

Going Beyond Traditional Characterizations in the Age of Big Data and Network Sciences

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Abstract

What are efficient algorithms? What are network models? Big Data and Network Sciences have fundamentally challenged the traditional polynomial-time characterization of efficiency and the conventional graph-theoretical characterization of networks.

More than ever before, it is not just desirable, but essential, that efficient algorithms should be scalable. In other words, their complexity should be nearly linear or sub-linear with respect to the problem size. Thus, scalability, not just polynomial-time computability, should be elevated as the central complexity notion for characterizing efficient computation.

For a long time, graphs have been widely used for defining the structure of social and information networks. However, real-world network data and phenomena are much richer and more complex than what can be captured by nodes and edges. Network data are multifaceted, and thus network science requires a new theory, going beyond traditional graph theory, to capture the multifaceted data.

In this talk, I discuss some aspects of these challenges. Using basic tasks in network analysis, social influence modeling, and machine learning as examples, I highlight the role of scalable algorithms and axiomatization in shaping our understanding of “effective solution concepts” in data and network sciences, which need to be both mathematically meaningful and algorithmically efficient.

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