Semantics-Directed Compiler Generation*

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Abstract

This dissertation concerns the design and implementation of SEMCOM, an interpreter generator for arbitrary languages, which compiles a two-level operational semantics (in either big- or small-step style). Input to SEMCOM is expressed in a purpose-designed Semantic Description Language (SDL). An SDL file contains the definition of an evaluation and typing relation, and can express type systems up to polymorphism. The SEMCOM compiler performs a sequence of analyses on this input, and generates a lexer, parser, and interpreter (in both OCaml and F#) for the user's language. SDL itself is typed, and a number of consistency checks are performed, producing comprehensive debugging output and useful error messages. Non-deterministic semantics are supported.

1   Introduction

In essence, computation has always been concerned with automation, and this takes place at many different levels. Rather than building systems directly in hardware, we have a processor that provides a convenient *abstraction* – that is to say, we can concern ourselves with the movement and processing of binary data, rather than the control of electrical signals. Furthermore, we do not write general purpose programs in assembler, but use an *abstracted* language in which we can talk about more meaningful concepts, such as objects, functions, and so forth.

The concept of abstraction does not end here, however. A programming language is not just a shorthand for sequences of assembler instructions – it has an underlying meaning, which is in some sense separate from the implementation. Over the course of time, our concept of the *semantics* of a language has developed, so that we now have an underlying mathematical framework with which to describe the execution of a program. In particular, an *operational* semantics is a specification of an abstract machine (an inductively defined transition relation), that explains the execution of a program as a sequence of syntactic transformations. Given this formal description of a programming language, is it not natural to ask whether a compiler could be generated automatically?

This is not as far-fetched as it sounds. Consider the humble parser. Before the theory of formal context-free grammars was understood, the programmer had to code their lexing and parsing routines by hand. Now, we have tools such as yacc, which will generate an efficient parser from a BNF-style description of a grammar. Although this is a considerably more constrained problem than the one just posed, it shows that useful tools can arise from the

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*In this document, the term *compiler generator* is used to refer more generally to the automated generation of compilers, interpreters and abstract machines.

Semantics Directed Compiler Generation

J. Diaz,I. Ramos

Semantics Directed Compiler Generation:

Semantics-Directed Compiler Generation N. D. Jones,2014-01-15   Semantics-Directed Compiler Generation ,
Semantics-directed Compiler Generation Neil D. Jones,1980   **Semantics and Algebraic Specification** Jens Palsberg,2009-08-28 This Festschrift volume published to honor Peter D Mosses on the occasion of his 60th birthday includes 17 invited chapters by many of Peter s coauthors collaborators close colleagues and former students Peter D Mosses is known for his many contributions in the area of formal program semantics In particular he developed action semantics a combination of denotational operational and algebraic semantics The presentations given on a symposium in his honor in Udine Italy on September 10 2009 were on subjects related to Peter s many technical contributions and they were a tribute to his lasting impact on the field Topics addressed by the papers are action semantics security policy design colored petri nets order sorted parameterization and induction object oriented action semantics structural operational semantics model transformations the scheme programming language type checking action algebras and denotational semantics   Compiler Generators Mads Tofte,2012-12-06 The OrIgIn of this monograph is a course entitled Semantics directed Compiler Generation which Professor Neil D Jones gave in 1982 at Copenhagen University where I was a student at the time In this course he described a compiler generator called CERES which he was developing I immediately felt attracted to the unusual combination of mathematical reasoning about com pilers and the small intricate building blocks that made up the running system As I came to understand the system I discovered that within the existing mathematical framework one could express compiler generation as a special case of compilation this led to a specification of a compiler generator which was bootstrapped on itself resulting in a machine generated compiler generator The purpose of this monograph is to describe the CERES system we produced in 1983 84 and compare it with other systems includ ing more recent ones Also it is as relevant today as it was then to discuss the role of compiler generators as an aid in the design and implementation of programming languages this I do in Chap 5 This monograph is a strongly revised version of the cando scient   *Partial Evaluation and Automatic Program Generation* Neil D. Jones,Carsten K. Gomard,Peter Sestoft,1993 Partial evaluation reconciles generality with efficiency by providing automatic specialization and optimization of programs This book covers the entire field of partial evaluation provides simple and complete algorithms and demonstrates that specialization can increase efficiency   **ESOP 86** Bernard Robinet,1986-03   **Mathematical Foundations of Programming Language Semantics** Michael Main,Austin Melton,Michael Mislove,David Schmidt,1988-03-09 This volume is the proceedings of the 3rd Workshop on the Mathematical Foundations of Programming Language Semantics held at Tulane University New Orleans Louisiana April 8 10 1987 The 1st Workshop was at Kansas State University Manhattan Kansas in April 1985 see LNCS 239 and the 2nd Workshop with a limited number of participants was at Kansas State in April 1986 It was the intention of the organizers that the 3rd Workshop survey as many areas of the Mathematical Foundations of Programming Language Semantics as

