Data Science And Complex Networks Real Case Studies With Python

This book contains contributions presented at the 12th International Conference on Complex Networks (CompleNet), 24-26 May 2021. CompleNet is an international conference on complex networks that brings together researchers and practitioners from diverse disciplines—from sociology, biology, physics, and computer science—who share a passion to better understand the interdependencies within and across systems. CompleNet is a venue to discuss ideas and findings about all types networks, from biological, to technological, to informational and social. It is this interdisciplinary nature of complex networks that CompleNet aims to explore and celebrate.

Network science is the field dedicated to the investigation and analysis of complex systems via their representations as networks. We normally model such networks as graphs: sets of nodes connected by sets of edges and a number of node and edge attributes. This deceptively simple object is the starting point of never-ending complexity, due to its ability to represent almost every facet of reality: chemical interactions, protein pathways inside cells, neural connections inside the brain, scientific collaborations, financial relations, citations in art history, just to name a few examples. If we hope to make sense of complex networks, we need to master a large analytic toolbox: graph and probability theory, linear algebra, statistical physics, machine learning, combinatorics, and more. This book aims at providing the first access to all these tools. It is intended as an "Atlas", because its interest is not in making you a specialist in using any of these techniques. Rather, after reading this book, you will have a general understanding about the existence and the mechanics of all these approaches. You can use such an understanding as the starting point of your own career in the field of network science. This has been, so far, an interdisciplinary endeavor. The founding fathers of this field come from many different backgrounds: mathematics, sociology, computer science, physics, history, digital humanities, and more. This Atlas is charting your path to be something different from all of that: a pure network scientist.

Construct, analyze, and visualize networks with networkx, a Python language module. Network analysis is a powerful tool you can apply to a multitude of datasets and situations. Discover how to work with all kinds of networks, including social, product, temporal, spatial, and semantic networks. Convert almost any real-world data into a complex network--such as recommendations on co-using cosmetic products, muddy hedge fund connections, and online friendships. Analyze and visualize the network, and make business decisions based on your analysis. If you're a curious Python programmer, a data scientist, or a CNA specialist interested in mechanizing mundane tasks, you'll increase your productivity exponentially. Complex network analysis used to be done by hand or with non-programmable network analysis tools, but not anymore! You can now automate and program these tasks in Python. Complex networks are collections of connected items, words, concepts, or people. By exploring their structure and individual elements, we can learn about their meaning, evolution, and resilience. Starting with simple networks, convert real-life and synthetic network graphs into networkx data structures. Look at more sophisticated networks and learn more powerful machinery to handle centrality calculation, blockmodeling, and clique and community detection. Get familiar with presentation-quality network visualization tools, both programmable and interactive--such as Gephi, a CNA explorer. Adapt the patterns from the case studies to your problems. Explore big networks with NetworKit, a high-performance networkx substitute. Each part in the book gives you an overview of a class of networks, includes a practical study of networkx functions and techniques, and concludes with case studies from various fields, including social networking, anthropology, marketing, and sports analytics. Combine your CNA and Python programming skills to become a better network analyst, a more accomplished data scientist, and a more versatile programmer. What You Need: You will need a Python 3.x installation with the following additional modules: Pandas (>=0.18), NumPy (>=1.10), matplotlib (>=1.5), networkx (>=1.11), python-louvain (>=0.5), NetworKit (>=3.6), and generalizesimilarity. We recommend using the Anaconda distribution that comes with all these modules, except for python-louvain, NetworKit, and generalizedsimilarity, and works on all major modern operating systems.

Data science unifies statistics, data analysis and machine learning to achieve a better understanding of the masses of data which are produced today, and to improve prediction. Special kinds of data (symbolic, network, complex, compositional) are increasingly frequent in data science. These data require specific methodologies, but there is a lack of reference work in this field. Advances in Data Science fills this gap. It presents a collection of up-to-date contributions by eminent scholars following two international workshops held in Beijing and Paris. The 10 chapters are organized into four parts: Symbolic Data, Complex Data, Network Data and Clustering. They include fundamental contributions, as well as applications to several domains, including business and the social sciences.

