

Chapter 11

Hypergraph Computation for Computer Vision



Abstract In this chapter, the applications of hypergraph computation in computer vision are introduced. Computer vision is one of the most widely used areas of hypergraph computation. The hypergraphs can be constructed by modeling the high-order relationship among inter- or intra-visual samples, and then computer vision tasks can be solved by hypergraph computation procedures. More specifically, four typical applications, including visual classification, 3D object retrieval, and tag-based social image retrieval, are provided, in which hypergraphs are used to model high-order relationship among samples and solve visual problems by hypergraph computation. For example, in social image retrieval, hypergraphs are used to model the high-order relationship among social images based on both visual and textual information, which is the high-order modeling of elements within samples.

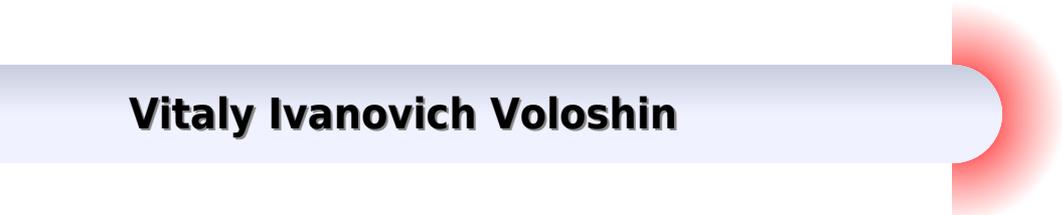
11.1 Introduction

Hypergraphs have demonstrated excellent performance in modeling high-order relationship of data and have been applied in several fields. In computer vision, this property of hypergraphs is also promising for a wide range of works, and many researches focus on how to use hypergraph modeling to solve visual problems. On one hand, hypergraphs can be used to model high-order relationship of images within a class or different classes, and then to conduct the hypergraph-based label propagation procedures, which is useful for visual classification and retrieval. On the other hand, the relation can be modeled within the elements in a visual object to exploit the structural information.

In this chapter, we discuss four typical applications of hypergraph computation in computer vision, i.e., visual classification [1–6], 3D object retrieval [2, 7–12], and tag-based social image retrieval [13–17]. In these applications, the vertices represent the visual objects, and a hypergraph is constructed to formulate the high-order correlations among all the samples by some metric. In this hypergraph, some vertices are labeled. The prediction of other vertices can be obtained by the label propagation procedure. Visual classification and retrieval problems can be solved by this method. The elements within one sample, such as pixels in an image, can

Computer Funda Hypergraph Text

Vitaly Ivanovich Voloshin



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Computer Funda Glencoe/McGraw-Hill, Advanced Intelligent Computing Technology and Applications De-Shuang Huang, Haiming Chen, Bo Li, Qinhu Zhang, 2025-08-25 This 20 volume set LNCS 15842 15861 constitutes in conjunction with the 4 volume set LNAI 15862 15865 and the 4 volume set LNBI 15866 15869 the refereed proceedings of the 21st International Conference on Intelligent Computing ICIC 2025 held in Ningbo China during July 26 29 2025 The total of 1206 regular papers were carefully reviewed and selected from 4032 submissions This year the conference concentrated mainly on the theories and methodologies as well as the emerging applications of intelligent computing Its aim was to unify the picture of contemporary intelligent computing techniques as an integral concept that highlights the trends in advanced computational intelligence and bridges theoretical research with applications Therefore the theme for this conference was **Advanced Intelligent Computing Technology and Applications**

