

# CAMBRIDGE

## Logical Environments

Edited by G. HUET and G. PLOTKIN

In *Logical Frameworks* Huet and Plotkin gathered contributions from the first International Workshop on Logical Frameworks. This new volume has grown from the second workshop. Four main themes are covered: the problem of representing formal systems in logical frameworks, basic algorithms of general uses in proof assistants, logical issues, and large-scale experiments with proof assistants.

£35.00 net HB 0 521 43312 6 352 pp. 1993

Still available: *Logical Frameworks*

£35.00 net HB 0 521 41300 1 416 pp. 1991

## Oriented Matroids

A. BJÖRNER, M. LAS VERGNAS, B. STURMFELS, NEIL WHITE and G. M. ZIEGLER

This is the first comprehensive and accessible account of oriented matroids and is intended for graduate students, researchers and specialists who need a thorough reference work.

£60.00 net HB 0 521 41836 4 528 pp. 1993

*Encyclopedia of Mathematics and its Applications 46*

## Lectures on Parallel Computation

Edited by A. GIBBONS and P. SPIRAKIS

The foundations of parallel computation are the concern of this book. Distinguished international researchers have contributed fifteen chapters which together form a coherent text for readers who have little prior knowledge of the field.

£25.00 net HB 0 521 41556 X 448 pp. 1993

*Cambridge International Series on Parallel Computation*

## The Clausal Theory of Types

D. A. WOLFRAM

This book introduces a theory of theorem-proving based on a lambda-calculus formulation of a clausal logic with equality, known as the Clausal Theory of Types.

£24.95 net HB 0 521 39538 0 132 pp. 1993

*Cambridge Tracts in Theoretical Computer Science 21*

## Efficient Algorithms for Listing Combinatorial Structures

LESLIE ANN GOLDBERG

The award winning research described here gives some answers to the following questions: which families of combinatorial structures have fast computer algorithms for listing their members? What general methods are useful for listing combinatorial structures? How can these be applied to those families which are of interest to theoretical computer scientists and combinatorialists?

£27.95 net HB 0 521 45021 7 176 pp. 1993

*Distinguished Dissertations in Computer Science 5*

## Introduction to HOL

A Theorem-Proving Environment for Higher-Order Logic

Edited by MIKE GORDON and T. F. MELHAM

This book provides a coherent and self-contained introduction to HOL. It succeeds in extracting and compressing from various sources most of the material that is needed for day-to-day work with the system.

£27.95 net Spiral Bound 0 521 44189 7 496 pp. 1993

## Specification and Proof in Real Time CSP

JIM DAVIES

This award winning thesis contains the very latest work on the specification and verification of real-time systems.

£27.95 net HB 0 521 45055 1 196 pp. 1993

*Distinguished Dissertations in Computer Science 6*

## Mathematics For Computer Graphics

S. G. HOGGAR

This unique textbook introduces the geometry, analysis and topology necessary to understand the mathematical framework for computer graphics.

£25.00 net HB 0 521 37574 6 500 pp. 1993

*Cambridge Tracts in Theoretical Computer Science 14*

To order or get further information 'phone Tom Peacock on 0223 325782, fax 0223 315052,

E mail TW10002@PHX.CAM.AC.UK, or write to the address below.



CAMBRIDGE  
UNIVERSITY PRESS

The Edinburgh Building, Cambridge CB2 2RU

## INSTRUCTIONS TO AUTHORS

**SUBMISSION OF MANUSCRIPTS:** Papers (three copies) may be submitted to any member of the Editorial Board. Authors should always keep a fully up-to-date version themselves. A copy of the paper and the name of the member of the Editorial Board to whom the paper has been submitted should also be sent to the Editor-in-Chief, who will record the submission. Submission of a paper is taken to imply that it has not been previously published and that it is not being considered for publication elsewhere. Upon acceptance of a paper, the author will be asked, under certain conditions, to transfer copyright to the publisher.

**ELECTRONIC MANUSCRIPTS:** The publisher would like to encourage the submission of manuscripts written in LaTeX, which can be used for direct typesetting. Authors using LaTeX may wish to use the MSCS style file, which can be obtained from the Editor-in Chief or directly from the publisher using anonymous FTP to retrieve the file `mcs.s.all` from the Internet address `cus.cam.ac.uk` (Cambridge Unix Service) where the macro is in the directory `/pub/cupress/journals/latex/mcs.s.all`. The file `mcs.s.all` is a concatenated file containing both the style file and the author's guide; look at the `readme` header for information on how to split these files. Alternatively, authors may use the 'article style'. The publisher may be able to use Plain TeX and AMSTeX for typesetting if submitted by authors. Authors should send discs (Apple Mac or PC) plus relevant details on **acceptance of their paper** to the Editor-in-Chief. The TeX (source code) files should be sent. These should correspond exactly to the hardcopy accepted for publication. Discs will not be returned. The publisher reserves the right to typeset any article by conventional means if the author's TeX code presents problems in production.

