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### Information processing in complex networks

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## References

1. Erdős P, Rényi A (1960) in *PUBLICATION OF THE MATHEMATICAL INSTITUTE OF THE HUNGARIAN ACADEMY OF SCIENCES*, pp 17–61.
2. Solomonoff R, Rapoport A (1951) Connectivity of random nets. *Bulletin of Mathematical Biology* 13:107–117.
3. Erdős P, Rényi A (1961) On the strength of connectedness of a random graph. *Acta Mathematica Hungarica* 12:261–267.
4. De Solla Price DJ (1965) Networks of Scientific Papers. *Science* 149:510–515.
5. Garfield E, Sher IH (1963) New factors in the evaluation of scientific literature through citation indexing. *American Documentation* 14:195–201.
6. Redner S (1998) How popular is your paper? An empirical study of the citation distribution. *The European Physical Journal B - Condensed Matter and Complex Systems* 4:131–134.
7. Newman MEJ (2003) The Structure and Function of Complex Networks. *SIAM Rev Soc Ind Appl Math* 45:167–256.
8. Boccaletti S, Latora V, Moreno Y, Chavez M, Hwang D-U (2006) Complex networks: Structure and dynamics. *Physics Reports* 424:175–308.
9. Newman M, Barabási A-L, Watts DJ (2006) *The Structure and Dynamics of Networks* (Princeton University Press). 1st Ed.
10. Barabási A-L (2009) Scale-Free Networks: A Decade and Beyond. *Science* 325:412–413.

11. Hopfield JJ (1982) Neural networks and physical systems with emergent collective computational abilities. *Proceedings of the National Academy of Sciences* 79:2554–2558.
12. Fraiman D, Balenzuela P, Foss J, Chialvo DR (2009) Ising-like dynamics in large-scale functional brain networks. *Phys Rev E* 79:061922.
13. Qian L, Winfree E, Bruck J (2011) Neural network computation with DNA strand displacement cascades. *Nature* 475:368–372.
14. Chialvo DR (2010) Emergent complex neural dynamics. *Nat Phys* 6:744–750.
15. Holland JH (1992) Complex Adaptive Systems. *Daedalus* 121:17–30.
16. John H. Holland (2006) Studying Complex Adaptive Systems. *Journal of Systems Science and Complexity* 19:1–8.
17. Kauffman SA (1969) Metabolic stability and epigenesis in randomly constructed genetic nets. *J Theor Biol* 22:437–467.
18. Stuart Alan Kauffman (1993) *The Origins of Order: Self Organization and Selection in Evolution* (Oxford University Press, Oxford).
19. Bhalla, Ravi Iyengar US (1999) Emergent Properties of Networks of Biological Signaling Pathways. *Science* 283:381–387.
20. Thattai M, Van Oudenaarden A (2001) Intrinsic noise in gene regulatory networks. *Proceedings of the National Academy of Sciences* 98:8614–8619.
21. Cattuto C, Barrat A, Baldassarri A, Schehr G, Loreto V (2009) Collective dynamics of social annotation. *Proceedings of the National Academy of Sciences* 106:10511–10515.
22. Vespignani A (2009) Predicting the Behavior of Techno-Social Systems. *Science* 325:425–428.

23. Sornette D (2004) *Why Stock Markets Crash: Critical Events in Complex Financial Systems* (Princeton University Press).
24. Arenas A, Díaz-Guilera A, Kurths J, Moreno Y, Zhou C (2008) Synchronization in complex networks. *Physics Reports* 469:93 – 153.
25. Tanaka G, Morino K, Aihara K (2012) Dynamical robustness in complex networks: the crucial role of low-degree nodes. *Scientific Reports* 2.
26. Peter M.A. Sloot (1999) *De som der delen - inaugural address*.
27. Shante VKS, Kirkpatrick S (1971) An introduction to percolation theory. *Advances in Physics* 20:325–357.
28. Berkowitz B, Ewing RP (1998) Percolation Theory and Network Modeling Applications in Soil Physics. *Surveys in Geophysics* 19:23–72.
29. Callaway DS, Newman ME, Strogatz SH, Watts DJ (2000) Network robustness and fragility: percolation on random graphs. *Phys Rev Lett* 85:5468–5471.
30. Cohen, Erez, ben-Avraham, Havlin (2000) Resilience of the internet to random breakdowns. *Phys Rev Lett* 85:4626–4628.
31. Cohen R, Erez K, ben-Avraham D, Havlin S (2001) Breakdown of the internet under intentional attack. *Phys Rev Lett* 86:3682–3685.
32. Vázquez A, Moreno Y (2003) Resilience to damage of graphs with degree correlations. *Phys Rev E* 67:015101.
33. Estrada E, Hatano N (2008) Communicability in complex networks. *Phys Rev E* 77:036111.
34. Kempe D, Kleinberg J, Tardos É (2003) in *Proceedings of the ninth ACM SIGKDD international conference on Knowledge discovery and data mining*, KDD '03. (ACM, New York, NY, USA), pp 137–146.

