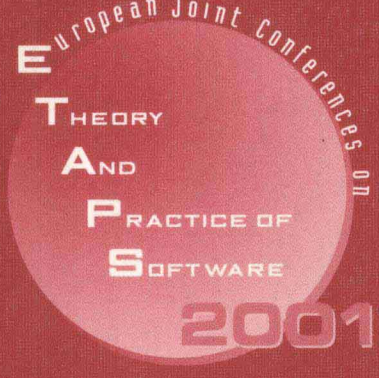
Reinhard Wilhelm (Ed.)

LNCS 2027

Compiler Construction

10th International Conference, CC 2001
Held as Part of the Joint European Conferences
on Theory and Practice of Software, ETAPS 2001
Genova, Italy, April 2001, Proceedings



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Proceedings

Springer

Volume Editor

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Cataloging-in-Publication Data applied for

Die Deutsche Bibliothek - CIP-Einheitsaufnahme

Compiler construction : 10th international conference ; proceedings /
CC 2001, held as part of the Joint European Conferences on Theory and
Practice of Software, ETAPS 2001, Genova, Italy, April 2 - 6, 2001.
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
ISBN 3-540-41861-X Springer-Verlag Berlin Heidelberg New York

Springer-Verlag Berlin Heidelberg New York
a member of BertelsmannSpringer Science+Business Media GmbH

http://www.springer.de

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

Lecture Notes in Computer Science 2027

Edited by G. Goos, J. Hartmanis and J. van Leeuwen

Springer
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Heidelberg
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Foreword

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
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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

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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
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INDAM - Gruppo Nazionale per l'Informatica Matematica (GNIM)
Marconi
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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

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Virtual Classes and Their Implementation

Ole Lehrmann Madsen

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Abstract. One of the characteristics of BETA [4] is the unification of *abstraction* mechanisms such as class, procedure, process type, generic class, interface, etc. into one abstraction mechanism: the *pattern*. In addition to keeping the language small, the unification has given a systematic treatment of all abstraction mechanisms and leads to a number of new possibilities.

One of the interesting results of the unification is the notion of *virtual class* [7,8], which is the BETA mechanism for expressing genericity. A class may define an attribute in the form of a virtual class just as a class may define an attribute in the form of a virtual procedure. A subclass may then refine the definition of the virtual class attribute into a more specialized class. This is very much in the same way as a virtual procedure can be refined - resulting in a more specialized procedure. Virtual classes can be seen as an object-oriented version of generics. Other attempts to provide genericity for OO languages has been based on various forms of parametric polymorphism and function application rather than inheritance. Virtual classes have been used for more than 15 years in the BETA community and they have demonstrated their usefulness as a powerful abstraction mechanism. There has recently been an increasing interest in virtual classes and a number of proposals for adding virtual classes to other languages, extending virtual classes, and unifying virtual classes and parameterized classes have been made [1,2,3,13,14,15,16,17].

Another distinguishing feature of BETA is the notion of *nested class* [6]. The nested class construct originates already with Simula and is supported in a more general form in BETA. Nested classes have thus been available to the OO community for almost 4 decades, and the mechanism has found many uses in particular to structure large systems. Despite the usefulness, mainstream OO languages have not included general nesting mechanisms although C++ has a restricted form of nested classes, only working as a scoping mechanism. Recently nested classes has been added to the Java language.

From a semantic analysis point of view the combination of inheritance, and general nesting adds some complexity to the semantic analysis, since the search space for names becomes two-dimensional. With virtual classes, the analysis becomes even more complicated – for details see ref. [10].

The unification of class and procedure has also lead to *an inheritance mechanism for procedures* [5] where method-combination is based on the **inner**-construct known from Simula. In BETA, patterns are *first-class values*, which implies that procedures as well as classes are first-class values. BETA also supports the notion of *class-less* objects, which has been adapted in the form of anonymous classes in Java. Finally, it

R. Wilhelm (Ed.): CC 2001, LNCS 2027, pp. 1–2, 2001.

might be mentioned that BETA supports *coroutines* as well as *concurrent active objects*. For further details about BETA, see [6,9,11]. The Mjølner System is a program development environment for BETA and may be obtained from ref. [12].

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