A First Course In Network Science

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Conducting Personal Network Research Christopher McCarty 2019-02-22 Written at an introductory level, and featuring engaging case examples, this book reviews the theory and practice of personal and egocentric network research. This approach offers powerful tools for capturing the impact of overlapping, changing social relationships and contexts on individuals' attitudes and behavior. The authors provide solid guidance on the formulation of research questions; research design; data collection, including decisions about survey modes and sampling frames; the measurement of network composition and structure, including the use of name generators; and statistical modeling, from basic regression techniques to more advanced multilevel and dynamic models. Ethical issues in personal network research are addressed. User-friendly features include boxes on major published studies, end-of-chapter suggestions for further reading, and an appendix describing the main software programs used in the field.

Networks, Crowds, and Markets David Easley 2010-07-19 Are all film stars linked to Kevin Bacon? Why do the stock markets rise and fall sharply on the strength of a vague rumour? How does gossip spread so quickly? Are we all related through six degrees of separation? There is a growing awareness of the complex networks that pervade modern society. We see them in the rapid growth of the Internet, the ease of global communication, the swift spread of news and information, and in the way epidemics and financial crises develop with startling speed and intensity. This introductory book on the new science of networks takes an interdisciplinary approach, using economics, sociology, computing, information science and applied mathematics to address fundamental questions about the links that connect us, and the ways that our decisions can have consequences for others.

Six Degrees: The Science of a Connected Age Duncan J. Watts 2004-01-27 An architect of network theory summarizes his team's endeavor to create a blueprint of the world's networks, citing the scientific elements of the Internet, economies, terrorist organizations, and other knowledge-based groups. Reprint.

Graph Theory and Complex Networks Maarten van Steen 2010 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.

A First Course in Bayesian Statistical Methods Peter D. Hoff 2009-06-02 A self-contained introduction to probability, exchangeability and Bayes' rule provides a theoretical understanding of the applied material. Numerous examples with R-code that can be run "as-is" allow the reader to perform the data analyses themselves. The development of Monte Carlo and Markov chain Monte Carlo methods in the context of data analysis examples provides motivation for these computational methods.

A First Course in Logic Shawn Hedman 2004-07-08 The ability to reason and think in a logical manner forms the basis of learning for most mathematics, computer science, philosophy and logic students. Based on the author's teaching notes at the University of Maryland and aimed at a broad audience, this text covers the fundamental topics in classical logic in an extremely clear, thorough and accurate style that is accessible to all the above. Covering propositional logic, first-order logic, and second-order logic, as well as proof theory, computability theory, and model theory, the text also contains numerous carefully graded exercises and is ideal for a first or refresher course.

Guide To Temporal Networks, A (Second Edition) Naoki Masuda 2020-10-05 Network science offers a powerful language to represent and study complex systems composed of interacting elements — from the Internet to social and biological systems. A Guide to Temporal Networks presents recent theoretical and modelling progress in the emerging field of temporally varying networks and provides connections between the different areas of knowledge required to address this multi-disciplinary subject. After an introduction to key concepts on networks and stochastic dynamics, the authors guide the reader through a coherent selection of mathematical and computational tools for network dynamics. Perfect for students and professionals, this book is a gateway to an active field of research developing between the disciplines of applied mathematics, physics and computer science, with applications in others including social sciences, neuroscience and biology.This second edition extensively expands upon the coverage of the first edition as the authors expertly present recent theoretical and modelling progress in the emerging field of temporal networks, providing the keys to (and connections between) the different areas of knowledge required to address this multi-disciplinary problem.

Linked Albert-laszlo Barabasi 2014-06-24 In the 1980's, James Gleick's Chaos introduced the world to complexity. Now, Albert-László Barabási's Linked reveals the next major scientific leap: the study of networks. We've long suspected that we live in a small world, where everything is connected to everything else. Indeed, networks are pervasive--from the human brain to the Internet to the economy to our group of friends. These linkages, it turns out, aren't random. All networks, to the great surprise of scientists, have an underlying order and follow simple laws. Understanding the structure and behavior of these networks will help us do some amazing things, from designing the optimal organization of a firm to stopping a disease outbreak before it spreads catastrophically.In Linked, Barabási, a physicist whose work has revolutionized the study of networks, traces the development of this rapidly unfolding science and introduces us to the scientists carrying out this pioneering work. These "new cartographers" are mapping networks in a wide range of scientific disciplines, proving that social networks, corporations, and