35. Kimura M, Saito K, Nakano R, Motoda H (2010) Extracting influential nodes on a social network for information diffusion. *Data Min Knowl Discov* 20:70–97.
36. Agnieszka Czaplicka, Janusz A. Holyst, Peter M.A. Sloot Noise enhances information transfer in hierarchical networks. *Scientific Reports*.
37. Fortunato S (2010) Community detection in graphs. *Physics Reports* 486:75–174.
38. Newman MEJ (2002) Spread of epidemic disease on networks. *Phys Rev E* 66:016128.
39. Keeling MJ, Eames KT. (2005) Networks and epidemic models. *Journal of The Royal Society Interface* 2:295–307.
40. Meyers LA, Pourbohloul B, Newman MEJ, Skowronski DM, Brunham RC (2005) Network theory and SARS: predicting outbreak diversity. *Journal of Theoretical Biology* 232:71 – 81.
41. Barthélemy M, Barrat A, Pastor-Satorras R, Vespignani A (2004) Velocity and Hierarchical Spread of Epidemic Outbreaks in Scale-Free Networks. *Phys Rev Lett* 92:178701.
42. Dorogovtsev SN, Goltsev AV, Mendes JFF (2008) Critical phenomena in complex networks. *Rev Mod Phys* 80:1275–1335.
43. Zhu G, Fu X, Chen G (2012) Spreading dynamics and global stability of a generalized epidemic model on complex heterogeneous networks. *Applied Mathematical Modelling* 36:5808 – 5817.
44. Cohen R, Havlin S, ben-Avraham D (2003) Efficient Immunization Strategies for Computer Networks and Populations. *Phys Rev Lett* 91:247901.
45. Kleinberg J (2007) in *Algorithmic Game Theory*, eds Nisan N, Roughgarden T, Tardos E, Vazirani VV (Cambridge University Press).

46. Goldenberg J, Han S, Lehmann DR, Hong JW (2009) The Role of Hubs in the Adoption Process. *Journal of Marketing* 73:1–13.
47. Jackson MO, Yariv L (2007) Diffusion of Behavior and Equilibrium Properties in Network Games. *The American Economic Review* 97:92–98.
48. Bakshy E, Karrer B, Adamic LA (2009) in *Proceedings of the 10th ACM conference on Electronic commerce, EC '09*. (ACM, New York, NY, USA), pp 325–334.
49. Nyabadza F, Mukwembi S, Rodrigues BG (2011) A graph theoretical perspective of a drug abuse epidemic model. *Physica A: Statistical Mechanics and its Applications* 390:1723 – 1732.
50. Moreno Y, Nekovee M, Pacheco AF (2004) Dynamics of rumor spreading in complex networks. *Phys Rev E* 69:066130.
51. Nekovee M, Moreno Y, Bianconi G, Marsili M (2007) Theory of rumour spreading in complex social networks. *Physica A: Statistical Mechanics and its Applications* 374:457 – 470.
52. Hedetniemi SM, Hedetniemi ST, Liestman AL (1988) A survey of gossiping and broadcasting in communication networks. *Networks* 18:319–349.
53. Buchegger S, Le Boudec J (2003) in *WiOpt'03: Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks* (Sophia Antipolis, France), p 10 pages.
54. Chierichetti F, Lattanzi S, Panconesi A (2009) in *Automata, Languages and Programming*, Lecture Notes in Computer Science., eds Albers S, Marchetti-Spaccamela A, Matias Y, Nikolettseas S, Thomas W (Springer Berlin / Heidelberg), pp 375–386.
55. Doerr B, Friedrich T, Sauerwald T (2009) in *Automata, Languages and Programming*, Lecture Notes in Computer Science., eds Albers S, Marchetti-Spaccamela A, Matias Y, Nikolettseas S, Thomas W (Springer Berlin / Heidelberg), pp 366–377.

