Commentaries on Albert-László Barabási's books

Networks101Link7.1   Rich Get Richer, Preferential Attachment, Scale-Free Networks

Barabási here recounts how he came to switch from the topology of the network to its evolution and the power law's dependence on preferential attachment.

During this process of realization, he was travelling in Transylvania directing his graduate student, Réka Albert, to check the power laws on several networks which she found to be the case, commenting "I looked at the degree distribution too, and in almost all systems (IBM, actors, power grid), the tail of the distribution follows a power law." (p. 80.) This caught my eye because of the qualification that the power law was restricted to the tail of the distribution, because in my earlier commentary (Networks101Link6.1 80-20Rule) I showed the distribution for C. elegans as intermediate between a Poisson and a power law, and now that seems to be the case with the scale-free networks Barabási offers as power law distributions. This but an aside for this chapter, but interesting to me. A separate dynamic may be involved.

Growth and Evolution of Networks: By Preferential Attachment, aka the Rich get Richer.

He describes how preferential attachment of new nodes and links is not based on Erdős-Rényi random or equi-probabilities to previous nodes, but is based on conditional probabilities proportional to the degree or in-degree of the existing nodes. I showed some examples in the 6.1 commentary mentioned above.

I especially liked the generalization of these models with more complex rules for adding and subtracting nodes and links: "We understand that internal links, rewiring, removal of nodes and links, aging, nonlinear effects, and many other processes affecting network topology can e seamlessly incorporated into an amazing theoretical construct of evolving networks, which contain as a particular case the scale-free model." (p. 90.) And: "If we correctly model the network assembly, our final result should closely match the reality. Thus our goals have shifted from describing the topology to understanding the mechanisms that shape network evolution." (p. 91).

I might modify but one thing, when he says "Does the presence of power laws imply that real networks are the result of a phase transition from disorder to order? The answer we've arrived at is simple: Networks are not en route from a random to an ordered state. Neither are they at the edge of randomness and chaos. Rather, the scale-free topology is evidence of organizing principles acting at each stage of the network forming process." (p. 91.) I would argue differently. I view this process as the μ-bifurcation process I introduced in my last commentary (Link6.2 80-20 & Power Laws). Each addition or subtraction of a node or link would constitute a micro bifurcation, and a series of them the cascade of the macro μ-bifurcation process. When disparate clusters are suddenly bridged by a new link, that could constitute a regular major bifurcation. This is a self-organizational process, as the addition/substraction of links depends on the state of the system.