposium held at the University of North Carolina, Chapel Hill, June 1972. Prentice-Hall, Englewood Cliffs 1973.

SATTERTHWAITE, E.: Debugging tools for high level languages, Software-Practice and Experience, Vol. 2 (1972), pp. 197-217.

SCHONFELDER, J L and THOMASON, J T: Applications support by direct language extension - an arbitrary precision arithmetic facility in Algol 68. In "International Computing Symposium 1975". Ed. by E. Gelenbe and D Potier, North-Holland Publishing Co, Amsterdam 1975. Pp. 55-60.

R.S. Scowen, D.Allin, A.L. Hillman, M. Shimell, SOAP - A program which documents and edits ALGOL 60 programs, Computing Journal, Vol. 14, No 2 pp 133-135 (1971).

SHOOMAN, M L and BOLSKY, M I: Types, Distribution, and Test and Correction Times for Programming Errors. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 347-357.

SIMON, Janos: A comment on do traces, SIGPLAN Notices, Vol. 11, No. 10, (October 1976), pp. 49-52.

STUCKI, L G: Automatic generation of self-metric software. In Proceedings of the 1973 IEEE Symposium of Computer Software Reliability, pp 94-100.

SUZUKI, Norihisa and ISHIHATA, Kiyoshi: Implementation of an array bound checker. Conference Record of the Fourth ACM Symposium on Principles of Programming Languages, Los Angeles, California (17-19 January 1977), pp. 132-143.
This paper describes a system which checks correctness of array accesses automatically without any inductive assertions or human interaction.

SVENSSON, Per: En sammanställning av programmeringsverktyg som används vid FOA (Collation of programming aids being used at FOA) (in Swedish). FOA Report C 20089, January 1976. Available from Försvarets Forskningsanstalt, National Defence Research Institute, S-104 50 Stockholm 80, Sweden. (32 pp.)

WARNER, J L: A Cross Reference Computer Program for Program Disc Libraries. SCS Library, Bell Laboratories, 1971.

YAU, S S and CHEUNG, R C: Design of Self-Checking Software. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 450-457.

YELOWITZ, L.: Derivation of path-connectivity matrix for tagged flowcharts, Journal ACM, Vol. 22, No. 1 (1975), pp. 145-154.

YUVAL, G: Gathering Run-Time Statistics Without Black Magic. Software-Practice and Experience, Vol 5 (1), 1975, pp. 105-108.
Summary
It is shown that it is possible to gather run-time statistics from a program without either slowing it down too much, or changing things such as the hardware or the operating-system kernel.

ZELKOWITZ, M. V.: An integrated software development and evaluation tool, TR-395, University of Maryland (1975).

ZELKOWITZ, Marvin V.: Automatic program analysis and evaluation, Proceedings of the 2nd International Conference on Software Engineering, 13-15 October 1976, San Francisco, pp. 158-163. Available from ACM and IEEE, Catalog No. 76CH1125-4C.

## 13. MACHINE CONSTANTS

Aird, T.J., The FORTRAN Converter-User's Guide, International Mathematical and Statistical Libraries, Inc., Houston, Texas, 1976.

AIRD, T J; BATTISTE, E L; BOSTEN, N E; DARILEK, H J and GREGORY, W C: Name Standardization and Value Specification for Machine Dependent Constants. SIGNUM Newsletter, Vol 9, No. 4, October 1974, pp. 11-13.

**ASHENHURST, R. L.: Number Representation and Significance Monitoring, pp. 67 - 92.**

In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

CODY, W: Machine Parameters for Numerical Analysis. See COWELL, Wayne R (Editor) in section 2, Books related to Numerical Software.

P. A. Fox, A. D. Hall and N. L. Schryer, "The PORT Mathematical Subroutine Library", Computing Science Technical Report No. 47, Bell Laboratories, Murray Hill, New Jersey, September 1976.

**GOLDSTEIN, M. and HOFFBERG, S.: The Estimation of Significance, pp. 93 - 104.**

In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

IFIP WG 2.5: Parameters for Transportable Numerical Software. Manuscript July 1, 1976. Submitted to IFIP for publication.

NAUR, P: Machine dependent programming in common languages. BIT 7, 1967, pp 123-131.

ØSTERBY, Ole: Foreläsningsnoter til Matematik B, Regnenøjagtihed (Lecture Notes in Mathematics, Numerical Accuracy) (In Danish). Department of Mathematics, Aarhus University, DK-8000 Aarhus C, Denmark (1975).

## 14. HARDWARE FEATURES

AMDAHL, G M, BLAAUW, G A and BROOKS, Jr. F P: Architecture of the IBM System/360. IBM J. Res. Devel., Vol 8, No. 2, (1964), pp 87-101.

BRENT, R. P. [1973]: On the Precision Attainable with Various Floating-Point Number Systems, IEEE Transactions on Computers, Vol C-22(6), pp. 601 - 607.
For scientific computations on a digital computer the set of real numbers is usually approximated by a finite set F of "floating-point" numbers. We compare the numerical accuracy possible with different choices of F having approximately the same range and requiring the same word length. In particular we compare different choices of base (or radix) in the usual floating point systems. The emphasis is on the choice of F, not on the details of the number representation or the arithmetic, but both rounded and truncated arithmetic are considered. Theoretical results are given, and some simulations of typical floating-point computations (forming sums, solving systems of linear equations, finding eigenvalues) are described. If the leading fraction bit of a normalized base-2 number is not stored explicitely (saving a bit), and the criterion is to minimize the mean square roundoff error, then base 2 is best. If unnormalized numbers are allowed, so the first bit must be stored explicitely, then base 4 (or sometimes base 8) is the best of the usual systems.

BROMLEY, Allan G.: On the accuracy and range of binary representations of floating point numbers, The Australian Computer Journal, Vol. 8, No. 1, March 1976, pp. 38-40.

CHARTRES, B. A. and GEUDER, J. C. [1967]: Computable error bounds for direct solution of linear equations, JACM 14(1), pp. 63 - 71.

CODY, W. J., Jr [1973]: Static and Dynamic Numerical Characteristics of Floating-Point Arithmetic, IEEE Transactions on Computers, Vol C-22(6), pp. 598 - 601.
The appearance of hexadecimal floating-point arithmetic systems has prompted a continuing discourse of the relative numerical merits of various choises of base. Until lately this discourse has centered about the static properties of floating-point representation of numbers, and has primarily concerned only binary and hexadecimal representations. Recent eventsmay change this discrouse considerably. A third numerically attractive alternative for the choice of base has been proposed, and a comparison of the dynamic numerical properties of floating-point arithmetic systems has been completed. This paper surveys these recent events and summarizes our current knowledge of the numerical characteristics of floating-point number systems.

CODY, W. J. [1971]: Desirable Hardware Characteristics for Scientific Computation. A Preliminary Report, SIGNUM Newsletter Vol 6(1).
Discusses the choice of a suitable work length, basis and rounding principles. A simple example shows that the base 2 together with rounding is to be preferred.

CODY, W J: Desirable Arithmetic Design of Proposed Math Net Computer. Informal Paper, December 20, 1974, 10 pp.

DEKKER, T: Machine Requirements for Reliable, Portable Software. See COWELL, Wayne R (Editor) in section 2, Books related to Numerical Software.

DORR, Fred W and MOLER, Cleve B: Roundoff Error on the CDC 6600/7600 Computers. SIGNUM Newsletter Vol 8, No. 2, April 1973, pp. 24-26.

DUNHAM, Charles B: On Hardware for Scientific Computation. SIGNUM Newsletter Vol 7, No. 1, April 1972, p. 20.

GENTLEMAN, W. M. and MAROVICH, S. B. [1974]: More on Algorithms that Reveal Properties of Floating Point Arithmetic Units. CACM 17(5), pp. 276 - 277.
Comments on the paper by Malcolm [1972] :"Algorithms to Reveal Properties of Floating Point Arithmetic". The algorithms in that paper has to be changed to some extent to work well on some machines. Results from using Malcolm's routines are cited.

GEORGE, James E: Algorithms To Reveal the Representation of Characters, Integers, and Floating-Point Numbers. ACM Transactions on Mathematical Software, Vol 1, No. 3, September 1975, pp. 210-216.

IFIP WG 2.5: Summary of a discussion on Machine Arithmetic, held on Wednesday 23rd June 1976 during the Workshop on Portability of Numerical Software at Oak Brook, Illinois. Manuscript.

HARMS, D. W.: Improved algorithms: making $2^3=8$, in Session 32 "Advanced Pocket Calculators" of Electro 76, the IEEE meeting in Boston, 11-14 May 1976.
A Bowdlerized version appears on pp. 16-17 of the November 1976 Hewlett-Packard Journal, Vol. 28, No. 3.

HIGBIE, L. C.: Vector floating-point data format, IEEE Transactions on Computers, Vol. 25 (1976), pp. 25-32.

HIGGINBOTHAM, T. T.: Extended precision arithmetic. Presented at SIAM 1976 Fall Meeting, Atlanta, Georgia, 18-20 October 1976.

GARNER, Harvey L.: A survey of some recent contributions to computer arithmetic. IEEE Transactions on Computers, Vol. 25 (1976), pp. 1277-1282.

KAHAN, W: The Floating Point Processor on a chip or two. Se COWELL, Wayne R (Editor) in section 2, Books related to Numerical Software.

KAHAN, W: Four Aphorisms Concerning Floating Point Hardware Design. SICNUM Newsletter Vol 3, No. 2, July 1968, 1 p.

KAHAN, W. and PARLETT, B. N.: Can you count on your calculator. Submitted to Electronics.

LEVITAN, Edwin S: A Problem Resolved - - - Almost. SICNUM Newsletter Vol 3, No. 3, October 1968, 1 p.

LIDDIARD, L A: A quantative measure of precision. Computer Journal, Vol 19, No. 2 (May 1976), p 191.

MALCOLM, M. [1972]: Algorithms to Reveal Properties of Floating Point Arithmetic. CACM 15(11), pp. 949 - 951.
Two algorithms are presented in the form of FORTRAN subroutines. Each subroutine computes the radix and number of digits in the floating numbers and whether rounding or chopping is done on the machine on which it is run. The methods are shown to work on any "reasonable" floating point computer.

See also Gentleman and Marovich (1974).

MATULA, D W: In-and-Out Conversions. Communications of the ACM, Vol 11, No. 1, 1968, p. 47.

MATULA, D W: A formalization of floating-point numeric base conversion. IEEE Trans. Comput., Vol C-19, (1970), pp 681-692.

GEORGE PAUL - IBM Houston Scientific Center Page 209
Impact of Future Computer Architecture on Mathematical Software

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

PAUL, George and WILSON, M Wayne: Should the Elementary Function Library Be Incorporated Into Computer Instruction Sets? ACM Transactions on Mathematical Software, Vol 2, No. 2, June 1976, pp 132-142

RIS, F. N.: A unified decimal floating-point architecture for the support of high-level languages (extended abstract), Report RC 6202 (#26651) of 9/14/76, IBM Research Center, Yorktown Heights, N.Y. Also in ACM's SIGARCH Newsletter "Computer Architecture News," 1976, and in SIGNUM Newsletter, Vol. 11, No. 3 (October 1976), pp. 18-23.

STERBENZ, Pat H: Floating-point Computation. Prentice-Hall, Englewood Cliffs, N.J., 1974, 316 pp., $15.00.

## 15. CRITERIA FOR EVALUATING NUMERICAL SOFTWARE

### a) GENERAL ARTICLES


AMSTER, S J and DICKMAN, B N: An Experiment in Automatic Quality Evaluation of Software. Ref: Proceedings of the "Polytechnic Institute of New York-MRI Symposium on Computer Software Engineering", April 20-22, 1976.