56. Adler FR, Gordon DM (1992) Information Collection and Spread by Networks of Patrolling Ants. *The American Naturalist* 140:373–400.
57. Gruhl D, Guha R, Liben-Nowell D, Tomkins A (2004) in *Proceedings of the 13th international conference on World Wide Web, WWW '04*. (ACM, New York, NY, USA), pp 491–501.
58. Huberman B, Adamic L (2004) in *Complex Networks*, Lecture Notes in Physics., eds Ben-Naim E, Frauenfelder H, Toroczkai Z (Springer Berlin / Heidelberg), pp 371–398.
59. Wu F, Huberman BA, Adamic LA, Tyler JR (2004) Information flow in social groups. *Physica A: Statistical Mechanics and its Applications* 337:327 – 335.
60. Kitsak M et al. (2010) Identification of influential spreaders in complex networks. *Nat Phys* 6:888–893.
61. Gai P, Kapadia S (2010) Contagion in financial networks. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Science* 466:2401–2423.
62. Pastor-Satorras R, Vespignani A (2001) Epidemic Spreading in Scale-Free Networks. *Phys Rev Lett* 86:3200–3203.
63. Boguñá M, Pastor-Satorras R, Vespignani A (2003) Absence of Epidemic Threshold in Scale-Free Networks with Degree Correlations. *Phys Rev Lett* 90:028701.
64. Norbert Wiener (1948) *Cybernetics: Or Control and Communication in the Animal and the Machine* (John Wiley & Sons, New York).
65. Winfree AT (1967) Biological rhythms and the behavior of populations of coupled oscillators. *J Theor Biol* 16:15–42.
66. Charles S Peskin (1975) *Mathematical aspects of heart physiology* (Courant Institute of Mathematical Sciences, New York University).

67. Mirollo R, Strogatz S (1990) Synchronization of Pulse-Coupled Biological Oscillators. *SIAM Journal on Applied Mathematics* 50:1645–1662.
68. Strogatz SH, Stewart I (1993) Coupled oscillators and biological synchronization. *Sci Am* 269:102–109.
69. Arkady Pikovsky, Michael Rosenblum, Jürgen Kurths (2001) *Synchronization: A Universal Concept in Nonlinear Sciences* (Cambridge University Press).
70. Osipov GV, Kurths J, Zhou C (2007) *Synchronization in Oscillatory Networks* (Springer).
71. Comellas F, Gago S (2007) Synchronizability of complex networks. *Journal of Physics A: Mathematical and Theoretical* 40:4483.
72. Su R-Q, Ni X, Wang W-X, Lai Y-C (2012) Forecasting synchronizability of complex networks from data. *Phys Rev E* 85:056220.
73. Dorogovtsev SN, Goltsev AV, Mendes JFF (2002) Ising model on networks with an arbitrary distribution of connections. *Phys Rev E* 66:016104.
74. Reichardt J, Bornholdt S (2004) Detecting Fuzzy Community Structures in Complex Networks with a Potts Model. *Phys Rev Lett* 93:218701.
75. Grabowski A, Kosiński RA (2006) Ising-based model of opinion formation in a complex network of interpersonal interactions. *Physica A: Statistical Mechanics and its Applications* 361:651 – 664.
76. Holme P, Newman MEJ (2006) Nonequilibrium phase transition in the coevolution of networks and opinions. *Phys Rev E* 74:056108.
77. Serge Galam (2012) *Sociophysics: A Physicist's Modeling of Psychopolitical Phenomena* (Springer).



78. Bryngelson JD, Wolynes PG (1987) Spin glasses and the statistical mechanics of protein folding. *Proceedings of the National Academy of Sciences* 84:7524–7528.
79. Frauenfelder H, Sligar SG, Wolynes PG (1991) The energy landscapes and motions of proteins. *Science* 254:1598–1603.
80. Goldstein RA, Luthey-Schulten ZA, Wolynes PG (1992) Optimal protein-folding codes from spin-glass theory. *Proceedings of the National Academy of Sciences* 89:4918–4922.
81. Ferreiro DU, Walczak AM, Komives EA, Wolynes PG (2008) The energy landscapes of repeat-containing proteins: Topology, cooperativity, and the folding funnels of one-dimensional architectures. *PLOS COMPUTATIONAL BIOLOGY* 4.
82. Amit DJ, Gutfreund H, Sompolinsky H (1985) Spin-glass models of neural networks. *Phys Rev A* 32:1007–1018.
83. Hidetoshi Nishimori (2001) *Statistical Physics of Spin Glasses and Information Processing* (Oxford University Press).
84. Cover TM, Thomas JA (1991) *Elements of information theory* (Wiley-Interscience).
85. Lloyd S (2006) *Programming the Universe: A Quantum Computer Scientist Takes on the Cosmos* (Knopf, New York).
86. Wiesner K (2010) Nature computes: Information processing in quantum dynamical systems. *Chaos* 20:037114.
87. Dambre J, Verstraeten D, Schrauwen B, Massar S (2012) Information processing capacity of dynamical systems. *Sci Rep* 2:514.
88. Still S, Sivak DA, Bell AJ, Crooks GE (2012) Thermodynamics of Prediction. *Phys Rev Lett* 109:120604.
89. Chen B-S, Lin Y-P (2012) On the Information Transmission Ability of Nonlinear Stochastic Dynamic Networks. *Entropy* 14:1652–1670.

