

MSCS Mathematical Structures in Computer Science

A journal in the applications of categorical, algebraic and geometric methods in Computer Science

DECEMBER 1993 VOLUME 3 NUMBER 4

Cambridge University Press

https://doi.org/10.1017/S0960129500000268 Published online by Cambridge University Press

EDITOR-IN-CHIEF Giuseppe Longo Laboratoire d'Informatique (CNRS) et DMI, Ecole Normale Supérieure. 45, Rue D'Ulm, 75005 Paris (France), e-mail: longo@dmi.ens.fr

ASSOCIATE EDITORS P. L. Curien LIENS, 45 rue d'Ulm, 75230 Paris, Cedex 05, France e-mail:curien@dmi.ens.fr

EDITORIAL BOARD

S. Abramsky Department of Computing, Imperial College of Science, Technology & Medicine, University of London

M. Barr Department of Mathematics, McGill University, Montreal, Quebec G. Berry

Ecole des Mines, Valbonne, France

R. M. Burstall Computer Science Department, University of Edinburgh

H. Ehrig Technische Universität, Berlin

E. Engeler Informatik, ETH-Zentrum, Zürich

P. J. Freyd Department of Mathematics, University of Pennsylvania, Philadelphia J. Y. Girard UER de Math. Equipe de Logique Mathematique, Un. de Paris VII I Goguen

Computing Laboratory, Oxford University

J. W. Gray Department of Mathematics, University of Illinois, Urbana

S. Hayashi Department of Applied Mathematics & Informatics, Ryukoku University, Shiga Japan

C. A. R. Hoare Computing Laboratory, Oxford University

R. J. M. Hughes Department of Computer Sciences, Chalmers University of Technology, Göteborg M. Hyland

Department of Mathematics, University of Cambridge

J. Lambek Department of Mathematics, McGill University, Montreal, Quebec

William F. Lawvere State University of New York at Buffalo, New York

E. G. Manes

Department of Mathematics and Statistics, Amherst, Massachusetts Josè Meseguer SRI International, Menlo Park, California A. Pitts University of Cambridge, Computer Laboratory, New Museums Site, Pembroke Street, Cambridge CB2 3QG R. Milner Department of Computer Science, University of Edinburgh G. Mints Department of Philosophy, Stanford University, California J. C. Mitchell Computer Science Department, Stanford University, California U. Montanari Dipartimento de Informatica, Università di Pisa A. Obtulowicz Institute of Mathematics, Polish Academy of Sciences, Warsaw G. D. Plotkin Department of Computer Science, University of Edinburgh Vaughan Pratt Department of Computer Science, Stanford University, California J. C. Reynolds School of Computer Science, Carnegie Mellon University, Pittsburgh, Pennsylvania Vladimur Yu. Sazonov Institute of Programmable Systems, AS. Russia A. Scedrov Department of Mathematics, University of Pennsylvania, Philadelphia D. S. Scott School of Computer Science, CMU, Pittsburgh, Pennsylvania P. J. Scott Department of Mathematics, University of Ottawa, Ontario R. A. G. Seelv Department of Mathematics, John Abbott College, Montreal, Quebec J. Tiuryn Institute of Mathematics, University of Warsaw E. G. Wagner IBM T. J. Watson Research Center, Yorktown Heights, New York Mitchell Wand Computer Science Department, Northeastern University, Boston, Massachusetts C. Wells Department of Mathematics and Statistics, Case Western Reserve University, Cleveland, Ohio G. Winskel

Computer Science Department, Aarhus University, Denmark

© CAMBRIDGE UNIVERSITY PRESS 1993

SUBSCRIPTIONS. *MSCS-Mathematical Structures in Computer Science* (ISSN: 0960-1295) is published four times a year in March, June, September and December. The subscription price of Volume 3, 1993, is £105 net (UK), (USA, Canada and Mexico US \$185) post free; single parts cost £27 net (USA, Canada and Mexico US \$50) plus postage. Four parts form a volume. Orders, which must be accompanied by payment, may be sent to any bookseller, subscription agent or to the publisher: Cambridge University Press, The Edinburgh Building, Shaftesbury Road, Cambridge CB2 2RU, or in the USA, Canada and Mexico to Cambridge University Press, The Journals Department, 40 West 20th Street, New York, NY 10011-4211, USA. Copies of the journal for subscribers in the USA, Canada and Mexico are sent by air to New York to arrive with minimum delay. Japanese prices for institutions (including ASP delivery) are available from Kinokuniya Company Ltd, P.O. Box 55, Chitose, Tokyo. Second class postage is paid at New York, NY and at additional mailing offices.

POSTMASTER: send address changes in USA, Canada and Mexico to MSCS-Mathematical Structures in Computer Science, Cambridge University Press, 110 Midland Avenue, Port Chester, NY 10573–9864, USA.

Claims for missing issues should be made immediately on receipt of the subsequent issue.

COPYING. This journal is registered with the Copyright Clearance Center, 27 Congress Street, Salem, MA 01970. Organisations in the USA who are also registered with the C.C.C. may therefore copy material (beyond the limits permitted by sections 107 and 108 of the US copyright law) subject to payment to C.C.C. of the per-copy fee of \$5.00. This consent does not extend to multiple copying for promotional or commercial purposes. Code 0960-1295/93 \$5.00 + .00. *ISI Tear Sheet Service*, 3501 Market Street, Philadelphia, Pennsylvania 19104, USA, is authorised to supply single copies of separate articles for private use only.

Organisations authorised by the Copyright Licensing Agency may also copy material subject to the usual conditions. For all other use, permission should be sought from Cambridge or the American branch of Cambridge University Press.