BAILEY, Carl B and JONES, Rondall E: Usage and Argument Monitoring of Mathematical Library Routines. ACM Transactions on Mathematical Software, Vol 1, No. 3, September 1975, pp. 196-209.

BARINKA, Lawrence L: Some Experience with Constructing, Testing, and Certifying a Standard Mathematical Subroutine Library. ACM Transactions on Mathematical Software, Vol 1, No. 2, June 1975, pp. 165-177.

BECKMAN, Anders: Programvarukvalitet, en nordisk förstudie (Software Quality, A Scandinarian Pre-study). Report in Swedish from NORDFORSK, Box 5103, S-102 43 Stockholm, Sweden, July 1976.

BIELSKI, John P. and BLANKERTZ, William H.: The general acceptance test system (GATS), Digest of Papers, Comp Con Spring 77, IEEE Catalog No. 77CH1165-0C, pp. 207-210.

BOEHM, B. W., BROWN, J. R. and LIPOW, M.: Quantitative evaluation of software quality. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 592-605.

CODY, W. J.: The Evaluation of Mathematical Software, pp. 121 - 133.
In HETZEL, William C (Ed): Program Test Methods, Based on the proceedings of the Computer Program Test Methods Symposium held at the University of North Carolina, Chapel Hill, June 1972. Prentice-Hall, Englewood Cliffs 1973.

COWELL, Wayne R: The Validation of Mathematical Software. Presented at IFIP-INFOPOL 76, International Conference on Data Processing, Warsaw, Poland, March 22-27, 1976. Proceedings to be published by North-Holland Publishing Co, Amsterdam.

DOUGLAS, A. S.: Can we evaluate software? Software 71, D. J. Evans (ed.), Transcripta Books (1972), pp. 163-166.

FERRARI, Domenico and LAU, Edwin: An experiment in program restructuring for performance enhancement, Proceedings of the 2nd International Conference on Software Engineering, 13-15 October 1976, San Francisco, pp. 146-150, Available from ACM and IEEE, Catalog No. 76CH1125-4C.

HAMMER, C.: Statistical validation of mathematical computer routines. AFIPS conference proceedings, SJCC (1967), pp. 311-333.

HEIBERGER, Richard M: A Procedure for the Review of Statistical Packages and its Application to the User Interface with Regression Programs. In the proceedings of " Computer Science and Statistics: 8th Annual Symposium on the Interface, 1975", pp 115-121.

JENKINS, M A and TRAUB, J F: Principles for Testing Polynomial Zerofinding Programs. ACM Transactions on Mathematical Software, Vol 1, No. 1, March 1975, pp 26-34.

KNUTH, D. E. and STEVENSON, F. R.: Optimal measurement points for program frequency counts, BIT, Vol. 13 (1973), pp. 313-322.

LOVE, L. T. and BOWMAN, A. B.: An independent test of the theory of software physics. SIGPLAN Notices, Vol. 11, No. 11, November 1976, pp. 42-49.
Regarding the nature of algorithms to measureable properties of computer programs.

MILLS, H. D.: On the statistical validation of computer programs. IBM Report FSC-72-6015 (1970), 16 pp.

MOHANTY, S N: Proposed Measures for Evaluation of Software. Ref: Proceedings of the "Polytechnic Institute of New York-MRI Symposium on Computer Software Engineering", April 20-22, 1976.

RICE, John R: TOMS Policy Statement. The Rights of Program Authors in the Evaluation of Programs. ACM Transactions on Mathematical Software,. Vol 2, No. 2, June 1976, pp 113-114.

RICE, John R.: The algorithm selection problem. In "Advances in Computers," Vol. 15, M. Rubinoff and M. C. Yorits (eds.), Academic Press, New York, 1976, pp. 65-118.

RUBEY, Raymond J; DANA, Joseph A and BICHÉ, Peter W: Quantitative aspects of software validation. IEEE Transactions on Software Engineering, June 1975, pp. 150-155.

RUBEY, R. and HARTWICK, R. D.: Quantitative measurement of program quality. Proceedings, 23rd National Conference ACM (1968), pp. 671-677.

WORTMAN, David B; KHAIAT, Phillip J and LASKER, David M: Six PL/I Compilers. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 411-422.

Summary

This paper describes an experimental evaluation of the execution speed of object programs produced by six PL/I compilers. An analysis is made of the relative speed of the object code produced by each compiler and also of the relative execution speed of each statement.

ZELKOWITZ, M. V.: An integrated software development and evaluation tool, TR-395, University of Maryland (1975).

## 15. CRITERIA FOR EVALUATING NUMERICAL SOFTWARE

### b) GUIDELINES FOR TRANSPORTABLE EVALUATION TOOLS

REINSCH, Christian H: Building a library of numerical algorithms: A case study from the handbook "Linear Algebra". IFIP WG 2.5 Position Paper, January 13-16, 1975, Oxford University, 6 pp.

## 15. CRITERIA FOR EVALUATING NUMERICAL SOFTWARE

### c) CRITERIA FOR EVALUATING QUADRATURE, ORDINARY DIFFERENTIAL EQUATION AND INTEGRAL EQUATION SOFTWARE

HULL, T. E. [1974]: The Development of Software for Solving Ordinary Differential Equations, in "Lecture Notes" in Mathematics, Vol 363 (Conference on the Numerical Solution of Differential Equations, Dundee, 1973), Springer-Verlag, pp. 55 - 63.

Factors involved in the development of good software are discussed, with practical reference to programs for solving ODE's. These factors include the basic structuring of the programs themselves, along with the appropriantness of various language facilitities, comparisons of efficiency, proofs of correctness, certification and distrubution e t c.

Keast, P., The evaluation of one-dimensional quadrature routines, Technical Report No. 83, Department of Computer Sciences, University of Toronto (1975).

## 16. EVALUATIONS

### a) GENERAL ARTICLES AND MISCELLANEOUS EVALUATIONS

EINARSSON, Bo [1974]: Utvärdering av matematisk programvara - En kombination av matematik, numerisk analys, datalogi och informationsteknik (in Swedish). (Evaluation of mathematical software - A combination of mathematics, numerical analysis, computer science and library science), ITM Working Paper No 19. Lecture at Chalmers Institute of Technology.

GEPNER, Herbert L.: User ratings of software packages, Datamation (December 1976), pp. 108-133.
More detailed results are available as "User Ratings of Proprietary Software" for $12 from Datapro Research Corporation, 1805 Underwood Boulevard, Delran, New Jersey 08075.

KROGH, Fred T: A Plea for Tolerance in the Evaluation of Numerical Methods and Mathematical Software. SIGNUM Newsletter Vol 6, No. 3, November 1971, pp. 7-8.

LIM, R. T. C. and BLACKBURN, J. D.: On program verification in numerical methods, Letter to the Editor, The Computer Journal, Vol. 19 (1976), pp. 272-273.

LOESER, R. [1974]: Some Performance Test of "quicksort" and Descendants CACM Vol 17(3), pp. 143 - 152.
Detailed performance evaluations are presented for six ACM algorithms: quicksort (No 64), Shellsort (No 201), stringsort (No 207), "TREESORTS" (No 245), quickersort (No 271) and qsort (No 402). Algorithms 271 and 402 are refinements of algorithm 64, and all three are discussed in some detail. The evidence given here demonstrates that qsort (No 242) requires many more comparisons than its author claims. Of all these algorithms, quickersort requires the fewest comparisons to sort random arrays.

LOESER, Rudolf: Survey on algorithms 347, 426, and Quicksort. ACM Transactions on Mathematical Software, Vol. 2 (1976), pp. 290-299.

MADSEN, Niel K. and SINCOVEC, Richard F.: General software for partial differential equations, Lapidus, L. and Schiesser, W. E. (eds.), Numerical Methods for Differential Systems, Academic Press (1976), pp. 229-242.

NG, E. W.: Mathematical Software Testing Activities, pp. 135 - 141.
In HETZEL, William C (Ed): Program Test Methods, Based on the proceedings of the Computer Program Test Methods Symposium held at the University of North Carolina, Chapel Hill, June 1972. Prentice-Hall, Englewood Cliffs 1973.

OSTERWEIL, Leon J. and FOSDICK, Lloyd D.: DAVE--a validation error detection and documentation system for Fortran programs. Software-Practice and Experience, Vol. 6 (1976), pp. 473-486.

OSTERWEIL, Leon J.: A proposal for an integrated testing system for computer programs. Technical Report No. CU-CS-093-76, Department of Computer Science, University of Colorado, Boulder, Colorado 80309 (1976).

RICHARDS, F. R.: Computer software: testing, reliability models, and quality assurance. Monterey, Naval Postgraduate School (1974), 80 pp.

SLYSZ, W. D.: An evaluation of statistical software in the social sciences. Communications of the ACM, Vol. 17, No. 6 (1974), pp. 326-332.

Several hundred college and university computer installations now offer various types of statistical packages for general use. Among those most widely available are OSIRIS, SPSS, BMD, DATA-TEXT and TSAR. In order to provide users with a basis for selection and use, tests were made for each of the systems, and the results are summarized as to cost and performance.

USOW, Karl H: Certification Bibliography. SIGNUM Newsletter Vol 4, No. 3, October 1969, pp. 16-18 and SIGNUM Newsletter Vol 5, No. 2, August 1970, pp. 14-15.

USOW, Karl H and FOSDICK, Lloyd D: Guidelines for Evaluating an Algorithm for Publication. SIGNUM Newsletter Vol 4, No. 3, October 1969, pp. 19-20.

16. EVALUATIONS

b) LINEAR ALGEBRA

BARWELL, Victor and GEORGE, Alan: A comparison of algorithms for solving symmetric indefinite systems of linear equations. ACM Transactions on Mathematical Software, Vol. 2 (1976), pp. 242-251.

A. BLASER and U. SCHAUER - IBM Deutschland GMBH Page 301
Performance Measurements on the Sparse Matrix Subroutines of SL-MATH

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

CHAN, Chorkin and KLASSEN, Melvin: A performance comparison study between subroutine packages LINSYS, IBMSSP and IMSL for solving systems of linear equations. Journal of Computational and Applied Mathematics, Vol 1, No. 2, 1975, pp. 111-113.

DUFF, I. S. and REID, J. K.: A comparison of some methods for the solution of sparse overdetermined systems of linear equations, Journal of the Institute of Mathematics and Its Applications, Vol. 17 (1976), pp. 267-280.

FITZGERALD, Kenneth E: Comparison of Some FORTRAN Programs for Matrix Inversion. Journal of Research of the National Bureau of Standards - B. Mathematical Sciences, Vol. 78B, No. 1, January-March 1974, pp. 15-33.

GIBBS, Norman E. et al.: A comparison of several bandwidth and profile reduction algorithms, ACM Transactions on Mathematical Software, Vol. 2 (1976), pp. 322-330.

HANSON, Richard J: Certifying Linear Equation Solvers. SIGNUM Newsletter Vol 4, No. 3, October 1969, pp. 21-27.

JOHNSON, A. I. and BARNEY, J. R.: Numerical solution of large systems of stiff ordinary differential equations in a modular simulation framework, Lapidus, L. and Schiesser, W. E. (eds.), Numerical Methods for Differential Systems, Academic Press (1976), pp. 97-124.

LAMBIOTTE Jr, Jules J and VOIGT, Robert G: The Solution of Tridiagonal Linear Systems on the CDC STAR-100 Computer. ACM Transactions on Mathematical Software, Vol 1, No. 4, December 1975, pp. 308-329.

C. L. LAWSON - Jet Propulsion Laboratory
Standardization of Fortran Callable Subprograms for Basic Linear Algebra

Page 261

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

MADSEN, Niel K. and RODRIGUE, Garry H.: A comparison of direct methods for tridiagonal systems on the CDC-STAR-100, Preprint UCRL-76993, Rev. 1, May 1976, Lawrence Livermore Laboratory. Presented at the SIAM Fall Meeting, December 1975.