90. Lukoševičius M, Jaeger H (2009) Reservoir computing approaches to recurrent neural network training. *Computer Science Review* 3:127 – 149.
91. Barbara Hammer, Benjamin Schrauwen, Jochen J. Steil (2009) in *ESANN'2009 proceedings* (D-side Publications).
92. Paquot Y et al. (2012) Optoelectronic Reservoir Computing. *Sci Rep* 2.
93. Crutchfield JP, Feldman DP (1997) Statistical complexity of simple one-dimensional spin systems. *Phys Rev E* 55:R1239–R1242.
94. Crutchfield JP, Ellison CJ, Mahoney JR (2009) Time's Barbed Arrow: Irreversibility, Crypticity, and Stored Information. *Phys Rev Lett* 103:094101.
95. Ellison C, Mahoney J, Crutchfield J (2009) Prediction, Retrodiction, and the Amount of Information Stored in the Present. *Journal of Statistical Physics* 136:1005–1034.
96. James RG, Ellison CJ, Crutchfield JP (2011) Anatomy of a Bit: Information in a Time Series Observation. *Chaos* 21:15.
97. Li M, Vitanyi PMB (2008) *An Introduction to Kolmogorov Complexity and Its Applications* (Springer, New York)
98. Feldman DP, Crutchfield JP (2003) Structural information in two-dimensional patterns: Entropy convergence and excess entropy. *Phys Rev E* 67:051104.
99. Keizer J (1987) *Statistical Thermodynamics of Nonequilibrium Processes* (Springer). 1st Ed.
100. Milne EA (1928) The effect of collisions on monochromatic radiative equilibrium. *Monthly Notices of the Royal Astronomical Society* 88:493.
101. Coolen ACC, Kuhn R, Sollich P (2005) *Theory of Neural Information Processing Systems* (Oxford University Press).

102. Schneidman E, Berry MJ, Segev R, Bialek W (2006) Weak pairwise correlations imply strongly correlated network states in a neural population. *Nature* 440:1007–1012.
103. Gillespie DT (1977) Exact stochastic simulation of coupled chemical reactions. *The Journal of Physical Chemistry* 81:2340–2361.
104. McAdams HH, Arkin A (1997) Stochastic mechanisms in gene expression. *Proc Natl Acad Sci USA* 94:814–819.
105. Friedman N (2004) Inferring Cellular Networks Using Probabilistic Graphical Models. *Science* 303:799–805.
106. Margolin AA et al. (2006) ARACNE: an algorithm for the reconstruction of gene regulatory networks in a mammalian cellular context. *BMC Bioinformatics* 7 Suppl 1:S7.
107. Karlebach G, Shamir R (2008) Modelling and analysis of gene regulatory networks. *Nat Rev Mol Cell Biol* 9:770–780.
108. Barra A, Agliari E (2010) Stochastic dynamics for idiotypic immune networks. *Physica A: Statistical Mechanics and its Applications* 389:5903 – 5911.
109. Agliari E, Barra A, Guerra F, Moauro F (2011) A thermodynamic perspective of immune capabilities. *Journal of Theoretical Biology* 287:48 – 63.
110. Bikas K. Chakrabarti, Anirban Chakraborti, Arnab Chatterjee eds. (2006) *Econophysics and Sociophysics* (Wiley-VCH). 1st Ed.
111. Suo S, Chen Y (2008) The Dynamics of Public Opinion in Complex Networks. *Journal of Artificial Societies and Social Simulation* 11:2.
112. Castellano C, Fortunato S, Loreto V (2009) Statistical physics of social dynamics. *Rev Mod Phys* 81:591–646.
113. Johannes Voit (2010) *The Statistical Mechanics of Financial Markets* (Springer).

