Series Editors

Gerhard Goos, Karlsruhe University, Germany
Juris Hartmanis, Cornell University, NY, USA
Jan van Leeuwen, Utrecht University, The Netherlands

Volume Editor

Reinhard Wilhelm
Universität des Saarlandes, Fachrichtung Informatik
Postfach 15 11 50, 66041 Saarbrücken, Germany
E-mail: wilhelm@cs.uni-sb.de

Cataloging-in-Publication Data applied for
Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Reinhard Wilhelm (ed.). - Berlin ; Heidelberg ; New York ; Barcelona ; Hong Kong ; London ; Milan ; Paris ; Singapore ; Tokyo : Springer, 2001
(Lecture notes in computer science ; Vol. 2027)
ISBN 3-540-41861-X

CR Subject Classification (1998): D.3.4, D.3.1, F.4.2, D.2.6, I.2.2, F.3

ISSN 0302-9743

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 New York
a member of BertelsmannSpringer Science+Business Media GmbH
http://www.springer.de
© Springer-Verlag Berlin Heidelberg 2001
Printed in Germany

Typesetting: Camera-ready by author, data conversion by PTP-Berlin, Stefan Sossna
Printed on acid-free paper SPIN: 10782418 06/3142 5 4 3 2 1 0
ETAPS 2001 was the fourth instance of the European Joint Conferences on Theory and Practice of Software. ETAPS is an annual federated conference that was established in 1998 by combining a number of existing and new conferences. This year it comprised five conferences (FOSSACS, FASE, ESOP, CC, TACAS), ten satellite workshops (CMCS, ETI Day, JOSES, LDTA, MMAABS, PFM, RelMiS, UNIGRA, WADT, WTUML), seven invited lectures, a debate, and ten tutorials.

The events that comprise ETAPS address various aspects of the system development process, including specification, design, implementation, analysis, and improvement. The languages, methodologies, and tools which support these activities are all well within its scope. Different blends of theory and practice are represented, with an inclination towards theory with a practical motivation on one hand and soundly-based practice on the other. Many of the issues involved in software design apply to systems in general, including hardware systems, and the emphasis on software is not intended to be exclusive.

ETAPS is a loose confederation in which each event retains its own identity, with a separate program committee and independent proceedings. Its format is open-ended, allowing it to grow and evolve as time goes by. Contributed talks and system demonstrations are in synchronized parallel sessions, with invited lectures in plenary sessions. Two of the invited lectures are reserved for “unifying” talks on topics of interest to the whole range of ETAPS attendees. The aim of cramming all this activity into a single one-week meeting is to create a strong magnet for academic and industrial researchers working on topics within its scope, giving them the opportunity to learn about research in related areas, and thereby to foster new and existing links between work in areas that were formerly addressed in separate meetings.

ETAPS 2001 was hosted by the Dipartimento di Informatica e Scienze dell’Informazione (DISI) of the Università di Genova and was organized by the following team:

Egidio Astesiano (General Chair)
Eugenio Moggi (Organization Chair)
Maura Cerioli (Satellite Events Chair)
Gianna Reggio (Publicity Chair)
Davide Ancona
Giorgio Delzanno
Maurizio Martelli

with the assistance of Convention Bureau Genova. Tutorials were organized by Bernhard Rumpe (TU München). Overall planning for ETAPS conferences is the responsibility of the ETAPS Steering Committee, whose current membership is:

Egidio Astesiano (Genova), Ed Brinksma (Enschede), Pierpaolo Degano (Pisa), Hartmut Ehrig (Berlin), José Fiadeiro (Lisbon), Marie-Claude Gaudel (Paris), Susanne Graf (Grenoble), Furio Honsell (Udine), Nigel
VI Foreword

Horspool (Victoria), Heinrich Hußmann (Dresden), Paul Klint (Amsterdam), Daniel Le Métayer (Rennes), Tom Maibaum (London), Tiziana Margaria (Dortmund), Ugo Montanari (Pisa), Mogens Nielsen (Aarhus), Hanne Riis Nielson (Aarhus), Fernando Orejas (Barcelona), Andreas Podelski (Saarbrücken), David Sands (Göteborg), Don Sannella (Edinburgh), Perdita Stevens (Edinburgh), Jerzy Tiuryn (Warsaw), David Watt (Glasgow), Herbert Weber (Berlin), Reinhard Wilhelm (Saarbrücken)

