# Optimizing Compilers for Modern Architectures

Syllabus

Allen and Kennedy, Preface

# **Optimizing Compilers For Modern Architectures**

Sunita Chandrasekaran, Guido Juckeland

#### **Optimizing Compilers For Modern Architectures:**

Optimizing Compilers for Modern Architectures: A Dependence-Based Approach Randy Allen, Ken Kennedy, 2001-10 Modern computer architectures designed with high performance microprocessors offer tremendous potential gains in performance over previous designs Yet their very complexity makes it increasingly difficult to produce efficient code and to realize their full potential This landmark text from two leaders in the field focuses on the pivotal role that compilers can play in addressing this critical issue The basis for all the methods presented in this book is data dependence a fundamental compiler analysis tool for optimizing programs on high performance microprocessors and parallel architectures It enables compiler designers to write compilers that automatically transform simple sequential programs into forms that can exploit special features of these modern architectures The text provides a broad introduction to data dependence to the many transformation strategies it supports and to its applications to important optimization problems such as parallelization compiler memory hierarchy management and instruction scheduling The authors demonstrate the importance and wide applicability of dependence based compiler optimizations and give the compiler writer the basics needed to understand and implement them They also offer cookbook explanations for transforming applications by hand to computational scientists and engineers who are driven to obtain the best possible performance of their complex applications. The approaches presented are based on research conducted over the past two decades emphasizing the strategies implemented in research prototypes at Rice University and in several associated commercial systems Randy Allen and Ken Kennedy have provided an indispensable resource for researchers practicing professionals and graduate students engaged in designing and optimizing compilers for modern computer architectures Offers a guide to the simple practical algorithms and approaches that are most effective in real world high performance microprocessor and parallel systems Demonstrates each transformation in worked examples Examines how two case study compilers implement the theories and practices described in each chapter Presents the most complete treatment of memory hierarchy issues of any compiler text Illustrates ordering relationships with dependence graphs throughout the book Applies the techniques to a variety of languages including Fortran 77 C hardware definition languages Fortran 90 and High Performance Fortran Provides extensive references to the most sophisticated algorithms known in research The Compiler Design Handbook Y.N. Srikant, Priti Shankar, 2018-10-03 Today s embedded devices and sensor networks are becoming more and more sophisticated requiring more efficient and highly flexible compilers Engineers are discovering that many of the compilers in use today are ill suited to meet the demands of more advanced computer architectures Updated to include the latest techniques The Compiler Design Handbook Second Edition offers a unique opportunity for designers and researchers to update their knowledge refine their skills and prepare for emerging innovations The completely revised handbook includes 14 new chapters addressing topics such as worst case execution time estimation garbage collection and energy aware compilation. The editors take special care to consider the

growing proliferation of embedded devices as well as the need for efficient techniques to debug faulty code New contributors provide additional insight to chapters on register allocation software pipelining instruction scheduling and type systems Written by top researchers and designers from around the world The Compiler Design Handbook Second Edition gives designers the opportunity to incorporate and develop innovative techniques for optimization and code generation High Performance Embedded Architectures and Compilers André Seznec, Michael O'Boyle, Joel Emer, Margaret Martonosi, Theo Ungerer, 2009-01-12 This book constitutes the refereed proceedings of the Fourth International Conference on High Performance Embedded Architectures and Compilers HiPEAC 2009 held in Paphos Cyprus in January 2009 The 27 revised full papers presented together with 2 invited keynote paper were carefully reviewed and selected from 97 submissions The papers are organized in topical sections on dynamic translation and optimisation low level scheduling parallelism and resource control communication mapping for CMPs power cache issues as well as parallel embedded applications 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 Compilers for Parallel Computing Santosh Pande, Vivek Sarkar, 2021-03-25 This book constitutes the thoroughly refereed post conference proceedings of the 32nd International Workshop on Languages and Compilers for Parallel Computing LCPC 2019 held in Atlanta GA USA in October 2019 The 8 revised full papers and 3 revised short papers were carefully reviewed and selected from 17 submissions The scope of the workshop includes advances in programming systems for current domains and platforms e g scientific computing batch streaming real time data analytics machine learning cognitive computing heterogeneous reconfigurable computing mobile computing cloud computing IoT as well as forward looking computing domains such as analog and quantum computing Languages and Compilers for Parallel Computing Lawrence Rauchwerger, 2019-11-19 This book constitutes the proceedings of the 30th International Workshop on Languages and Compilers for Parallel Computing LCPC 2017 held in College Station TX USA in October 2017 The 17 full papers presented together with abstracts of 5 keynote talks 11 invited speakers and 4 poster papers in this volume were carefully reviewed and selected from 26 submissions LCPC encourages submissions that go outside its original scope of scientific computing to diverse areas that are enable or enhanced by the power of parallel systems such as mobile computing big data relevant aspects of machine learning data centers cognitive computing etc LCPC strongly encourages personal interaction and technical discussions along the initial material **Engineering a Compiler** Keith D. Cooper, Linda Torczon, 2011-01-18 This entirely revised second edition of Engineering a Compiler is full of technical updates and new material covering the latest developments in compiler technology In this comprehensive text you will learn important techniques for constructing a modern compiler Leading educators and researchers Keith Cooper and Linda Torczon combine basic principles with