114. Watts DJ (2002) A simple model of global cascades on random networks. *Proc Natl Acad Sci USA* 99:5766–5771.
115. Wang XF, Xu J (2004) Cascading failures in coupled map lattices. *Phys Rev E* 70:056113.
116. Albert R, Jeong H, Barabasi A-L (2000) Error and attack tolerance of complex networks. *Nature* 406:378–382.
117. Restrepo JG, Ott E, Hunt BR (2006) Characterizing the dynamical importance of network nodes and links. *Phys Rev Lett* 97:094102–094102.
118. Yu H, Kim PM, Sprecher E, Trifonov V, Gerstein M (2007) The Importance of Bottlenecks in Protein Networks: Correlation with Gene Essentiality and Expression Dynamics. *PLoS Comput Biol* 3:e59.
119. Latora V, Marchiori M (2007) A measure of centrality based on network efficiency. *New Journal of Physics* 9:188.
120. Jaynes ET (1957) Information Theory and Statistical Mechanics. *Phys Rev* 106:620–630.
121. Bialek W et al. (2012) Statistical mechanics for natural flocks of birds. *Proceedings of the National Academy of Sciences*.
122. Ross Kindermann (1980) *Markov Random Fields and Their Applications* (American Mathematical Society). 1st Ed.
123. Berg J, Lässig M (2002) Correlated Random Networks. *Phys Rev Lett* 89:228701.
124. Leskovec J, Adamic LA, Huberman BA (2007) The dynamics of viral marketing. *ACM Trans Web* 1.
125. Brown KR, Jurisica I (2007) Unequal evolutionary conservation of human protein interactions in interologous networks. *Genome Biol* 8:R95.

126. Ivenshitz M, Segal M (2010) Neuronal Density Determines Network Connectivity and Spontaneous Activity in Cultured Hippocampus. *Journal of Neurophysiology* 104:1052–1060.
127. Newman MEJ (2003) Mixing patterns in networks. *Phys Rev E* 67:026126.
128. Glauber RJ (1963) Time-Dependent Statistics of the Ising Model. *Journal of Mathematical Physics* 4:294–307.
129. Valdar WSJ (2002) Scoring residue conservation. *Proteins: Structure, Function, and Bioinformatics* 48:227–241.
130. Ostaszewski, M, Eifes, S, Del Sol, A (2012) Evolutionary Conservation and Network Structure Characterize Genes of Phenotypic Relevance for Mitosis in Human. *PLoS ONE* 7:e36488.
131. Watts DJ, Dodds PS (2007) Influentials, networks, and public opinion formation. *Journal of Consumer Research* 34:441–458.
132. Granovetter MS (1973) The Strength of Weak Ties. *The American Journal of Sociology* 78:1360–1380.
133. David Easley, Jon Kleinberg (2010) *Networks, Crowds, and Markets* (Cambridge University Press).
134. Rogers EM (2003) *Diffusion of innovations* (Free Press).
135. Wheeler JA (1999) in ed Hey AJG (Perseus Books, Cambridge, MA, USA), pp 309–336.
136. Bavelas A (1948) A Mathematical Model for Group Structures. *Human Organization* 7:16–30.
137. Pujol JM, Sangüesa R, Delgado J (2002) in *Proceedings of the first international joint conference on Autonomous agents and multiagent systems: part 1*, AAMAS '02. (ACM, New York, NY, USA), pp 467–474.

138. Kiss C, Bichler M (2008) Identification of influencers — Measuring influence in customer networks. *Decision Support Systems* 46:233 – 253.
139. Liu Y-Y, Slotine J-J, Barabasi A-L (2011) Controllability of complex networks. *Nature* 473:167–173.
140. Pereira T (2010) Hub synchronization in scale-free networks. *Phys Rev E* 82:036201.
141. Kohring GA (1996) Ising Models of Social Impact: the Role of Cumulative Advantage. *J Phys I France* 6:301–308.
142. Aleksiejuk A, Holyst JA, Stauffer D (2002) Ferromagnetic phase transition in Barabasi-Albert networks. *Physica A* 310:260–266.
143. Bak P (1996) *How nature works: the science of self-organized criticality* (Copernicus Press, New York).
144. Scheffer M et al. (2009) Early-warning signals for critical transitions. *Nature* 461:53–59.
145. Dakos V, Van Nes E, Donangelo R, Fort H, Scheffer M (2010) Spatial correlation as leading indicator of catastrophic shifts. *Theoretical Ecology* 3:163–174.
146. Grodzins M (1958) *The metropolitan area as a racial problem* (University of Pittsburgh Press, Pittsburgh).
147. Granovetter M (1978) Threshold Models of Collective Behavior. *American Journal of Sociology* 83:1420–1443.
148. Klemm K, Eguiluz VM, Toral R, Miguel MS (2003) Nonequilibrium transitions in complex networks: a model of social interaction. *Phys Rev E* 67:026120.
149. Castellano C, Fortunato S, Loreto V (2009) Statistical physics of social dynamics. *Rev Mod Phys* 81:591–646.