reasonably possible The Workshop attracted 49 submitted papers from which 28 papers were chosen for presentation The papers ranged in subject from category theory and Lambda calculus to the structure theory of domains and power domains to implementation issues surrounding semantics <u>Conference Record of the Eighteenth Annual ACM Symposium on Principles of Programming Languages</u> ,1991 **Programming Language Implementation and Logic Programming** Jan Małuszyński,Martin Wirsing,1991-08-14 This volume contains the papers which have been accepted for presentation atthe Third International Symposium on Programming Language Implementation andLogic Programming PLILP 91 held in Passau Germany August 26 28 1991 The aim of the symposium was to explore new declarative concepts methods and techniques relevant for the implementation of all kinds of programming languages whether algorithmic or declarative ones The intention was to gather researchers from the fields of algorithmic programming languages as well as logic functional and object oriented programming This volume contains the two invited talks given at the symposium by H Ait Kaci and D B MacQueen 32 selected papers and abstracts of several system demonstrations The proceedings of PLILP 88 and PLILP 90 are available as Lecture Notes in Computer Science Volumes 348 and 456 <u>Methods and Tools for Compiler Construction</u> B. Lorho,1984 For a long time compiler construction was considered an operation to be carried out by only a few skilled specialists However over the past decade numerous theoretical advances have led to a methodology of compiler writing as well as to tools for automatic and semi automatic compiler construction This book is the result of an advanced course sponsored by the Commission of the European Communities and the Institut National de Recherche en Informatique et en Automatique The course Methods and Tools for Compiler Construction was held in Rocquencourt in December 1983 The volume places its emphasis on specific areas where significant improvements have been made including attribute grammars compilation from semantic definitions code generation and optimization and Ada compiling <u>Algol-like Languages</u> Peter O'Hearn,Robert Tennent,1997 In recent years there has been a remarkable convergence of interest in programming languages based on ALGOL 60 Researchers interested in the theory of procedural and object oriented languages discovered that ALGOL 60 shows how to add procedures and object classes to simple imperative languages in a general and clean way And on the other hand researchers interested in purely functional languages discovered that ALGOL 60 shows how to add imperative mechanisms to functional languages in a way that does not compromise their desirable properties Unfortunately many of the key works in this field have been rather hard to obtain The primary purpose of this collection is to make the most significant material on ALGoL like languages conveniently available to graduate students and researchers *Functional Programming Languages and Computer Architecture* John Hughes,1991-08-07 This book offers a comprehensive view of the best and the latest work in functional programming It is the proceedings of a major international conference and contains 30 papers selected from 126 submitted A number of themes emerge One is a growing interest in types powerful type systems or type checkers supporting overloading coercion dynamic types and incremental inference linear types to optimize storage and

