

# Symbolic Analysis for Parallelizing Compilers

Mohammad R.  
Haghighat

foreword by  
Constantine D.  
Polychronopoulos

# Symbolic Analysis For Parallelizing Compilers

**David O'Hallaron**



## **Symbolic Analysis For Parallelizing Compilers:**

*Symbolic Analysis for Parallelizing Compilers* Mohammad R. Haghighat, 2007-08-19 In *Symbolic Analysis for Parallelizing Compilers* the author presents an excellent demonstration of the effectiveness of symbolic analysis in tackling important optimization problems some of which inhibit loop parallelization The framework that Haghighat presents has proved extremely successful in induction and wraparound variable analysis strength reduction dead code elimination and symbolic constant propagation The approach can be applied to any program transformation or optimization problem that uses properties and value ranges of program names Symbolic analysis can be used on any transformational system or optimization problem that relies on compile time information about program variables This covers the majority of if not all optimization and parallelization techniques The book makes a compelling case for the potential of symbolic analysis applying it for the first time and with remarkable results to a number of classical optimization problems loop scheduling static timing or size analysis and dependence analysis It demonstrates how symbolic analysis can solve these problems faster and more accurately than existing hybrid techniques

**Symbolic Analysis for Parallelizing Compilers** Mohammad Reza Haghighat, 1994 Abstract The notion of dependence captures the most important properties of a program for efficient execution on parallel computers The dependence structure of a program defines the necessary constraints of the order of execution of the program components and provides sufficient information for the exploitation of the available parallelism Static discovery and management of the dependence structure of programs saves a tremendous amount of execution time and dynamic utilization of dependence information results in a significant performance gain on parallel computers However experiments with supercomputers indicate that existing multiprocessing environments are unable to deliver the desired performance over a wide range of real applications mainly due to lack of precision of their dependence information This calls for an effective compilation scheme capable of understanding the dependence structure of complicated application programs This thesis describes a methodology for capturing and analyzing program properties that are essential in the effective detection and efficient exploitation of parallelism on parallel computers Based on this methodology a symbolic analysis framework is developed for the Parafrase 2 parallelizing compiler This framework extends the scope of a variety of important program analysis problems and solves them in a unified way The attained solution space of these problems is much larger than that handled by existing compiler technology Such a powerful approach is required for the effective compilation of a large class of application programs

**Advanced Symbolic Analysis for Compilers** Thomas Fahringer, Bernhard Scholz, 2003-08-03 The objective of program analysis is to automatically determine the properties of a program Tools of software development such as compilers performance estimators debuggers reverse engineering tools program verification testing proving systems program comprehension systems and program specialization tools are largely dependent on program analysis Advanced program analysis can help to find program errors detect

and tune performan critical code regions ensure assumed constraints on data are not violated tailor a generic program to suit a speci c application reverse engineer so ware modules etc A prominent program analysis technique is symbolic a lysis which has attracted substantial attention for many years as it is not dependent on executing a program to examine the semantics of a program and it can yield very elegant formulations of many analyses Moreover the complexity of symbolic analysis can be largely independent of the input data size of a program and of the size of the machine on which the program is being executed In this book we present novel symbolic control and data ow repres tation techniques as well as symbolic techniques and algorithms to analyze and optimize programs Program contexts which de ne a new symbolic scription of program semantics for control and data ow analysis are at the center of our approach We have solved a number of problems encountered in program analysis by using program contexts Our solution methods are e cient versatile uni ed and more general they cope with regular and irregular codes than most existing methods

**Symbolic Program Analysis and Optimization for Parallelizing Compilers** University of Illinois at Urbana-Champaign. Center for Supercomputing Research and Development, M. R. Haghighat, C. D. Polychronopoulos, 1992 A systematic method for generalized strength reduction based on this representation is also presented This results in an effective scheme for exploitation of parallelism and optimization of the code Symbolic analysis also serves as a basis for other code generation optimizations such as elimination of redundant computations Languages and Compilers for Parallel Computing Bill Pugh, Chau-Wen Tseng, 2005-12-17 The 15th Workshop on Languages and Compilers for Parallel Computing was held in July 2002 at the University of Maryland College Park It was jointly sponsored by the Department of Computer Science at the University of Ma land and the University of Maryland Institute for Advanced Computer Studies UMIACS