McCLELLAN, M. T. [1973]: The Exact Solution of Systems of Linear Equations with Polynomial Coefficients, JACM Vol 20(4), pp. 563 - 588.

An algorithm is presented for computing exactly general solutions for systems of linear equations with integer or polynomial coefficients.

McCLELLAN, M. T. [1974]: A Comparison of Algorithms for the Exact Solution of Linear Equations, University of Maryland, Computer Science Center, Techn. Rep. TR-290.

A computing time study of several algorithms for the exact solution of systems of linear equations with integer or polynomial coefficients is presented. The analytical computing times for rational Gauss elimination, exact division elimination (one-step and two-step), and the modular algorithm are summarized and supplemented. Extensive empirical studies illustrate the superiority of the modular algorithm in agreement with the analytical results. All algorithms were programmed in FORTRAN IV for the SAC-1 System and all cases were run on a UNIVAC 1108.

CLEVE B. MOLER - University of New Mexico
Software for Matrix Computations

Page 307 -321

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

NEWBERY, A. C. R.: Quality tests for linear equation solvers, Department of Computer Science, University of Kentucky, Technical Report No. 18-75 (1975), 20 pp.

JAMES PANTTAJA - Univer. of California - Berkeley 
A Comparison of the PLU and QR Methods for Determining Eigenvalues of Real Hessenberg Matrices

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

PARLETT, B N and WANG, Y: The Influence of the Compiler on the Cost of Mathematical Software - in Particular on the Cost of Triangular Factorization. ACM Transactions on Mathematical Software, Vol 1, No. 1, March 1975, pp. 35-46.

PEREYRA, V. and SCHERER, Godela [1973]: Eigenvalues of Symmetric Tridiagonal Matrices: A Fast, Accurate and Reliable Algorithm, J. Inst. Maths Applics Vol 12, pp. 209 - 222.
An algorithm is developed for obtaining eigenvalues of real, symmetric, tridiagonal matrices. It combines dynamically Given's method of bisection and the use of Sturm sequences with various acceleration devices. A FORTRAN IV computer implementation of the algorithm was used on ten test matrices found in the literature. The new method is as precise and reliable as the best published program (Kahan and Varah, 1966), it is never slower, and in at least one case is two and a half times faster than the Kahan and Varah program.

REDISH, K A and WARD, W A: Summary of "Eigenvalue and Eigenvector Routines in the McMaster Program Library. SIGNUM Newsletter Vol 6, No. 2, May 1971, pp. 8-9.

16. EVALUATIONS

c) QUADRATURE

BLUE, James L: Automatic Numerical Quadrature - DQUAD. Computing Science Technical Report No. 25, Bell Laboratories, Murray Hill, New Jersey, 1975.

Casalletto, J., Pickett, M., and Rice, J., A Comparison of some numerical integration programs, SIGNUM Newsletter 4, 3 (1969), pp. 30-40.

DAVIS, Philip J and RABINOWITZ, Philip: Methods of Numerical Integration. Academic Press, New York, 1975, 459 pp. $ 34.50 or £ 16.55.

de BOOR, Carl, On Writing an Automatic Integration Algorithm, pp. 201 - 209.

In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

DeBoor, C., CADRE: An algorithm for numerical quadrature, Mathematical Software (Ed. J. R. Rice), Academic Press, London and New York (1971), pp. 417-449.

DE DONCKER, E and PIESSENS, R: Measurement of Quality of Quadrature Routines. Manuscript, Applied Mathematics and Programming Division, University of Leuven, January 15, 1976, 11 pp.

DIXON, Valerie A.: Numerical quadrature: a survey of the available algorithms, pp. 105 - 137.

In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

EINARSSON, Bo: Testing and evaluation of some subroutines for numerical quadrature, pp. 149 - 157.

In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

Fritsch, F. N., Testing of two-dimensional quadrature routines -- preliminary results, unpublished (1973).

GALLAHER, L. J.: Adaptive quadrature and proof of program correctness. Presented at SIAM 1976 Fall Meeting, Atlanta, Georgia, 18-20 October 1976.

Jones, R., Results of some quadrature tests, unpublished (1973).

Kahaner, D. K., Comparison of numerical quadrature formulas, Mathematical Software (Ed. J. R. Rice), Academic Press, London and New York (1971), pp. 229-259.

KAHANER, D. K. [1969]: Comparison of Numerical Quadrature Formulas, Los Alamos Scientific Laboratory, Los Alamos, New Mexico, Report LA-4137.
Several methods for general purpose numerical quadrature are considered. Selection criteria are total time, including bookkeeping time and function evaluation time, and accuracy of the estimate. The effectiveness of several new methods has been compared with the adaptive Simpson's rule and under certain circumstances at least two of these new methods perform better.
This report is a preliminary version of the article with the same title in Rice [1971]. The report contains more formulas and more text than the article, which mostly consists of computer print-outs.

KAHANER, David: Report on the Los Alamos quadrature workshop. SIGNUM Newsletter, Vol. 11, No. 1 (May 1976), pp. 4-26.

Keast, P., The evaluation of one-dimensional quadrature routines, Technical Report No. 83, Department of Computer Sciences, University of Toronto (1975).

KROGH, F T and SNYDER, W V: Preliminary Results with a New Quadrature Subroutine. Jet Propulsion Laboratory, Section 314, Computational Memorandum No. 363 (Revised April 1975), Pasadena, California.

LYNESS, J N: Some Interesting Quadrature Tests. SICNUM Newsletter Vol 3, No. 2, July 1968, 1 p.

LYNESS, J N: GAUSS Versus ROMBERG. SIGNUM Newsletter Vol 4, No. 1, January 1969, p. 9.

LYNESS, J. N. [1972]: Guidelines for automatic quadrature routines, pp. 1351 - 1355 of Information Processing 71, Proceedings of IFIP Congress 71 in Ljubljana, August 23-28, 1971. Ed. by C. V. Freiman, North-Holland Publishing Company, Amsterdam.

LYNESS, J. N. and KAGANOVE, J. J.: Evaluation of automatic routines report QR1 (April 1975) and QR2 (May 1975), Applied Mathematics Division, Argonne National Laboratory.
Results of numerical experiments involving different automatic quadrature routines and problem families. The method used as described in two articles by Lyness and Kaganove.

Lyness, J. N. and Kaganove, J. J., A technique for comparing automatic quadrature routines, Manuscript (May 1975).

LYNESS, J.N. and Kaganove, J.J., Comments on the nature of automatic quadrature routines, ACM Trans. Math. Software, Vol. 2, No. 1, March 1976, pp. 65-81.

LYNESS, J N: Quid, Quo, Quadrature. In "Survey of Numerical Analysis 1976", proceedings of the York University Conference of the Institute of Mathematics and Its Applications held in April 1976, Ed. by R A Scriven and D Jacobs, Academic Press, to appear.

LYNESS, J. N.: When not to use a quadrature routine. Presented at SIAM 1976 Fall Meeting, Atlanta, Georgia, 18-20 October 1976.

MALCOLM, Michael A and SIMPSON, R Bruce: Local Versus Global Strategies for Adaptive Quadrature. ACM Transactions on Mathematical Software, Vol 1, No. 2, June 1975, pp. 129-146.

Oliver, J., A doubly-adaptive Clenshaw-Curtis quadrature method, Comput. J. 15 (1972), pp. 141-147.

Patterson, T. N. L., Algorithm 468: Algorithm for automatic numerical integration over a finite interval. Comm. ACM 16 (1973), pp. 694-699.

Piessens, R., An algorithm for automatic integration, Angewandte Informatik 15 (1973), pp. 399-401.

Piessens, R., and DeDonker, E., A Bibliography on Automatic Integration, Report TW 26, Applied Mathematics and Programming Division, Katholieke University, Leuven (August 1975). Celestynenlaan 200A, B-3030, Heverlee, Belgium. (For published version see DeDoncker in section 7)

PIESSENS, Robert: An Automatic Routine for the Integration of Oscillatory Functions, Report TW 30, November 1975. Applied Mathematics and Programming Division, University of Leuven.
Treats only sine and cosine oscillations. Sixteen test integrands are used in the calculation of the quality Q. Extensive listings are included.

PIESSENS, R and DE DONCKER, E: Testing and Comparison of Quadrature Routines. Manuscript, Applied Mathematics and Programming Division, University of Leuven, January 15, 1976, 22 pp.

RICE, John R.: The algorithm selection problem. In "Advances in Computers," Vol. 15, M. Rubinoff and M. C. Yorits (eds.), Academic Press, New York, 1976, pp. 65-118.
Section 3, The Selection of Quadrature Algorithms, pp. 77-82, discusses ten different evaluations.

STETTER, Hans J and UEBERHUBER, Christoph W: Proposal for population studies in numerical quadrature. Journal of Computational and Applied Mathematics, Vol 1, No. 3, 1975, pp. 213-215.

TOMPA, H: Romberg versus GAUSS. SIGNUM Newsletter Vol 4, No. 1, January 1969, p. 8.

16. EVALUATIONS

d) ORDINARY DIFFERENTIAL EQUATIONS

BARTON, D., WILLERS, I. M. and ZAHAR, R. V. M.: Taylor Series Methods for Ordinary Differential Equations-An Evaulation, pp. 369 - 390.

In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

BUSHARD, Louis B.: Subroutine packages for the numerical solution of stiff ordinary differential equations. Alliance Research Center Report 8098, The Babcock & Wilcox Company, Alliance Research Center, Alliance, Ohio, 27 February 1976, 172 pp.

BYRNE, G. D., GEAR, C. W., HINDMARSH, A. C., HULL, T. E., KROGH, F. T. and SHAMPINE, L. F.: Panel discussion of quality software for ODEs, Lapidus, L. and Schiesser, W. E. (eds.), Numerical Methods for Differential Systems, Academic Press (1976), pp. 267-285.

BYRNE, George D. et al.: A comparison of two ODE codes: GEAR and EPISODE. Preprint UCRL-79141, January 1977, 41+8pp., Lawrence Livermore Laboratory. Submitted for publication.
Contains an extensive bibliography and special information on report and code availability.

BYRNE, George D. et al.: Comparative test results for two ODE solvers--EPISODE and GEAR. Argonne National Laboratory Report, to appear.

W. ENRIGHT, R. BEDET, G. HALL, T. HULL and B. LINDBERG - University of Toronto

Page 296

On the Evaluation of Numerical Methods for Initial Value Problems in Ordinary Differential Equations

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

ENRIGHT, W H, HULL, T E and LINDBERG B: Comparing Numerical Methods for Stiff Systems of O.D.E:s. BIT 15 (1975), pp 10-48.

ENRIGHT, W. H. and HULL, T. E.: Comparing numerical methods for the solution of stiff systems of ODEs arising in chemistry, in Lapidus, L. and Schiesser, W. E. (eds.), Numerical Methods for Differential Systems, Academic Press (1976), pp. 45-66.

FOX, P. A.: DESUB: Integration of a First-Order System of a Ordinary Differential Equations, pp. 477 - 507.
In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

FOX, Phyllis [1972]: A comparative Study of Computer Programs for Integrating Differential Equations. CACM 15(11), pp. 949 - 951.
A study comparing the performance of several computer programs for integrating systems of ordinary differential equations (initial value problems) is reported. The integration methods represented include multistep methods (predictor-correctors), single-step methods (Runge-Kutta) and extrapolation methods (both polynomial and rational). The testing procedure is described together with the evaluation criteria applied. A set of 7 test problems on which the programs were tested is included in an appendix. For the particular problems and criteria used in the investigation it was found that a program based on rational extrapolation showed best performance. 25 references are given.

