Andrew B. Kahng
Jens Lienig
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VLSI Physical Design: From Graph Partitioning to Timing Closure

Second Edition

Vlsi Physical Design From Graph Partitioning To Timing Closure

Yangyuan Wang,Min-Hwa Chi,Jesse Jen-Chung Lou,Chun-Zhang Chen

Vlsi Physical Design From Graph Partitioning To Timing Closure:

VLSI Physical Design: From Graph Partitioning to Timing Closure Andrew B. Kahng,Jens Lienig,Igor L. Markov,Jin Hu,2011-01-27 Design and optimization of integrated circuits are essential to the creation of new semiconductor chips and physical optimizations are becoming more prominent as a result of semiconductor scaling Modern chip design has become so complex that it is largely performed by specialized software which is frequently updated to address advances in semiconductor technologies and increased problem complexities A user of such software needs a high level understanding of the underlying mathematical models and algorithms On the other hand a developer of such software must have a keen understanding of computer science aspects including algorithmic performance bottlenecks and how various algorithms operate and interact VLSI Physical Design From Graph Partitioning to Timing Closure introduces and compares algorithms that are used during the physical design phase of integrated circuit design wherein a geometric chip layout is produced starting from an abstract circuit design The emphasis is on essential and fundamental techniques ranging from hypergraph partitioning and circuit placement to timing closure   VLSI Physical Design: From Graph Partitioning to Timing Closure Andrew B. Kahng,Jens Lienig,Igor L. Markov,Jin Hu,2022-06-14 The complexity of modern chip design requires extensive use of specialized software throughout the process To achieve the best results a user of this software needs a high level understanding of the underlying mathematical models and algorithms In addition a developer of such software must have a keen understanding of relevant computer science aspects including algorithmic performance bottlenecks and how various algorithms operate and interact This book introduces and compares the fundamental algorithms that are used during the IC physical design phase wherein a geometric chip layout is produced starting from an abstract circuit design This updated second edition includes recent advancements in the state of the art of physical design and builds upon foundational coverage of essential and fundamental techniques Numerous examples and tasks with solutions increase the clarity of presentation and facilitate deeper understanding A comprehensive set of slides is available on the Internet for each chapter simplifying use of the book in instructional settings This improved second edition of the book will continue to serve the EDA and design community well It is a foundational text and reference for the next generation of professionals who will be called on to continue the advancement of our chip design tools and design the most advanced micro electronics Dr Leon Stok Vice President Electronic Design Automation IBM Systems Group This is the book I wish I had when I taught EDA in the past and the one I m using from now on Dr Louis K Scheffer Howard Hughes Medical Institute I would happily use this book when teaching Physical Design I know of no other work that s as comprehensive and up to date with algorithmic focus and clear pseudocode for the key algorithms The book is beautifully designed Prof John P Hayes University of Michigan The entire field of electronic design automation owes the authors a great debt for providing a single coherent source on physical design that is clear and tutorial in nature while providing details on key state of the art topics such as timing closure Prof Kurt Keutzer

