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Network Science: Theory and Practice

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NETWORK SCIENCE

Theory and Practice

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TABLE 1.1 Historical Timeline of Significant Events

Date	Who	Contribution
1736	Euler	Bridges of Königsberg
1925	G. Yule	Preferential attachment, Yule–Simon distribution
1927	Kermack, McKendrick	First epidemic model
1951	Solomonoff, Rappaport	Spread of infection in random networks
1955	Simon	Power law observed in word analysis
1959	Gilbert	First generative procedure for random graph
1960	Erdos, Renyi	Random graphs
1967	Milgram	Small-world experiment
1969	Bass	Diffusion of innovation in populations—nonnetwork model
1971	Fisher, Pry	Diffusion by product substitution—nonnetwork model
1972	Bollobas	Complex graphs
1972	Bonacich	Idea of influence in social networks leading to influence diagrams
1973	Granovetter	Job-seeking networks formed clusters with “weak links” between them
1978	Pool, Kochen	First theoretical examination of small worlds
1984	Kuramoto	Synchronization of linear systems
1985	Bollobas	Publishes book on “random graphs”
1988	Waxman	First graph model of the Internet
1989	Bristor, Ryan	“Buying networks” = application of network science to model economic system
1990	Guare	Coined phrase, “six degrees of separation” = name of his Broadway play
1995	Molloy, Reed	Generation of networks with arbitrary degree sequence distribution
1996	Kretschmar, Morris	Early application of network science to spread of infectious disease = contagion driven by largest connected component
1998	Holland	Introduction of emergence in complex adaptive systems
1998	Watts, Strogatz, Faloutsos, Faloutsos	Renewed interest in Milgram’s original work on small worlds, examples of clustering; first generative procedure for small world
1999	Faloutsos	Power law observed in Internet
1999	Albert, Jeong, Barabasi	Power law observed in WWW
1999	Dorogovtsev, Mendes	Small-world properties
1999	Barabasi, Albert,	Scale-free network model
1999	Dorogovtsev, Mendes, Samukhim, Krapivsky Redner	Exact solution to scale-free network degree sequence
1999	Watts	Explanation of “small-world dilemma”: high clustering, low path length

(*Continued*)

TABLE 1.1 *Continued*

Date	Who	Contribution
1999	Adamic	Distance between .edu sites shown to be small-world
1999	Kleinberg, Kumar, Raghavan, Rajagopalan Tomkins	Formalized model of WWW as "Webgraph"
1999	Walsh	Difficulty of search in small worlds using local properties
2000	Marchiori, Latora,	Harmonic distance replaces path length: works for disconnected networks
2000	Broder, Kumar, Maghoul, Raghavan, Rajagopalan Stata, Tomkins, Wiener	Full Webgraph map of the WWW
2000	Kleinberg	Shows $O(n)$ search in small world using "Manhattan distance"
2000	Albert, Jeong, Barabasi	Scale-free networks are resilient if hubs are protected (Internet's "Achilles heel")
2001	Yung	Taxonomy of applications of small-world theory to: SNA, collaboration, Internet, business, life sciences
2001	Pastor-Satorras, Vespignani	Claim no epidemic threshold in scale-free networks; Internet susceptible to SIS viruses
2001	Tadic, Adamic	Use of local information can speed search on scale-free networks
2002	Levene, Fenner, Loizou, Wheeldon	Enhanced Webgraph model concluded structure of the WWW couldn't be explained by preferential attachment alone
2002	Kleinfeld,	Claims Milgram experiments not well founded: small-world social network is an "urban myth"
2002	Wang, Chen, Barahona, Pecora, Liu, Hong, Choi Kim, Jost, Joy	Sync in small worlds equivalent to stability in coupled system
2003	Wang, Chakrabarti, Wang, Faloutsos	Showed spread of epidemics determined by network's spectral radius, largest eigenvalue of connection matrix
2003	Virtanen	Complete survey of network science results up to 2003
2003	Strogatz	Synchronization of crickets, heartbeats
2005	NRC	Definition of network science
2006	Atay	Synchronization in networks with degree sequence distribution—application to networks
2007	Gabbay	Consensus in influence networks—linear and nonlinear models

human behavior—and the reverse. The "small-world dilemma" was the subject of vigorous study throughout this period. Why is it, social scientists asked, that humans are able to connect to one another through an extremely small number of intermediaries, even as the size of a population grows?

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Ted Lewis has extensive academic and private-sector experience as a member of the faculties of the University of Missouri—Rolla, University of Louisiana—Lafayette, Oregon State University—Corvallis, and the Naval Postgraduate School, Monterey, California. His industrial experience includes senior vice president of Eastman Kodak Company; President and CEO of Daimler Research and Technology, North America, Inc.; and Director of Research at the Oregon Advanced Computing Institute. As a member of the IEEE-Computer Society, Lewis had the privilege of serving as the Editor-in-Chief of *IEEE Software* and *Computer* magazines. He is the Wiley author of *Critical Infrastructure Protection: Defending a Networked Nation* and over 30 other books on computing and business.

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