GEAR, C. W.: Experience and Problems with the Software for the Automatic Solution of Ordinary Differential Equations, pp. 211 - 227.
In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

GEAR, William: Numerical Initial Value Problems in Ordinary Differential Equations. Prentice-Hall, Englewood Cliffs, N.J., 1971, 253 pp, $ 12.95.

GUDERLEY, Karl G: A unified view of some methods for stiff two-point boundary value problems. SIAM Reveiw, Vol 17, No. 3, July 1975, pp. 416-442.

HILL, D. R.: On comparing Adams and natural spline multistep formulas, Mathematics of Computation, Vol. 29 (1975), pp. 741-745.

HULL, T. E. et al [1972]: Comparing Numerical Methods for Ordinary Differential Equations, SIAM Journal on Numerical Analysis 9(4), pp. 603 - 637, errata in [1974] 11(3), page 681.
Numerical methods for systems of first order ordinary differential equations are tested on a variety of initial value problems. The problems, methods and comparison criteria are specified very carefully.

INGRAM, H. L.: A comparison of digital computer programs for the numerical soltuion of ordinary differential equations, NASA Tech. Memo X-64781, Marshall Space Flight Center, Alabama (1973).

JOHNSON, A. I. and BARNEY, J. R.: Numerical solution of large systems of stiff ordinary differential equations in a modular simulation framework, Lapidus, L. and Schiesser, W. E. (eds.), Numerical Methods for Differential Systems, Academic Press (1976), pp. 97-124.

P. KEMP - Cambridge University Page 289
Mathematical Software for Ordinary Differential Equations: Chebyshev Series Methods

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

KROGH, Fred T: Opinions on Matters Connected with the Evaluation of Programs and Methods for Integrating Ordinary Differential Equations. SIGNUM Newsletter Vol 7, No. 3, October 1972, pp. 27-48.

KROGH, F. T. [1973]: On Testing a Subroutine for the Numerical Solution of Ordinary Differential Equations, JACM Vol 20(4), pp. 545 - 562.
This paper discusses how to numerically test a subroutine for the solution of ordinary differential equations. Results obtained with a variable order Adams methods are given for eleven simple test cases.

LAMBERT, J D: Initial value problems. In "Survey of Numerical Analysis 1976", proceedings of the York University Conference of the Institute of Mathematics and Its Applications held in April 1976, Ed. by R A Scriven and D Jacobs, Academic Press, to appear.

OPPELSTRUP, Jesper [1973]: Integrationsmetoder för ordinära differentialekvationer (in Swedish). (Integration Methods for Ordinary Differential Equations). ITM Working Paper No 5.
A review of popular numerical methods for solution of initial value problems for systems of ordinary differential equations, existing programs and recommendations.

SCOTT, M. R. and WATTS, H. A.: A systematized collection of codes for solving two-point boundary-value problems, Lapidus, L. and Schiesser, W. E. (eds.), Numerical Methods for Differential Systems, Academic Press (1976), pp. 197-227.

SHAMPINE, L F and GORDON, M K: Computer Solution of Ordinary Differential Equations, The Initial Value Problem.
W H Freeman and Co, San Francisco 1975.

SHAMPINE, L F and WATTS, H A: Global Error Estimation for Ordinary Differential Equations. ACM Transactions on Mathematical Software, Vol 2, No. 2, June 1976, pp 172-186.

SHAMPINE, L F, WATTS, H A and DAVENPORT, S M: Solving Nonstiff Ordinary Differential Equations - the State of the Art.
SIAM Review, Vol 18, No. 3, July 1976, pp 376-411.



A. SILVER and E. SULLIVAN - Goddard Space Flight Ctr.
The Numerical Solution of Ordinary Differential Fquations by the Taylor Series Method

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

WALSH, Joan: Initial and boundary value routines for ordinary differential equations, pp. 177 - 189.
In EVANS, D J (Ed): Software for Numerical Mathematics.
Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

WALSH, J E: Boundary value problems. In "Survey of Numerical Analysis 1976", proceedings of the York University Conference of the Institute of Mathematics and Its Applications held in April 1976, Ed. by R A Scriven and D Jacobs, Academic Press, to appear.

YU, T: Comparison of Numerical Methods for Ordinary Differential Equations. Technical Report CNA-73, 1973. Center for Numerical Analysis, University of Texas at Austin.

16. EVALUATIONS

e) FUNCTIONS

D. AMOS, S. DANIEL and M. WESTON - Sandia Laboratories Page 257
CDC 6600 Subroutines IBESS and JBESS for Bessel Functions $I_\nu(x)$ and $J_\nu(x)$, $x \geq 0$, $\nu \geq 0$

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.
To be published in ACM Transactions on Mathematical Software.

BRENT, R P: Fast Multiple-Precision Evaluation of Elementary Functions. J. Association for Computing Machinery, 23 (April, 1976), pp 242-251.

CLARK, N A; CODY, W J; HILLSTROM, K E and THIELKER, E A: Performance Statistics of the FORTRAN IV (H) LIBRARY for the IBM SYSTEM/360. SICNUM Newsletter Vol 2, No. 3, December 1967, 7 pp.

CLENSHAW, C. W.: Rational approximations for special functions, pp. 275 - 284.
In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

CODY, W. J. [1969]: Performance Testing of Function Subroutines, AFIPS Conference Proceedings, SJCC, 1969, pp. 759 - 763.
Discussion about possibilities for testing of routines for computation of functions. The method recommended, which also is well described, is based on the computation of both the function to be tested and a routine in extended precision for random arguments.

CODY, W. J.: Software for the Elementary Functions, pp. 171 - 186.
In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

CODY, W J: The FUNPACK Package of Special Function Subroutines. ACM Transactions on Mathematical Software, Vol 1, No. 1, March 1975, pp. 13-25.

CODY, W J: An overview of software development for special functions. Lecture Notes in Mathematics 506, Numerical Analysis Dundee 1975, Springer Verlag, Berlin, 1976, pp 38-48.

COX, W M: UNIVAC Claims Super Accurate Fortran Math Library. SIGNUM Newsletter Vol 6, No. 3, November 1971, p. 9.

FIKE, C. T.: Computer Evaluation of Mathematical Functions, Prentice Hall, New Jersey (1968).

FULLERTON, W: Absolutely Portable Special Function Routines. See COWELL, Wayne R (Editor) in section 2, Books related to Numerical Software.

HART, J. et al [1968]: Computer Approximations, Wiley, New York. A fundamental book for construction of routines for computation of functions. Tables of coefficients are given for polynomial and rational approximations of the elementary functions.

HILLSTROM, K. E.: Performance statistics for the Fortran IV (H) and PL/I (Version 5) Libraries in IBM OS/360 Release 18, Report ANL-7666 (August 1970), Argonne National Laboratory.

HO, J C and SCHRYER, N L: Implementation of Supplementary Elementary Functions for the Port Library. Computing Science Technical Report No. 43, Bell Laboratories.

KAHAN, W: Hirondo Kuki in memoriam. SIGNUM Newsletter Vol 7, No. 1, April 1972, pp. 8-10.

KEMP, P: Writing Elementary Function Procedures for the ALGOL 68C Compiler. See COWELL, Wayne R (Editor) in section 2, Books related to Numerical Software.

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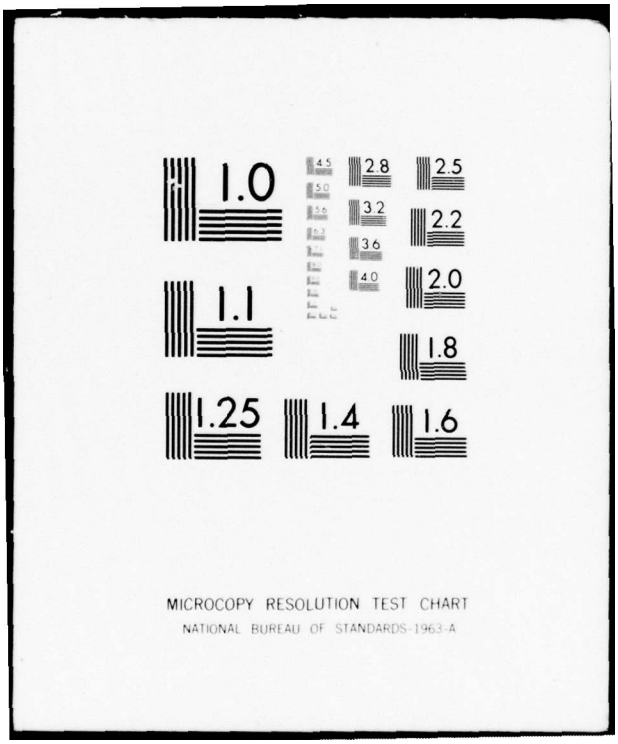
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6.3
7.1
8.0
9.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

**KUKI, H.: Mathematical Function Subprograms for Basic System Libraries -Objectives, Constraints and Trade-Off, pp. 187 - 199.**
In RICE, John R (Ed): Mathematical Software. Based on the proceedings of the Mathematical Software Symposium held at Purdue University, Lafayette, Indiana, April 1970. Academic Press, New York 1971.

**LOZIER, D. W. et al [1971]: A Bit Comparison Program for Algorithm Testing, National Bureau of Standards Report 10-449, Washington D.C.**
**Describes a very careful way of testing function routines at the implementation on different computers.**

LUKE, Yudell L: Mathematical Functions and Their Approximation. Academic Press, New York 1975.

**NEWBERY, A. C. R. and LEIGH, Anne, P. [1971]: Consistency Test for Elementary Functions, 1971 Fall Joint Computer Conference, AFIPS Proceedings, Vol 39, pp. 419 - 422.**

NG, Edward W: A Comparison of Computational Methods and Algorithms for the Complex Gamma Function. ACM Transactions on Mathematical Software, Vol 1, No. 1, March 1975, pp. 56-70.

PAUL, George and WILSON, M Wayne: Should the Elementary Function Library Be Incorporated Into Computer Instruction Sets? ACM Transactions on Mathematical Software, Vol 2, No. 2, June 1976, pp 132-142.

SCHONFELDER, J: The Production and Testing of Special Function Software in the NAG Library. See COWELL, Wayne R (Editor) in section 2, Books related to Numerical Software.

**SCHONFELDER, J. L.: Special functions in the NAG library, pp. 285 - 300.**
In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

SCHONFELDER, J L: The Production of Special Function Routines for a Multi-Machine Library. Software-Practice and Experience, Vol 6, No. 1, 1976, pp. 71-82.

TURNER, L Richard: Difficulty in Sin/Cos Routine. SIGNUM Newsletter Vol 4, No. 3, October 1969, p. 13.

WALLACW, W. [1969]: FORTRAN V Library Functions Reference Manual for 1108, University of Wisconsin, Madison, Wisconsin.
A well done testing of a complete FORTRAN library, which inspired UNIVAC to write a similar official manual.

WALTHER, J. S.: A unified algorithm for elementary functions, Proceedings 1971 Spring Joint Computer Conference (1971), pp. 379-385.

WYATT, W. T., LOZIER, D. W. and ORSER, D. J.: A portable extended precision arithmetic package and library with Fortran precompiler.
ACM Transactions on Mathematical Software, Vol 2 (1976), pp. 209-231.

## 16. EVALUATIONS

### f) OPTIMIZATION

DENNIS, J: Nonlinear equations and nonlinear least squares. In "Survey of Numerical Analysis 1976", proceedings of the York University Conference of the Institute of Mathematics and Its Applications held in April 1976, Ed. by R A Scriven and D Jacobs, Academic Press, to appear.

