[P9] Community structure and modularity in directed networks

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The modularity is the most widely used quality function of community identification in networks. However, the modularity has not been well defined in directed networks while many real-world networks are directed ones, such as World-Wide-Web, citation networks, and gene regulatory networks.

We propose a generalized form of modularity in directed networks by introducing a new quantity LinkRank, which is the probability that a random walker passes through a particular link during the random walk, and it can be shown that this generalized form is consistent with the original modularity in undirected networks. An immediate advantage of this generalized modularity is that the various algorithms developed to optimize modularity in undirected networks can be applied to directed networks by optimizing our generalized modularity.

Also, a directed model network, which can be used as a benchmark network in further community studies, is proposed to verify our method. Our method is supposed to find communities effectively in citation- or reference-based directed networks.

References
[1] Y. Kim, S.-W. Son and H. Jeong, Phys. Rev. E **81**, 016103 (2010).