cells are more similar than they are different, and providing important new insights into the interconnected world around us. This knowledge, says Barabási, can shed light on the robustness of the Internet, the spread of fads and viruses, even the future of democracy. Engaging and authoritative, Linked provides an exciting preview of the next century in science, guaranteed to be transformed by these amazing discoveries.From Linked:This book has a simple message: think networks. It is about how networks emerge, what they look like, and how they evolve. It aims to develop a web-based view of nature, society, and technology, providing a unified framework to better understand issues ranging from the vulnerability of the Internet to the spread of diseases. Networks are present everywhere. All we need is an eye for them...We will see the challenges doctors face when they attempt to cure a disease by focusing on a single molecule or gene, disregarding the complex interconnected nature of the living matter. We will see that hackers are not alone in attacking networks: we all play Goliath, firing shots at a fragile ecological network that, without further support, could soon replicate our worst nightmares by turning us into an isolated group of species...Linked is meant to be an eye-opening trip that challenges you to walk across disciplines by stepping out of the box of reductionism. It is an invitation to explore link by link the next scientific revolution: the new science of networks.

Inferential Network Analysis Skyler J. Cranmer 2020-11-19 Pioneering introduction of unprecedented breadth and scope to inferential and statistical methods for network analysis.

Deep Learning for Coders with fastai and PyTorch Jeremy Howard 2020-06-29 Deep learning is often viewed as the exclusive domain of math PhDs and big tech companies. But as this hands-on guide demonstrates, programmers comfortable with Python can achieve impressive results in deep learning with little math background, small amounts of data, and minimal code. How? With fastai, the first library to provide a consistent interface to the most frequently used deep learning applications. Authors Jeremy Howard and Sylvain Gugger, the creators of fastai, show you how to train a model on a wide range of tasks using fastai and PyTorch. You'll also dive progressively further into deep learning theory to gain a complete understanding of the algorithms behind the scenes. Train models in computer vision, natural language processing, tabular data, and collaborative filtering Learn the latest deep learning techniques that matter most in practice Improve accuracy, speed, and reliability by understanding how deep learning models work Discover how to turn your models into web applications Implement deep learning algorithms from scratch Consider the ethical implications of your work Gain insight from the foreword by PyTorch cofounder, Soumith Chintala

Principles and Techniques in Combinatorics Chuan-Chong Chen 1992 A textbook suitable for undergraduate courses. The materials are presented very explicitly so that students will find it very easy to read. A wide range of examples, about 500 combinatorial problems taken from various mathematical competitions and exercises are also included.

Foundations of Data Science Avrim Blum 2020-01-23 This book provides an introduction to the mathematical and algorithmic foundations of data science, including machine learning, high-dimensional geometry, and analysis of large networks. Topics include the counterintuitive nature of data in high dimensions, important linear algebraic techniques such as singular value decomposition, the theory of random walks and Markov chains, the fundamentals of and important algorithms for machine learning, algorithms and analysis for clustering, probabilistic models for large networks, representation learning including topic modelling and non-negative matrix factorization, wavelets and compressed sensing. Important probabilistic techniques are developed including the law of large numbers, tail inequalities, analysis of random projections, generalization guarantees in machine learning, and moment methods for analysis of phase transitions in large random graphs. Additionally, important structural and complexity

measures are discussed such as matrix norms and VC-dimension. This book is suitable for both undergraduate and graduate courses in the design and analysis of algorithms for data.

The Structure and Dynamics of Networks Mark Newman 2011-10-23 From the Internet to networks of friendship, disease transmission, and even terrorism, the concept--and the reality--of networks has come to pervade modern society. But what exactly is a network? What different types of networks are there? Why are they interesting, and what can they tell us? In recent years, scientists from a range of fields--including mathematics, physics, computer science, sociology, and biology--have been pursuing these questions and building a new "science of networks." This book brings together for the first time a set of seminal articles representing research from across these disciplines. It is an ideal sourcebook for the key research in this fast-growing field. The book is organized into four sections, each preceded by an editors' introduction summarizing its contents and general theme. The first section sets the stage by discussing some of the historical antecedents of contemporary research in the area. From there the book moves to the empirical side of the science of networks before turning to the foundational modeling ideas that have been the focus of much subsequent activity. The book closes by taking the reader to the cutting edge of network science--the relationship between network structure and system dynamics. From network robustness to the spread of disease, this section offers a potpourri of topics on this rapidly expanding frontier of the new science.

