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Graph Mining

Laws, Tools, and Case Studies

Deepayan Chakrabarti
Christos Faloutsos

SYNTHESIS LECTURES ON
DATA MINING AND KNOWLEDGE DISCOVERY

Jiawei Han, Lise Getoor, Wei Wang, Johannes Gehrke, Robert Grossman, *Series Editors*

Graph Mining Laws Tools And Case Studies Christos Faloutsos

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Graph Mining Deepayan Chakrabarti, Christos Faloutsos, 2022-05-31 What does the Web look like How can we find patterns communities outliers in a social network Which are the most central nodes in a network These are the questions that motivate this work Networks and graphs appear in many diverse settings for example in social networks computer communication networks intrusion detection traffic management protein protein interaction networks in biology document text bipartite graphs in text retrieval person account graphs in financial fraud detection and others In this work first we list several surprising patterns that real graphs tend to follow Then we give a detailed list of generators that try to mirror these patterns Generators are important because they can help with what if scenarios extrapolations and anonymization Then we provide a list of powerful tools for graph analysis and specifically spectral methods Singular Value Decomposition SVD tensors and case studies like the famous pageRank algorithm and the HITS algorithm for ranking web search results Finally we conclude with a survey of tools and observations from related fields like sociology which provide complementary viewpoints Table of Contents Introduction Patterns in Static Graphs Patterns in Evolving Graphs Patterns in Weighted Graphs Discussion The Structure of Specific Graphs Discussion Power Laws and Deviations Summary of Patterns Graph Generators Preferential Attachment and Variants Incorporating Geographical Information The RMat Graph Generation by Kronecker Multiplication Summary and Practitioner s Guide SVD Random Walks and Tensors Tensors Community Detection Influence Virus Propagation and Immunization Case Studies Social Networks Other Related Work Conclusions *Individual and Collective Graph Mining* Danai Koutra, Christos Faloutsos, 2022-06-01 Graphs naturally represent information ranging from links between web pages to communication in email networks to connections between neurons in our brains These graphs often span billions of nodes and interactions between them Within this deluge of interconnected data how can we find the most important structures and summarize them How can we efficiently visualize them How can we detect anomalies that indicate critical events such as an attack on a computer system disease formation in the human brain or the fall of a company This book presents scalable principled discovery algorithms that combine globality with locality to make sense of one or more graphs In addition to fast algorithmic methodologies we also contribute graph theoretical ideas and models and real world applications in two main areas Individual Graph Mining We show how to interpretably summarize a single graph by identifying its important graph structures We complement summarization with inference which leverages information about few entities obtained via summarization or other methods and the network structure to efficiently and effectively learn information about the unknown entities Collective Graph Mining We extend the idea of individual graph summarization to time evolving graphs and show how to scalably discover temporal patterns Apart from summarization we claim that graph similarity is often the underlying problem in a host of applications where multiple graphs occur e g temporal anomaly detection discovery of behavioral patterns and we present principled scalable algorithms for aligning networks and

measuring their similarity The methods that we present in this book leverage techniques from diverse areas such as matrix algebra graph theory optimization information theory machine learning finance and social science to solve real world problems We present applications of our exploration algorithms to massive datasets including a Web graph of 6.6 billion edges a Twitter graph of 1.8 billion edges brain graphs with up to 90 million edges collaboration peer to peer networks browser logs all spanning millions of users and interactions

Detecting Fake News on Social Media Kai Shu, Huan Liu, 2022-05-31 In the past decade social media has become increasingly popular for news consumption due to its easy access fast dissemination and low cost However social media also enables the wide propagation of fake news i.e. news with intentionally false information Fake news on social media can have significant negative societal effects Therefore fake news detection on social media has recently become an emerging research area that is attracting tremendous attention This book from a data mining perspective introduces the basic concepts and characteristics of fake news across disciplines reviews representative fake news detection methods in a principled way and illustrates challenging issues of fake news detection on social media In particular we discussed the value of news content and social context and important extensions to handle early detection weakly supervised detection and explainable detection The concepts algorithms and methods described in this lecture can help harness the power of social media to build effective and intelligent fake news detection systems This book is an accessible introduction to the study of detecting fake news on social media It is an essential reading for students researchers and practitioners to understand manage and excel in this area This book is supported by additional materials including lecture slides the complete set of figures key references datasets tools used in this book and the source code of representative algorithms The readers are encouraged to visit the book website for the latest information <http://dmml.asu.edu/dfn>