polymorphic types to optimize semantic analysis The hot topic of partial evaluation is well represented techniques for higher order binding time analysis assuring termination of partial evaluation and improving the residual programs a partial evaluator generates The thorny problem of manipulating state in functional languages is addressed one paper even argues that parallel programs with side effects can be more declarative than purely functional ones Theoretical work covers a new model of types based on projections parametricity a connection between strictness analysis and logic and a discussion of efficient implementations of the lambda calculus The connection with computer architecture and a variety of other topics are also addressed **Attribute Grammars** Pierre Deransart,Martin Jourdan,Bernard Lorho,1988-08-10 This book treats the problem of formulating models in mathematical programming and thereafter solving the resulting model Particular emphasis is placed on the interaction between the two The topic is viewed from different angles namely linear programming Walter Murray integer programming Ellis Johnson network flows John Mulvey and stochastic programming Roger J B Wets The book will be very useful for any mathematics programmer or operations researcher who works in the field of real world modelling The book is an important part of any university course in modelling particularly in operations research economics and business The book also contains an article on the origins of mathematical programming Alexander Rinnooy Kan This is important reading for anyone interested in the history of the field **Formal Methods: State of the Art and New Directions** Paul Boca,Jonathan P. Bowen,Jawed Siddiqi,2009-12-04 Through fundamental contributions from leading researchers this volume describes the use of formal modeling methods in the areas of requirements design and validation The self contained chapters provide readers with rich background information and a diverse breadth of specialist material *Denotational Semantics-directed Compiler Generation for Data Flow Machines* William Shan-Jon Chao,Barrett Richard Bryant,1988 *Semantic Methods for Knowledge Management and Communication* Radosław Katarzyniak Katarzyniak,Tzu-Fu Chiu,Chao-Fu Hong,Ngoc-Thanh Nguyen,2011-08-04 The book consists of 31 chapters in which the authors deal with multiple aspects of modeling utilization and implementation of semantic methods for knowledge management and communication in the context of human centered computing It is assumed that the modern human centered computing requires the intensive application of these methods as well as effective integration with multiple techniques of computational collective intelligence The book is organized in four parts devoted to the presentation of utilization of knowledge processing in agent and multiagent systems application of computational collective intelligence to knowledge management models for collectives of intelligent agents and models and environments tailored directly to human centered computing All chapters in the book discuss theoretical and practical issues related to various models and aspects of computational techniques for semantic methods which are currently studied and developed in many academic and industry centers over the world The editors hope that the book can be useful for graduate and PhD students of computer science as well as for mature academics researchers and practitioners interested in developing of modern methods for representation

processing and distribution of knowledge in the context of human centered computing and by means of computer based information systems It is the hope of the editors that readers of this volume can find in all chosen chapters many inspiring ideas and influential practical examples as well as use them in their current and future work   *Intelligent Agents* Michael J. Wooldridge,1995-01-26 This volume coherently present 24 thoroughly revised full papers accepted for the ECAI 94 Workshop on Agent Theories Architectures and Languages There is currently considerable interest from both the AI and the mainstream CS communities in conceptualizing and building complex computer systems as collections of intelligent agents This book is devoted to theoretical and practical aspects of architectural and language related design and implementation issues of software agents Particularly interesting is the comprehensive survey by the volume editors which outlines the key issues and indicates via a comprehensive bibliography topics for further reading In addition a glossary of key terms in this emerging field and a comprehensive subject index is included   *Programming Logics* Andrei Voronkov,Christoph Weidenbach,2013-04-05 This Festschrift volume published in memory of Harald Ganzinger contains 17 papers from colleagues all over the world and covers all the fields to which Harald Ganzinger dedicated his work during his academic career The volume begins with a complete account of Harald Ganzinger s work and then turns its focus to the research of his former colleagues students and friends who pay tribute to him through their writing Their individual papers span a broad range of topics including programming language semantics analysis and verification first order and higher order theorem proving unification theory non classical logics reasoning modulo theories and applications of automated reasoning in biology **Formalization of Programming Concepts** J. Diaz,I. Ramos,1981-04

Semantics Directed Compiler Generation Book Review: Unveiling the Magic of Language

In an electronic era where connections and knowledge reign supreme, the enchanting power of language has be more apparent than ever. Its capability to stir emotions, provoke thought, and instigate transformation is truly remarkable. This extraordinary book, aptly titled "**Semantics Directed Compiler Generation**," compiled by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound affect our existence. Throughout this critique, we shall delve to the book is central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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