University of California Berkeley An excellent balance of the basics and more advanced concepts presented by top experts in the field Prof Sachin Sapatnekar University of Minnesota   **Graphs in VLSI** Rassul Bairamkulov,Eby G. Friedman,2022-11-28 Networks are pervasive Very large scale integrated VLSI systems are no different consisting of dozens of interconnected subsystems hundreds of modules and many billions of transistors and wires Graph theory is crucial for managing and analyzing these systems In this book VLSI system design is discussed from the perspective of graph theory Starting from theoretical foundations the authors uncover the link connecting pure mathematics with practical product development This book not only provides a review of established graph theoretic practices but also discusses the latest advancements in graph theory driving modern VLSI technologies covering a wide range of design issues such as synchronization power network models and analysis and interconnect routing and synthesis Provides a practical introduction to graph theory in the context of VLSI systems engineering Reviews comprehensively graph theoretic methods and algorithms commonly used during VLSI product development process Includes a review of novel graph theoretic methods and algorithms for VLSI system design   *Numerical Methods and Applications* Geno Nikolov,Natalia Kolkovska,Krassimir Georgiev,2019-01-21 This book constitutes the thoroughly refereed post conference proceedings of the 9th International Conference on Numerical Methods and Applications NMA 2018 held in Borovets Bulgaria in August 2018 The 56 revised regular papers presented were carefully reviewed and selected from 61 submissions for inclusion in this book The papers are organized in the following topicalsections numerical search and optimization problem driven numerical method motivation and application numerical methods for fractional diffusion problems orthogonal polynomials and numerical quadratures and Monte Carlo and Quasi Monte Carlo methods   *Very-Large-Scale Integration Physical Design* Kim Ho Yeap,Ing Ming Tan,2025-01-17 This book presents an innovative approach to rectify Timing Design Rule Check TDRC violations in Very Large Scale Integration VLSI chip design Through the utilization of Tool Command Language TCL scripting this automated solution streamlines the Engineering Change Order ECO process offering efficiency accuracy and accessibility By incorporating various strategies such as cell up sizing low threshold voltage cell swapping and buffer insertion the authors tackle TDRC violations with precision Their methodology integrates a slope violation percentage based guide and net length based buffer insertion strategy tailored to address specific violations effectively Moreover the proactive integration of a Non Linear Delay Model NLDM look up table ensures robust timing optimization preventing hold timing violations This comprehensive guide navigates fundamental placement rules and ECO implementation featuring a two step approach named make shorts into opens to resolve violations efficiently Impressively the automated TDRC Fixer achieves an 87% TDRC violation fix rate with minimal global timing shifts showcasing the effectiveness of TCL scripting in VLSI physical design workflows This book is a must read for professionals researchers and students seeking to enhance their understanding of VLSI chip design methodologies and optimize their ECO workflows with pragmatic and accessible solutions   <u>Algorithmic</u>

Aspects in Information and Management Qiufen Ni,Weili Wu,2022-09-18 This book constitutes the proceedings of the 16th International Conference on Algorithmic Aspects in Information and Management AAIM 2022 which was held online during August 13 14 2022 The conference was originally planned to take place in Guangzhou China but changed to a virtual event due to the COVID 19 pandemic The 41 regular papers included in this book were carefully reviewed and selected from 59 submissions Graph-Theoretic Concepts in Computer Science Dieter Kratsch,Ioan Todinca,2014-10-20 This book constitutes the thoroughly refereed post conference proceedings of the 40th International Workshop on Graph Theoretic Concepts in Computer Science WG 2014 held in Nouan le Fuzelier France in June 2014 The 32 revised full papers presented were carefully reviewed and selected from 80 submissions The book also includes two invited papers The papers cover a wide range of topics in graph theory related to computer science such as design and analysis of sequential parallel randomized parameterized and distributed graph and network algorithms structural graph theory with algorithmic or complexity applications computational complexity of graph and network problems graph grammars graph rewriting systems and graph modeling graph drawing and layouts computational geometry random graphs and models of the web and scale free networks and support of these concepts by suitable implementations and applications **Neuromorphic Computing and Beyond** Khaled Salah Mohamed,2020-01-25 This book discusses and compares several new trends that can be used to overcome Moore s law limitations including Neuromorphic Approximate Parallel In Memory and Quantum Computing The author shows how these paradigms are used to enhance computing capability as developers face the practical and physical limitations of scaling while the demand for computing power keeps increasing The discussion includes a state of the art overview and the essential details of each of these paradigms **Cooperative Game Theory Tools in Coalitional Control Networks** Francisco Javier Muros,2019-04-24 This book analyzes coalitional control schemes by incorporating concepts of cooperative game theory into a distributed control framework It considers a networked architecture where the nodes are the agents and the edges are their communication links and either the agents or the links are established as the players of cooperative games related to the cost function of the coalitional schemes The book discusses various cooperative game theory tools that are used to measure analyze the players features impose constraints on them provide alternative methods of game computation detect critical players inside the control scheme and perform system partitioning of large scale systems such as the Barcelona drinking water network which is described in a case study *Next Generation EDA Flow* Khaled Salah Mohamed,2025-05-13 This book serves as a comprehensive guide to the world of EDA tools offering readers a deeper understanding of their inner workings and a glimpse into the future of electronic design With a meticulous focus on numerical methods the author delves deeply into the mathematical foundations that underpin EDA tools From finite element analysis to Monte Carlo simulations readers will gain a thorough understanding of the numerical techniques employed to model and simulate complex electronic systems Furthermore this book elucidates the diverse modeling methods utilized in