**MAHENDRARAJAH, A. and FIALA, F.: A comparison of three algorithms for linear zero-one programs, ACM Transactions on Mathematical Software, Vol. 2 (1976), pp. 331-334.**

NERINCKX, D and HAEGEMANS, A: A Comparison of Non-Linear Equation Solvers. *Journal of Computational and Applied* Mathematics, 2 (1976), pp 145-148.

A comparative study of 10 Fortran and Algol programs for solving non-linear equations with one unknown, without using derivatives.

POWELL, M J D: A View of Unconstrained Minimization Algorithms That Do Not Require Derivatives. ACM Transactions on Mathematical Software, Vol 1, No. 2, June 1975, pp 97-107.

**RAMSIN, Håkan [1973]: Metoder och program för ickelinjär optimering. (in Swedish). (Methods and Programs for Non-linear optimization) ITM Working Paper No 4.**
**Contains a review of some modern methods for non-linear optimization and directions where to find programs for these methods.**

RAMSIN, Håkan and WEDIN, Per-Åke: A comparison of some algorithms for the nonlinear least squares problem. Report LU/CS-75:06. Lund University Computing Center, Sölvegatan 18, S-223 62 Lund, Sweden.

**WAMPLER, R. H. [1970]: On the accuracy of least squares computer programs, Journal Amer. Stat. Assoc. 65, pp. 549 - 565.**

WEISS, Rotraut [1973]: A Comparative study of Multidimensional Function Optimizers. CGTM No 148, SLAC Computation Group, Stanford, California.
Comparison between PRAXIS (Powell's conjugate axis method), STREAM (Rosenbrock method) and MIGRAD from MINUIT (CERN). For the class of functions on which the minimizers in this study were tested there is no doubt - PRAXIS is, by far, superior.

## 16. EVALUATIONS

### g) INTEGRAL EQUATIONS

ANDERSSEN, R. S.: Stable procedures for the inversion of Abel's equation, Journal of the Institute of Mathematics and Its Applications, Vol. 17 (1976), pp. 329-342.

ATKINSON, Kendall E: A Survey of Numerical Methods for the Solution of Fredholm Integral Equations of the Second Kind. SIAM, 1976, 230 pp.

ATKINSON, Kendall: An Automatic Program for Linear Fredholm Integral Equations of the Second Kind. ACM Transactions on Mathematical Software, Vol 2, No 2, June 1976, pp 154 - 171.

L. M. DELVES - University of Liverpool — Page 238
An Automatic Ritz-Galerkin Procedure for the Numerical Solution of Linear Fredholm Integral Equations of the Second Kind

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

NOBLE, B: Integral equations. In "Survey of Numerical Analysis 1976", proceedings of the York University Conference of the Institute of Mathematics and Its Applications held in April 1976, Ed. by R A Scriven and D Jacobs, Academic Press, to appear.

MILLER, G. F.: Algorithms for integral equations, pp. 139 - 147.

In EVANS, D J (Ed): Software for Numerical Mathematics. Proceedings of the Loughborough University Conference of the Institute of Mathematics and Its Applications held in April 1973, Academic Press, London 1974.

## 17. FORMAL PROOFS OF CORRECTNESS


AMBLER, Allen L. et al.: GYPSY -- a language for specification and implementation fo verifiable programs. To be presented at the ACM Conference on Language Design for Reliable Software, Raleigh, North Carolina (28-30 March 1977).

BASU, S. K. and MISRA, J.: Some classes of naturally provable programs. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 400-406.

CHOW, Tsun S.: A generalized assertion language. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C. pp. 392-399.

COUSOT, P. and COUSOT, R.: Static verification of dynamic type properties of variables, Research Report No. 25, Laboratoire d'Informatique, Grenoble, France.

DEUTSCH, L. P.: An interactive program verifier, Ph.D. Dissertation, Computer Science Division, University of California, Berkeley, 1973, and Xerox PARC Report CSL-73-1, Palo Alto, California.

DIJKSTRA, E. W.: A constructive approach to the problem of program correctness, Basic Information Technology, Vol. 8, No. 3 (1968), pp. 174-186.

FLOYD, R. W.: Assigning meanings to programs, Proceedings American Mathematical Society Symposium in Applied Mathematics, Vol. 19 (1967), pp. 19-31.

GALLAHER, L. J.: Adaptive quadrature and proof of program correctness. Presented at SIAM 1976 Fall Meeting, Atlanta, Georgia, 18-20 October 1976.

GERMAN, Steven M and WEGBREIT, Ben: A Synthesizer of Inductive Assertions. IEEE Transactions on Software Engineering, Vol SE-1, No. 1, March 1975. Pp. 68-75.

GOOD, Donald I; LONDON, Ralph L and BLEDSOE, W W: An Interactive Program Verification System. IEEE Transactions on Software Engineering, Vol SE-1, No. 1, March 1975. Pp. 59-67.

GRIES, D.: An illustration of current ideas on the derivation of correctness proofs and correct programs, IEEE Transactions on Software Engineering, Vol. 2 (December 1976), pp. 238-244.

HANTLER, Sidney L. and KING, James C.: An introduction to proving the correctness of programs, Computing Surveys, Vol. 8 (1976), pp. 331-353.

IGARASHI, S., LONDON, R. L. and LUCKHAM, D. C.: Automatic program verification I: a logic basis and its implementation, Acta Informatica, Vol. 4 (1975), pp. 145-182.

KEIRSTEAD, R. E. and PARKER, D. B.: On the Feasibility of Formal Certification, pp. 291 - 301.

In HETZEL, William C (Ed): Program Test Methods. Based on the proceedings of the Computer Program Test Methods Symposium held at the University of North Carolina, Chapel Hill, June 1972. Prentice-Hall, Englewood Cliffs 1973.

KING, J. C.: Proving programs to be correct, IEEE Transactions on Computers, Vol. 20 (1971), pp. 1331-1336.

KING, J. C.: A program verifier, Ph.D. Dissertation, Carnegie Mellon University, Pittsburgh, Pennsylvania, 1969.

KING, James C.: Symbolic execution and program testing. RC 5082 (October 1974), Computer Science Department, IBM Thomas J. Watson Research Center, Yorktown Heights, N. Y. Also in Communications of ACM, Vol. 19 (1976), pp. 385-394.

KING, James C: A New Approach to Program Testing. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 228-233.

LAMPSON, B. W. et al.: Report on the programming language Euclid, SIGPLAN Notices, Vol. 12, No. 2, February 1977, Special issue, 3+79 pp.
This report describes the Euclid language, intended for the expression of system programs which are to be verified. Euclid draws heavily on Pascal.

LONDON, R. L.: The current state of proving programs correct, Proc. of ACM Annual Conference 1972, ACM, New York, 1972, pp. 39-46.

LUCKHAM, David and SUZUKI, Norihisa: Automatic program verification V: verification-oriented proof rules for arrays, records, and pointers. Dept. of Computer Science, Stanford University (March 1976), 52 pp., Report No. STAN-CS-76-549. Also available from NTIS as AD-A027 455/5WC.

MILLER, Edward F: RXVP, Fortran Automated Verification System, Level 1, User's Guide, February 1975, Program Validation Project, GENERAL RESEARCH Corporation, P.O.Box 3587, Santa Barbara, California 93105.

MILLER, Edward F: RXVP, Fortran Automated Verification System, Level 1, System Summary October 1974. Program Validation Project, GENERAL RESEARCH Corporation, P.O.Box 3587, Santa Barbara, California 93105.

De MILLO, Richard A., LIPTON, Richard J. and PERLIS, Alan J.: Social processes and proofs of theorems and programs. Proceedings of the Fourth ACM Symposium on Principles of Programming Languages, Los Angeles, California (17-19 January 1977), pp. 206-214.

MORRIS, J. H. and WEGBREIT, B.: Subgoal induction, Xerox, Palo Alto Research Center, Report CSL 75-6 (July 1975).

NAUR, P.: Proof of algorithms by general snapshots, BIT, Vol. 6 (1966), pp. 310-316.

NEUMANN, Peter G. et al.: Software development and proofs of multi-level security, Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 421-428.

PARNAS, D. L., et al.: Using predicate transformers to verify the effects of "real" programs. Forschungsbericht BSI 76/3, Technische Hochshule Darmstadt, Fachbereich Informatik, Darmstadt (1976). Also available from the Department of Computer Science, University of North Carolina.

RAGLAND, L. C.: A verified program verifier, Ph.D. Thesis, Department of Computer Science, University of Texas, Austin, Texas, May 1973.

REYNOLDS, C. and YEH, R. T.: Induction as the basis for program verification, IEEE Transactions on Software Engineering, Vol. 2 (December 1976), pp. 244-252.

SCHORRE, V: A Program Verifier With Assertions in Terms of Abstract Data. Ref: Proceedings of the "Polytechnic Institute of New York-MRI Symposium on Computer Software Engineering", April 20-22, 1976.

SHAW, Mary et al.: Abstraction and verification in ALPHARD: defining and specifying iteration and generators. To be presented at the ACM Conference on Language Design for Reliable Software, Raleigh, North Carolina (28-30 March 1977).

STUCKI, Leon G and FOSHEE, Gary L: New Assertion Concepts for Self-Metric Software Validation. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 59-71.

STUCKI, L. G., et al.: A methodology for producing reliable software, Vol. 1 and Vol. 2. McDonnel-Douglas Astronautics Co., Huntington Beach, California (March 1976), 228 and 339 pp. NASA-CR-144769 and 144770. Available from NTIS as N76-29945/2WC and 29946/OWC.

SUZUKI, N.: Automatic verification of programs with complex data structures, Ph.D. thesis, Dept. of Computer Science, Stanford University, STAN-CS-76-552 (February 1976).

SYRJÄNEN, M.: On construction of correct programs as a two-level process. OtaDATA ry (1975), 137 pp. (Finland).

TOPOR, R. W.: Interactive program verification using virtual programs, Ph.D. Dissertation, University of Edinburgh, Scotland, 1975.

WULF, W. A., et al.: An introduction to the construction and verification of Alphard programs, IEEE Transactions on Software Engineering, Vol. 2 (December 1976), pp. 253-265.

WULF, William A., et al.: Abstraction and verification in Alphard: introduction to language and methodology. University of Southern California, Marina del Rey, Information Sciences Institute (14 June 1976) 50 pp. Report No. ISI/RR-76-46. Also available as AD-A028 365/5WC from NTIS.

## 18. STRUCTURED PROGRAMMING


ABRAHAMS, Paul: "Structured Programming" Considered Harmful. SIGPLAN Notices, Vol 10, No. 4, April 1975, pp 13-24.

ALLENSWORTH, J A: Structured Programming in Fortran. Sandia Laboratories, Albuquerque, N.M., Report SAND-75-0423, September 1975, 56 pp.

ANDERSON, Peter G: Structured Programming Rules in Fortran. New Jersey Institute of Technology, Newark, New Jersey 07102.

B. S. Baker, "An Algorithm for Structuring Flowgraphs", Journ. ACM 24, 98 - 120 (Jan. 1977).

BATES, D. (ed.): Infotech state of the art report: structured programming. Infotech, Berkshire, England, 1976, 495 pp., $185.

CARROW, John C.: Structured programming: from theory to practice. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 370-372.

CHARMONMAN, S and WAGENER, J L: On Structured Programming in FORTRAN. SIGNUM Newsletter, Vol 10, No. 1, January 1975, pp. 21-23.

CROES, G A and DECKERS, F (1975): Aspects of structured programming in FORTRAN. Informatie (Amsterdam), Vol 17 (1975), pp 121-131.

DAHL, O J, DIJKSTRA, E W and HOARE, C A R: Structured Programming. Academic Press, New York, 1972.

ELGOT, Calvin C.: Structured programming with and without GOTO statements, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 41-54 and errata p. 232.