Big Data in Complex and Social Networks

In Memory of Professor Valentin Afraimovich

Large Scale Structure and Dynamics of Complex Networks

Machine Learning in Complex Networks

Principles, Methods and Applications

Structural Analysis of Complex Networks

This book aims to explain the basics of graph theory that are needed at an introductory level for students in computer or information sciences. To motivate students and to show that even these basic notions can be extremely useful, the book also aims to provide an introduction to the modern field of network science. Mathematics is often unnecessarily difficult for students, at times even intimidating. For this reason, explicit attention is paid in the first chapters to mathematical notations and proof techniques, emphasizing that the notations form the biggest obstacle, not the mathematical concepts themselves. This approach allows to gradually prepare students for using tools that are necessary to put graph theory to work: complex networks. In the second part of the book the student learns about random networks, small worlds, the structure of the Internet and the Web, peer-to-peer systems, and social networks. Again, everything is discussed at an elementary level, but such that in the end students indeed have the feeling that they: 1.Have learned how to read and understand the basic mathematics related to graph theory. 2.Understand how basic graph theory can be applied to optimization problems such as routing in communication networks. 3.Know a bit more about this sometimes mystical field of small worlds and random networks. There is an accompanying web site www.distributed-systems.net/gtcn from where supplementary material can be obtained, including exercises, Mathematica notebooks, data for analyzing graphs, and generators for various complex networks.

This two volume set (CCIS 1257 and 1258) constitutes the refereed proceedings of the 6th International Conference of Pioneering Computer Scientists, Engineers and Educators, ICPCSEE 2020 held in Taiyuan, China, in September 2020. The 98 papers presented in these two volumes were carefully reviewed and selected from 392 submissions. The papers are organized in topical sections: database, machine learning, network, graphic images, system, natural language processing, security, algorithm, application, and education.

This book highlights cutting-edge research in the field of network science, offering scientists, researchers, students and practitioners a unique update on the latest advances in theory and a multitude of applications. It presents the peer-reviewed proceedings of the VI International Conference on Complex Networks and their Applications (COMPLEX NETWORKS 2017), which took place in Lyon on November 29 - December 1, 2017. The carefully selected papers cover a wide range of theoretical topics such as network models and measures; community structure, network dynamics; diffusion, epidemics and spreading processes; resilience and control as well as all the main network applications, including social and political networks; networks in finance and economics; biological and ecological networks and technological networks.

This book presents the features and advantages offered by complex networks in the machine learning domain. In the first part, an overview on complex networks and network-based machine learning is presented, offering necessary background material. In the second part, we describe in details some specific techniques based on complex networks for supervised, non-supervised, and semi-supervised learning. Particularly, a stochastic particle competition technique for both non-supervised and semi-supervised learning using a stochastic nonlinear dynamical system is described in details. Moreover, an analytical analysis is supplied, which enables one to predict the behavior of the proposed technique. In addition, data reliability issues are explored in semi-supervised learning. Such matter has practical importance and is not often found in the literature. With the goal of validating these techniques for solving real problems, simulations on broadly accepted databases are conducted. Still in this book, we present a hybrid supervised classification technique that combines both low and high orders of learning. The low level term can be implemented by any classification technique, while the high level term is realized by the extraction of features of the underlying network constructed from the input data. Thus, the former classifies the test instances by their physical features, while the latter measures the compliance of the test instances with the pattern formation of the data. We show that the high level technique can realize classification according to the semantic meaning of the data. This book intends to combine two widely studied research areas, machine learning and complex networks, which in turn will generate broad interests to scientific community, mainly to computer science and engineering areas.

Complex Networks X

Real Case Studies with Python

Complex Networks XII

The Atlas for the Aspiring Network Scientist

Theory and Applications

Advances in Data Science

Networks can provide a useful model and graphic image useful for the description of a wide variety of web-like structures in the physical and man-made realms, e.g. protein networks, food webs and the Internet. The contributions gathered in the present volume provide both an introduction to, and an overview of, the multifaceted phenomenology of complex networks. Statistical Mechanics of Complex Networks also provides a state-of-the-art picture of current theoretical methods and approaches.

The book integrates approaches from mathematics, physics and computer sciences to analyse the organisation of complex networks. Every organisational principle of networks is defined, quantified and then analysed for its influences on the properties and functions of molecular, biological, ecological and social networks.

