MASSACHUSETTS INSTITUTE OF TECHNOLOGY

6.268 Spring 2018

Lecture 8: Scale-Free Networks 3/6/2018

The lecture will discuss research and controversy around power laws and scale-free networks over the last 20 years. Reading the primary sources beforehand is optional but encouraged.

Models of Scale-Free Networks

1. Newman [New10] provides a nice analysis of the models of Price and Barabasi-Albert in Chapter 14.
2. An extensive review is provided by Part XI of [DM02].

The Classic Paper

1. The most famous paper in this area claimed that the World Wide Web, an actor collaboration network, and a power grid network all displayed power-law degree distributions. Now cited 30,000 times: [BA99].
2. [Bar09] provides a nice illustration of preferential attachment, and a helpful review of developments since the original paper.

Measuring Power Laws

1. Many empirical papers plot the degree distribution on log-log axes and find that it appears approximately linear, concluding that it must be a power law. How reliable is this method? Read [CSN09] to find out.
2. Applying the methodology above, Broido and Clauset published a paper [BC18] in January with a startling claim – "Scale Free Networks are Rare"!

References

[BA99] Albert-László Barabási and Reka Albert. Emergence of scaling in random networks. *Science*, 286(5439):11, 1999.

[Bar09] A. L. Barabási. Scale-free networks: A decade and beyond. *Science*, 325(5939):412–413, 2009.

[BC18] Anna Broido and Aaron Clauset. Scale-free networks are rare. *arXiv:1801.03400*, pages 1–14, 2018.

[CSN09] Aaron Clauset, C R Shalizi, and M E J Newman. Power-law distributions in empirical data. *SIAM Review*, 51(4):661–703, 2009.

[DM02] S. N. Dorogovtsev and J. F.F. Mendes. Evolution of networks. *Advances in Physics*, 51(4):1079–1187, 2002.

[New10] M. E. J. Newman. *Networks: An Introduction*. Oxford University Press, 2010.