

Lecture Notes in Computer Science

666

Edited by G. Goos and J. Hartmanis

Advisory Board: W. Brauer D. Gries J. Stoer



J.W. de Bakker W.-P. de Roever
G. Rozenberg (Eds.)

Semantics: Foundations and Applications

REX Workshop
Beekbergen, The Netherlands, June 1-4, 1992
Proceedings

Springer-Verlag
Berlin Heidelberg New York
London Paris Tokyo
Hong Kong Barcelona
Budapest

Series Editors

Gerhard Goos
Universität Karlsruhe
Postfach 69 80
Vincenz-Priessnitz-Straße 1
W-7500 Karlsruhe, FRG

Juris Hartmanis
Cornell University
Department of Computer Science
4130 Upson Hall
Ithaca, NY 14853, USA

Volume Editors

J. W. de Bakker
Centre for Mathematics and Computer Science
P. O. Box 4079, 1009 AB Amsterdam, The Netherlands

W.-P. de Roever
Institute of Computer Science and Practical Mathematics II
Christian-Albrechts-Universität zu Kiel, Preußerstraße 1-9, W-2300 Kiel, FRG

G. Rozenberg
Department of Computer Science, Leiden University
P. O. Box 9512, 2300 RA Leiden, The Netherlands

CR Subject Classification (1991): F.3, D.1-3

ISBN 3-540-56596-5 Springer-Verlag Berlin Heidelberg New York
ISBN 0-387-56596-5 Springer-Verlag New York Berlin Heidelberg

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1993
Printed in Germany

Typesetting: Camera ready by author/editor
45/3140-543210 - Printed on acid-free paper

Preface

The aim of the workshop on 'Semantics - Foundations and Applications' was to bring together researchers working on the semantics of programming languages. Faithfully reflecting the rich variety in present-day semantic research, the program of the workshop included presentations on a wide range of topics situated in the two areas:

Foundations

- comparative domain theory, category theory, information systems,

Applications

- concurrency - process algebras, asynchronous communication, trace nets, action semantics, process refinement, concurrent constraint programming,
 - predicate transformers, refinement, weakest preconditions,
 - comparative semantics of programming concepts, full abstraction,
 - reasoning about programs - total correctness, epistemic logic,
 - logic programming,
 - functional programming - sequentiality, integration with concurrency,
 - applied structured operational semantics,
- and several others.

The present volume is based on this meeting which the editors organized June 1-4, 1992, in Conference Centre De Wippselberg, Beekbergen, The Netherlands. The workshop was an activity of the project REX - Research and Education in Concurrent Systems, one of the projects sponsored by the Netherlands NFI (Nationale Faciliteit Informatica) Programme. A short description of the REX project is given below.

The material presented in this volume was prepared by the lecturers (and their coauthors) after the meeting took place - in this way the papers also reflect the discussions that took place during the workshop. The editors moreover invited a few authors to contribute papers not based on work presented during the meeting. We were fortunate to enjoy the cooperation of such an excellent group of lecturers and further participants. We are grateful to all of them for contributing to the success of the event. Special thanks go to Jan Rutten for his help in preparing the scientific program of the workshop.

We gratefully acknowledge the financial support for the workshop from the NFI programme.

The CWI, Amsterdam, was responsible for the technical organization of the meeting. The local organization was in the capable hands of Mieke Bruné and Frans Snijders.

The REX project

The REX - Research and Education in Concurrent Systems - project investigates syntactic, semantic and proof-theoretic aspects of concurrency. In addition, its objectives are the education of young researchers and, in general, the dissemination of scientific results relating to these themes. REX is a collaborative effort of Leiden University (G. Rozenberg), the CWI in Amsterdam (J.W. de Bakker), and the Eindhoven University of Technology (W.P. de Roever), representing the areas of syntax, semantics and proof theory, respectively. The project is supported by the Netherlands National Facility for Informatics (NFI); its duration is approximately six years starting in 1988. The educational activities of REX include regular "concurrency days", consisting of tutorial introductions, presentations of research results, and lecture series of visiting professors. The research activities of the REX project include, more specifically:

- a) Three subprojects devoted to the themes: syntax of concurrent systems; comparative semantics, metric transition systems and domain theory; and high-level specification and refinement of real-time distributed systems.
- b) Collaboration with visiting professors and post-doctoral researchers.
- c) Workshops and Schools. Aiming at a broad coverage of major themes in, or relating to, concurrency, REX has organized the following events:

- 1988 Linear Time, Branching Time and Partial Order in Logics and Models for Concurrency
Proceedings published as Springer Lecture Notes in Computer Science 354
- 1989 Stepwise Refinement of Distributed Systems - Models, Formalisms, Correctness
LNCS 430
- 1990 Foundations of Object-Oriented Languages
LNCS 489
- 1991 Real-Time: Theory in Practice
LNCS 600
- 1992 Semantics: Foundations and Applications
These Proceedings.

The project closes in 1993 with the School/Symposium "A Decade of Concurrency - Reflections and Perspectives", where the accomplishments in the field of concurrency will be surveyed and a look into the future will be attempted as to (un)expected developments.

February 1993

J.W. de Bakker
W.P. de Roever
G. Rozenberg

Table of Contents

R.J.R. Back, J. von Wright Predicate Transformers and Higher Order Logic	1
E. Badouel, P. Darondeau Trace Nets	21
R. Berghammer, B. Elbl, U. Schmerl Proving Total Correctness of Programs in Weak Second-Order Logic	51
F.S. de Boer, J.N. Kok, C. Palamidessi, J.J.M.M. Rutten On Blocks: Locality and Asynchronous Communication	73
M. Bonsangue, J.N. Kok Semantics, Orderings and Recursion in the Weakest Precondition Calculus	91
A. Corradini, A. Asperti A Categorical Model for Logic Programs: Indexed Monoidal Categories	110
P. Degano, R. Gorrieri, G. Rosolini A Categorical View of Process Refinement	138
A. Edalat, M.B. Smyth Compact Metric Information Systems	154
A. Eliëns, E.P. de Vink Asynchronous Rendez-Vous in Distributed Logic Programming	174
M. Gabbrielli, G. Levi, M. Martelli New Semantic Tools for Logic Programming	204
W.H. Hesselink, R. Reinds Temporal Preconditions of Recursive Procedures	236
W. van der Hoek, M. van Hulst, J.-J.Ch. Meyer Towards an Epistemic Approach to Reasoning about Concurrent Programs	261
E. Horita A Fully Abstract Model for a Nonuniform Concurrent Language with Parameterization and Locality	288

VIII

R. Kanneganti, R. Cartwright, M. Felleisen SPCF: Its Model, Calculus, and Computational Power	318
M. Kwiatkowska Infinite Behaviour and Fairness in Concurrent Constraint Programming	348
M. W. Mislove, F.J. Oles Full Abstraction and Unnested Recursion	384
P.D. Mosses On the Action Semantics of Concurrent Programming Languages	398
F. Nielson, H.R. Nielson Layered Predicates	425
P. Panangaden, V. Saraswat, P.J. Scott, R.A.G. Seely A Hyperdoctrinal View of Concurrent Constraint Programming	457
J.J.M.M. Rutten, D. Turi On the Foundations of Final Semantics: Non-Standard Sets, Metric Spaces, Partial Orders	477
V. Stoltenberg-Hansen, J.V. Tucker Infinite Systems of Equations over Inverse Limits and Infinite Synchronous Concurrent Algorithms	531
B. Thomsen, L. Leth, A. Giacalone Some Issues in the Semantics of Facile Distributed Programming	563
R.T. Udink, J.N. Kok On the Relation Between Unity Properties and Sequences of States	594
F.W. Vaandrager Expressiveness Results for Process Algebras	609
S. Weber, B. Bloom, G. Brown Compiling Joy Into Silicon: An Exercise in Applied Structural Operational Semantics	639