GILB, T.: A skeptical view of structured programming and some alternatives--part I, Computers and People, No. 5 (1976), pp. 20-23.

GILEADI, A. N. and LEDGARD, H. F.: On a proposed measure of program structure, SIGPLAN Notices, Vol. 9, No. 5 (1975), pp. 31-36.

HEHNER, Eric C. R.: Structuring. Proceedings of the Fourth ACM Symposium on Principles of Programming Languages, Los Angeles, California (17-19 January 1977), pp. 201-205.

HIGGINS, Donald S: SFTRAN - A Structured FORTRAN Translator. Digital Equipment Computer Users Society, Maynard, Mass., USA. (DECUS No. 10-234).

HOROWITZ, E.: Fortran - can it be structured and should it be? In "Development of Software Systems," Addison-Wesley, Reading, Mass. (1975).

HULL, T E: Would you believe Structured Fortran? SIGNUM Newsletter Vol 8, No. 4, October 1973, pp. 13-16.

Discusses structured programming in connection with FORTRAN programming.

HULL, T E: Correspondence on Structured Fortran. SIGNUM Newsletter Vol 9, No. 2, April 1974. p. 22.

INMON, Bill: An Example of Structured Design. Datamation, March 1976.

KERNIGHAN, B W (1975): RATFOR - a preprocessor for a rational FORTRAN. SOFTWARE - Practice & Experience, Vol 5 (1975), pp 395-406.

KERNIGHAN, Brian W and PLAUGER, P J: Software Tools. Addison-Wesley, Reading, Massachusetts, 1976.

KIEBURTZ, Richard B: Structured programming and problem solving with ALGOL W. Prentice-Hall, Englewood Cliffs, N.J., 1975, 365 pp., $ 10.95.

KILOV, H I (1976): Preprocessor for structured Fortran. Latvian University Computing Center, Riga 1976, 16 pp, in Russian and Fortran.

KNOBE, Bruce and YUVAL, Gideon: Compilers should indent, BIT, Vol. 16 (1976), pp. 340-343.

KNUTH, Donald E: Structured Programming with go to Statements, Computing Surveys, Vol 6, No. 4, December 1974. pp. 261-301.

LAWSON, C L (Ed): Workshop on Fortran Preprocessors for Numerical Software. Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California.

MATHIS, Robert F: Flow Trace of A Structured Program. SIGPLAN Notices, Vol 10, No. 4, April 1975, pp 33-37.

McCLURE, Carma L (1975): Top-Down, Bottom-Up, and Structured Programming, IEEE Transactions on Software Engineering, Vol SE-1, No. 4, pp. 397-403.

Loren P. Meissner,
Structured Fortran Bibliography (I),
FOR-WORD, Fortran Development Newsletter, No. 2, 24 March 1975.
(Loren P. Meissner (50-B 3239), Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720).

MEISSNER, Loren P.
Structured Fortran Preprocessor Survey. (Preprocessor update)
FOR-WORD, Fortran Development Newsletter, Vol. 2, No. 1, pp. 4-5.

MEISSNER, Loren P: Structured Fortran Preprocessors - Editorial. FOR-WORD, Fortran Development Newsletter, Vol 2, No. 3, July 1976, pp 19-20.

De MILLO, R. A. et al.: Can structured programs be efficient? SIGPLAN Notices, Vol. 11, No. 10, October 1976, pp. 10-18.
The December 1976 issue (No. 12) contains on pp. 1-9 several letters commenting on this article.

MILLS, H.: Top down programming in large systems. In "Debugging techniques in large systems," R. Rustin (ed.). Prentice Hall (1971), pp. 43-55.

MILLS, H. D.: Mathematical foundations of structured programming, IBM-FSD Report 72-6012 (1972).

MISURI, Giorgio: Survey of Existing Programming Aids. SIGPLAN Notices, Vol 11, No. 8, August 1976, pp 38-41. (33 refs).

NEELY, Peter M: The New Programming Discipline. Software-Practice and Experience, Vol 6, No. 1, 1976, pp. 7-27.
Discusses structured programming with special emphasis on Fortran.

NELDER, J A: Structured programming in Fortran. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 437-438.

NOONAN, Robert E (1975): Structured Programming and Formal Specification, IEEE Transactions on Software Engineering, Vol SE-1, No. 4, pp. 421-425.

NYVALL JONES, Martha: HIPO for Developing Specifications. Datamation, March 1976.

PLAUGER, P J: Special Issue on Preprocessors. SIGPLAN Notices, Vol 11, No. 9, September 1976.

Contributions:

Bridge, R F and Thomson, E W. BRIDGES - A Tool for Increasing the Reliability of References to FORTRAN Variables.

Cook, A James. Experience with Extensible, Portable FORTRAN Extensions.

Musstoph, Guenter. The Programming System POLYP - Structure and Experience.

Wells, Mark B. Preprocessing of Typed Two-Dimensional Mathematical Expressions.

Woolley, John D, Miller, Leland R and Bernstein, Charles M: LINUS: An experiment in Language Preprocessing.

RALSTON, Anthony and WAGENER, Jerrold L.: Structured Fortran - an evolution of standard Fortran, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 154-176.
Describes a suggested programming language, upward compatible with Fortran IV, and which contains newly defined data and control structures.

REIFER, Donald J: The Structured FORTRAN Dilemma. SIGPLAN Notices, Vol 11, No. 2, February 1976, pp. 30-32.

Contains a list of 55 preprocessors.

ROWLAND, Stuart W.: Some comments on structured Fortran, SIGPLAN Notices, Vol 11, No. 10, (October 1976), pp. 43-48.

STEVENS, W. P. and MYERS, G. J. and CONSTANTINE, L. L.: Structured design. IBM Systems Journal, No. 2 (1974), pp. 115-139.

THORPE, A J L: Family Programming Teams. Datamation, March 1976.

WEINBERG, G M, YASUKAWA, N and MARCUS, R: Structured Programming in PL/C - An Abecedarian. Wiley, New York, 1973, 220 pp. Price: £ 3.75.

WILKES, M. V., WHEELER, D. J. and GILL, S.: The preparation of programs for an electronic digital computer, Addison Wesley, Reading, MA. (1951).

WILKES, M. V.: Software engineering and structured programming, IEEE Transactions on Software Engineering, Vol. 2 (December 1976), pp. 274-276.

WIRTH, Niklaus: On the Composition of Well-Structured Programs, Computing Surveys, Vol 6, No. 4, December 1974, pp. 247-259

WRANDLE BARTH, C: STRCMACS - An extensive set of Macros to aid in structured programming in 360/370 Assembly Language. SIGPLAN Notices, Vol 11, No. 8, August 1976, pp 31-35.

19. TEST PROBLEMS

Most references in section 16 (Evaluations) also contain test problems.

AEGERTER, M. J.: Construction of a set of test matrices, CACM Vol 2, pp. 10 - 12.

BRENNER, J. L.: A set of test matrices for testing computer programs, CACM Vol 5, pp. 443 - 444.

CHARNES, A., RAIKE, W. M., STUTZ, J. D. and WALTERS, A. S.: On generation of test problems for linear programming codes. Communications ACM, Vol. 17, No. 10 (1974), pp. 583-586.

CLARKE, Lori: A system to generate test data and symbolically execute programs, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 215-222.

CURTIS, A. R.: Stiff Ordinary Differential Equation Test Problems. SIGNUM Newsletter Vol 8(4), pp. 10 - 12.

GABOW, H. N., MAHESHWARI, S. N. and OSTERWEIL, L. J.: On two problems in generation of program test paths, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 227-231.

GOODENOUGH, J. B. and GERHART, S. L.: Toward a theory of test data selection, SIGPLAN Notices, Vol. 10, No. 6 (1975), pp. 493-510.

GOODENOUGH, John B and GERHART, Susan L: Toward a theory of test data selection. IEEE Transactions on Software Engineering, Vol. SE-1, No. 2, June 1975, pp. 156-173, correction December 1975, p. 425.

GREGORY, R. T. and KARNEY, D. L. [1969]: A collection of Matrices for Testing Computational Algorithms, Wiley, 154 pp.
Contains a chapter on the construction of test matrices and a large number of matrices with inverses, determinants, eigenvalues and eigenvectors given. 81 references.

HALDI, J.: 25 integer programming test problems, Working Paper No. 43, Graduate School of Business, Stanford University, Stanford, California, December 1964.

HENNEL, M A; HEDLEY, D and WOODWARD, M R: Experience with an Algol 68 Numerical Algorithms Testbed. Ref: Proceedings of the "Polytechnic Institute of New York-MRI Symposium on Computer Software Engineering", April 20-22, 1976.

HOWDEN, W. E.: Methodology for the generation of program test data, IEEE Transactions on Computers, Vol. 24, No. 5 (1975), pp. 554-560.

MILLER Jr., E. F. and MELTON, R. A.: Automated generation of testcase datasets. Proceedings of the International Conference on Reliable Software, 21-23 April 1975, Los Angeles, California, pp. 51-58 (and SIGPLAN Notices, Vol. 10, No. 6 (1975), pp. 51-58).

MILLER, Webb and SPOONER, David L.: Automatic generation of floating-point test data, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 223-226.

OSTERWEIL, Leon: Depth-first search techniques and efficient methods for creating test paths. Technical Report No. CU-CS-077-75, Department of Computer Science, University of Colorado, Boulder, Colorado 80309 (1975).

RAMAMOORTHY, C. V., et al.: On the automated generation of program test data, IEEE Transactions of Software Engineering, Vol. 2 (December 1976), pp. 293-300.

RICE, John R: A set of 74 test functions for nonlinear equation solvers, Report CSD-TR 34, Computer Science Department, Purdue University, Lafayette, Indiana, April 1969.

WESTLAKE, Joan R. [1968]: A handbook of numerical matrix inversion and solution of linear equations, Wiley, 171 pp.
Contains in an appendix 41 test matrices together with their inverses and/or eigenvalues.

WITTE, Bruno F W: Comparative Tabulations of Test Problems and Test Results for Mathematical Computer Routines. SICNUM Newsletter Vol 2, No. 3, December 1967, 12 pp.

ZIELKE, G: Testmatrizen mit freien Parametern. Computing 15 (2), 1975, pp. 87-103. (In German)
Test Matrices with Free Parameters.
A method to construct test matrices with free parameters is given. As an example of application a new test matrix of even order which is also appropriate to the eigenproblem is derived. Moreover some known test matrices with constant elements are generalized in such a way that they can be supplied with condition numbers of arbitrary order.

## 20. MISCELLANEOUS

ABERTH, O [1974]: A Precise Numerical Analysis Program. CACM 17(9), 509 - 513.
A description is given of a program for computing the solution to a small number of standard numerical analysis problems to any specified accuracy, up to a limit of 2000 correct decimal places. Each computed number is bounded in an interval with a multiple precision midpoint. Arithmetic operations involving these numbers are executed according to interval arithmetic concepts, with non-significant digits automatically discarded. Details are supplied of problem specification and computation.

AICA: Proceedings of the 1st AICA International Symposium on Computer Methods for Partial Differential Equations (June 1975), 410 pp., $29. Available from IMACS (AICA), Department of Computer Science, Rutgers University, New Brunswick, NJ 08903.

AIRD, T., DODSON, D., HOUSTIS, E. and RICE, J. [1973]: Statistics on the Use of Mathematical Subroutines from a Computer Center Library. SIGNUM Newsletter Vol 8(4), pp. 8 - 9.
Shows how the different FORTRAN functions and some mathematical software were used at the Purdue University Computer Center.

C. BAILEY and R. JONES - Sandia Laboratories Page 281
Usage and Argument Monitoring of Mathematical Library Routines

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

BARTH, Jeffrey M.: An interprocedural data flow analysis algorithm. Conference Record of the Fourth ACM Symposium on Principles of Programming Languages, Los Angeles, California (17-19 January 1977), pp. 119-131.