Big Data of Complex Networks presents and explains the methods from the study of big data that can be used in analysing massive structural data sets, including both very large networks and sets of graphs. As well as applying statistical analysis techniques like sampling and bootstrapping in an interdisciplinary manner to produce novel techniques for analyzing massive amounts of data, this book also explores the possibilities offered by the special aspects such as computer memory in investigating large sets of complex networks. Intended for computer scientists, statisticians and mathematicians interested in the big data and networks, Big Data of Complex Networks is also a valuable tool for researchers in the fields of visualization, data analysis, computer vision and bioinformatics. Key features: Provides a complete discussion of both the hardware and software used to organize big data Describes a wide range of useful applications for managing big data and resultant data sets Maintains a firm focus on massive data and large networks Unveils innovative techniques to help readers handle big data Matthias Dehmer received his PhD in computer science from the Darmstadt University of Technology, Germany. Currently, he is Professor at UMIT - The Health and Life Sciences University, Austria, and the Universit ä t der Bundeswehr M ü nchen. His research interests are in graph theory, data science, complex networks, complexity, statistics and information theory. Frank Emmert-Streib received his PhD in theoretical physics from the University of Bremen, and is currently Associate professor at Tampere University of Technology, Finland. His research interests are in the field of computational biology, machine learning and network medicine. Stefan Pickl holds a PhD in mathematics from the Darmstadt University of Technology, and is currently a Professor at Bundeswehr Universit ä t M ü nchen. His research interests are in operations research, systems biology, graph theory and discrete optimization. Andreas Holzinger received his PhD in cognitive science from Graz University and his habilitation (second PhD) in computer science from Graz University of Technology. He is head of the Holzinger Group HCI-KDD at the Medical University Graz and Visiting Professor for Machine Learning in Health Informatics Vienna University of Technology.

This elementary book provides some state-of-the-art research results on broad disciplinary sciences on complex networks. It presents an in-depth study with detailed description of dynamics, controls and applications of complex networks. The contents of this book can be summarized as follows. First, the dynamics of complex networks, for example, the cluster dynamic analysis by using kernel spectral methods, community detection algorithms in bipartite networks, epidemiological modeling with demographics and epidemic spreading on multi-layer networks, are studied. Second, the controls of complex networks are investigated including topics like distributed finite-time cooperative control of multi-agent systems by applying homogenous-degree and Lyapunov methods, composite finite-time containment control for disturbed second-order multi-agent systems, fractional-order observer design of multi-agent systems, chaos control and anticontrol of complex systems via Parrondos game and many more. Third, the applications of complex networks provide some applicable carriers, which show the importance of theories developed in complex networks. In particular, a general model for studying time evolution of transition networks, deflection routing in complex networks, recommender systems for social networks analysis and mining, strategy selection in networked evolutionary games, integration and methods in computational biology, are discussed in detail.

A Translational Research Perspective

Network Science

Complex Networks

Dynamics, Controls and Applications

Network Science Models for Data Analytics Automation

An Algorithmic Perspective

This book highlights cutting-edge research in the field of network science, offering scientists, researchers, students and practitioners a unique update on the latest advances in theory and a multitude of applications. It presents the peer-reviewed proceedings of the IX International Conference on Complex Networks and their Applications (COMPLEX NETWORKS 2020). The carefully selected papers cover a wide range of theoretical topics such as network models and measures; community structure, network dynamics; diffusion, epidemics and spreading processes; resilience and control as well as all the main network applications, including social and political networks; networks in finance and economics; biological and neuroscience networks and technological networks.

The availability of large data sets has allowed researchers to uncover complex properties such as large-scale fluctuations and heterogeneities in many networks, leading to the breakdown of standard theoretical frameworks and models. Until recently these systems were considered as haphazard sets of points and connections. Recent advances have generated a vigorous research effort in understanding the effect of complex connectivity patterns on dynamical phenomena. This book presents a comprehensive account of these effects. A vast number of systems, from the brain to ecosystems, power grids and the internet, can be represented as large complex networks. This book will interest graduate students and researchers in many disciplines, from physics and statistical mechanics to mathematical biology and information science. Its modular approach allows readers to readily access the sections of most interest to them, and complicated maths is avoided so the text can be easily followed by non-experts in the subject.