150. Barthélemy M, Nadal J-P, Berestycki H (2010) Disentangling collective trends from local dynamics. *Proc Natl Acad Sci USA* 107:7629–7634.
151. Xie J et al. (2011) Social consensus through the influence of committed minorities. *Phys Rev E* 84:011130.
152. Durrett R et al. (2012) Graph fission in an evolving voter model. *Proc Natl Acad Sci USA*.
153. Mormann F, Andrzejak RG, Elger CE, Lehnertz K (2007) Seizure prediction: the long and winding road. *Brain* 130:314–333.
154. Jefferys JGR, Curtis M de, Avoli M (2010) Neuronal network synchronization and limbic seizures. *Epilepsia* 51:19.
155. Cymerblit-Sabba A, Schiller Y (2010) Network Dynamics during Development of Pharmacologically Induced Epileptic Seizures in Rats In Vivo. *J Neurosci* 30:1619–1630.
156. Koehling R, Staley K (2011) Network mechanisms for fast ripple activity in epileptic tissue. *Epilepsy Res* 97:318–323.
157. Meisel C, Kuehn C (2012) Scaling Effects and Spatio-Temporal Multilevel Dynamics in Epileptic Seizures. *PLoS ONE* 7:e30371.
158. Cymerblit-Sabba A, Schiller Y (2012) Development of hypersynchrony in the cortical network during chemoconvulsant-induced epileptic seizures in vivo. *J Neurophysiol* 107:1718–1730.
159. Litt B, Echauz J (2002) Prediction of epileptic seizures. *Lancet Neurol* 1:22 – 30.
160. Johnson NF, Jefferies P, Hui PM (2003) *Financial Market Complexity* (Oxford University Press).
161. Kirou A, Ruszczycki B, Walser M, Johnson N (2008) in *Computational Science, Lecture Notes in Computer Science.*, eds

- Bubak M, van Albada G, Dongarra J, Sloot P (Springer Berlin / Heidelberg), pp 33–41.
162. May RM, Arinaminpathy N (2010) Systemic risk: the dynamics of model banking systems. *J R Soc Interface* 7:823–838.
  163. Haldane AG, May RM (2011) Systemic risk in banking ecosystems. *Nature* 469:351–355.
  164. Sornette D (2002) Predictability of catastrophic events: Material rupture, earthquakes, turbulence, financial crashes, and human birth. *Proc Natl Acad Sci USA* 99:2522–2529.
  165. Turcotte DL, Rundle JB (2002) Self-organized complexity in the physical, biological, and social sciences. *Proc Natl Acad Sci USA* 99:2463–2465.
  166. Hallerberg S (2008) Predictability of extreme events in time series.
  167. Feldman DP, McTague CS, Crutchfield JP (2008) The organization of intrinsic computation: Complexity-entropy diagrams and the diversity of natural information processing. *Chaos* 18:043106.
  168. Kaminsky G, Lizondo S, Reinhart CM (1998) Leading Indicators of Currency Crises. *Staff Papers - International Monetary Fund* 45:1–48.
  169. Berg A, Pattillo C (1999) Predicting currency crises: The indicators approach and an alternative. *Journal of International Money and Finance* 18:561 – 586.
  170. Gerdesmeier D, Reimers H-E, Roffia B (2010) Asset Price Misalignments and the Role of Money and Credit. *International Finance* 13:377–407.
  171. Riccardo Rebonato (2004) *Volatility and Correlation: The Perfect Hedger and the Fox* (Wiley). 2nd Ed.