Correlation Clustering Francesco Bonchi, David García-Soriano, Francesco Gullo, 2022-05-31 Given a set of objects and a pairwise similarity measure between them the goal of correlation clustering is to partition the objects in a set of clusters to maximize the similarity of the objects within the same cluster and minimize the similarity of the objects in different clusters In most of the variants of correlation clustering the number of clusters is not a given parameter instead the optimal number of clusters is automatically determined Correlation clustering is perhaps the most natural formulation of clustering as it just needs a definition of similarity its broad generality makes it applicable to a wide range of problems in different contexts and particularly makes it naturally suitable to clustering structured objects for which feature vectors can be difficult to obtain Despite its simplicity generality and wide applicability correlation clustering has so far received much more attention from an algorithmic theory perspective than from the data mining community The goal of this lecture is to show how correlation clustering can be a powerful addition to the toolkit of a data mining researcher and practitioner and to encourage further research in the area

Big Crisis Data Carlos Castillo, 2016-07-04 Social media is invaluable during crises like natural disasters but difficult to analyze This book shows how computer science can help

Mining Large

Graphs Christos Faloutsos, Jure Leskovec, 2007 **Graph Mining** Riju Bhattacharya, Yogesh Kumar Rathore, Tien Anh Tran, Suman Kumar Swarnkar, 2025-07-31 This book provides a thorough introduction to graph mining and addresses foundational concepts and advanced techniques along with practical applications across various fields As graphs have become increasingly vital for data representation in domains such as social network analysis bioinformatics and transportation there is a growing demand for a comprehensive source that covers both theory and practical insights This book seeks to fill that gap by offering clear explanations practical examples and actionable insights making complex graph mining techniques accessible to students postgraduate readers and researchers The authors also provide an extensive investigation into the process of gaining insightful knowledge from graph representations ranging from interpreting intricate relationships to decoding complex data structures Readers will learn to identify anomalous patterns locate communities arrange nodes predict connections and evaluate graphs effectively **Tools for Large Graph Mining** Deepayan Chakrabarti, 2005 Abstract Graphs show up in a surprisingly diverse set of disciplines ranging from computer networks to sociology biology ecology and many more How do such normal graphs look like How can we spot abnormal subgraphs within them Which nodes edges are suspicious How does a virus spread over a graph Answering these questions is vital for outlier detection such as terrorist cells money laundering rings forecasting simulations how well will a new protocol work on a realistic computer network immunization campaigns and many other applications We attempt to answer these questions in two parts First we answer questions targeted at applications what patterns properties of a graph are important for solving specific problems Here we investigate the propagation behavior of a computer virus over a network and find a simple formula for the epidemic threshold beyond which any viral outbreak might become an epidemic We find an information survival threshold which determines whether in a sensor or P2P network with failing nodes and links a piece of information will survive or not We also develop a scalable parameter free method for finding groups of similar nodes in a graph corresponding to homogeneous regions or CrossAssociations in the binary adjacency matrix of the graph This can help navigate the structure of the graph and find unobvious patterns In the second part of our work we investigate recurring patterns in real world graphs to gain a deeper understanding of their structure This leads to the development of the R MAT model of graph generation for creating synthetic but realistic graphs which match many of the patterns found in real world graphs including power law and lognormal degree distributions small diameter and community effects **Graph Mining and Community Evaluation with Degeneracy** Christos Giatsidis, 2013 **Managing and Mining Graph Data** Charu C. Aggarwal, Haixun Wang, 2010-02-02 Managing and Mining Graph Data is a comprehensive survey book in graph management and mining It contains extensive surveys on a variety of important graph topics such as graph languages indexing clustering data generation pattern mining classification keyword search pattern matching and privacy It also studies a number of domain specific scenarios such as stream mining web graphs social networks chemical and biological data The chapters are

written by well known researchers in the field and provide a broad perspective of the area This is the first comprehensive survey book in the emerging topic of graph data processing Managing and Mining Graph Data is designed for a varied audience composed of professors researchers and practitioners in industry This volume is also suitable as a reference book for advanced level database students in computer science and engineering **Information-theoretic Graph Mining** ,2015
Mining large graphs laws and tools ,2007 Graph Mining and Its Applications to Web Search Ilaria Bordino, Universitat Pompeu Fabra. Departament de Tecnologies de la Informació i les Comunicacions, Università di Roma, 2010

Graph Mining Laws Tools And Case Studies Christos Faloutsos Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has become more apparent than ever. Its ability to stir emotions, provoke thought, and instigate transformation is actually remarkable. This extraordinary book, aptly titled "**Graph Mining Laws Tools And Case Studies Christos Faloutsos**," written by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound effect on our existence. Throughout this critique, we shall delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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