EDA tools providing readers with a holistic view of the methods employed to represent and analyze electronic circuits and systems Whether exploring circuit level simulations or system level modeling readers will be equipped with the knowledge needed to navigate the intricacies of EDA toolsets The author also delves into the fascinating intersection of quantum mechanics and electronic design examining the evolving landscape of quantum EDA tools and offering insights into the transformative potential of quantum computing in electronic design Lastly this book explores the transformative impact of machine learning on EDA tools offering insights into how artificial intelligence techniques can enhance performance and productivity   Frontiers in Algorithmics Jianxin Wang,Chee Yap,2015-06-26 This book constitutes the proceedings of the 9th International Workshop on Frontiers in Algorithmics FAW 2015 held in Guilin China in July 2015 The 28 papers presented in this volume were carefully reviewed and selected from 65 submissions They deal with graph algorithms approximation algorithms combinatorial optimization parameterized algorithms and online algorithms   **Fundamentals of Electromigration-Aware Integrated Circuit Design** Jens Lienig,Matthias Thiele,2018-02-23 The book provides a comprehensive overview of electromigration and its effects on the reliability of electronic circuits It introduces the physical process of electromigration which gives the reader the requisite understanding and knowledge for adopting appropriate counter measures A comprehensive set of options is presented for modifying the present IC design methodology to prevent electromigration Finally the authors show how specific effects can be exploited in present and future technologies to reduce electromigration s negative impact on circuit reliability   Network Science Albert-László Barabási,MÃirton PÃ3sfai,2016-07-21 Illustrated throughout in full colour this pioneering text is the only book you need for an introduction to network science   Advances in VLSI and Embedded Systems Zuber Patel,Shilpi Gupta,Nithin Kumar Y. B.,2020-08-28 This book presents select peer reviewed proceedings of the International Conference on Advances in VLSI and Embedded Systems AVES 2019 held at SVNIT Surat Gujarat India The book covers cutting edge original research in VLSI design devices and emerging technologies embedded systems and CAD for VLSI With an aim to address the demand for complex and high functionality systems as well as portable consumer electronics the contents focus on basic concepts of circuit and systems design fabrication testing and standardization This book can be useful for students researchers as well as industry professionals interested in emerging trends in VLSI and embedded systems   A Practical Approach to VLSI System on Chip (SoC) Design Veena S. Chakravarthi,2019-09-25 This book provides a comprehensive overview of the VLSI design process It covers end to end system on chip SoC design including design methodology the design environment tools choice of design components handoff procedures and design infrastructure needs The book also offers critical guidance on the latest UPF based low power design flow issues for deep submicron SOC designs which will prepare readers for the challenges of working at the nanotechnology scale This practical guide will provide engineers who aspire to be VLSI designers with the techniques and tools of the trade and will also be a valuable professional reference for those already working in VLSI design