**LAYOUT OF MANUSCRIPTS:** Papers should be typewritten or equivalent in **double spacing throughout**, on one side of the paper. Please avoid footnotes. Papers should begin with an abstract of not more than 300 words.

**FIGURES:** Figures should be drawn in indian ink on good quality white paper or produced by computer to comparable quality. Wherever possible, they will be reproduced with the author's original lettering. Originals of figures should not be sent until the paper has been accepted. A list of captions should be attached separately.

**REFERENCES:** The Harvard system of references should be used. In the text, a reference should be quoted by the author's name and date in parentheses, in date order, e.g. (Smith 1983; Jones and Jones 1985; Hunter 1986a, b). Where there are three or more authors, the first name followed by *et al.* should be used. A full list of references should be given at the end of the text, listing, in alphabetical order, surname of author and initials; year of publication (in parentheses); title of paper; journal or book name (the former being abbreviated in accordance with the *World List of Scientific Periodicals*); volume number; first and last page of the reference. For books and conference proceedings, place of publication and publisher (and Editor(s) if appropriate) should be included.

**PROOF READING:** As far as possible, changes at proof stage should be restricted to typographical errors, and the publisher reserves the right to charge the author for additional corrections.

**OFFPRINTS:** Twenty-five offprints of each article will be supplied free to each first named author. Extra offprints may be purchased from the publisher if ordered at proof stage.

## THE JOURNAL

**Mathematical Structures in Computer Science (MSCS)** is a journal of theoretical computer science which focuses on the application of ideas from the structural side of mathematics and mathematical logic to computer science. The journal aims to bridge the gap between theoretical contributions and software design, publishing original papers or broad surveys with original perspectives in all areas of computing, provided that ideas or results from algebra, geometry or category theory form a basis for the work.

## EDITORIAL POLICY

The purpose of the journal is to increase the circulation of new very high standard results in this fast growing area. Notions, methods and results from algebras, geometry and category theory nowadays play a major role in theoretical and even applied computer science. This role is increasing and is stimulating new research directions in these mathematical disciplines as well as influencing various aspects of actual computing. Indeed, this journal is not meant to be only a 'theory journal' but, by choosing as a theme the use of mathematical methods of Computer Science independently of their area of application, it aims to highlight connections among different topics and to encourage applications of theoretical contributions.

This journal welcomes original papers, or broad surveys with original perspectives. Their standard should be at least comparable to the quality of the best journal in computer science or in mathematics. The papers may be in any area of computing, provided that they employ concepts or results from category theory, algebra or geometry. The journal also welcomes applications to computing based on the use of specific mathematical structures (e.g. topological and order-theoretic structures) as well as on proof-theoretic notions and results. The use of categorical or algebraic language just as a unifying tool for a variety of applications is also appreciated, in particular if linked with relevant experimental activity. In order to promote the use of categorical methods in computer science, expository and introductory papers are particularly welcome, with the specific aim of turning the (sometimes excessively) technical jargon of the community of category theorists to a commonly understood language for as many working computer scientists as possible. Equally, discussions of methodological or philosophical nature concerning the foundation of Computer Science are of interest for the journal.

Articles in pure category theory or in other areas of mathematics may be considered provided that there is a clear connection to computational issues or they investigate mathematical structures whose relevance to computer science is well established. However, these contributions should be directed to the broad audience of computer scientists to which this journal is addressed, since the applications of mathematical methods in the broadest sense in language design and software implementation is meant to be the main focus of this journal.



# MSCS

SEPTEMBER 1993 VOLUME 3 NUMBER 3

## CONTENTS

- |                                                                         |     |
|-------------------------------------------------------------------------|-----|
| Introduction to distributive categories<br>J. R. B. COCKETT             | 277 |
| An application of PER models to program extraction<br>STEFANO BERARDI   | 309 |
| Program specification and data refinement in type theory<br>ZHAOHUI LUO | 333 |

© Cambridge University Press 1993

*Printed in Great Britain by the University Press, Cambridge*

---

**CAMBRIDGE**  
UNIVERSITY PRESS



0960-1295(199309)3:3;1-B