172. Semiannual OTC derivatives statistics at end-December 2011 (2012) (Bank for International Settlements) Available at: <http://www.bis.org/statistics/derstats.htm> [Accessed June 28, 2012].
173. Wissel C (1984) A universal law of the characteristic return time near thresholds. *Oecologia* 65:101–107.
174. Dakos V et al. (2008) Slowing down as an early warning signal for abrupt climate change. *Proc Natl Acad Sci USA* 105:14308–14312.
175. Carpenter SR et al. (2011) Early Warnings of Regime Shifts: A Whole-Ecosystem Experiment. *Science* 332:1079–1082.
176. Lenton TM, Livina VN, Dakos V, Van Nes EH, Scheffer M (2012) Early warning of climate tipping points from critical slowing down: comparing methods to improve robustness. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 370:1185–1204.
177. Bloch I, Hansch TW, Esslinger T (2000) Measurement of the spatial coherence of a trapped Bose gas at the phase transition. *Nature* 403:166–170.
178. Guttal V, Jayaprakash C (2009) Spatial variance and spatial skewness: leading indicators of regime shifts in spatial ecological systems. *Theoretical Ecology* 2:3–12.
179. Drake JM, Griffen BD (2010) Early warning signals of extinction in deteriorating environments. *Nature* 467:456–459.
180. DONANGELO R, FORT H, DAKOS V, SCHEFFER M, VAN NES EH (2010) EARLY WARNINGS FOR CATASTROPHIC SHIFTS IN ECOSYSTEMS: COMPARISON BETWEEN SPATIAL AND TEMPORAL INDICATORS. *Int J Bifurcation Chaos* 20:315–321.
181. Bailey RM (2011) Spatial and temporal signatures of fragility and threshold proximity in modelled semi-arid vegetation. *Proceedings of the Royal Society B: Biological Sciences* 278:1064–1071.

182. Dakos V, Kéfi S, Rietkerk M, Nes EH van, Scheffer M (2011) Slowing Down in Spatially Patterned Ecosystems at the Brink of Collapse. *The American Naturalist* 177:E153–E166.
183. Estrella A, Mishkin FS (1998) Predicting U.S. Recessions: Financial Variables as Leading Indicators. *Rev Econ Stat* 80:45–61.
184. Christopher Whittall (2010) The price is wrong. *Risk magazine*.
185. MacKenzie D (2008) *An Engine, Not a Camera* (MIT Press).
186. Davis EP, Karim D (2008) Comparing early warning systems for banking crises. *Journal of Financial Stability* 4:89–120.
187. Morris Goldstein, Carmen Reinhart, Graciela Kaminsky (2000) *Assessing Financial Vulnerability: An Early Warning System for Emerging Markets* (Institute for International Economics).
188. Biggs R, Carpenter SR, Brock WA (2009) Turning back from the brink: Detecting an impending regime shift in time to avert it. *Proc Natl Acad Sci USA* 106:826–831.
189. Chen L, Liu R, Liu Z-P, Li M, Aihara K (2012) Detecting early-warning signals for sudden deterioration of complex diseases by dynamical network biomarkers. *Sci Rep* 2.
190. Dai L, Vorselen D, Korolev KS, Gore J (2012) Generic Indicators for Loss of Resilience Before a Tipping Point Leading to Population Collapse. *Science* 336:1175–1177.
191. Barnosky AD et al. (2012) Approaching a state shift in Earth's biosphere. *Nature* 486:52–58.
192. Sadler LE, Higbie JM, Leslie SR, Vengalattore M, Stamper-Kurn DM (2006) Spontaneous symmetry breaking in a quenched ferromagnetic spinor Bose-Einstein condensate. *Nature* 443:312–315.
193. Xu S-Y et al. (2011) Topological Phase Transition and Texture Inversion in a Tunable Topological Insulator. *Science* 332:560–564.

194. Gong M, Tewari S, Zhang C (2011) BCS-BEC Crossover and Topological Phase Transition in 3D Spin-Orbit Coupled Degenerate Fermi Gases. *Phys Rev Lett* 107:195303.
195. Kitano H (2004) Biological robustness. *Nat Rev Genet* 5:826–837.
196. MacNeil LT, Walhout AJM (2011) Gene regulatory networks and the role of robustness and stochasticity in the control of gene expression. *Genome Research* 21:645–657.
197. Gregor T, Fujimoto K, Masaki N, Sawai S (2010) The Onset of Collective Behavior in Social Amoebae. *Science* 328:1021–1025.
198. Sloot PMA, Overeinder BJ, Schoneveld A (2001) Self-organized criticality in simulated correlated systems. *Computer Physics Communications* 142:76–81.
199. Glynn M, Rhodes P (2005) *What is really happening with HIV trends in the United States? Modeling the national epidemic. Presented at the National HIV Prevention Conference, Session T1-B11-13* (Atlanta, GA).
200. Agency HP (2011) *HIV in the United Kingdom: 2011 Report* (Health Protection Services, London).
201. Leigh Brown AJ et al. (2011) Transmission Network Parameters Estimated From HIV Sequences for a Nationwide Epidemic. *Journal of Infectious Diseases* 204:1463–1469.
202. HO SYW, SHAPIRO B (2011) Skyline-plot methods for estimating demographic history from nucleotide sequences. *Molecular Ecology Resources* 11:423–434.
203. De Silva E, Ferguson NM, Fraser C (2012) Inferring pandemic growth rates from sequence data. *Journal of The Royal Society Interface*.
204. Stadler T et al. (2012) Estimating the Basic Reproductive Number from Viral Sequence Data. *Molecular Biology and Evolution* 29:347–357.

