



MICHAEL WOLFE

# **Optimizing Supercompilers for Supercomputers**

The MIT Press

# Optimising Supercompilers For Supercomputers

**Rudolf Eigenmann, Zhiyuan Li, Samuel  
P. Midkiff**



## **Optimising Supercompilers For Supercomputers:**

**Optimizing Supercompilers for Supercomputers** Michael Joseph Wolfe, 1989 Effective use of a supercomputer requires users to have a good algorithm and to express this algorithm in an appropriate language and requires compilers to generate efficient code This book investigates several problems facing compiler design for supercomputers including building efficient and comprehensive data dependence graphs recurrence relations the management of compiler temporary variables and WHILE loops The book first proposes an efficient means of representing the flow of data in a program by labeling the arcs in a data dependence graph with direction vectors to show how the flow of data corresponds to the loop structure of the program These data dependence direction vectors are then used in several high level compiler loop optimizations loop vectorization loop concurrentization loop fusion and loop interchanging The book shows how to perform these transformations and how to use them to optimize programs for a wide range of supercomputers The problems of recurrence relations studied include arithmetic recurrences with IF statements and recurrences involving both data and control dependence relations in a cycle The wavefront method of solving recurrences is also treated The book discusses ways to make the problem of managing temporary arrays more tractable It concludes by offering several methods for executing WHILE loops and describes a general structure of an optimizing compiler for supercomputers developed from the author's experience with a test bed compiler Michael Wolfe is Associate Professor in the Computer Science and Engineering Department at the Oregon Graduate Center **Optimizing Supercompilers for Supercomputers** is included in the series Research Monographs in Parallel Computing Copublished with Pitman Publishing

**Optimizing Supercompilers for Supercomputers** Michael Joseph Wolfe, 1982 **Languages and Compilers for Parallel Computing** Utpal Banerjee, 1993-12-08 The articles in this volume are revised versions of the best papers presented at the Fifth Workshop on Languages and Compilers for Parallel Computing held at Yale University August 1992 The previous workshops in this series were held in Santa Clara 1991 Irvine 1990 Urbana 1989 and Ithaca 1988 As in previous years a reasonable cross section of some of the best work in the field is presented The volume contains 35 papers mostly by authors working in the U S or Canada but also by authors from Austria Denmark Israel Italy Japan and the U K

**Compiler Optimizations for Scalable Parallel Systems** Santosh Pande, Dharma P. Agrawal, 2003-06-29 Scalable parallel systems or more generally distributed memory systems offer a challenging model of computing and pose fascinating problems regarding compiler optimization ranging from language design to run time systems Research in this area is foundational to many challenges from memory hierarchy optimizations to communication optimization This unique handbook like monograph assesses the state of the art in the area in a systematic and comprehensive way The 21 coherent chapters by leading researchers provide complete and competent coverage of all relevant aspects of compiler optimization for scalable parallel systems The book is divided into five parts on languages analysis communication optimizations code generation and run time systems This book will serve as a

landmark source for education information and reference to students practitioners professionals and researchers interested in updating their knowledge about or active in parallel computing

**Logic for Programming, Artificial Intelligence, and Reasoning** Miki Hermann, Andrei Voronkov, 2006-10-23 This book constitutes the refereed proceedings of the 13th International Conference on Logic for Programming Artificial Intelligence and Reasoning LPAR 2006 held in Phnom Penh Cambodia in November 2006 The 38 revised full papers presented together with one invited talk were carefully reviewed and selected from 96 submissions

**A Systolic Array Optimizing Compiler** Monica S. Lam, 2012-12-06 This book is a revision of my Ph D thesis dissertation submitted to Carnegie Mellon University in 1987 It documents the research and results of the compiler technology developed for the Warp machine Warp is a systolic array built out of custom high performance processors each of which can execute up to 10 million floating point operations per second 10 MFLOPS Under the direction of H T Kung the Warp machine matured from an academic experimental prototype to a commercial product of General Electric The Warp machine demonstrated that the scalable architecture of high performance programmable systolic arrays represents a practical cost effective solution to the present and future computation intensive applications The success of Warp led to the follow on iWarp project a joint project with Intel to develop a single chip 20 MFLOPS processor The availability of the highly integrated iWarp processor will have a significant impact on parallel computing One of the major challenges in the development of Warp was to build an optimizing compiler for the machine First the processors in the xx A Systolic Array Optimizing Compiler array cooperate at a fine granularity of parallelism interaction between processors must be considered in the generation of code for individual processors Second the individual processors themselves derive their performance from a VLIW Very Long Instruction Word instruction set and a high degree of internal pipelining and parallelism The compiler contains optimizations pertaining to the array level of parallelism as well as optimizations for the individual VLIW processors

