Vlsi Physical Design From Graph Partitioning To Timing Closure

VLSI Physical Design: From Graph Partitioning to Timing ClosureGraph PartitioningGraph Partitioning and Graph ClusteringGraph Partitioning: A Heuristic Procedure to Partition Network GraphsGraph Partitioning and Its Applications to Scientific ComputingSome Graph Partitioning Problems Related to Program SegmentationMulti-level Spectral K-way Graph PartitioningAlgorithms for Signal Decoding Using Graph PartitioningApproximation Algorithms for New Graph Partitioning and Facility Location ProblemsSpectral K-way Ratio-cut Graph PartitioningStatic and Dynamic Graph PartitioningOn the Partitioning of Graphs and HypergraphsOn the Complexity of the Graph Partitioning ProblemsHigh Quality Graph PartitioningMultiplicity in the Partitioning of Signed GraphsA Graph Partitioning Algorithm by Node SeparatorsGraph Partitioning for Scientific Computing ApplicationsThe Use of Structural Information in Graph Databases to Improve Query Processing PerformanceA Graph Partitioning Algorithm for the Berth Allocation ProblemMulti-level Graph Partitioning Andrew B. Kahng Charles-Edmond Bichot David A. Bader George Karypis Brian W. Kernighan Jason Y. Zien Chuang-Chien Chiu Zoya Svitkina Jason Y. Zien Ulrich Elsner Mallek Khelaf Thang Nguyen Bui Christian Schulz Nejat Arinik Joseph W. H. Liu Irene Moulitsas Girija Vijayaraghavan David Tat-Wee Ong Pawan Kumar Aurora

VLSI Physical Design: From Graph Partitioning to Timing Closure Graph Partitioning Graph Partitioning and Graph Clustering Graph Partitioning: A Heuristic Procedure to Partition Network Graphs Graph Partitioning and Its Applications to Scientific Computing Some Graph Partitioning Problems Related to Program Segmentation Multi-level Spectral K-way Graph Partitioning Algorithms for Signal Decoding Using Graph Partitioning Approximation Algorithms for New Graph Partitioning and Facility Location Problems Spectral K-way Ratio-cut Graph Partitioning Static and Dynamic Graph Partitioning On the Partitioning of Graphs and Hypergraphs On the Complexity of the Graph Partitioning Problems High Quality Graph Partitioning Multiplicity in the Partitioning of Signed Graphs A Graph Partitioning Algorithm by Node Separators Graph Partitioning for Scientific Computing Applications The Use of Structural Information in Graph Databases to Improve Query Processing Performance A Graph Partitioning Algorithm for the Berth Allocation Problem Multi-level Graph Partitioning *Andrew B. Kahng Charles-Edmond Bichot David A. Bader George Karypis Brian W. Kernighan Jason Y. Zien Chuang-Chien Chiu Zoya Svitkina Jason Y. Zien Ulrich Elsner Mallek Khelaf Thang Nguyen Bui Christian Schulz Nejat Arinik Joseph W. H. Liu Irene Moulitsas Girija Vijayaraghavan David Tat-Wee Ong Pawan Kumar Aurora* 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

graph partitioning is a theoretical subject with applications in many areas principally numerical analysis programs mapping onto parallel architectures image segmentation vlsi design during the last 40 years the literature has strongly increased and big improvements have been made this book brings together the knowledge accumulated during many years to extract both theoretical foundations of graph partitioning and its main applications

graph partitioning and graph clustering are ubiquitous subtasks in many applications where graphs play an important role generally speaking both techniques aim at the identification of vertex subsets with many internal and few external edges to name only a few problems addressed by graph partitioning and graph clustering algorithms are what are the communities within an online social network how do i speed up a numerical simulation by mapping it efficiently onto a parallel computer how must components be organized on a computer chip such that they can communicate efficiently with each other what are the segments of a digital image which functions are certain genes most likely responsible for the 10th dimacs implementation challenge workshop was devoted to determining realistic performance of algorithms where worst case analysis is overly pessimistic and probabilistic models are too unrealistic articles in the volume describe and analyze various experimental data with the goal of getting insight into realistic algorithm performance in situations where analysis fails

graphs are mathematical structures used to model pair wise relationship between objects of a certain collection it consists of collection of vertices or nodes and a collection of edges that connect these nodes graphs can be directed from one vertex to another or undirected in our context a graph denotes a network with computers distributed as nodes while the communication channel acting as the edges these are directed graphs where each edge has a capacity which cannot be exceeded in real life applications it becomes very essential that graphs are partitioned in some way so as to satisfy certain conditions for example while placing components of electronic circuit on circuit boards or substrates components that are highly dependent on each other exchanging maximum information should be placed on the same board also an important factor is the number of connections between these boards should be minimized similar situation arises in a computer network where computer systems are distributed over a wide geographic location this is the basis of graph partitioning problem the classical graph partitioning problem consists of dividing a graph into pieces such that the pieces are of about same size and there exists very few connections between these pieces the objective is to partition the nodes of a graph with costs on its edges into subsets so as to minimize the sum of the costs on all edges that are cut let g be graph with n nodes of sizes weights wi 0 i 1 2 n let p be a positive number such that 0