205. Unit MRCCT (2012) *UK HIV Drug Resistance Database* Available at: <http://www.hivrd.org/>.
206. Kothe D et al. (2003) Performance Characteristics of a New Less Sensitive HIV-1 Enzyme Immunoassay for Use in Estimating HIV Seroincidence. *JAIDS Journal of Acquired Immune Deficiency Syndromes* 33:625–634.
207. Parienti J-J et al. (2004) Predictors of Virologic Failure and Resistance in HIV-Infected Patients Treated with Nevirapine- or Efavirenz-Based Antiretroviral Therapy. *Clinical Infectious Diseases* 38:1311–1316.
208. Xiridou M, Geskus R, De Wit J, Coutinho R, Kretzschmar M (2003) The contribution of steady and casual partnerships to the incidence of HIV infection among homosexual men in Amsterdam. *AIDS* 17:1029–1038.
209. Quax R, Bader DA, Sloot PMA (2011) SEECN: Simulating complex systems using dynamic complex networks. *International Journal for Multi-scale Computational Engineering* 9:201–214.
210. Schneeberger A et al. (2004) Scale-Free Networks and Sexually Transmitted Diseases: A Description of Observed Patterns of Sexual Contacts in Britain and Zimbabwe. *Sexually Transmitted Diseases* 31:380–387.
211. Hurtado I et al. (2007) Trends in HIV testing, serial HIV prevalence and HIV incidence among people attending a Center for AIDS Prevention from 1988 to 2003. *Sexually Transmitted Infections* 83:23–28.
212. Cohen MS et al. (2011) Prevention of HIV-1 Infection with Early Antiretroviral Therapy. *New England Journal of Medicine* 365:493–505.
213. Wilson DP, Jin F, Jansson J, Zablotska I, Grulich AE (2010) Infectiousness of HIV-infected men who have sex with men in the era of highly active antiretroviral therapy. *AIDS* 24:2420–2421.

214. Vittinghoff E et al. (1999) Per-Contact Risk of Human Immunodeficiency Virus Transmission between Male Sexual Partners. *American Journal of Epidemiology* 150:306–311.
215. Dorrucchi M et al. (1999) Temporal Changes in the Rate of Progression to Death Among Italians With Known Date of HIV Seroconversion: Estimates of the Population Effect of Treatment. *JAIDS Journal of Acquired Immune Deficiency Syndromes* 22:65.
216. Time from HIV-1 seroconversion to AIDS and death before widespread use of highly-active antiretroviral therapy: a collaborative re-analysis (2000) *The Lancet* 355:1131 – 1137.
217. Davis KR, Weller SC (1999) The Effectiveness of Condoms in Reducing Heterosexual Transmission of HIV. *Family Planning Perspectives* 31:pp. 272–279.
218. Wawer MJ et al. (2005) Rates of HIV-1 Transmission per Coital Act, by Stage of HIV-1 Infection, in Rakai, Uganda. *Journal of Infectious Diseases* 191:1403–1409.
219. Izhikevich EM, Edelman GM (2008) Large-scale model of mammalian thalamocortical systems. *Proceedings of the National Academy of Sciences* 105:3593–3598.
220. Holme P, Saramäki J (2012) Temporal networks. *Physics Reports* 519:97–125.
221. Donangelo R, Fort H, Dakos V, Scheffer M, Nes EH (2010) Early warnings for catastrophic shifts in ecosystems: Comparison between spatial and temporal indicators.
222. Reshef DN et al. (2011) Detecting Novel Associations in Large Data Sets. *Science* 334:1518–1524.
223. Clark SP, Coggin TD (2011) Was there a U.S. house price bubble? An econometric analysis using national and regional panel data. *Q Rev Econ Finance* 51:189 – 200.

224. Monthly House Price Indexes for Census Divisions and U.S. January 1991 to Latest (2012) (Federal Housing Finance Agency) Available at: <http://www.fhfa.gov>.
225. Gros D (2007) *Bubbles in Real Estate? A Longer-Term Comparative Analysis of Housing Prices in Europe and the US* (Centre for European Policy Studies).
226. Mayer C (2011) Housing Bubbles: A Survey. *Annu Rev Econom* 3:59–77.
227. Rajdeep Sengupta, Yu Man Tam (2008) The LIBOR-OIS Spread as a Summary Indicator. *Economic Synopses*.