Complex Networks Vito Latora 2017-09-28 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.

Picturing Quantum Processes Bob Coecke 2017-03-16 The unique features of the quantum world are explained in this book through the language of diagrams, setting out an innovative visual method for presenting complex theories. Requiring only basic mathematical literacy, this book employs a unique formalism that builds an intuitive understanding of quantum features while eliminating the need for complex calculations. This entirely diagrammatic presentation of quantum theory represents the culmination of ten years of research, uniting classical techniques in linear algebra and Hilbert spaces with cutting-edge developments in quantum computation and foundations. Written in an entertaining and user-friendly style and including more than one hundred exercises, this book is an ideal first course in quantum theory, foundations, and computation for students from undergraduate to PhD level, as well as an opportunity for researchers from a broad range of fields, from physics to biology, linguistics, and cognitive science, to discover a new set of tools for studying processes and interaction.

The Atlas for the Aspiring Network Scientist Michele Coscia 2021-01-11 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.

Complex Network Analysis in Python Dmitry Zinoviev 2018-01-19 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.

Statistical Analysis of Network Data with R Eric D. Kolaczyk 2014-05-22 Networks have permeated everyday life through everyday realities like the Internet, social networks, and viral marketing. As such, network analysis is an important growth area in the quantitative sciences, with roots in social network analysis going back to the 1930s and graph theory going back centuries. Measurement and analysis are integral components of network research. As a result, statistical methods play a critical role in network analysis. This book is the first of its kind in network research. It can be used as a stand-alone resource in which multiple R packages are used to illustrate how to conduct a wide range of network analyses, from basic manipulation and visualization, to summary and characterization, to modeling of network data. The

central package is igraph, which provides extensive capabilities for studying network graphs in R. This text builds on Eric D. Kolaczyk's book Statistical Analysis of Network Data (Springer, 2009).

Computer Networks Larry L. Peterson 2011-03-02 Computer Networks: A Systems Approach, Fifth Edition, explores the key principles of computer networking, with examples drawn from the real world of network and protocol design. Using the Internet as the primary example, this best-selling and classic textbook explains various protocols and networking technologies. The systems-oriented approach encourages students to think about how individual network components fit into a larger, complex system of interactions. This book has a completely updated content with expanded coverage of the topics of utmost importance to networking professionals and students, including P2P, wireless, network security, and network applications such as e-mail and the Web, IP telephony and video streaming, and peer-to-peer file sharing. There is now increased focus on application layer issues where innovative and exciting research and design is currently the center of attention. Other topics include network design and architecture; the ways users can connect to a network; the concepts of switching, routing, and internetworking; end-to-end protocols; congestion control and resource allocation; and end-to-end data. Each chapter includes a problem statement, which introduces issues to be examined; shaded sidebars that elaborate on a topic or introduce a related advanced topic; What's Next? discussions that deal with emerging issues in research, the commercial world, or society; and exercises. This book is written for graduate or upper-division undergraduate classes in computer networking. It will also be useful for industry professionals retraining for network-related assignments, as well as for network practitioners seeking to understand the workings of network protocols and the big picture of networking. Completely updated content with expanded coverage of the topics of utmost importance to networking professionals and students, including P2P, wireless, security, and applications Increased focus on application layer issues where innovative and exciting research and design is currently the center of attention Free downloadable network simulation software and lab experiments manual available

A First Course in Systems Biology Eberhard Voit 2017-09-05 A First Course in Systems Biology is an introduction for advanced undergraduate and graduate students to the growing field of systems biology. Its main focus is the development of computational models and their applications to diverse biological systems. The book begins with the fundamentals of modeling, then reviews features of the molecular inventories that bring biological systems to life and discusses case studies that represent some of the frontiers in systems biology and synthetic biology. In this way, it provides the reader with a comprehensive background and access to methods for executing standard systems biology tasks, understanding the modern literature, and launching into specialized courses or projects that address biological questions using theoretical and computational means. New topics in this edition include: default modules for model design, limit cycles and chaos, parameter estimation in Excel, model representations of gene regulation through transcription factors, derivation of the Michaelis-Menten rate law from the original conceptual model, different types of inhibition, hysteresis, a model of differentiation, system adaptation to persistent signals, nonlinear nullclines, PBPK models, and elementary modes. The format is a combination of instructional text and references to primary literature, complemented by sets of small-scale exercises that enable hands-on experience, and large-scale, often open-ended questions for further reflection.