This book is a collection of reflections by thought leaders at first-mover organizations in the exploding field of "Data Science for Social Good", meant as the application of knowledge from computer science, complex systems and computational social science to challenges such as humanitarian response, public health, sustainable development. The book provides both an overview of scientific approaches to social impact identifying a social need, targeting an intervention, measuring impact and the complementary perspective of funders and philanthropies that are pushing forward this new sector. This book will appeal to students and researchers in the rapidly growing field of data science for social impact, to data scientists at companies whose data could be used to generate more public value, and to decision makers at nonprofits, foundations, and agencies that are designing their own agenda around data

Networks constitute the backbone of complex systems, from the human brain to computer communications, transport infrastructures to online social systems and metabolic reactions to financial markets. Characterising their structure improves our understanding of the physical, biological, economic and social phenomena that shape our world. Rigorous and thorough, this textbook presents a detailed overview of the new theory and methods of network science. Covering algorithms for graph exploration, node ranking and network generation, among others, the book allows students to experiment with network models and real-world data sets, providing them with a deep understanding of the basics of network theory and its practical applications. Systems of growing complexity are examined in detail, challenging students to increase their level of skill. An engaging presentation of the important principles of network science makes this the perfect reference for researchers and undergraduate and graduate students in physics, mathematics, engineering, biology, neuroscience and the social sciences.

Complex Network Analysis in Python

Complex Networks & Their Applications VI

Transportation Analytics in the Era of Big Data

Theories and Applications

Data Science

The Nature of Complex Networks provides a systematic introduction to the statistical mechanics of complex networks and the different theoretical achievements in the field that are now finding strands in common. The book presents a wide range of networks and the processes taking place on them, including recently developed directions, methods, and techniques. It assumes a statistical

mechanics view of random networks based on the concept of statistical ensembles but also features the approaches and methods of modern random graph theory and their overlaps with statistical physics. This book will appeal to graduate students and researchers in the fields of statistical physics, complex systems, graph theory, applied mathematics, and theoretical epidemiology.
"This edited book discusses data analytics and complex communication networks and recommends new methodologies, system architectures, and other solutions to prevail over the current limitations faced by the field"--
This volume is devoted to the applications of techniques from statistical physics to the characterization and modeling of complex networks. The first two parts of the book concern theory and modeling of networks, the last two parts survey applications to a wide variety of natural and artificial networks. The tutorial reviews that form this book are aimed at students and newcomers to the field, and will also constitute a modern and comprehensive reference for experts. To this aim, all contributions have been carefully peer-reviewed not only for scientific content but also for self-consistency and readability.
A practical introduction to network science for students across business, cognitive science, neuroscience, sociology, biology, engineering and other disciplines.
Data Science for Social Good
Modern and Interdisciplinary Problems in Network Science
Proceedings of the 10th Conference on Complex Networks CompleNet 2019
Data Science and Complex Networks
Big Data of Complex Networks
Nonlinear Dynamics, Chaos, and Complexity