LCPC2002broughttogetherover60researchersfromacademiaand research institutions from many countries The program of 26 papers was selected from 32 submissions Each paper was reviewed by at least three Program Committee members and sometimes by additional reviewers Prior to the workshop revised versions of accepted papers were informally published on the workshop s website and in a paper proceedings that was distributed at the meeting This year the workshopwas organizedinto sessions of papers on related topics and each session consisted of two to three 30 minute presentations Based on feedback from the workshop the papers were revised and submitted for inclusion in the formal proceedings published in this volume Two papers were presented at the workshop but later withdrawn from the nal proceedings by their authors We were very lucky to have Bill Carlson from the Department of Defense give the LCPC 2002 keynote speech on UPC A C Language for Shared M ory Parallel Programming Bill gave an excellent overview of the features and programming model of the UPC parallel programming language Symbolic Dependence Analysis for High Performance Parallelizing Compilers Mohammad Reza Haghighat, Constantine D. Polychronopoulos, 1990 Abstract A framework is introduced to solve the dependence problem in the presence of unknown symbolic terms This framework uses the idea of abstract interpretation of

programs and is based on lattice theoretical models Theories of dependence analysis flow analysis and approximate semantic analysis of programs are discussed The details of implementation of symbolic dependence analysis in Parafrase 21 PGH 89 is presented

**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

*Languages and Compilers for Parallel Computing* ,2003

*Symbolic Analysis Techniques for Effective Automatic Parallelization* William Joseph Blume,University of Illinois at Urbana-Champaign. Department of Computer Science,1995

**ACM Transactions on Programming Languages and Systems** Association for Computing Machinery,2005 Contains articles on programming languages and their semantics programming systems storage allocations and garbage collection languages and methods for writing specifications testing and verification methods and algorithms specifically related to the implementation of language processors

Proceedings of the 1996 ICPP Workshop on Challenges for Parallel Processing, August 12, 1996 Howard Jay Siegel,1996 The proceedings of the August 1996 workshop are contained in four volumes v 1 Architecture v 2 Algorithms and Applications v 3 Software and the fourth volume the proceedings of a workshop connected with the conference Challenges for Parallel Processing A total of 270 papers are present

**Compiler Analysis for Cache Coherence** Lynn Choi, Pen-Chung Yew, University of Illinois at Urbana-Champaign. Department of Computer Science,1996 Abstract In this paper we present compiler algorithms for detecting references to stale data in shared memory multiprocessors The algorithm consists of two key analysis techniques stale reference detection and locality preserving analysis While the stale reference detection finds the memory reference patterns that may violate cache coherence the locality preserving analysis minimizes the number of such stale references by analyzing both temporal and spatial reuses By computing the regions referenced by arrays inside loops we extend the previous scalar algorithms 8 for more precise analysis We develop a full interprocedural array data flow algorithm which performs both bottom up side effect analysis and top down context analysis on the procedure call graph to further exploit locality across procedure boundaries The interprocedural algorithm eliminates cache invalidations at procedure boundaries which were assumed in the previous compiler algorithms 9 We have fully implemented the algorithm in the Polaris parallelizing compiler 27 Using execution driven simulations on Perfect Club benchmarks we demonstrate how unnecessary cache misses can be eliminated by the automatic stale reference detection The algorithm can be used to implement cache coherence in the shared memory multiprocessors that do not have hardware directories such as Cray T3D 20

**Proceedings of the Fifth Euromicro Workshop on Parallel and Distributed Processing** ,1997 **Languages,**

**Compilers, and Run-Time Systems for Scalable Computers** David O'Hallaron,1998-10-07 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

**Compiler Construction** ,2000 **Proceedings of the ... ACM SIGPLAN Symposium on Principles & Practice of Parallel Programming** ,2007 *Conference Proceedings* ,2003 *Languages and Compilers for Parallel Computing* David Hillel Gelernter,Alexandru Nicolau,David A. Padua,1990 A collection of papers examining the languages and compilers for parallel computing It covers a wide variety of topics ranging from improving parallel program performance using critical path analysis to software engineering of parallel programs in the computation orientated display environment *Proceedings of the 1994 International Conference on Parallel Processing, August 15-19, 1994: Software* Dharma Prakash Agrawal,1994 **Conference Proceedings of the 2002 International Conference on Supercomputing** ,2002

## Unveiling the Energy of Verbal Art: An Psychological Sojourn through **Symbolic Analysis For Parallelizing Compilers**

In a global inundated with monitors and the cacophony of instant transmission, the profound energy and mental resonance of verbal art frequently disappear into obscurity, eclipsed by the constant assault of noise and distractions. However, nestled within the lyrical pages of **Symbolic Analysis For Parallelizing Compilers**, a captivating perform of literary brilliance that pulses with fresh thoughts, lies an unforgettable journey waiting to be embarked upon. Written with a virtuoso wordsmith, that mesmerizing opus books viewers on a mental odyssey, delicately exposing the latent possible and profound affect stuck within the elaborate web of language. Within the heart-wrenching expanse with this evocative examination, we shall embark upon an introspective exploration of the book is key styles, dissect their captivating publishing design, and immerse ourselves in the indelible impact it leaves upon the depths of readers souls.

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