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Adaptive networks with preferred degree: From the mundane to the astonishing

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Abstract:

Network studies have played a central role for understanding many systems in nature - e.g., physical, biological, and social. So far, much of the focus has been static networks in isolation. Yet, many networks are dynamic, coupled to each other. We considered this issue, in the context of social networks. In particular, We introduce a simple model of adaptive networks, modeling a society in which an individual cuts/adds links based on whether he or she has more/less links than some "preferred number" (κ). For example, introverts/extroverts typically have small/large κ 's. Evolving with detailed balance violating dynamics, the steady state distribution of this dynamic network is not known in general, though it displays reasonably understandable properties. I will begin with a brief summary of our findings for systems with a single κ (i.e., a homogeneous population), many of which are "mundane." On the other hand, many astonishing features arise when a system with just two κ 's are simulated. I will present the details of a "society" consisting of extreme introverts and extroverts. In particular, we find a mapping to a 2-D Ising-like model, restoration of detailed balance, the exact steady state distribution, and an abrupt transition (in the total number of links, as the I-E composition crosses 50-50). Sharp contrasts between this phenomenon and typical phase transitions (e.g., Lenz-Ising-Onsager) will be noted. Beyond this theoretically interesting limit of our system, we outline some potentially important applications, such as modeling the response to a spreading epidemic by a population with adaptive behavior.