

Lecture Notes in Computer Science

Edited by G. Goos and J. Hartmanis

142

Problems and Methodologies in Mathematical Software Production

International Seminar

Held at Sorrento, Italy, November 3–8, 1980

Edited by P.C. Messina and A. Murli



Springer-Verlag
Berlin Heidelberg New York 1982

Editorial Board

D. Barstow W. Brauer P. Brinch Hansen D. Gries D. Luckham
C. Moler A. Pnueli G. Seegmüller J. Stoer N. Wirth

Editors

Paul C. Messina
Mathematics and Computer Science Division
9700 South Cass Avenue, Argonne, IL 60439, USA

Almerico Murli
Istituto di Matematica "R.Caccioppoli", Università di Napoli
Via Mezzocannone 16, 80134 Napoli, Italy

CR Subject Classifications (1980): 2.41, 2.43, 4.43, 4.6, 5.0, 5.11, 5.16

ISBN 3-540-11603-6 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-11603-6 Springer-Verlag New York Heidelberg Berlin

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically those of translation, reprinting, re-use of illustrations, broadcasting, reproduction by photocopying machine or similar means, and storage in data banks. Under § 54 of the German Copyright Law where copies are made for other than private use, a fee is payable to "Verwertungsgesellschaft Wort", Munich.

© by Springer-Verlag Berlin Heidelberg 1982
Printed in Germany

Printing and binding: Beltz Offsetdruck, Hemsbach/Bergstr.
2145/3140-543210

Preface

In November, 1980 a week-long International Seminar on Problems and Methodologies in Mathematical Software Production was held in Sorrento, Italy.

The Seminar was organized and supported by the National Committee for the Mathematical Sciences and the National Group for Mathematical Informatics, both of which are part of Italy's National Council for Research.

Additional Sponsors for the seminar were Università di Napoli, AICA, Informatica Campania (Italsiel).

The Seminar was intended for university and industrial researchers with the following aims: to provide an opportunity for discussions among researchers and some of the well-known experts in the field of Mathematical Software; and to stimulate cooperation between industry and mathematical research.

The principal topics in the seminar were:

- fundamental concepts of computational software and the influence of computer architecture on the design of software;
- operational aspects of establishing, developing and maintaining mathematical software libraries;
- portability, transportability and software tools for numerical software;
- methods for evaluating numerical software;
- machine arithmetic and program correctness criteria.

Their presentations are collected in this book.

On the last day of the Seminar the speakers took part in a panel discussion. The discussion concentrated on current research directions in Mathematical Software; prospects for the future; and evolutionary trends now discernible, including the probable effects of new computer hardware architecture and technology.

A written version of the panel discussion appears at page 254.

SPEAKERS

William J. Cody, Jr.: Applied Mathematics Division, Argonne National Laboratory,
9700 South Cass Avenue, Argonne, IL 60439, USA.

Theodorus J. Dekker: Universiteit van Amsterdam, Subfaculteit Wiskunde/Depart-
ment of Mathematics, Roetersstraat 15, 1018 WB Amsterdam.

Brian Ford: Numerical Algorithms Group Limited, NAG Central Office,
Mayfield House, 256 Banbury Road, Oxford OX2 7DE.

Morven Gentleman: Computer Science Department, University of Waterloo,
Waterloo N2L 3G1, Canada.

James N. Lyness: Applied Mathematics Division, Argonne National Laboratory,
9700 South Cass Avenue, Argonne, IL 60439, USA.

Paul C. Messina: Applied Mathematics Division, Argonne National Laboratory,
9700 South Cass Avenue, Argonne, IL 60439, USA.

CONTENTS

<u>W.J. CODY, Jr.</u> : Basic concepts for computational software	1
<u>W.J. CODY, Jr.</u> : Implementation and testing of function software	24
<u>T.J. DEKKER</u> : Program correctness and machine arithmetic	48
<u>B. FORD and J. BENTLEY, J.J. DU CROZ, S.J. HAGUE</u> : Preparing the NAG library	81
<u>B. FORD and S.J. HAGUE, S.M. NUGENT</u> : Computer-based documentation for the NAG library	91
<u>B. FORD</u> : Transportable numerical software	128
<u>B. FORD and S.J. HAGUE</u> : Tools for numerical software engineering	141
<u>W.M. GENTLEMAN</u> : Portability and other source management problems	152
<u>J.N. LYNESS</u> : Remarks about performance profiles	186
<u>P.C. MESSINA</u> : The role of computer centers in the field of mathematical software	198
<u>P.C. MESSINA</u> : Guidelines for managing mathematical software libraries at computer centers	207
Panel session on the challenges for developers of mathematical software	254