A Brief Review of “Network Science—Theory and Application”

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As far as I know, the emerging field of network science has just begun after 1998 [1]. And a few books and review articles or special reports named after “Network Science” has been published worldwide [1-8]. The words “Network Science” or “New Science of Networks” firstly appeared in the United States [2-5], followed by China [6-12] and others. However, “Network Science” was already used by Professor Ted G. Lewis for his book, published by Wiley, which was perhaps the first comprehensive and representative book on Network Science published in the United States. Although a common feature of this kind of books is the theory and methodology from Network Science and their extensive applications to various interdisciplinary areas, each book has its unique viewpoints and distinguishing features. Here, I would like to provide my personal review on the remarkable merits of this book, which deserve special attention.

Firstly, the contents of the book have thirteen chapters which include key issues with exercises except for the first chapter. The first chapter describes the history timeline of significant events of network science development, from graph theory particularly random graphs, to modern network theory and its applications, which is the most complete description about the network history that I know. I agree that the history of network science has three milestones, corresponding to three time periods, as the book shows.

Secondly, there is an abstract-like introduction to summarize and point out the most important part of each chapter. The first half of this book traces the development of network science along a trail blazed by the pioneers and inventors. This makes readers easily understand the objectives.

Thirdly, the book describes each issue (chapter) of network science through the use of illustrations, tables, practical problems with solutions, case studies, and applications to related Java software (there are 5 major Java applications for demonstration), where the latter is quite different from all the other books. The first 6 chapters develop the field from its graph-theory root to the modern definition of a network. These chapters are devoted to the most well-known classes: regular, random, small-world, and scale-free networks. All materials in the contents are adequately described and presented.

Fourthly, Chapter 7 about “Emergence” is a concept with extensive and profound meanings about complex systems and networks. And searching for emergence has been one of the very important and interesting issues for complex network theory and interdisciplinary science. What is emergence and what is network emergence? This is one significant subject and phenomenon arising from complex systems and networks. The book gives a definition of

network emergence, which is more than a network's transformation from an initial state to the final state. In physical and biological sciences, emergence is a concept of some new phenomena arising from a system that were not in the system's specification to start with. This book's definition refers to the repeated application of microrules that result in an unexpected macrostructure that hints a key point. The book gives a brief explanation and is easy to understand. And it introduces new self-organizing principles for networks, and shows how to custom-design networks with an arbitrary degree sequence distribution. That may help people design faster, more resilient communication networks and revise some associated networks.

Fifthly, the second half of this book, from Chapter 8 to Chapter 13, briefly describes several important issues, from a practical application point of view, with further studies. Chapter 8, "Epidemics," may excite new endeavor of designing antigen countermeasures for the Internet, and can be used to explain human epidemics as well as epidemics that sweep across the Internet. Chapter 9, "Synchrony," is an issue that has received a great deal of attention in the studies of complex networks in the past, but the book only gives a brief description. Chapter 10, "Influence networks," proposes what conditions must be met in order for a social network to come to consensus. Chapter 11, "Vulnerability," shows how network might be attacked, which may be used on a daily basis to valuate critical infrastructure and protect them against natural and synthetic attacks. Chapter 12, "Netgain," is an exploration of a business model, and introduces some classical market models as reference. Chapter 13, "Biology," introduces the reader to the exciting new field of protein-expression networks and suggests some new directions for the reader to consider. It emphasizes both of static and dynamical analysis as well as the relationship of dynamics with structure and function, where the latter is the most fascinating application of network science today.

As mentioned in the Preface, "This book is a start, but it also leaves many questions unanswered." Yes, some important issues have not been addressed by it, such as information networks, swarm aggregation or flocking of multiple agents, weighted nonlinear evolution networks, social networks, network centric warfare, and so on.

However, I believe that researchers, professionals and technicians in engineering, computer science, and biology will benefit from this book with an overview of new concepts in network science. And it will inspire a new generation of investigators and researchers.

In summary, the book is a valuable reference with practicability especially for engineering and graduate students, although some more theoretical subjects or deep-level problems could be involved to strengthen and improve its quality and presentation.

Finally, I may mention that the cover of the book is "Network Science: Theory and Application" but it is changed to "Network Science: Theory and Practice" on the opening page. Why is that? A correction may be needed.

References

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