Vital nodes identification in complex networks

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Abstract

Real networks exhibit heterogeneous nature with nodes playing far different roles in structure and function. To identify vital nodes is thus very significant, allowing us to control the outbreak of epidemics, to conduct advertisements for e-commercial products, to predict popular scientific publications, and so on. The vital nodes identification attracts increasing attentions from both computer science and physical societies, with algorithms ranging from simply counting the immediate neighbors to complicated machine learning and message passing approaches. In this review, we clarify the concepts and metrics, classify the problems and methods, as well as review the important progresses and describe the state of the art. Furthermore, we provide extensive empirical analyses to compare well-known methods on disparate real networks, and highlight the future directions. In despite of the emphasis on physics-rooted approaches, the unification of the language and comparison with cross-domain methods would trigger interdisciplinary solutions in the near future.

Keywords: Complex Networks, Vital Nodes, Centrality, Message Passing Theory, Epidemic Spreading, Percolation