Dynamical Processes on Complex Networks

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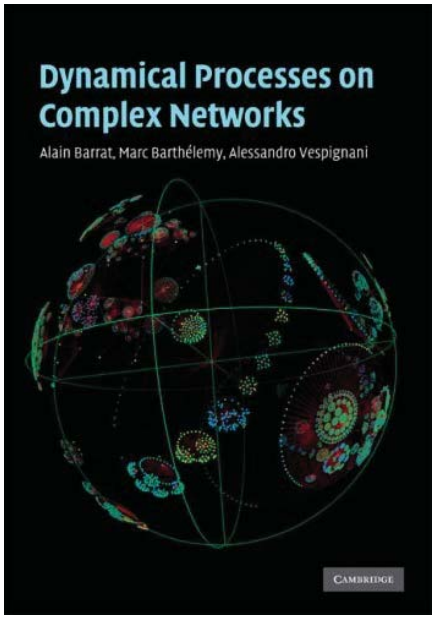

As stated by the authors, the goal of this book is to present a comprehensive and unifying account of understanding the effect of complex connectivity patterns on dynamical phenomena in networks such as large-scale fluctuations and heterogeneities. For this purpose, there are examples from various disciplines to attract diverse audiences from physics and statistical mechanics, mathematical biology, and information science. These include examples from ecosystems, power grids, and the internet. However, in one of the chapters, there are also discussions about and examples from social sciences. The book is organized in modular approach and is devoid of complicated math, giving an easier access to new-to-the-topic JASSS readers.

Chapter 1 starts with an overview of basic networks (graph theory) and continues with basic overviews of statistical mechanics and weighted characterizations of networks. Chapter 2 presents the complexity of real networks and the problems they present. It presents various introductions of networks in regards to various disciplines and classes. This chapter ends with a discussion about the differences between 'complex' and merely 'complicated.'

Chapter 3-5 discusses the modeling aspects. Chapter 3 starts with commonly used random graph models, continues with evolving networks, the non-equilibrium models, then finishes with discussions about modeling higher order statistics, modeling frameworks, and model validation. Chapter 4 is built on chapter 3 and moves on to discuss the dynamical aspects of network modeling. It starts with explanations about the master equation formalism: (i) its distinctions in equilibrium and non-equilibrium systems; and (ii) the

approximate solutions. Then, it continues with discussions about agent-based modeling and numerical simulations. Chapter 5 continues the discussion about network modeling by explaining about the phase transitions phenomenon: how micro changes affect macro behaviors. In other words, this chapter explains about how purely-local rules result in the emergence of global cooperative behavior. In particular, this chapter uses the Ising model to describe such property.

In chapter 6, there is a shift of focus from modeling to assessment of networks although it is still a continuation on the discussions on the phase transition phenomenon. This chapter discusses the resilience and robustness of networks: the effects of removing nodes on the network structure. Percolation theory, alternative ranking strategies, and weighted networks are discussed extensively to explain and understand these effects. Chapter 7 discusses about the synchronization phenomena in networks as the results of coupled oscillations. It discusses various oscillation couplings of networks such as linear and non-linear coupling, and also the Kuramoto model. Chapter 8 discusses walking and searching on networks. This includes diffusion processes, random walks, and search strategies in complex networks.

Chapter 9-12 discusses specific applications of network analyses in various disciplines. Chapter 9 is dedicated to studies and examples on epidemic spreading in population networks. Chapter 10 is about social networks and collective behavior. This chapter discusses various model examples of social behaviors that include: social influence, rumor and information spreading, opinion formation and the Voter model (and also the Axelrod model), Prisoner's dilemma, and the dynamical processes of coevolution of opinions and network. Chapter 11 discusses traffic, congestion, and routing. It also discusses the curious phenomena of avalanches and breakdown models. Chapter 12 is dedicated to networks in biology: from cell to ecosystems. There are discussions on anything from flux-balance approaches in the metabolic activity, Boolean networks in gene regulations, brain as a network, to ecosystems and food webs.

The book concludes with chapter 13 that serves as postface in which the authors express their criticisms on some of the current approaches of network science research.

With a focus in dynamical processes, this book is an excellent introduction book on the statistical mechanics approach of networks. Using the modular approach, there is an integration of various topics in statistical mechanic side of network research. In turn, this collection of modules itself could serve as a statistical mechanic module in the bigger picture of network science research. Not only it consists of a wide array of commonly-used techniques in the discipline but also it provides multitudes of the techniques' applied examples. These techniques could then be adapted as powerful tools for research in social sciences. Thus,

this book could serve as an introduction book and a reference to new-to-the-topic JASSS readers. To conclude, I believe that this book has contributed another step in integrating the vast multi-disciplinary approaches in network science.