This book presents recent developments on the theoretical, algorithmic, and application aspects of Big Data in Complex and Social Networks. The book consists of four parts, covering a wide range of topics. The first part of the book focuses on data storage and data processing. It explores how the efficient storage of data can fundamentally support intensive data access and queries, which enables sophisticated analysis. It also looks at how data processing and visualization help to communicate information clearly and efficiently. The second part of the book is devoted to the extraction of essential information and the prediction of web content. The book shows how Big Data analysis can be used to understand the interests, location, and search history of users and provide more accurate predictions of User Behavior. The latter two parts of the book cover the protection of privacy and security, and emergent applications of big data and social networks. It analyzes how to model rumor diffusion, identify misinformation from massive data, and design intervention strategies. Applications of big data and social networks in multilayer networks and multiparty systems are also covered in-depth.
This book provides a comprehensive yet short description of the basic concepts of Complex Network theory. In contrast to other books the authors present these concepts through real case studies. The application topics span from Foodwebs, to the Internet, the World Wide Web and the Social Networks, passing through the International Trade Web and Financial time series. The final part is devoted to definition and implementation of the most important network models. The text provides information on the structure of the data and on the quality of available datasets. Furthermore it provides a series of codes to allow immediate implementation of what is theoretically described in the book. Readers already used to the concepts introduced in this book can learn the art of coding in Python by using the online material. To this purpose the authors have set up a dedicated web site where readers can download and test the codes. The whole project is aimed as a learning tool for scientists and practitioners, enabling them to begin working instantly in the field of Complex Networks.
This book explains network science and its applications in data analytics for critical infrastructures, engineered systems, and knowledge acquisition. Each chapter describes step-by-step processes of how network science enables and automates data analytics through examples. The book not only dissects modeling techniques and analytical results but also explores the intrinsic development of these models and analyses. This unique approach bridges the gap between theory and practice and channels' managerial and problem-solving skills. Engineers, researchers, and managers would benefit from the extensive theoretical background and practical examples discussed in this book. Advanced undergraduate students and graduate students in mathematics, statistics, engineering, business, public health, and social science may use this book as a one-semester textbook or a reference book. Readers who are more interested in applications may skip Chapter 1 and peruse through the rest of the book with ease.
Network science is a rapidly emerging field of study that encompasses mathematics, computer science, physics, and engineering. A key issue in the study of complex networks is to understand the collective behavior of the various elements of these networks. Although the results from graph theory have proven to be powerful in investigating the structures of complex networks, few books focus on the algorithmic aspects of complex network analysis. Filling this need, Complex Networks: An Algorithmic Perspective supplies the basic theoretical algorithmic and graph theoretic knowledge needed by every researcher and student of complex networks. This book is about specifying, classifying, designing, and implementing mostly sequential and also parallel and distributed algorithms that can be used to analyze the static properties of complex networks. Providing a focused scope which consists of graph theory and algorithms for complex networks, the book identifies and describes a repertoire of algorithms that may be useful for any complex network. Provides the basic background in terms of graph theory Supplies a survey of the key algorithms for the analysis of complex networks Presents case studies of complex networks that illustrate the implementation of algorithms in real-world networks, including protein interaction networks, social networks, and computer networks Requiring only a basic discrete mathematics and algorithms background, the book supplies guidance that is accessible to beginning researchers and students with little background in complex networks. To help beginners in the field, most of the algorithms are provided in ready-to-be-executed form. While not a primary textbook, the author has included pedagogical features such as learning objectives, end-of-chapter summaries, and review questions
Dynamical Processes on Complex Networks
Optimization, Learning, and Control for Interdependent Complex Networks
Graph Theory and Complex Networks
Real Cases Studies with Python
Volume 1, Proceedings of the Ninth International Conference on Complex Networks and Their Applications COMPLEX NETWORKS 2020
Theory, Algorithms, and Applications