BELL, D.: Programmer selection and programming errors, The Computer Journal, Vol. 19 (1976), pp. 202-206.

BLAIN, G; LABARTHE, A; RAULT, J-C, SCIARDIS, M and ZAMANSKY, P: BAL: An Aid to Scientific Programming Based upon a "BANK of ALGORITHMS". In "Information Processing 74", Proceedings of the IFIP Congress 74, Ed. by Jack L Rosenfeld. North-Holland Publishing Company, Amsterdam 1974, pp. 547-551.

BLAIN, G; LABARTHE, A and RAULT, J C: THE SYSTEM BAL: A technique for spreading the use of CAD techniques within an industrial environment. 12th Design Automation Conference, Boston, Mass., June 23-25, 1975.

BOEHM, B. W.: The high cost of software, Software World, Vol. 6, No. 1 (1975), pp. 2-10.

BOEHM, Barry W.: Software engineering, IEEE Transactions on Computers, Vol. 25 (1976), pp. 1226-1241.
Survey with extensive bibliography.

BOYLE, James M: Note on "The Design of a User Interface to Large Fortran Subroutine Packages Under IBM 360/370 OS". SIGNUM Newsletter, Vol 10, No. 2-3, November 1975, p. 40.

BROWN, A. R. and SAMPSON, W. A.: Program debugging - the prevention and cure of program errors. London, Macdonald (1973).

Also Elsevier Publishing Company, New York 1973, 166 pp.,$ 7.75.

BROWN, J. R., DeSALVIO, A. J., HEINE, D. E. and PURDY, J. G.: Automated software quality assurance: a case study of three systems, TRW-SS-72-02, TRW Systems Group, Redondo Beach (1972), 23 pp.

BYRNE, G D and HINDMARSH, A C: A Polyalgorithm for the Numerical Solution of Ordinary Differential Equations. ACM Transactions on Mathematical Software, Vol 1, No. 1, March 1975, pp. 71-96.

CRAIG, G. R., HETRICK, W. L., LIPOW, M. and THAYER, T. A., et al., Software reliability study, AD-787 784, TRW Systems Group, Redondo Beach (1974), 109 pp.

CSC Report: The Evolution of Software. CSC Report, A Publication of Computer Sciences Corporation, Vol 8 No. 2. 9841 Airport Boulevard, Los Angeles, California 90045.

DONZEAU-GOUGE, V; HUET, G; KAHN, G; LANG, B and LEVY, J.J.: A Structured-oriented Program Editor: A first step towards computer assisted Programming. In "International Computing Symposium 1975", Ed. by E Gelenbe and D Potier, North-Holland Publishing Co, Amsterdam 1975. Pp. 113-120.

ELSHOFF, James L.: An analysis of some commercial PL/I programs, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 113-120.

ELSPAS, Bernard; LEVITT, Karl N; WALDINGER, Richard J and WAKSMAN, Abraham: An Assessment of Techniques for Proving Program Correctness. Computing Surveys, Vol 4, No. 2, June 1972, pp. 97-147.

FAIRLEY, Richard E: An Experimental Program-Testing Facility. IEEE Transactions on Software Engineering, Vol SE-1, No. 4, December 1975, pp. 350-357.

FELDSTEIN, A and GOODMAN, R: Convergence Estimates for the Distribution of Trailing Digits. J. Association for Computing Machinery, 23, (April, 1976), pp 287-297.

FORSYTHE, G. E. [1970]: Pitfalls in Computations, or Why a Math Book Isn't Enough, Stanford University Technical Report CS-147 (Jan. 1970).
A splendid introduction for the layman to the problems of numerical computations. Originally written for a mathematical congress, it is well worth reading also for non-professional mathematicians.

FOSDICK, Lloyd D.: Proceedings of the Conference on the Validation and Distribution of Computer Software, 30-31 March 1972, Boulder, Colorado, Technical Report No. CU-CS-004-72, Department of Computer Science, University of Colorado, Boulder, Colorado 80309.

FOSDICK, Lloyd D. [1972]: The Production of Better Mathematical Software, CACM Vol 15(7), pp. 611 - 617.
A well written summary of problems and possibilities for documentation, standardization and evaluation of mathematical software. Contains extensive bibliography.

FRANCIS, Ivor; HEIBERGER, Richard M and VELLEMAN, Paul F: Report and Proposal of the Committee on Evaluation of Program Packages to the Section on Statistical Computing, August 1974, American Statistical Association, 14 pp.

FRITSCH, Fred N.: Profile on the Numerical Mathematics Section of the Lawrence Livermore Laboratory. SIGNUM Newsletter, Vol 8(4), pp. 9 - 10.
Contains a description of the work at the laboratory and a list of reports.

GABOW, H. N., MAHESHWARI, S. N. and OSTERWEIL, L. J.: On two problems in the generation of program test paths, CU-CS-081-75, University of Colorado (1975), 22 pp.

GAINES, R. S.: The debugging of computer programs (thesis), Working Paper No. 266, Communications Research Division, Institute for Defence Analyses, Princeton, N. J. (1969), 163 pp.

GANNON, John D and HORNING, J J: Language design for programming reliability. IEEE Trans. Software Engineering SE-1, 2 (June 1975), pp 179-191.

GAULDING, Scott N.: A software design methodology and tools, Digest of Papers, Comp Con Spring 77, IEEE Catalog No. 77CH1165-OC, pp. 198-201.

C. WILLIAM GEAR - University of Illinois
What Do We Need in Programming Languages?
Page 19
-24

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

GIRARD, E and RAULT, J-C: A Programming Technique for Software Reliability. Record of the 1973 IEEE Symposium on Computer Software Reliability, April 30 - May 2, 1973, pp. 44-50.

GIRARD, E and RAULT, J-C: L'etude des methodes de test et d'evaluation de la fiabilité du logiciel (Study of test methods and evaluation of software reliability). Report SCAS 74.589, May 1974 in French, 89 pp. and a bibliography with 1556 items. THOMSON-CSF, DIB, 33 Rue de Vouillé, F-75724 Paris.

GOODMAN, Richard: On Round-Off Error in Fixed-Point Multiplication. BIT 16, No. 1, 1976, pp 41-51.

GOULD, J. D. and DRONGOWSKI, P.: An exploratory study of computer program debugging, Human Factors, Vol. 16, No. 3 (1974), pp. 258-277.

HANSON, R J; KROGH, F T and LAWSON, C L: Improving the Efficiency of Portable Software for Linear Algebra. SIGNUM Newsletter Vol 8, No. 4, October 1973, p. 16.

HECHT, Matthew S. and ULLMAN, Jeffrey D.: A simple algorithm for global data flow analysis problems, SIAM Journal on Computing, Vol. 4 (1975), pp. 519-532.

HEWITT, Carl E and SMITH, Brian: Towards a Programming Apprentice. IEEE Transactions on Software Engineering, Vol SE-1, No. 1, March 1975, pp. 26-45.

HILL, I. D. [1971]: Faults in Functions, in ALGOL and FORTRAN, Computer Journal, Vol 14(3).
Discusses 7 different possibilities for error exits from routines for computations of functions.

ELLIS HOROWITZ - University of Southern California Page 45
A Sorting Algorithm for Polynomial Multiplication -83
In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

HOWDEN, William E.: Reliability of the path analysis testing strategy, IEEE Transactions on Software Engineering, Vol. 2 (1976), pp. 208-215.

HUANG, J C: Program Testing. (May 1974) Department of Computer Science, University of Houston, Texas.

HUANG, J C: An Approach to Program Testing. ACM Computing Surveys, Vol 7, No. 3, September 1975, pp. 113-128.

HULL, T. E. et al [1972]: The Correctness of Numerical Algorithms, Proc. of the Conf. on Proving Assertions About Programs, Jan. 1972.
Among the numerous articles on proving the correctness of a given algorithm, this is the first to cover also the numerical aspects (e.g. rounding errors). Examples are given from linear algebra and ordinary differential equations.

IGNIZIO, James P. [1973]: Validating Claims for Algorithms Proposed for Publication. Oper. Res. Vol 21, pp. 852 - 854.
Calls attention to the problems of validating the claims made for algorithms in published papers, and proposes a system for review that will validate such claims thoroughly before publication.

RICHARD D. JENKS - IBM Research Laboratories Page 299
Systems for Symbolic Mathematical Computation - The State of the Art

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

KAHAN, W: A Survey of Error Analysis (Preliminary version). Preprints of the IFIP Congress 71, Ljubljana - August 1971. Booklet Invited Papers, pp. 200-206.

KAHAN, W: A Survey of Error Analysis. In "Information Processing 71", Proceedings of the IFIP Congress 71, Ed. by C V Freiman, Vol. 2, North-Holland Publishing Company, Amsterdam 1972, pp. 1214-1239.

W. M. KAHAN - University of California, Berkeley Page 25 -38
The Table-Makers' Dilemma and other Quandaries

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

**KANE, J. R. and YAU, S. S.: Concurrent software fault detection, IEEE Transactions Software Engineering, Vol. 1, No. 1 (1975), pp. 87-99.**

KULISCH, U and BOHLENDER, G: Formalization and Implementation of Floating-Point Matrix Operations. Computing 16 (3), 1976, pp 239-261.

LAMBIOTTE Jr, Jules J and VOIGT, Robert G: The Solution of Tridiagonal Linear Systems on the CDC STAR-100 Computer. ACM Transactions on Mathematical Software, Vol 1, No. 4, December 1975, pp. 308-329.

LANG, Bernard: Programming with Dummy Variables. In "International Computing Symposium 1975", Ed. by E Gelenbe and D Potier, North-Holland Publishing Co, Amsterdam 1975. Pp. 191-196.

LENFANT, J and BURGEVIN, P: Empirical Data on Program Behaviour. In "International Computing Symposium 1975", Ed. by E Gelenbe and D Potier, North-Holland Publishing Co, Amsterdam 1975. Pp. 163-169.

LINNAINMAA, Seppo: Taylor Expansion of the Accumulated Rounding Error. BIT 16 (1976), pp 146-160.

MADSEN, Niel K. and SINCOVEC, Richard F.: PDECOL: general collocation software for partial differential equations, Preprint UCRL-78263, May 1976, 43 pp., Lawrence Livermore Laboratory. Submitted for publication.

MALCOLM, Michael A. [1973]: A Machine-independent ALGOL Procedure for Accurate Floating-Point Summation, Stanford University, Calif., STAN-CS-73-374.
Describes an ALGOL 60 procedure which is an implementation of the floating-point summation technique described in Malcolm (1971). This implementation is machine-independent in a certain sense.

MATULA, David W: Significant Digits: Numerical Analysis or Numerology. In "Information Processing 71", Proceedings of the IFIP Congress 71, Ed. by C V Freiman, Vol 2, North-Holland Publishing Company, Amsterdam 1972, pp. 1278-1283. See also the Preprints, Booklet TA-1, pp. 33-37.

MAURER, W. D.: Software systems design and correct software, Digest of Papers, Comp Con Spring 77, IEEE Catalog No. 77CH1165-OC, pp. 194-197.

McCLUSKEY, Edward J. et al.: Center for reliable computing: current research. Stanford Electronics Laboratory, Stanford, California, 103 pp. Available as R76-33 from IEEE Repository at $10.30.

McKEEMAN, W M: On Preventing Programming Languages from Interfering with Programming. IEEE Transactions on Software Engineering, Vol SE-1, No. 1, March 1975, pp. 19-26.

MILLER, Webb: Computer Search for Numerical Instability. Journal of the Association for Computing Machinery, Vol 22, No. 4, October 1975, pp. 512-521.