A First Course in Random Matrix Theory Marc Potters 2020-12-03 An intuitive, up-to-date introduction to random matrix theory and free calculus, with real world illustrations and Big Data applications.

A First Course in Network Science Filippo Menczer 2020-01-30 A practical introduction to network

science for students across business, cognitive science, neuroscience, sociology, biology, engineering and other disciplines.

A First Course in Network Theory Ernesto Estrada 2015 The study of network theory is a highly interdisciplinary field, which has emerged as a major topic of interest in various disciplines ranging from physics and mathematics, to biology and sociology. This book promotes the diverse nature of the study of complex networks by balancing the needs of students from very different backgrounds. It references the most commonly used concepts in network theory, provides examples of their applications in solving practical problems, and clear indications on how to analyse their results. In the first part of the book, students and researchers will discover the quantitative and analytical tools necessary to work with complex networks, including the most basic concepts in network and graph theory, linear and matrix algebra, as well as the physical concepts most frequently used for studying networks. They will also find instruction on some key skills such as how to proof analytic results and how to manipulate empirical network data. The bulk of the text is focused on instructing readers on the most useful tools for modern practitioners of network theory. These include degree distributions, random networks, network fragments, centrality measures, clusters and communities, communicability, and local and global properties of networks. The combination of theory, example and method that are presented in this text, should ready the student to conduct their own analysis of networks with confidence and allow teachers to select appropriate examples and problems to teach this subject in the classroom.

A First Course in Graph Theory Gary Chartrand 2013-05-20 Written by two prominent figures in the field, this comprehensive text provides a remarkably student-friendly approach. Its sound yet accessible treatment emphasizes the history of graph theory and offers unique examples and lucid proofs. 2004 edition.

Network Science Albert-László Barabási 2016-07-21 Illustrated throughout in full colour, this pioneering text is the only book you need for an introduction to network science.

Networks Mark Newman 2010-03-25 The scientific study of networks, including computer networks, social networks, and biological networks, has received an enormous amount of interest in the last few years. The rise of the Internet and the wide availability of inexpensive computers have made it possible to gather and analyze network data on a large scale, and the development of a variety of new theoretical tools has allowed us to extract new knowledge from many different kinds of networks. The study of networks is broadly interdisciplinary and important developments have occurred in many fields, including mathematics, physics, computer and information sciences, biology, and the social sciences. This book brings together for the first time the most important breakthroughs in each of these fields and presents them in a coherent fashion, highlighting the strong interconnections between work in different areas. Subjects covered include the measurement and structure of networks in many branches of science, methods for analyzing network data, including methods developed in physics, statistics, and sociology, the fundamentals of graph theory, computer algorithms, and spectral methods, mathematical models of networks, including random graph models and generative models, and theories of dynamical processes taking place on networks.

A First Course in Vibrations and Waves Mohammad Samiullah 2015-08-21 The study of vibrations and waves is central to physics and engineering disciplines.This text contains a detailed treatment of vibrations and waves at an introductory level suitable for second and third year students. It builds on first year physics and emphasizes understanding of vibratory motion and waves based on first principles. Since waves appear in almost all branches of physics and engineering, readers will be exposed to many

different types of waves; this study aims to draw together their similarities, by examining them in a common language. The book is divided into three parts: Part I contains a preliminary chapter that serves as a review of relevant ideas of mechanics and complex numbers. Part II is devoted to a detailed discussion of vibrations of mechanical systems. This part covers simple harmonic oscillator, coupled oscillators, normal coordinates, beaded string, continuous string, and Fourier series. It concludes with a presentation of stationary solutions of driven finite systems. Part III is concerned with waves, focusing on the discussion of common aspects of all types of waves, and the applications to sound, electromagnetic, and matter waves are illustrated. Finally, relevant examples are provided at the end of the chapters to illustrate the main ideas, and better the reader's understanding.