**Languages and Compilers for High Performance Computing** Rudolf Eigenmann, Zhiyuan Li, Samuel P. Midkiff, 2005-08-25 The 17th International Workshop on Languages and Compilers for High Performance Computing was hosted by Purdue University in September 2004 on Purdue campus in West Lafayette Indiana USA

**Parallel Language and Compiler Research in Japan** Lubomir Bic, Alexandru Nicolau, Mitsuhiro Sato, 2012-12-06 Parallel Language and Compiler Research in Japan offers the international community an opportunity to learn in depth about key Japanese research efforts in the particular software domains of parallel programming and parallelizing compilers These are important topics that strongly bear on the effectiveness and affordability of high performance computing systems The chapters of this book convey a comprehensive and current depiction of leading edge research efforts in Japan that focus on parallel software design development and optimization that could be obtained only through direct and personal interaction with the researchers themselves

**EURO-PAR '95: Parallel Processing** Seif Haridi, Khayri Ali, Peter Magnusson, 1995 This book presents the proceedings of the First International EURO PAR Conference on Parallel Processing held in Stockholm Sweden in August

1995 EURO PAR is the merger of the former PARLE and CONPAR VAPP conference series the aim of this merger is to create the premier annual scientific conference on parallel processing in Europe The book presents 50 full revised research papers and 11 posters selected from a total of 196 submissions on the basis of 582 reviews The scope of the contributions spans the full spectrum of parallel processing ranging from theory over design to application thus the volume is a must for anybody interested in the scientific aspects of parallel processing or its advanced applications *Languages and Compilers for Parallel Computing* Keshav Pingali,1995-01-26 This volume presents revised versions of the 32 papers accepted for the Seventh Annual Workshop on Languages and Compilers for Parallel Computing held in Ithaca NY in August 1994 The 32 papers presented report on the leading research activities in languages and compilers for parallel computing and thus reflect the state of the art in the field The volume is organized in sections on fine grain parallelism alignment and distribution postlinear loop transformation parallel structures program analysis computer communication automatic parallelization languages for parallelism scheduling and program optimization and program evaluation *Proceedings of the Fifth SIAM Conference on Parallel Processing for Scientific Computing* J. J. Dongarra,1992-01-01 This text gives the proceedings for the fifth conference on parallel processing for scientific computing Languages, Compilers, and Run-Time Systems for Scalable Computers David O'Hallaron,2003-06-29 This book constitutes the strictly refereed post workshop proceedings of the 4th International Workshop on Languages Compilers and Run Time Systems for Scalable Computing LCR 98 held in Pittsburgh PA USA in May 1998 The 23 revised full papers presented were carefully selected from a total of 47 submissions also included are nine refereed short papers All current issues of developing software systems for parallel and distributed computers are covered in particular irregular applications automatic parallelization run time parallelization load balancing message passing systems parallelizing compilers shared memory systems client server applications etc **Languages and Compilers for Parallel Computing** Henry Gordon Dietz,2003-05-20 This book constitutes the thoroughly refereed post proceedings of the 14th International Workshop on Languages and Compilers for Parallel Computing LCPC 2001 held in Lexington KY USA in August 1 3 2001 The 28 revised full papers presented were carefully selected during two rounds of reviewing and improvement All current issues in parallel processing are addressed in particular compiler optimization HP Java programming power aware parallel architectures high performance applications power management of mobile computers data distribution shared memory systems load balancing garbage collection parallel components job scheduling dynamic parallelization cache optimization specification and dataflow analysis *Supercomputing in Engineering Analysis* Hojjat Adeli,2020-08-13 The first volume in this new series has a companion in volume 2 unseen Parallel processing in computational mechanics The first six contributions present general aspects of supercomputing from both hardware and software engineering points of view Subsequent chapters discuss homotopy algorithms Languages, Compilers, and Tools for Embedded Systems Frank Mueller,Azer Bestavros,1998 This book constitutes the strictly refereed post workshop

proceedings of the ACM SIGPLAN Workshop on Languages Compilers and Tools for Embedded Systems LCTES 98 held in Montreal Canada in June 1998 The 19 revised papers presented were carefully reviewed and selected from a total of 54 submissions for inclusion in the book also included are one full paper and an abstract of an invited contribution The papers address all current aspects of research and development in the rapidly growing area of embedded systems and real time computing