and verification with a focus on complex SoC designs A comprehensive practical guide for VLSI designers Covers end to end VLSI SoC design flow Includes source code case studies and application examples **Artificial Intelligence and Soft Computing** Leszek Rutkowski,Marcin Korytkowski,Rafał Scherer,Ryszard Tadeusiewicz,Lotfi A. Zadeh,Jacek M. Zurada,2017-06-01 The two volume set LNAI 10245 and LNAI 10246 constitutes the refereed proceedings of the 16th International Conference on Artificial Intelligence and Soft Computing ICAISC 2017 held in Zakopane Poland in June 2017 The 133 revised full papers presented were carefully reviewed and selected from 274 submissions The papers included in the second volume are organized in the following five parts data mining artificial intelligence in modeling simulation and control various problems of artificial intelligence special session advances in single objective continuous parameter optimization with nature inspired algorithms special session stream data mining International Conference on Signal, Machines, Automation, and Algorithm Hasmat Malik,Sukumar Mishra,Y. R. Sood,Fausto Pedro García Márquez,Taha Selim Ustun,2024-12-18 This book is a set of best quality peer reviewed innovative research papers from the International Conference on Signals Machines Automation and Algorithm SIGMAA 2023 held at Shoolini University India during 15 16 December 2023 in hybrid mode This book has originality of work with the innovative ideas regarding artificial intelligence AI and its applications in the field of communication computing and power technologies **Single Flux Quantum Integrated Circuit Design** Gleb Krylov,Tahereh Jabbari,Eby G. Friedman,2024-04-15 High efficiency large scale stationary computing systems supercomputers and data centers are becoming increasingly important due to the movement of data storage and processing onto remote cloud servers This book is dedicated to a technology particularly appropriate for this application superconductive electronics in particular rapid single flux quantum circuits The primary purpose of this book is to introduce and systematize recent developments in superconductive electronics into a cohesive whole to support the further development of large scale computing systems A brief background into the physics of superconductivity and the operation of common superconductive devices is provided followed by an introduction into different superconductive logic families including the logic gates interconnect and bias current distribution Synchronization fabrication and electronic design automation methodologies are presented reviewing both widely established concepts and techniques as well as recent approaches Issues related to memory synchronization interconnects coupling noise bias networks signal interfaces and deep scaling of superconductive structures and design for testability are described and models expressions circuits algorithms and design methodologies are discussed and placed in context The aim of this book is to provide insight and engineering intuition into the design of large scale digital superconductive circuits and systems **Handbook of Integrated Circuit Industry** Yangyuan Wang,Min-Hwa Chi,Jesse Jen-Chung Lou,Chun-Zhang Chen,2023-11-27 Written by hundreds experts who have made contributions to both enterprise and academics research these excellent reference books provide all necessary knowledge of the whole industrial chain of integrated circuits and cover topics related to the technology evolution trends

fabrication applications new materials equipment economy investment and industrial developments of integrated circuits Especially the coverage is broad in scope and deep enough for all kind of readers being interested in integrated circuit industry Remarkable data collection update marketing evaluation enough working knowledge of integrated circuit fabrication clear and accessible category of integrated circuit products and good equipment insight explanation etc can make general readers build up a clear overview about the whole integrated circuit industry This encyclopedia is designed as a reference book for scientists and engineers actively involved in integrated circuit research and development field In addition this book provides enough guide lines and knowledges to benefit enterprisers being interested in integrated circuit industry

Network Models for Data Science Alan Julian Izenman,2023-01-05 This text on the theory and applications of network science is aimed at beginning graduate students in statistics data science computer science machine learning and mathematics as well as advanced students in business computational biology physics social science and engineering working with large complex relational data sets It provides an exciting array of analysis tools including probability models graph theory and computational algorithms exposing students to ways of thinking about types of data that are different from typical statistical data Concepts are demonstrated in the context of real applications such as relationships between financial institutions between genes or proteins between neurons in the brain and between terrorist groups Methods and models described in detail include random graph models percolation processes methods for sampling from huge networks network partitioning and community detection In addition to static networks the book introduces dynamic networks such as epidemics where time is an important component

Vlsi Physical Design From Graph Partitioning To Timing Closure Book Review: Unveiling the Power of Words

In a world driven by information and connectivity, the power of words has be evident than ever. They have the capacity to inspire, provoke, and ignite change. Such could be the essence of the book **Vlsi Physical Design From Graph Partitioning To Timing Closure**, a literary masterpiece that delves deep in to the significance of words and their impact on our lives. Compiled by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we will explore the book is key themes, examine its writing style, and analyze its overall impact on readers.

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