A First Course in Loop Quantum Gravity Rodolfo Gambini 2011-09-22 This book provides an accessible introduction to loop quantum gravity and some of its applications, at a level suitable for undergraduate students and others with only a minimal knowledge of college level physics. In particular it is not assumed that the reader is familiar with general relativity and only minimally familiar with quantum mechanics and Hamiltonian mechanics. Most chapters end with problems that elaborate on the text, and aid learning. Applications such as loop quantum cosmology, black hole entropy and spin foams are briefly covered. The text is ideally suited for an undergraduate course in the senior year of a physics major. It can also be used to introduce undergraduates to general relativity and quantum field theory as part of a 'special topics' type of course.

Symmetry, Broken Symmetry, and Topology in Modern Physics Mike Guidry 2022-03-31 Written for use in teaching and for self-study, this book provides a comprehensive and pedagogical introduction to groups, algebras, geometry, and topology. It assimilates modern applications of these concepts, assuming only an advanced undergraduate preparation in physics. It provides a balanced view of group theory, Lie algebras, and topological concepts, while emphasizing a broad range of modern applications such as Lorentz and Poincaré invariance, coherent states, quantum phase transitions, the quantum Hall effect, topological matter, and Chern numbers, among many others. An example based approach is adopted from the outset, and the book includes worked examples and informational boxes to illustrate and expand on key concepts. 344 homework problems are included, with full solutions available to instructors, and a subset of 172 of these problems have full solutions available to students.

Fundamentals of Brain Network Analysis Alex Fornito 2016-03-04 Fundamentals of Brain Network Analysis is a comprehensive and accessible introduction to methods for unraveling the extraordinary complexity of neuronal connectivity. From the perspective of graph theory and network science, this book introduces, motivates and explains techniques for modeling brain networks as graphs of nodes connected by edges, and covers a diverse array of measures for quantifying their topological and spatial organization. It builds intuition for key concepts and methods by illustrating how they can be practically applied in diverse areas of neuroscience, ranging from the analysis of synaptic networks in the nematode worm to the characterization of large-scale human brain networks constructed with magnetic resonance imaging. This text is ideally suited to neuroscientists wanting to develop expertise in the rapidly developing field of neural connectomics, and to physical and computational scientists wanting to understand how these quantitative methods can be used to understand brain organization. Extensively illustrated throughout by graphical representations of key mathematical concepts and their practical applications to analyses of nervous systems Comprehensively covers graph theoretical analyses of structural and functional brain networks, from microscopic to macroscopic scales, using examples based on a wide variety of experimental methods in neuroscience Designed to inform and empower scientists at all levels of experience, and from any specialist background, wanting to use modern methods of network science to understand the organization of the brain

A First Course in String Theory Barton Zwiebach 2009-01-22 String theory made understandable. Barton Zwiebach is once again faithful to his goal of making string theory accessible to undergraduates. He presents the main concepts of string theory in a concrete and physical way to develop intuition before formalism, often through simplified and illustrative examples. Complete and thorough in its coverage, this new edition now includes AdS/CFT correspondence and introduces superstrings. It is perfectly suited to introductory courses in string theory for students with a background in mathematics and physics. New sections cover strings on orbifolds, cosmic strings, moduli stabilization, and the string theory landscape. Now with almost 300 problems and exercises, with password-protected solutions for instructors at www.cambridge.org/zwiebach.