**Programming Languages and System Architectures** Jürg Gutknecht, 1994-02-22 Programming languages and system architectures are at the frontiers of two different worlds The conference on which this book is based was an adventure in a land where the two worlds the formal world of algorithms and the physical world of electronic circuits interact The participants explored this land under the guidance of internationally renowned researchers such as Butler W Lampson Susan Graham Jan L A van de Snepscheut and C A R Hoare all of whom gave invited papers The volume includes these papers together with sixteen session papers Subjects of special interest include programming language design and history programming environments programming methods operating systems compiler construction and innovative system architectures

**Code Generation — Concepts, Tools, Techniques** Robert Giegerich, S.L. Graham, 2013-03-09 Code Generation Concepts Tools Techniques is based upon the proceedings of the Dagstuhl workshop on code generation which took place from 20-24 May 1991 The aim of the workshop was to evaluate current methods of code generation and to indicate the main directions which future research is likely to take It provided an excellent forum for the exchange of ideas and had the added advantage of bringing together European and American experts who were unlikely to meet at less specialised gatherings This volume contains 14 of the 30 papers presented at the Dagstuhl workshop The papers deal mainly with the following four topics tools and techniques for code generation code generation for parallel architectures register allocation and phase ordering problems and formal methods and validations Most of the papers assess the progress of on going research work much of which is published here for the first time while others provide a review of recently completed projects The volume also contains summaries of two discussion groups which looked at code generation tools and parallel architectures As a direct result of one of these discussions a group of the participants have collaborated to make a pure BURS system available for public distribution This system named BURG is currently being beta tested Code Generation Concepts Tools Techniques provides a representative summary of state of the art code generation techniques and an important assessment of possible future innovations It will be an invaluable reference work for researchers and practitioners in this important area

*Software and Compilers for Embedded Systems* Andreas Krall, 2003-10-24 This volume contains the proceedings of the 7th International Workshop on Software and Compilers for Embedded Systems SCOPES 2003 held in Vienna Austria September 24-26 2003 Initially the workshop was referred to as the International Workshop on Code Generation for Embedded Systems The first workshop took place in 1994 in Schloss Dagstuhl Germany From its beginnings the intention of the organizers was to create an atmosphere in which the researchers could participate actively in dynamic

discussions and profit from the assembly of international experts in the field. It was at the fourth workshop in St. Goar, Germany, in 1999 that the spectrum of topics of interest for the workshop was extended and not only code generation but also software and compilers for embedded systems were considered. The change in fields of interest led to a change of name and this is when the present name was used for the first time. Since then SCOPES has been held again in St. Goar, Germany, in 2001, Berlin, Germany, in 2002, and this year 2003 in Vienna, Austria. In response to the call for papers, 43 very strong papers from all over the world were submitted. The program committee selected 26 papers for presentation at SCOPES 2003. All submitted papers were reviewed by at least three experts in order to ensure the quality of the work presented at the workshop.

**Algorithm Engineering for Integral and Dynamic Problems** Lucia Rapanotti, 2001-01-23. Algorithm engineering allows computer engineers to produce a computational machine that will execute an algorithm as efficiently and cost effectively as possible given a set of constraints such as minimal performance or the availability of technology. Addressing algorithm engineering in a parallel setting, regular array syntheses offer powerful computation and embody best practice but often face the criticism that they are applicable only to restricted classes of algorithms. *Algorithm Engineering for Integral and Dynamic Problems* reviews the basic principles of regular array synthesis and shows how to extend its use into classes of algorithms traditionally viewed to be beyond its domain of application. The author discusses the transformation of the initial algorithm specification into a specification with data dependencies of increased regularity in order to obtain corresponding regular arrays by direct application of the standard mapping techniques. The book includes a review of the basic principles of regular array synthesis followed by applications of these techniques to well-known algorithms, concluding with numerous case studies to illustrate the methods. Researchers and practitioners in algorithm engineering will find that this text significantly extends their understanding of the applications of regular array synthesis and regular array processors beyond the traditionally narrow field of relevance.

**Languages and Compilers for Parallel Computing** Chua-Huang Huang, 1996-01-24. This book presents the refereed proceedings of the Eighth Annual Workshop on Languages and Compilers for Parallel Computing held in Columbus, Ohio, in August 1995. The 38 full revised papers presented were carefully selected for inclusion in the proceedings and reflect the state of the art of research and advanced applications in parallel languages, restructuring compilers, and runtime systems. The papers are organized in sections on fine grain parallelism, interprocedural analysis, program analysis, Fortran 90 and HPF loop parallelization for HPF compilers, tools and libraries, loop level optimization, automatic data distribution, compiler models, irregular computation, object oriented and functional parallelism.

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