MUO-E8029 - Systems Thinking
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Linked: The New Science of Networks

Linked: The New Science of Networks, by Albert-László Barabási introduces the science of networks to the layperson, putting forward the properties, principles, structures, and history of humans' understanding of networks, along with their relevance to everyday life.

In *Linked* Barabási, a Romanian born Hungarian physicist, takes us on a journey through the history of how humans have understood networks, presenting various studies and theories that were based around network theory in the 1900's and then brings us to the then current day of early 2000's, highlighting how discoveries over the years have changed the understanding of networks, and how that has vast implications on everyday life.

Barabási introduces earlier studies, including the works of Paul Erdős and Alfred Renyi, two renowned mathematicians who understood the formation of networks as completely random i.e. nodes connected to each other through completely randomly formed links, where each node thus has the same probability to attach to any other node within the network. He proceeds to introduce the findings of his research team's work in studying the network of the internet, and how these findings have changed the way we see networks and disproven long-standing theories of randomness held previously.

With his team, Barabási found the internet network to be a scale-free network – one that follows a power law. In relation to networks, this means a network that has numerous nodes with a few links that link them to other nodes, and a small number of 'hubs', super connectors that have an extremely large number of links – hence bringing the entire network together. Through the course of the book, he proposes that the scale-free nature is actually present in almost all the complex networks surrounding us. He illustrates the point with examples such as the citation networks of scientists, cells in a living organism, Airport routes and the economic field of businesses.

Barabási outlines that scale-free networks are characterised by three main features: **their capacity to grow and evolve**, the **capacity of preferential attachment** (of nodes to attach to hubs), and **competitive fitness** (of nodes, determining whether other nodes should attach to them). Barabási cites examples of how by understanding these characteristics, one can attain more knowledge of the topology of networks and understand where their strengths and vulnerabilities lie. A key vulnerability in scale-free networks is the possibility of cascading disasters, paired with stability and robustness of a decentralized system. Studying these features can help us to mitigate risks of attacks shutting down online systems, aid in understanding the inner workings of a terrorist organization, or track how small undetected setbacks in corporations can cause major financial failures in the economy, and fathom the routes through which deadly viruses can spread to different corners of the world.

<u>Book details</u>

Barabási, A. (2003). Linked: How everything is connected to everything else and what it means for business, science, and everyday life. New York: Plume.