pragmatic insights from their experience building state of the art compilers They will help you fully understand important techniques such as compilation of imperative and object oriented languages construction of static single assignment forms instruction scheduling and graph coloring register allocation In depth treatment of algorithms and techniques used in the front end of a modern compiler Focus on code optimization and code generation the primary areas of recent research and development Improvements in presentation including conceptual overviews for each chapter summaries and review questions for sections and prominent placement of definitions for new terms Examples drawn from several different programming languages Languages and Compilers for Parallel Computing Chen Ding, John Criswell, Peng Wu, 2017-01-20 This book constitutes the thoroughly refereed post conference proceedings of the 29th International Workshop on Languages and Compilers for Parallel Computing LCPC 2016 held in Rochester NY USA in September 2016 The 20 revised full papers presented together with 4 short papers were carefully reviewed The papers are organized in topical sections on large scale parallelism resilience and persistence compiler analysis and optimization dynamic computation and languages GPUs and private memory and runt time and performance analysis Itanium Architecture for Programmers James S. Evans, Gregory L. Trimper, 2003 Step by step guide to assembly language for the 64 bit Itanium processors with extensive examples Details of Explicitly Parallel Instruction Computing EPIC Instruction set addressing register stack engine predication I O procedure calls floating point operations and more Learn how to comprehend and optimize open source Intel and HP UX compiler output Understand the full power of 64 bit Itanium EPIC processorsItaniumreg Architecture for Programmersis a comprehensive introduction to the breakthrough capabilities of the new 64 bit Itanium architecture Using standard command line tools and extensive examples the authors illuminate the Itanium design within the broader context of contemporary computer architecture via a step by step investigation of Itanium assembly language Coverage includes The potential of Explicitly Parallel Instruction Computing EPIC Itanium instruction formats and addressing modes Innovations such as the register stack engine RSE and extensive predication Procedure calls and procedure calling mechanisms Floating point operations I O techniques from simple debugging to the use of files Optimization of output from open source Intel and HP UX compilers An essential resource for both computing professionals and students of architecture or assembly language Itanium Architecture for Programmers includes extensive printed and Web based references plus many numeric essay and programming exercises for each chapter Compilers: Principles and Practice Parag H. Dave, Himanshu B. Dave, Compilers Principles and Practice explains the phases and implementation of compilers and interpreters using a large number of real life examples It includes examples from modern software practices such as Linux GNU Compiler Collection GCC and Perl This book has been class tested and tuned to the requirements of undergraduate computer engineering courses across universities in India **Introduction to Compiler Design** Torben Ægidius Mogensen, 2017-10-29 The second edition of this textbook has been fully revised and adds material about loop optimisation function call optimisation and dataflow analysis It

