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Modularity and community structure in networks

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Many systems of scientific interest can be represented as networks—sets of nodes joined in pairs by lines or edges. Examples include metabolic and other biochemical networks, neural networks, food webs, the Internet and the worldwide web, and social networks. The physics community has made substantial contributions to the study of networked systems in the last decade, drawing particularly on ideas from statistical physics, field theory, and data analysis. One issue that has received considerable attention is the detection and characterization of "modules" or "communities" within networks—densely connected groups of nodes, with only sparser connections between groups. The ability to find and quantify such communities has proved to be of significant practical worth in the study of biochemical, technological, and social networks, among others, and there has been a lot of activity directed at the development of community-finding methods and algorithms to make these kinds of studies possible. This talk will describe some of the work in this area, focusing in particular on several powerful methods developed recently that appear to outperform previous ones by a substantial margin. A number of example applications will be shown demonstrating the utility of community structure detection in the analysis of real-world network data.