Data Science and Complex NetworksReal Case Studies with PythonOxford University Press
Illustrated throughout in full colour, this pioneering text is the only book you need for an introduction to network science.
Modern and Interdisciplinary Problems in Network Science: A Translational Research Perspective covers a broad range of concepts and methods, with a strong emphasis on interdisciplinarity. The topics range from analyzing mathematical properties of network-based methods to applying them to application areas. By covering this broad range of topics, the book aims to fill a gap in the contemporary literature in disciplines such as physics, applied mathematics and information sciences.
This book presents papers based on the presentations and discussions at the international workshop on Big Data Smart Transportation Analytics held July 16 and 17, 2016 at Tongji University in Shanghai and chaired by Professors Ukkusuri and Yang. The book is intended to explore a multidisciplinary perspective to big data science in urban transportation, motivated by three critical observations: The rapid advances in the observability of assets, platforms for matching supply and demand, thereby allowing sharing networks previously unimaginable. The nearly universal agreement that data from multiple sources, such as cell phones, social media, taxis and transit systems can allow an understanding of infrastructure systems that is critically important to both quality of life and successful economic competition at the global, national, regional, and local levels. There is presently a lack of unifying principles and methodologies that approach big data urban systems. The workshop brought together varied perspectives from engineering, computational scientists, state and central government, social scientists, physicists, and network science experts to develop a unifying set of research challenges and methodologies that are likely to impact infrastructure systems with a particular focus on transportation issues. The book deals with the emerging topic of data science for cities, a central topic in the last five years that is expected to become critical in academia, industry, and the government in the future. There is currently limited literature for researchers to know the opportunities and state of the art in this emerging area, so this book fills a gap by synthesizing the state of the art from various scholars and help identify new research directions for further study.
Complex Networks & Their Applications IX
Web and Network Data Science
6th International Conference of Pioneering Computer Scientists, Engineers and Educators, ICPCSEE 2020, Taiyuan, China, September 18-21, 2020, Proceedings, Part II
Mining Complex Networks
Philanthropy and Social Impact in a Complex World
Statistical Mechanics of Complex Networks
Filling a gap in literature, this self-contained book presents theoretical and application-oriented results that allow for a structural exploration of complex networks. The work focuses not only on classical graph-theoretic methods, but also demonstrates the usefulness of structural graph theory as a tool for solving interdisciplinary problems. Applications to biology, chemistry, linguistics, and data analysis are emphasized. The book is suitable for a broad, interdisciplinary readership of researchers, practitioners, and graduate students in discrete mathematics, statistics, computer science, machine learning, artificial intelligence, computational and systems biology, cognitive science, computational linguistics, and mathematical chemistry. It may also be used as a supplementary textbook in graduate-level seminars
structural graph analysis, complex networks, or network-based machine learning methods.
This book demonstrates how mathematical methods and techniques can be used in synergy and create a new way of looking at complex systems. It becomes clear nowadays that the standard (graph-based) network approach, in which observable events and transportation hubs are represented by nodes and relations between them are represented by edges, fails to describe the important properties of cor
systems, capture the dependence between their scales, and anticipate their future developments. Therefore, authors in this book discuss the new generalized theories capable to describe a complex nexus of dependences in multi-level complex systems and to effectively engineer their important functions. The collection of works devoted to the memory of Professor Valentin Afraimovich introduces new conc
methods, and applications in nonlinear dynamical systems covering physical problems and mathematical modelling relevant to molecular biology, genetics, neurosciences, artificial intelligence as well as classic problems in physics, machine learning, brain and urban dynamics. The book can be read by mathematicians, physicists, complex systems scientists, IT specialists, civil engineers, data scientists, urb
planners, and even musicians (with some mathematical background).
This book focuses on a wide range of optimization, learning, and control algorithms for interdependent complex networks and their role in smart cities operation, smart energy systems, and intelligent transportation networks. It paves the way for researchers working on optimization, learning, and control spread over the fields of computer science, operation research, electrical engineering, civil engineering, a
system engineering. This book also covers optimization algorithms for large-scale problems from theoretical foundations to real-world applications, learning-based methods to enable intelligence in smart cities, and control techniques to deal with the optimal and robust operation of complex systems. It further introduces novel algorithms for data analytics in large-scale interdependent complex networks. •
Specifies the importance of efficient theoretical optimization and learning methods in dealing with emerging problems in the context of interdependent networks • Provides a comprehensive investigation of advance data analytics and machine learning algorithms for large-scale complex networks • Presents basics and mathematical foundations needed to enable efficient decision making and intelligence in
interdependent complex networks M. Hadi Amini is an Assistant Professor at the School of Computing and Information Sciences at Florida International University (FIU). He is also the founding director of Sustainability, Optimization, and Learning for InterDependent networks laboratory (solid lab). He received his Ph.D. and M.Sc. from Carnegie Mellon University in 2019 and 2015 respectively. He also holds
a doctoral degree in Computer Science and Technology. Prior to that, he received M.Sc. from Tarbiat Modares University in 2013, and the B.Sc. from Sharif University of Technology in 2011.
Master modern web and network data modeling: both theory and applications. InWeb and Network Data Science, a top faculty member of Northwestern University's prestigious analytics program presents the first fully-integrated treatment of both the business and academic elements of web and network modeling for predictive analytics. Some books in this field focus either entirely on business issues (e.g.,
Google Analytics and SEO); others are strictly academic (covering topics such as sociology, complexity theory, ecology, applied physics, and economics). This text gives today's managers and students what they really need: integrated coverage of concepts, principles, and theoryin the context of real-world applications. Building on his pioneering Web Analytics course at Northwestern University, Thomas W
covers usability testing, Web site performance, usage analysis, social media platforms, search engine optimization (SEO), and many other topics. He balances this practical coverage with accessible and up-to-date introductions to both social network analysis and network science, demonstrating how these disciplines can be used to solve real business problems.
Modeling Techniques in Predictive Analytics
Proceedings of the 12th Conference on Complex Networks CompleNet 2021
Handbook of Research on Advances in Data Analytics and Complex Communication Networks
Third International Conference of Pioneering Computer Scientists, Engineers and Educators, ICPCSEE 2017, Changsha, China, September 22–24, 2017, Proceedings, Part I
A First Course in Network Science
An Introduction

