

# Lecture Notes in Computer Science

545

Edited by G. Goos and J. Hartmanis

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



H. Alblas B. Melichar (Eds.)

# Attribute Grammars, Applications and Systems

International Summer School SAGA  
Prague, Czechoslovakia, June 4-13, 1991  
Proceedings

**Springer-Verlag**

Berlin Heidelberg New York  
London Paris Tokyo  
Hong Kong Barcelona  
Budapest

Series Editors

Gerhard Goos  
GMD Forschungsstelle  
Universität Karlsruhe  
Vincenz-Priessnitz-Straße 1  
W-7500 Karlsruhe, FRG

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

Volume Editor

Henk Alblas  
University of Twente, Department of Computer Science  
P. O. Box 217, 7500 AE Enschede, The Netherlands

Bořivoj Melichar  
Czech Technical University, Department of Computers  
Karlovo náměstí 13, 121 35 Prague 2, Czechoslovakia

CR Subject Classification (1991): A.1, D.2.m, D.3.1, D.3.4, F.4.1-3, J.6

ISBN 3-540-54572-7 Springer-Verlag Berlin Heidelberg New York  
ISBN 0-387-54572-7 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 1991  
Printed in Germany

Typesetting: Camera ready by author  
Printing and binding: Druckhaus Beltz, Hemsbach/Bergstr.  
45/3140-543210 - Printed on acid-free paper

# Foreword

Attribute grammars have shown themselves to be a useful formalism for specifying the syntax and the static semantics of programming languages, as well as for implementing syntax-directed editors, compilers, translator writing systems and compiler generators, and, more generally, any application that has a strong syntactic basis. The large amount of literature on theoretical aspects, applications and systems, which has appeared since Knuth introduced the basic concepts in 1968 proves the importance of the area.

Nevertheless, no textbooks are available that cover the entire field. To redress this imbalance, an International Summer School on Attribute Grammars, BApplications and Systems was held in Prague, Czechoslovakia, June 4 – 13, 1991. The course aimed at teaching the state of the art in attribute grammars, and their relation to other language specification methods. The emphasis was both on theory and applications.

The papers in these proceedings are well suited for self-tuition, but a selection of the collection of papers can also be used for introductory courses in attribute grammars.

The summer school was organized by the Czechoslovak Society for Computer Science and the Department of Computers, Faculty of Electrical Engineering, Czech Technical University. It was sponsored by International Computers Limited, Commercial Representation, Czechoslovakia, and Unilever, The Netherlands.

The Organization Committee consisted of Henk Alblas, University of Twente, Enschede, The Netherlands, and Bořivoj Melichar, Czech Technical University, Prague, Czechoslovakia. The Secretary was Milada Kučerová, Czech Technical University, Prague, Czechoslovakia.

University of Twente  
Czech Technical University  
August 1991

Henk Alblas  
Bořivoj Melichar

# Table of Contents

## Attribute Grammars

<b>Introduction to Attribute Grammars</b> .....	1
Henk Alblas (The Netherlands)	
<b>Attribute Grammars as a Specification Method</b> .....	16
Uwe Kastens (FRG)	
<b>Attribute Evaluation Methods</b> .....	48
Henk Alblas (The Netherlands)	
<b>Implementation of Visit-Oriented Attribute Evaluators</b> .....	114
Uwe Kastens (FRG)	
<b>Storage Allocation for Attribute Evaluators Using Stacks and Queues</b> .....	140
Rieks op den Akker and Erik Sluiman (The Netherlands)	
<b>Grammar Flow Analysis</b> .....	151
Ulrich Möncke and Reinhard Wilhelm (FRG)	
<b>Attribute Evaluation and Parsing</b> .....	187
Rieks op den Akker (The Netherlands), Bořivoj Melichar (Czechoslovakia), Jorma Tarhio (Finland)	
<b>Incremental Attribute Evaluation</b> .....	215
Henk Alblas (The Netherlands)	
<b>A Survey of Parallel Attribute Evaluation Methods</b> .....	234
Martin Jourdan (France)	

## Related Formalisms

<b>Higher Order Attribute Grammars</b> .....	256
Doaitse Swierstra and Harald Vogt (The Netherlands)	
<b>Object-Orientation in Attribute Grammars</b> .....	297
Kai Koskimies (Finland)	
<b>Attribute Grammars and Logic Programs:</b>	
<b>A Comparison of Concepts</b> .....	330
Jan Maluszyński (Sweden)	
<b>Affix Grammars for Programming Languages</b> .....	358
Kees Koster (The Netherlands)	

<b>Incremental Static-Semantic Analysis for Object-Oriented Languages Using Door Attribute Grammars</b> .....	374
Görel Hedin (Sweden)	

## **Applications**

<b>Attribute Grammars in a Compiler Construction Environment</b> .....	380
Uwe Kastens (FRG)	
<b>Prototyping by Using an Attribute Grammar as a Logic Program</b> .....	401
Günter Riedewald (FRG)	
<b>Using the Generative Aspect of Attribute Grammars in a Knowledge Based Way</b> .....	438
Peter Forbrig (FRG)	
<b>Natural Language Interface Construction Using Attribute Grammars</b> .....	460
Tibor Gyimóthy (Hungary)	
<b>Affix Grammars for Natural Languages</b> .....	469
Kees Koster (The Netherlands)	

## **Systems**

<b>Internals and Externals of the FNC-2 Attribute Grammar System</b> .....	485
Martin Jourdan and Didier Parigot (France)	
<b>An Overview of the OPTRAN System</b> .....	505
Peter Lipps, Ulrich Möncke, Reinhard Wilhelm (FRG)	
<b>Attribute Reevaluation in OPTRAN</b> .....	507
Reinhard Wilhelm (FRG)	
<b>The Translator Writing System RUEGEN - KS</b> .....	508
Ralf Lämmel (FRG)	