Cartography and Geographic Information Systems, 1990 **Mathematical Reviews**, 2004 Introduction to Graph and Hypergraph Theory Vitaly Ivanovich Voloshin, 2009 This book is for math and computer science majors for students and representatives of many other disciplines like bioinformatics for example taking courses in graph theory discrete mathematics data structures algorithms It is also for anyone who wants to understand the basics of graph theory or just is curious No previous knowledge in graph theory or any other significant mathematics is required The very basic facts from set theory proof techniques and algorithms are sufficient to understand it but even those are explained in the text Structurally the text is divided into two parts where Part II is the generalisation of Part I The first part discusses the key concepts of graph theory with emphasis on trees bipartite graphs cycles chordal graphs planar graphs and graph colouring The second part considers generalisations of Part I and discusses hypertrees bipartite hypergraphs hypercycles chordal hypergraphs planar hypergraphs and hypergraph colouring There is an interaction between the parts and within the parts to show how ideas of generalisations work The main point is to exhibit the ways of generalisations and interactions of mathematical concepts from the very simple to the most advanced One of the features of this text is the duality of hypergraphs This fundamental concept is missing in graph theory and in its introductory teaching because dual graphs are not properly graphs they are hypergraphs However as Part II shows the duality is a very powerful tool in understanding simplifying and unifying many combinatorial relations it is basically a look at the same structure from the opposite vertices versus edges point of view □□□□, 1993 **Text Notes for Peter Norton's Introduction to Computers**, 1995 On the Second Eigenvalue of Hypergraph Hebrew University of Jerusalem. Dept. of Computer Science, J. Friedman, A. Wigderson, 1992 **Fundamentals of Computation Theory** Adrian Kosowski, Igor Walukiewicz, 2015-08-03 This book constitutes the refereed proceedings of the 20th International Symposium on Fundamentals of Computation Theory FCT 2015 held in Gdansk Poland in August 2015 The 27 revised full papers presented were carefully reviewed and selected from 60 submissions The papers cover topics in three main areas algorithms formal

methods and emerging fields and are organized in topical sections on geometry combinatorics text algorithms complexity and Boolean functions languages set algorithms covering and traversal graph algorithms and networking applications anonymity and indistinguishability graphs automata and dynamics and logic and games

Human-Centered Social Media Analytics Yun Fu, 2014-03-24 This book provides a timely and unique survey of next generation social computational methodologies The text explains the fundamentals of this field and describes state of the art methods for inferring social status relationships preferences intentions personalities needs and lifestyles from human information in unconstrained visual data Topics and features includes perspectives from an international and interdisciplinary selection of pre eminent authorities presents balanced coverage of both detailed theoretical analysis and real world applications examines social relationships in human centered media for the development of socially aware video location based and multimedia applications reviews techniques for recognizing the social roles played by people in an event and for classifying human object interaction activities discusses the prediction and recognition of human attributes via social media analytics including social relationships facial age and beauty and occupation

Introduction to Graph Theory Vitaly Ivanovich Voloshin, 2009 Graph Theory is an important area of contemporary mathematics with many applications in computer science genetics chemistry engineering industry business and in social sciences It is a young science invented and developing for solving challenging problems of computerised society for which traditional areas of mathematics such as algebra or calculus are powerless This book is for math and computer science majors for students and representatives of many other disciplines like bioinformatics for example taking the courses in graph theory discrete mathematics data structures algorithms It is also for anyone who wants to understand the basics of graph theory or just is curious No previous knowledge in graph theory or any other significant mathematics is required The very basic facts from set theory proof techniques and algorithms are sufficient to understand it but even those are explained in the text The book discusses the key concepts of graph theory with emphasis on trees bipartite graphs cycles chordal graphs planar graphs and graph colouring The reader is conducted from the simplest examples definitions and concepts step by step towards an understanding of a few most fundamental facts in the field

Optimal Traversal of Directed Hypergraphs International Computer Science Institute, Giorgio Ausiello, Giuseppe F. Italiano, Umberto Nanni, 1992 Abstract A directed hypergraph is defined by a set of nodes and a set of hyperarcs each of which connects a set of source nodes to a single target node Directed hypergraph are used in several contexts to model different combinatorial structures such as functional dependencies 20 Horn clauses in propositional calculus 6 AND OR graphs 17 Petri nets 18 A hyperpath similarly to the analogous notion of path in directed graphs consists of a connection among nodes using hyperarcs Unlike paths in graphs hyperpaths are suitable of different definitions of measure corresponding to different concepts arising in various applications

Social Media Retrieval Naeem Ramzan, Roelof van Zwol, Jong-Seok Lee, Kai Clüver, Xian-Sheng Hua, 2012-12-05 This comprehensive text reference examines in depth the synergy between multimedia content analysis

personalization and next generation networking The book demonstrates how this integration can result in robust personalized services that provide users with an improved multimedia centric quality of experience Each chapter offers a practical step by step walkthrough for a variety of concepts components and technologies relating to the development of applications and services Topics and features introduces the fundamentals of social media retrieval presenting the most important areas of research in this domain examines the important topic of multimedia tagging in social environments including geo tagging discusses issues of personalization and privacy in social media reviews advances in encoding compression and network architectures for the exchange of social media information describes a range of applications related to social media

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