presents techniques for making realistic compilers for simple programming languages using techniques that are close to those used in real compilers albeit in places slightly simplified for presentation purposes All phases required for translating a high level language to symbolic machine language are covered including lexing parsing type checking intermediate code generation machine code generation register allocation and optimisation interpretation is covered briefly Aiming to be neutral with respect to implementation languages algorithms are presented in pseudo code rather than in any specific programming language but suggestions are in many cases given for how these can be realised in different language flavours Introduction to Compiler Design is intended for an introductory course in compiler design suitable for both undergraduate and graduate courses depending on which chapters are used <u>Fundamentals of Multicore Software Development Victor</u> Pankratius, Ali-Reza Adl-Tabatabai, Walter Tichy, 2011-12-12 With multicore processors now in every computer server and embedded device the need for cost effective reliable parallel software has never been greater By explaining key aspects of multicore programming Fundamentals of Multicore Software Development helps software engineers understand parallel programming and master the multicore challenge **Testing of Software and Communicating Systems** Margus Veanes, Jan Tretmans, Wolfgang Grieskamp, 2007-08-19 This book constitutes the refereed proceedings of the 19th IFIP TC 6 WG 6 1 International Conference on Testing Communicating Systems TestCom 2007 and the 7th International Workshop on Formal Approaches to Testing of Software FATES 2007 held in Tallinn Estonia It covers all current issues in testing communicating systems and formal approaches in testing of software from classical telecommunication issues to general software testing Introduction to Compiler Construction in a Java World Bill Campbell, Swami Iyer, Bahar Akbal-Delibas, 2012-11-21 Immersing students in Java and the JVM this text enables a deep understanding of the Java programming language and its implementation It focuses on design organization and testing helping students learn good software engineering skills and become better programmers By working with and extending a real functional compiler students develop a hands on appreciation of how compilers work how to write compilers and how the Java language behaves Fully documented Java code for the compiler is accessible on a supplementary website Static Analysis Francesco Logozzo, Manuel Fähndrich, 2013-06-15 This book constitutes the thoroughly refereed proceedings of the 20th International Symposium on Static Analysis SAS 2013 held in Seattle WA USA in June 2013 The 23 revised full papers presented together with 2 invited talks were selected from 56 submissions. The papers address all aspects of static analysis including abstract domains abstract interpretation abstract testing bug detection data flow analysis model checking new applications program transformation program verification security analysis theoretical frameworks and type checking **Computing Handbook** Allen Tucker, Teofilo Gonzalez, Heikki Topi, Jorge Diaz-Herrera, 2022-05-29 This two volume set of the Computing Handbook Third Edition previously the Computer Science Handbook provides up to date information on a wide range of topics in computer science information systems IS information technology IT and software engineering The third edition of this

popular handbook addresses not only the dramatic growth of computing as a discipline but also the relatively new delineation of computing as a family of separate disciplines as described by the Association for Computing Machinery ACM the IEEE Computer Society IEEE CS and the Association for Information Systems AIS Both volumes in the set describe what occurs in research laboratories educational institutions and public and private organizations to advance the effective development and use of computers and computing in today s world Research level survey articles provide deep insights into the computing discipline enabling readers to understand the principles and practices that drive computing education research and development in the twenty first century Chapters are organized with minimal interdependence so that they can be read in any order and each volume contains a table of contents and subject index offering easy access to specific topics The first volume of this popular handbook mirrors the modern taxonomy of computer science and software engineering as described by the Association for Computing Machinery ACM and the IEEE Computer Society IEEE CS Written by established leading experts and influential young researchers it examines the elements involved in designing and implementing software new areas in which computers are being used and ways to solve computing problems The book also explores our current understanding of software engineering and its effect on the practice of software development and the education of software professionals The second volume of this popular handbook demonstrates the richness and breadth of the IS and IT disciplines The book explores their close links to the practice of using managing and developing IT based solutions to advance the goals of modern organizational environments Established leading experts and influential young researchers present introductions to the current status and future directions of research and give in depth perspectives on the contributions of academic research to the practice of IS and IT development use and management **Computing Handbook** Teofilo Gonzalez, Jorge Diaz-Herrera, Allen Tucker, 2014-05-07 The first volume of this popular handbook mirrors the modern taxonomy of computer science and software engineering as described by the Association for Computing Machinery ACM and the IEEE Computer Society IEEE CS Written by established leading experts and influential young researchers it examines the elements involved in designing and implementing software new areas in which computers are being used and ways to solve computing problems The book also explores our current understanding of software engineering and its effect on the practice of software development and the education of software professionals OpenACC for Programmers Sunita Chandrasekaran, Guido Juckeland, 2017-09-11 The Complete Guide to OpenACC for Massively Parallel Programming Scientists and technical professionals can use OpenACC to leverage the immense power of modern GPUs without the complexity traditionally associated with programming them OpenACCTM for Programmers is one of the first comprehensive and practical overviews of OpenACC for massively parallel programming This book integrates contributions from 19 leading parallel programming experts from academia public research organizations and industry The authors and editors explain each key concept behind OpenACC demonstrate how to use essential OpenACC development tools and thoroughly explore each OpenACC feature set

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