MILLER, Webb: Roundoff Analysis by Direct Comparison of Two Algorithms. SIAM Journal on Numerical Analysis, Vol 13, No. 3, June 1976, pp 382-392.

MILLS, H. D.: How to write correct programs and know it. IBM Report FSC-73-5008 (1973), 26 pp.

MOOERS, Calvin N: Computer Software and Copyright. ACM Computing Surveys, Vol 7, No. 1, March 1975, pp. 45-72.

MORGAN, D. E. and TAYLOR, D. J.: A survey of methods of achieving reliable software, Computer (IEEE), Vol. 10, No. 2 (February 1977), pp. 44-53.

JOEL MOSES - Massachusetts Institute of Technology Page 208
The Evolution of Algebraic Manipulation Algorithms

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

MUSA, John D: A theory of software reliability and its application. IEEE Transactions on Software Engineering, Vol SE-1, No. 3, September 1975, pp. 312-327.

MYERS, G. J.: Reliable software through composite design, Petrocelli/ Charter, New York (1975), 159 pp.

NAG Project Note Number 5: Draft Specification for TEST PROGRAM CONVENTIONS, 7 pp.

PARLETT, B N and WANG, Y: The Influence of the Compiler on the Cost of Mathematical Software - in Particular on the Cost of Triangular Factorization. ACM Transactions on Mathematical Software, Vol 1, No. 1, March 1975, pp. 35-46.

PARLETT, Beresford: Progress in Numerical Analysis. Presented at SIAM 1976 Fall Meeting, Atlanta, Georgia, 18-20 October 1976. To appear in the SIAM Review.

PIMONT, Simon and RAULT, Jean-Claude: A software reliability assessment based on a structural and behavioral analysis of programs. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 486-491.

POOLE, P. C.: Debugging and testing, Advanced Course on Software Engineering, Bauer, F. L. (ed.), Springer-Verlag (1973), pp. 278-318.

RAMAMOORTHY, C. V., CHEUNG, R. C. and KIM, K. H.: Reliability and integrity of large computer programs. Fachtagung Prozessrechner 1974, Karlsruhe, Germany.

RAMAMOORTHY, C. V., KIM, K. H. and CHEN, W. T.: Optimal placement of software monitors aiding systematic testing, IEEE Transactions Software Engineering, Vol. 1, No. 1 (1975), pp. 403-411.

RAMAMOORTHY, C. V. and HO, S. F.: Testing large software with automated software evaluation system, SIGPLAN Notices, Vol. 10, No. 6 (1975), pp. 382-394.

RAMDÉN, Hans-Åke: JCL and Advanced FORTRAN Programming. Methods in Geomathematics, Volume 2, 1976, 168 pp. Price: US $ 19.75/Dfl. 49.00. Elsevier Scientific Publishing Company, Amsterdam and New York.

RICE, J. R. [1972]: On the Present and Future of Scientific Computation, CACM, Vol 15(7), pp. 637 - 639.
A forecast is given of what can be expected to happen in the application of computers to the physical sciences.

RICE, J. R.: NAPSS-like systems: problems and prospects, Proceedings National Computer Conference (1973), pp. 43-47.

RICE, John R: Parallel Algorithms for Adaptive Quadrature III. Program Correctness. ACM Transactions on Mathematical Software, Vol 2, No. 1, March 1976, pp 1-30.

RICE, John R: Algorithmic Progress in Solving Partial Differential Equations. Computer Science Department, Report CSD-TR 173, January 1976, Purdue University, Lafayette, Indiana 47907, USA.

RICE, J. R.: Statistical computing: the vanguard of the revolution in education, Proceedings Computer Science and Statistics, 9th Symposium on the Interface, Harvard University (1976), pp. 1-3.

RICHARDS, F. R.: Computer software: testing, reliability models, and quality assurance, AD/A-001 260, NTIS (1974), 80 pp.

ROBINET, B. (ed.): Programming symposium, proceedings, Paris 1974, Springer-Verlag, Berlin-Heidelberg (1974), 425 pp.

RUSSEL, David L and SUE, Jeffrey Y: Implementation of a PASCAL Compiler for the IBM 360. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 371-376.

RUSTIN, R: Debugging Techniques in Large Systems. Prentice-Hall, Englewood Cliffs, N.J., 1971. 148 pp. Price: £4.00. Ref: Software-Practice and Experience Vol 4 (4) October-December 1974.

SAMET, P A: Detailed Analysis of a Program - an Instructive Horror Story. Software-Practice and Experience, Vol 5 (2), 1975, pp. 211-213.

SCHWARTZ, J. T.: What constitutes progress in programming? Communications of the ACM, Vol. 18 (November 1975), pp. 663-664.

SIGNUM: Proceedings of the SIGNUM meeting on software for partial differential equations. SIGNUM Newsletter, Vol. 10, No. 4 (December 1975), pp. 1-42 (Special issue).

SINCOVEC, R. and MADSEN, N.: Software for nonlinear partial differential equations. ACM Transactions on Mathematical Software, Vol. 1 (1975), pp. 232-263.

SPIER, Michael J: Software Malpractice - A Distasteful Experience. SOFTWARE - Practice & Experience, Vol 6, No. 3, July-September 1976, pp 293-299.

STOCKENBERG, John E and VAN DAM, Andries: STRUCT Programming Analysis System. IEEE Transactions on Software Engineering, Vol SE-1, No. 4, December 1975, pp. 384-389.

SUGIURA, N, YAMAMOTO, M. and SHINO, T.: On the software reliability, Microelectronics and Reliability, Vol. 13 (1974), pp. 529-533.

SWARTZLANDER, E. E. and ALEXOPOULOS, A. G.: The sign/logarithm number system. IEEE Transactions on Computers, Vol. 24 (1976), pp. 1238-1242.

SWARZTRAUBER, Paul and SWEET, Roland: Efficient FORTRAN Subprograms for the Solution of Elliptic Partial Differential Equations, NCAR Technical Note NCAR-TN/IA-109, July 1975. Atmospheric Technology Division, National Center for Atmospheric Research, Boulder, Colorado.

THAYER, R. H. and HINTON, E. S.: Software reliability--a method that works, Proceedings AFIPS 1975 National Computer Conference, Vol. 44 (1975), pp. 877-883.

THAYER, T. A. et al.: Software reliability study. TRW Defense and Space Systems Group, Redondo Beach, California (August 1976), 343 pp., TRW-76-2266.1.9-5, Available from NTIS as AD-A030 798/3WC.

TRAUB, J. F. [1972]: Numerical Mathematics and Computer Science, CACM Vol 15(7), pp. 537 - 541.
Numerical matehmatics is viewed as the analysis of continuous algorithms. Four of the components of numerical mathematics are discussed. These are: foundations (finite precision number system), synthesis and analysis of algorithms, analysis of error, programs and program libraries.

TSAO, Nai-kuan [1974]: On the Distribution of Significant Digits and Roundoff Errors. CACM 17(5), pp. 269 - 271.
Generalized logarithmic law is derived for the distribution of the first t significant digits of a random digital integer. This result is then used to determine the distribution of the roundoff errors in floating point operations, which is a mixture of uniform and reciprocal distributions.

TWEEDALE, A and CHAN, C: On the Design of a User Interface to Large Fortran Subroutine Packages Under IBM 360/370 OS . SIGNUM Newsletter, Vol 10, No. 1, January 1975, pp. 15-17.

VAN TASSEL, Dennie: Program Style, Design, Efficiency, Debugging and Testing. Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1974, 256 pp. Price : $ 12.95

VOGES, U.: Aspects of design, test and validation of the software for a computerized reactor protection system. Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No. 76 CH1125-4C, pp. 606-616.

VICTOR A. VYSSOTSKY - Bell Telephone Laboratories Page 212
Some Problems in Large Software Systems

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

WANG, Arne: An Axiomatic Basis for Proving Total Correctness of Goto-Programs. BIT 16 (1976),pp 88-102.

WHITAKER, William A.: A defense view of software engineering, Proceedings of the 2nd International Conference on Software Engineering (13-15 October 1976), San Francisco, California. Available from ACM or IEEE, Catalog No.76 CH1125-4C. pp. 358-362.

WHITE, William W: A Status Report on Computing Algorithms for Mathematical Programming. Computing Surveys, Vol 5, No. 3, September 1973, pp. 135-166.

WICHMANN, B A and JONES, B: Testing ALGOL 60 Compilers.
SOFTWARE - Practice & Experience, Vol 6, (2), 1976,
pp 261-270.

WORTMAN, David B.: Notes from a workshop on the attainment of reliable software, University of Toronto, Toronto, Canada, 51 pp.
Report from June 1974 workshop in Toronto, arranged by ACM and IEEE. This report is available as R76-276 from IEEE Repository.

RICHARD ZIPPEL - Massachussetts Institute of Technology Page 191-206
Power Series Expansions in MACSYMA

In: Rice, John R.
Mathematical Software II, Informal Proceedings of a Conference.
Purdue University, May 29-31, 1974.

## 21. JOURNALS RELATED TO NUMERICAL SOFTWARE

The following journals publish algorithms and/or computer codes within the numerical software area:

ACM Transactions on Mathematical Software (Association for Computing Machinery, 1133 Avenue of the Americas, New York, New York 10036)

Angewandte Informatik (Friedr. Vieweg + Sohn GmbH, Burgplatz 1, D-3300 Braunschweig, German Federal Republic)

BIT (DATA A/S, Kronprinsensgade 14, DK-1114 Copenhagen K, Denmark)

Communications of the ACM (Association for Computing Machinery, 1133 Avenue of the Americas, New York, New York 10036)

Computer Journal (British Computer Society, 29 Portland Place, London W1N 4AP, England)

Computer Physics Communications (North-Holland Publishing Company, P.O.Box 103, Amsterdam W, The Netherlands)

Computing (Springer-Verlag, P.O.Box 367, A-1011 Vienna, Austria)

Journal of Computational and Applied Mathematics (Koninklijke Vlaamse Ingenieursvereniging, Jan van Rijswicijcklaan 58, B-2000 Antwerp, Belgium)

Numerische Mathematik (Springer-Verlag, Heidelberger Platz 3, D-1 Berlin 33, German Federal Republic)

The following are important review journals:

Computing Reviews (Association for Computing Machinery, 1133 Avenue of the Americas, New York, New York 10036)
This journal also has the annual "Bibliography and Subject Index of Current Computing Literature".

CPST, Computer programs in science and technology. Science Associates/ International, Inc., 23 East 26th Street, New York, NY 10010 (Annual subscription $95.00).

Computer and Information Systems, Cambridge Scientific Abstracts, Inc., Suite 437, 6611 Kenilworth Avenue, Riverdale, Maryland 20840.

Quaterly Bibliography of Computers and Data Processing, Applied Computer Research, P.O. Box 9280, Phoenix, Arizona 85068.

Weekly Government Abstracts. Computers, Control & Information Theory, National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This bibliography has been written at the request of the IFIP Working Group on Numerical Software (IFIP WG 2.5), and is intended to serve both members of the working group and others intent on improving numerical software. It has been divided into twenty-one different areas. Within each area the references are given in alphabetical order by the first author. Some references occur in two or at most three areas. This is especially true for the individual articles in books. For some entries a summary is included; either the original abstract, or a shortened form of the original, or a summary written by the present author.

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The aim of the bibliography is to be useful in the production and evaluation of good software for numerical mathematics. However, it does not include references to algorithms in the numerical analysis literature, nor does it include references to individual software products (routines). The section on bibliographies includes many entries not strictly within the scope of the present work. I have tried to get the sections on Numerical program libraries, Transportability, and Evaluations, as complete as possible, but the other sections are not so well covered, especially as regards matters outside of numerical software.