in applications as diverse as data placement in peer to peer systems control of epidemic outbreaks and routing in sensor networks the fundamental questions can be abstracted as problems in combinatorial optimization however many of these problems are np hard which makes it unlikely that exact polynomial time algorithms for them exist approximation algorithms are designed to circumvent this difficulty by finding provably near optimal solutions in polynomial time this thesis introduces a number of new combinatorial optimization problems that arise from various applications and proposes approximation algorithms for them these problems fall into two general areas graph partitioning and facility location the first problem that we introduce is the unbalanced graph cut problem here the goal is to find a graph cut minimizing the size of one of the sides while also respecting an upper bound on the number of edges cut we develop two bicriteria approximation algorithms for this problem using the technique of lagrangian relaxation and a different algorithm for its maximization version the other graph partitioning problem that we introduce and study is the min max multiway cut problem it aims to partition a graph into multiple components minimizing the maximum number of edges coming out of any component we present an approximation algorithm for this problem which uses unbalanced cuts as well as the greedy technique in the second part of the thesis we study two generalizations of the facility location problem which aims to open facilities assigning clients to them in order to minimize the facility opening costs and the connection costs in the facility location with hierarchical facility costs problem the facility costs are more general and depend on the set of assigned clients our algorithm based on the local search technique uses two new local improvement operations achieving a constant factor approximation guarantee the second generalization is the load balanced facility location problem which specifies a lower bound for the number of clients assigned to an open facility we give the first true constant factor approximation algorithm which uses a reduction to the capacitated facility location problem the thesis is concluded with related open problems and directions for future research abstract

abstract in this paper we consider the problems of removing the smallest weight set of edges or vertices to partition a graph into two disjoint subgraphs of bounded size the complexity of these problems on general graphs is well known to be np hard however the complexity of these problems on planar graphs has remained open for some time we show that the vertex partitioning problem on vertex weighted planar graphs and the edge partitioning problem on edge and vertex weighted planar graphs are np complete we also describe a polynomial time approximation algorithm for the edge partitioning problem which has an approximation factor of o n superscript 2 3 for planar graphs and an approximation factor of o n log n superscript 2 3 for general graphs in particular this approximation algorithm can also handle the case when the partitioned subgraphs are required to be of equal size i e the graph bisection problem this case has not been dealt with until recently and our algorithm has better approximation factor than the algorithm given in 16

the book presents the dissertation high quality graph partitioning of christian schulz

according to the structural balance theory a signed graph is considered structurally balanced when it can be partitioned into a number of modules such that positive edges are located inside the modules and negatives ones are in between them in practice real world networks are rarely perfectly balanced when it is not the case one wants to measure the magnitude of the imbalance and to identify the set of edges related to the network imbalance the correlation clustering cc problem is precisely defined as finding the partition with minimal imbalance signed graph partitioning is an important task which has many applications as finding a balanced partition helps understanding the system modeled by the graph however the standard approach used in the literature is to find a single partition and focus the rest of the analysis on it as if it was sufficient to fully characterize the studied system yet it may not reflect the meso structure of the network and one may need to seek for other partitions to build a better picture although this need to look for multiplicity is extremely important from the end user s perspective only a very few works took it into consideration in their analysis up to now in this thesis we want to relax this traditional single partition assumption to allow searching for multiple partitions in two separate situations the first one arises in the context of signed multiplex networks all traditional approaches proposed to partition multiplex networks in general are based on the single partition assumption to overcome this limitation we propose a new partitioning method that integrates a meta clustering process before merging the partitions of individual layers which allows identifying structurally similar layers the second situation is specific to the cc problem when solving an instance of such problem several or even many optimal partitions may coexist if multiple optimal partitions coexist one can then wonder how different diverse they are put differently we want to know what we loose when considering only one partition while there might be multiple ones in order to answer these questions one should ideally enumerate completely the space of optimal partitions and perform its analysis to this end we propose a new efficient solution space enumeration method and a cluster analysis based framework in order to first enumerate the space of optimal partitions and then empirically study such space lastly each of these previous situations requires to compute the similarity between partitions in the context of graph partitioning this task can be done through a so called external evaluation measure however there exist many such measures each having different characteristics this makes it challenging to select the most appropriate for a given situation for the end user to this end we propose a new empirical evaluation framework in order to produce results that end users can easily interpret for a collection of candidate measures it first consists in describing their behavior by computing them for a generated dataset of parametric partitions obtained by applying a set of predefined parametric partition transformations second our framework characterizes the measures in terms of how they are affected by these parameters and transformations

abstract graph partitioning is an important problem that has extensive applications in many areas including scientifc computing vlsi design and task scheduling the multi level graph partitioning algorithm reduces the size of the graph gradually by collapsing vertices and edges over various levels partitions the smallest graph and then uncoarsens it to construct a partition for the original graph also at each step of uncoarsening the partition is refined as the degree of freedom increases in this thesis we have implemented the multi level graph partitioning algorithm and used the fiduccia mattheyses algorithm for refining the partition at each level of uncoarsening along with the few published heuristics we have tried one of our own for handling dense nodes during the coarsening phase we present our results and compare them to those of the metis software that is the current state of the art package for graph partitioning

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