Probabilistic Foundations of Statistical Network Analysis Harry Crane 2018-04-17 Probabilistic Foundations of Statistical Network Analysis presents a fresh and insightful perspective on the fundamental tenets and major challenges of modern network analysis. Its lucid exposition provides necessary background for understanding the essential ideas behind exchangeable and dynamic network models, network sampling, and network statistics such as sparsity and power law, all of which play a central role in contemporary data science and machine learning applications. The book rewards readers with a clear and intuitive understanding of the subtle interplay between basic principles of statistical inference, empirical properties of network data, and technical concepts from probability theory. Its mathematically rigorous, yet non-technical, exposition makes the book accessible to professional data scientists, statisticians, and computer scientists as well as practitioners and researchers in substantive fields. Newcomers and non-quantitative researchers will find its conceptual approach invaluable for developing intuition about technical ideas from statistics and probability, while experts and graduate students will find the book a handy reference for a wide range of new topics, including edge exchangeability, relative exchangeability, graphon and graphex models, and graph-valued Levy process and rewiring models for dynamic networks. The author's incisive commentary supplements these core concepts, challenging the reader to push beyond the current limitations of this emerging discipline. With an approachable exposition and more than 50 open research problems and exercises with solutions, this book is ideal for advanced undergraduate and graduate students interested in modern network analysis, data science, machine learning, and statistics. Harry Crane is Associate Professor and Co-Director of the Graduate Program in Statistics and Biostatistics and an Associate Member of the Graduate Faculty in Philosophy at Rutgers University. Professor Crane's research interests cover a range of mathematical and applied topics in network science, probability theory, statistical inference, and mathematical logic. In addition to his technical work on edge and relational exchangeability, relative exchangeability, and graph-valued Markov processes, Prof. Crane's methods have been applied to domain-specific cybersecurity and counterterrorism problems at the Foreign Policy Research Institute and RAND's Project AIR FORCE.

A First Course in Design and Analysis of Experiments Gary W. Oehlert 2000-01-19 Oehlert's text is suitable for either a service course for non-statistics graduate students or for statistics majors. Unlike most texts for the one-term grad/upper level course on experimental design, Oehlert's new book offers a superb balance of both analysis and design, presenting three practical themes to students: • when to use various designs • how to analyze the results • how to recognize various design options Also, unlike other older texts, the book is fully oriented toward the use of statistical software in analyzing experiments.

Network Science National Research Council 2006-01-15 The military is currently attempting to develop itself into a force capable of networkcentric operations. While this effort has highlighted the military's dependence on interacting networks, it has also shown that there is a huge gap between what we need to know about networks and our fundamental knowledge about network behavior. This gap makes the

military vision of NCO problematic. To help address this problem, the Army asked the NRC to find out whether identifying and funding a new field of "network science" could help close this gap. This report presents an examination of networks andthe military, an analysis of the promise, content, and challenges of network science, and an assessment of approaches to creating value from network science.

A First Course in Information Theory Raymond W. Yeung 2012-12-06 This book provides an up-to-date introduction to information theory. In addition to the classical topics discussed, it provides the first comprehensive treatment of the theory of I-Measure, network coding theory, Shannon and non-Shannon type information inequalities, and a relation between entropy and group theory. ITIP, a software package for proving information inequalities, is also included. With a large number of examples, illustrations, and original problems, this book is excellent as a textbook or reference book for a senior or graduate level course on the subject, as well as a reference for researchers in related fields.

An Introduction to Statistical Learning Gareth James 2013-06-24 An Introduction to Statistical Learning provides an accessible overview of the field of statistical learning, an essential toolset for making sense of the vast and complex data sets that have emerged in fields ranging from biology to finance to marketing to astrophysics in the past twenty years. This book presents some of the most important modeling and prediction techniques, along with relevant applications. Topics include linear regression, classification, resampling methods, shrinkage approaches, tree-based methods, support vector machines, clustering, and more. Color graphics and real-world examples are used to illustrate the methods presented. Since the goal of this textbook is to facilitate the use of these statistical learning techniques by practitioners in science, industry, and other fields, each chapter contains a tutorial on implementing the analyses and methods presented in R, an extremely popular open source statistical software platform. Two of the authors co-wrote The Elements of Statistical Learning (Hastie, Tibshirani and Friedman, 2nd edition 2009), a popular reference book for statistics and machine learning researchers. An Introduction to Statistical Learning covers many of the same topics, but at a level accessible to a much broader audience. This book is targeted at statisticians and non-statisticians alike who wish to use cutting-edge statistical learning techniques to analyze their data. The text assumes only a previous course in linear regression and no knowledge of matrix algebra.

