

# Preface

*The oldest, shortest words - “yes” and “no” - are those which require the most thought.*

Pythagoras (Greek Philosopher 582 BC – 497 BC)

One common problem that spans several diverse applications is the management and derivation of knowledge from huge amounts of data, especially in scenarios involving human and social activities. In many practical situations, a real-life dataset can be represented as a large network (graph) – a structure that can be easily understood and visualized. Furthermore, special structures of graphs, when viewed in the context of a given application, provide insights into the internal structure and patterns of the data. Among the many examples of datasets that can be represented as graphs are the Web graph derived from the World Wide Web, the Call graph arising in telecommunications traffic data, and metabolic networks arising in biology. Of particular interest are social networks, in which vertices represent people or groups of people.

Although the concept of a network roots back to the ancient Greek philosopher Pythagoras in his theory of cosmos (*κόσμος*), the mathematical principles of networks were first developed in the last century. The first book in networks appeared in 1936 (D. König: Theory of Finite and Infinite Graphs). Since then, there has been a huge explosion of research regarding theoretical tools and algorithms in the analysis of networks.

One of the most exciting moments came at the dawn of the new Millennium, in 1999 with the discovery of new types of graphs, called complex networks. Examples of such well-known classes of complex networks are scale-free networks and small-world networks. These classes of networks are characterized by specific structural features such as the power-law vertex degree distribution (scale-free networks) and for the short path lengths, small diameter, and high clustering (small-world networks). Moreover, several other measures and features have been discovered, and are recently the focus of active research, that related to the structural properties of complex networks. A new area of complex networks has been rapidly developing,

spanning several disciplines such as mathematics, physics, computer science, social science, biology, and telecommunications.

In our two volume handbook, an attempt was made to present a wide spectrum of recent developments with emphasis in both theory and applications on complex networks. The first volume focuses on basic theory and properties of complex networks, on their structure and dynamics, and optimization algorithmic approaches. The last part of the volume concentrates on some feature applications. The second volume, this volume, deals with the emerging issues on communication networks and social networks. It covers material on vulnerability and robustness of complex networks. The second part is dedicated to complex communication networks, discussing several critical problems such as traffic activity graph analysis, throughput optimization, and traffic optimization. The last part of this volume focuses on recent research topics on online social networks such as security and privacy, social aware solutions, and social based routing algorithms.

We would like to take this opportunity to thank all authors, the anonymous referees, and Springer for helping us to finalize this handbook. Our thanks also go to our students for their help during the processing of all contributions. We hope that this handbook will encourage research on the many intriguing open questions and applications on complex networks that still remain.

Gainesville, Florida

My T. Thai  
Panos M. Pardalos



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Theory and Applications

Thai, M.T.; Pardalos, P. (Eds.)

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