ETAPS 2001 was organized in cooperation with

the Association for Computing Machinery
the European Association for Programming Languages and Systems
the European Association of Software Science and Technology
the European Association for Theoretical Computer Science

and received generous sponsorship from:

ELSAG
Fondazione Cassa di Risparmio di Genova e Imperia
INDAM - Gruppo Nazionale per l’Informatica Matematica (GNIM)
Marconi
Microsoft Research
Telecom Italia
TXT e-solutions
Università di Genova

I would like to express my sincere gratitude to all of these people and organizations, the program committee chairs and PC members of the ETAPS conferences, the organizers of the satellite events, the speakers themselves, and finally Springer-Verlag for agreeing to publish the ETAPS proceedings.

January 2001

Donald Sannella
ETAPS Steering Committee chairman
Preface

The International Conference on Compiler Construction (CC) is a forum for the presentation and discussion of recent developments in programming language implementation. It emphasizes practical methods and tools. CC 2001 was the tenth conference in the series.

The CC conference originated as a series of workshops started by Günter Riedewald in East Germany in 1986. In 1992 the series was relaunched by Uwe Kastens in Paderborn. In 1994 CC joined ESOP and CAAP in Edinburgh as it did 1996 in Linköping. CC federated with ESOP, FOSSACS, and TACAS to form ETAPS in 1998 and became annual. The number of submissions has shown a nice increase. The program committee received 69 submissions for CC 2001, from which 22 high-quality papers were selected for presentation. These papers are included in these proceedings. The areas of program analysis and architecture received the highest number of submissions and were rewarded with the highest number of accepted papers. Exploiting the intra-processor parallelism and improving the locality of memory referencing remain challenging problems for the compiler.

The invited speaker at CC 2001 was Ole Lehrman Madsen, whose talk was entitled *Virtual Classes and Their Implementation*. An abstract of the invited talk opens these proceedings.

The work of the CC 2001 program committee was conducted entirely by electronic means. We used the START conference management software from the University of Maryland. This proved to be very supportive for the work of the PC. Christian Probst did a remarkable job in setting it up, adding more functionality, and managing the technicalities of the submission and the reviewing process.

I am glad to acknowledge the hard work and friendly cooperation of the members of the program committee. I also wish to thank the much larger number of additional reviewers who helped us to read and evaluate the submitted papers. I appreciated very much the support and advice of the ETAPS chair, Don Sannella. Finally, I wish to thank all the authors of submitted papers for their continued interest, without which the CC conference could not thrive.

January 2001

Reinhard Wilhelm
Program Committee

Uwe Assmann (Karlsruhe)  Lex Augusteijn (Eindhoven)
David Bernstein (Haifa)  Stefano Crespi-Reghizzi (Milano)
Evelyn Duesterwald (Cambridge, USA)  Christine Eisenbeis (Rocquencourt)
Andreas Krall (Vienna)  Xavier Leroy (Rocquencourt)
Rainer Leupers (Dortmund)  Borivoj Melichar (Prague)
Mikael Petersson (Uppsala )  Tom Reps (Madison)
Martin Rinard (Cambridge, USA)  Reinhard Wilhelm (Saarbrücken)

(Chair)

Referees

Giovanni Agosta  Paul F. Hoogendijk  Sara Porat
Pierre Amiranoff  Jan Hoogerbrugge  Christian Probst
Denis Barthou  Daniel Kaestner  Ganesan Ramalingam
Miroslav Benes  Felix Klock  Martin Rinard
Francois Bodin  Elliot K. Kolodner  Erven Rohou
Boris Boesler  Jaroslav Kral  Radu Rugina
Pierre Boullier  Viktor Kuncak  Petr Saloun
Alessandro Campi  Patrick Lam  Pierluigi San Pietro
Zbigniew Chamski  Marc Langenbach  Bernhard Scholz
Albert Cohen  Sam Larsen  Helmut Seidl
Giuseppe Desoli  Sylvain Lelait  André Seznec
Damien Doligez  Florian Liekweg  Dafna Shenwald
A. Ealan  Goetz Lindenmaier  Ron Sivan
Erik Eckstein  Vassily Litvinov  Mark Stephenson
Anton Ertl  Andreas Ludwig  Henrik Theiling
Paolo Faraboschi  Evelyne Lutton  Stephan Thesing
Paul Feautrier  Willem C. Mallon  François Thomasset
Stefan Freudenberger  Luc Maranget  Sid Ahmed Ali Touati
Hans van Gageldonk  Darko Marinov  Joachim A. Trescher
Thilo Gaul  Vincenzo Martena  Mon Ping Wang
Daniela Genius  Florian Martin  Rik van de Wiel
David Grove  Nicolay Mateev  Wim F.D. Yedema
Mustafa Hagog  Bilha Mendelson
Dirk Heuzeroth  Andrea Ornstein
Table of Contents