Network Science with Python and NetworkX Quick Start Guide Edward L. Platt 2019-04-26 Manipulate and analyze network data with the power of Python and NetworkX Key FeaturesUnderstand the terminology and basic concepts of network scienceLeverage the power of Python and NetworkX to represent data as a networkApply common techniques for working with network data of varying sizesBook Description NetworkX is a leading free and open source package used for network science with the Python programming language. NetworkX can track properties of individuals and relationships, find communities, analyze resilience, detect key network locations, and perform a wide range of important tasks. With the recent release of version 2, NetworkX has been updated to be more powerful and easy to use. If you're a data scientist, engineer, or computational social scientist, this book will guide you in using the Python programming language to gain insights into real-world networks. Starting with the fundamentals, you'll be introduced to the core concepts of network science, along with examples that use real-world data and Python code. This book will introduce you to theoretical concepts such as scale-free and small-world networks, centrality measures, and agent-based modeling. You'll also be able to look for scale-free networks in real data and visualize a network using circular, directed, and shell layouts. By the end of this book, you'll be able to choose appropriate network representations, use NetworkX to build and characterize networks, and uncover insights while working with real-world systems. What you will learnUse Python and NetworkX to analyze the properties of individuals and relationshipsEncode data in network nodes and edges using NetworkXManipulate, store, and summarize data in network nodes and

edgesVisualize a network using circular, directed and shell layoutsFind out how simulating behavior on networks can give insights into real-world problemsUnderstand the ongoing impact of network science on society, and its ethical considerationsWho this book is for If you are a programmer or data scientist who wants to manipulate and analyze network data in Python, this book is perfect for you. Although prior knowledge of network science is not necessary, some Python programming experience will help you understand the concepts covered in the book easily.

Lectures on Network Systems Francesco Bullo 2018-03-10 These lecture notes provide a mathematical introduction to multi-agent dynamical systems, including their analysis via algebraic graph theory and their application to engineering design problems. The focus is on fundamental dynamical phenomena over interconnected network systems, including consensus and disagreement in averaging systems, stable equilibria in compartmental flow networks, and synchronization in coupled oscillators and networked control systems. The theoretical results are complemented by numerous examples arising from the analysis of physical and natural systems and from the design of network estimation, control, and optimization systems.

Deep Learning Ian Goodfellow 2016-11-10 An introduction to a broad range of topics in deep learning, covering mathematical and conceptual background, deep learning techniques used in industry, and research perspectives. "Written by three experts in the field, Deep Learning is the only comprehensive book on the subject." —Elon Musk, cochair of OpenAI; cofounder and CEO of Tesla and SpaceX Deep learning is a form of machine learning that enables computers to learn from experience and understand the world in terms of a hierarchy of concepts. Because the computer gathers knowledge from experience, there is no need for a human computer operator to formally specify all the knowledge that the computer needs. The hierarchy of concepts allows the computer to learn complicated concepts by building them out of simpler ones; a graph of these hierarchies would be many layers deep. This book introduces a broad range of topics in deep learning. The text offers mathematical and conceptual background, covering relevant concepts in linear algebra, probability theory and information theory, numerical computation, and machine learning. It describes deep learning techniques used by practitioners in industry, including deep feedforward networks, regularization, optimization algorithms, convolutional networks, sequence modeling, and practical methodology; and it surveys such applications as natural language processing, speech recognition, computer vision, online recommendation systems, bioinformatics, and videogames. Finally, the book offers research perspectives, covering such theoretical topics as linear factor models, autoencoders, representation learning, structured probabilistic models, Monte Carlo methods, the partition function, approximate inference, and deep generative models. Deep Learning can be used by undergraduate or graduate students planning careers in either industry or research, and by software engineers who want to begin using deep learning in their products or platforms. A website offers supplementary material for both readers and instructors.

The Mathematics of Networks of Linear Systems Paul A. Fuhrmann 2015-05-26 This book provides the mathematical foundations of networks of linear control systems, developed from an algebraic systems theory perspective. This includes a thorough treatment of questions of controllability, observability, realization theory, as well as feedback control and observer theory. The potential of networks for linear systems in controlling large-scale networks of interconnected dynamical systems could provide insight into a diversity of scientific and technological disciplines. The scope of the book is quite extensive, ranging from introductory material to advanced topics of current research, making it a suitable reference for graduate students and researchers in the field of networks of linear systems. Part I can be used as the basis for a first course in Algebraic System Theory, while Part II serves for a second, advanced, course on linear systems. Finally, Part III, which is largely independent of the previous parts, is

ideally suited for advanced research seminars aimed at preparing graduate students for independent research. "Mathematics of Networks of Linear Systems" contains a large number of exercises and examples throughout the text making it suitable for graduate courses in the area.