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BOOK REVIEW

Advances in Network Complexity

edited by

Matthias Dehmer, Abbe Mowshowitz & Frank Emmert–Streib

Wiley–Blackwell, Weinheim, 2013, XIV+293 pp. ISBN 978-3-527-33291-5

Determining network complexity emerged around the middle of the last century, when Rashevsky (in the 1950s) and Mowshowitz (in the 1960s) designed measures aimed at quantifying the structural information contained in a graph. It is most pleasing to see that one of the pioneers of complexity theory is an Editor of the present book.

The book "*Advances in Network Complexity*" is concerned with various aspects of the currently very active mathematical theory of networks, especially with measures of network complexity and the closely related topics of network information content and entropy. "Information" contained in a message is a measure of the amount of reduction in uncertainty about the structure of a system, when this message is received. The smaller such a reduction is, the greater is the "complexity" of the underlying system. Neither "information", nor "complexity" have a unique and commonly accepted quantitative definition, resulting that in the modern literature there exist scores of different complexity measures. Irrespective of this, it is doubtless that measuring the complexity of networks is of crucial importance in both "pure" (mathematical) network theory and its applications in such diverse fields as ecology, communication, linguistics, transportation, poetry, biochemistry, economy, art, quantum physics, biology, military, ... Internet must never been forgotten.

The book consists of a short Preface (written by Dehmer, Mowshowitz and Emmert–Streib), followed by 12 chapters, written by a total of 18 authors. Each chapter has an exhaustive list of references.

In this reviewer's opinion, chapter 9, entitled "*Information–Based Complexity of Networks*" (pp. 209–227), written by Russell Standish, provides a brief, informative, and palatable introduction to network complexity. This chapter should be recommended for first–reading by neophytes and less informed (but interested) readers.

The other 11 chapters deal with particular aspects of network complexity and its applications. Their titles are self–explanatory:

1. *Functional Complexity Based on Topology* (pp. 1–15)
2. *Connection between Artificial Intelligence and Computational Complexity and the Complexity of Graphs* (pp. 17–40)
3. *Selection–Based Estimates of Complexity Unraveling Some Mechanisms and Selective Pressures Underlying the Evolution of Complexity in Artificial Networks* (pp. 41–61)
4. *Three Types of Network Complexity Pyramid* (pp. 63–98)
5. *Computational Complexity of Graphs* (pp. 99–153)
6. *The Linear Complexity of Graphs* (pp. 155–175)
7. *Kirchhoff's Matrix–Tree Theorem Revisited: Counting Spanning Trees with the Quantum Relative Entropy* (pp. 177–190)
8. *Dimension Measure for Complex Networks* (pp. 191–208)
10. *Thermodynamic Depth in Undirected and Directed Networks* (pp. 229–247)
11. *Circumscribed Complexity in Ecological Networks* (pp. 249–258)
12. *Metros as Biological Systems: Complexity in Small Real–Life Networks* (pp. 259–285).

The book ends with a detailed Index (pp. 287–293).

In summary, "*Advances in Network Complexity*" is a valuable treatise, outlining the many facets of the contemporary approaches to network complexity. It will be useful for both experts and beginners. It should be a must for any decent science library.

Ivan Gutman