Invited Talk

Virtual Classes and Their Implementation ................................ 1
  Ole Lehrman Madsen

Program Analysis

Alias Analysis by Means of a Model Checker ............................... 3
  Vincenzo Martena, Pierluigi San Pietro

Points-to and Side-Effect Analyses for Programs Built
with Precompiled Libraries ..................................................... 20
  Atanas Rountev, Barbara G. Ryder

A Novel Probabilistic Data Flow Framework ............................... 37
  Eduard Mehofer, Bernhard Scholz

Program Transformation

Imperative Program Transformation by Rewriting .......................... 52
  David Lacey, Oege de Moor

Compiler Transformation of Pointers to Explicit Array Accesses
in DSP Applications .............................................................. 69
  Björn Franke, Michael O’Boyle

User-Extensible Simplification—Type-Based Optimizer Generators ...... 86
  Sibylle Schupp, Douglas Gregor, David Musser, Shin-Ming Liu

A Practical, Robust Method for Generating Variable Range Tables ...... 102
  Caroline Tice, Susan L. Graham

Program Analysis

Efficient Symbolic Analysis for Optimizing Compilers .................... 118
  Robert A. van Engelen

Interprocedural Shape Analysis for Recursive Programs ................... 133
  Noam Rinetzky, Mooly Sagiv

Design-Driven Compilation ...................................................... 150
  Radu Rugina, Martin Rinard
Intraprocessor Parallelism

Software Pipelining of Nested Loops ........................................ 165
   Kalyan Muthukumar, Gautam Doshi

A First Step Towards Time Optimal Software Pipelining of Loops
with Control Flows ........................................................... 182
   Han-Saem Yun, Jihong Kim, Soo-Mook Moon

Comparing Tail Duplication with Compensation Code
in Single Path Global Instruction Scheduling ........................... 200
   David Gregg

Register Saturation in Superscalar and VLIW Codes .................... 213
   Sid Ahmed Ali Touati

Parsing

Directly-Executable Earley Parsing ........................................ 229
   John Aycock, Nigel Horspool

A Bounded Graph-Connect Construction for LR-regular Parsers ....... 244
   Jacques Farré, José Fortes Gálvez

Memory Hierarchy

Array Unification: A Locality Optimization Technique ................ 259
   Mahmut Taylan Kandemir

Optimal Live Range Merge for Address Register Allocation
in Embedded Programs ....................................................... 274
   Guilherme Ottoni, Sandro Rigo, Guido Araujo,
   Subramanian Rajagopalan, Sharad Malik

Speculative Prefetching of Induction Pointers ......................... 289
   Artour Stoutchinin, José Nelson Amaral, Guang R. Gao,
   James C. Dehnert, Suneel Jain, Alban Douillet

Constant-Time Root Scanning for Deterministic Garbage Collection ... 304
   Fridtjof Siebert

Profiling

Goal-Directed Value Profiling ............................................ 319
   Scott Watterson, Saumya Debray

A Framework for Optimizing Java Using Attributes .................... 334
   Patrice Pominville, Feng Qian, Raja Vallée-Rai, Laurie Hendren,
   Clark Verbrugge
Demos

SmartTools: A Generator of Interactive Environments Tools ............... 355
  Isabelle Attali, Carine Courbis, Pascal Degenne, Alexandre Fau,
  Didier Parigot, Claude Pasquier

Visual Patterns in the VLEli System ........................................... 361
  Matthias T. Jung, Uwe Kastens, Christian Schindler, Carsten Schmidt

The Asf+Sdf Meta-environment: A Component-Based Language
Development Environment .......................................................... 365
  M.G.J. van den Brand, A. van Deursen, J. Heering, H.A. de Jong,
  M. de Jonge, T. Kuipers, P. Klint, L. Moonen, P.A. Olivier,
  J. Scheerder, J.J. Vinju, E. Visser, J. Visser

Author Index ................................................................. 371