books

What tangled nets we weave

Networks
An Introduction

M. E. J. Newman
Oxford U. Press, New York, 2010. $85.00 (720 pp.). ISBN 978-0-19-920665-0

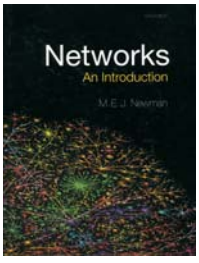
Networks, Crowds, and Markets
Reasoning About a Highly Connected World

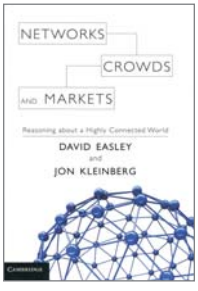
David Easley and Jon Kleinberg
Cambridge U. Press, New York, 2010. $50.00 (727 pp.). ISBN 978-0-521-19533-1

Reviewed by Dirk Brockmann

The past decade has seen a proliferation of discoveries based on a new generation of large-scale datasets best captured by complex-network representations. Prominent examples are small-world phenomena in social systems and the scale-free nature of many biological and technological networks. Such discoveries, in combination with high-performance computing, have transformed the rapidly growing field of complex systems, formerly a more qualitative type of science, into a quantitative and predictive one. The research can be empirical, computational, or theoretical and spans a variety of scientific disciplines, including physics, biology, and other natural sciences, the social sciences, including economics, engineering, and computer science. Each of those disciplines offers a different flavor of the subject and occasionally claims to be the cradle of complex-networks research.

Not surprisingly, a number of textbooks on complex networks, network theory, and graph theory, each with a different and often limited focus, have appeared in the past decade. Two books now entering the stage of network literature are more than mere extensions of the cast. They are *Networks: An Introduction* by Mark Newman and *Networks, Crowds, and Markets: Reasoning About a Highly Connected World* by David Easley and Jon Kleinberg. Both are comprehensive and cover a variety of aspects in the field, both have a similar level of technical sophistication, and both are well written. The books also complement each other to an extent: Newman's provides in-depth coverage of the analyses and structural aspects of networks and keeps a focus on systems that can be described by a network's adjacency matrix; Easley and Kleinberg's spans topics related to dynamical phenomena that evolve on networks and the multitude of methods for understanding them.





Networks accomplishes two key goals: It provides a comprehensive introduction and presents the theoretic backbone of network science. In more than 700 pages, Newman, an expert and pioneer in complex-networks research, introduces the field from a physicist's perspective; his approach reflects the substantial role that theoretical and statistical physics have played in advancing the field. The book is thus a step forward in legitimizing the study of networks as a branch of modern physics. As an introduction, *Networks* is carefully constructed. Newman starts off by highlighting examples of networks in natural, social, and artificial systems, and he provides a network-theory perspective that motivates readers—in particular, eager undergraduate and graduate students—to understand how those structures function.

The book is balanced in its presentation of theoretical concepts, computational techniques, and algorithms. The level of difficulty increases with each chapter, with the more advanced concepts concentrated in the final third of the book. That feature makes the book particularly valuable to physics students who wish to acquire a solid foundation based on their knowledge of basic linear algebra, calculus, and differential equations. Although *Networks* could be used to teach a course, it does not contain a more pronounced coverage of recent advances and discoveries that concern strongly heterogeneous networks with broad weight distributions.

Whereas *Networks* will resonate best with individuals who have a physics background, *Networks, Crowds, and Markets* targets a wider audience and focuses on dynamical aspects of networks in the social sciences. This book is a fun read. It offers a fast learning curve without confusing the reader with technical details, and it opens a great and timely perspective on dynamical processes in social systems. The authors' emphasis on network-driven dynamical processes—cascades, epidemics, market dynamics, and information flow—gives this book a contemporary and practical touch. Although focused on social subjects and phenomena related to human activity and on their increasing connectivity, Easley and Kleinberg nonetheless offer a broad approach within that domain.

Easley, an economist, and Kleinberg, a computer scientist, accomplish the difficult task of making the subject available to students from basically any field without being superficial. Their text was designed as transdisciplinary from the start and will be specifically interesting to physics students who pursue an interdisciplinary career geared toward the social sciences and econophysics.

Either book, or both of them in combination, is a hot pick for interested students and researchers new to the interdisciplinary field of complex networks.

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