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.
This two volume set (CCIS 727 and 728) constitutes the refereed proceedings of the Third International Conference of Pioneering Computer Scientists, Engineers and Educators, ICPCSEE 2017 (originally ICYCSEE) held in Changsha, China, in September 2017. The 112 revised full papers presented in these two volumes were carefully reviewed and selected from 987 submissions. The papers cover a wide range of topics related to Basic Theory and Techniques for Data Science including Mathematical Issues in Data Science, Computational Theory for Data Science, Big Data Management and Applications, Data Quality and Data Preparation, Evaluation and Measurement in Data Science, Data Visualization, Big Data Mining and Knowledge Management, Infrastructure for Data Science, Machine Learning for Data Science, Data Security and Privacy, Applications of Data Science, Case Study of Data Science, Multimedia Data Management and Analysis, Data-driven Scientific Research, Data-driven Bioinformatics, Data-driven Healthcare, Data-driven Management, Data-driven eGovernment, Data-driven Smart City/Planet, Data Marketing and Economics, Social Media and Recommendation Systems, Data-driven Security, Data-driven Business Model Innovation, Social and/or organizational impacts of Data Science.
This book concentrates on mining networks, a subfield within data science. Data science uses scientific and computational tools to extract valuable knowledge from large data sets. Once data is processed and cleaned, it is analyzed and presented to support decision-making processes. Data science and machine learning tools have become widely used in companies of all sizes. Networks are often large-scale, decentralized, and evolve dynamically over time. Mining complex networks aim to understand the principles governing the organization and the behavior of such networks is crucial for a broad range of fields of study. Here are a few selected typical applications of mining networks: Community detection (which users on some social media platforms are close friends). Link prediction (who is likely to connect to whom on such platforms). Node attribute prediction (what advertisement should be shown to a given user of a particular platform to match their interests). Influential node detection (which social media users would be the best ambassadors of a specific product). This textbook is suitable for an upper-year undergraduate course or a graduate course in programs such as data science, mathematics, computer science, business, engineering, physics, statistics, and social science. This book can be successfully used by all enthusiasts of data science at various levels of sophistication to expand their knowledge or consider changing their career path. Jupiter notebooks (in Python and Julia) accompany the book and can be accessed on https://www.ryerson.ca/mining-complex-networks/. These not only contain all the experiments presented in the book, but also include additional material. Bogumił Kamiński is the Chairman of the Scientific Council for the Discipline of Economics and Finance at SGH Warsaw School of Economics. He is also an Adjunct Professor at the Data Science Laboratory at Ryerson University. Bogumił is an expert in applications of mathematical modeling to solving complex real-life problems. He is also a substantial open-source contributor to the development of the Julia language and its package ecosystem. Paweł Prałat is a Professor of Mathematics in Ryerson University, whose main research interests are in random graph theory, especially in modeling and mining complex networks. He is the Director of Fields-CQAM Lab on Computational Methods in Industrial Mathematics in The Fields Institute for Research in Mathematical Sciences and has pursued collaborations with various industry partners as well as the Government of Canada. He has written over 170 papers and three books with 130 plus collaborators. François Théberge holds a B.Sc. degree in applied mathematics from the University of Ottawa, a M.Sc. in telecommunications from INRS and a PhD in electrical engineering from McGill University. He has been employed by the Government of Canada since 1996 where he was involved in the creation of the data science team as well as the research group now known as the Tutte Institute for Mathematics and Computing. He also holds an adjunct professorial position in the Department of Mathematics and Statistics at the University of Ottawa. His current interests include relational-data mining and deep learning.
This book aims to bring together researchers and practitioners working across domains and research disciplines to measure, model, and visualize complex networks. It collects the works presented at the 10th International Conference on Complex Networks (CompleNet) in Taragona, Spain, March, 2019. With roots in physical, information and social science, the study of complex networks provides a formal set of mathematical methods, computational tools and theories to describe, prescribe and predict dynamics and behaviors of complex systems. Despite their diversity, whether the systems are made up of physical, technological, informational, or social networks, they share many common organizing principles and thus can be studied with similar approaches. This book provides a view of the state-of-the-art in this dynamic field and covers topics such as group decision-making, brain and cellular connectivity, network controllability and resiliency, online activism, recommendation systems, and cyber security. This text will appeal to students and researchers in the field.
Symbolic, Complex, and Network Data
Complex Systems and Networks
Network Models for Data Science
The Structure of Complex Networks
Proceedings of Complex Networks 2017 (The Sixth International Conference on Complex Networks and Their Applications)
Recognize - Construct - Visualize - Analyze - Interpret