Principles of Complex Systems

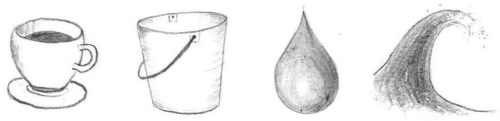
CSYS/MATH 300; Instructor: Prof. Peter Dodds
Tuesday and Thursday, 11:30 am to 12:45 pm in 102 Perkins
Level: Graduate/Advanced Undergraduate

Synopsis: Many of the problems we face in the modern world revolve around comprehending, controlling, and designing multi-scale, interconnected systems. Networked systems, for example, facilitate the diffusion and creation of ideas, the physical transportation of people and goods, and the distribution and redistribution of energy. Complex systems such as the human body and ecological systems are typically highly balanced, flexible, and robust, but are also susceptible to systemic collapse. These complex problems almost always have economic, social, and technological aspects.

So what do we know about complex systems? My basic aim in this introductory, interdisciplinary course is to impart knowledge of a suite of theories and ideas and tools that have been evolved over the last century in the pursuit of understanding complex systems. We'll touch on everything from physics to sociology, from randomness to cities to language. Throughout the course, we'll maintain a focus on (1) real small-scale mechanisms that give rise to observed macro phenomena, (2) scaling phenomena, and (3) complex networks, allowing us to explore how seemingly disparate systems connect to each other—the phenomenon of universality—and, just as importantly, where tempting analogies break down.

Potential topics:

Emergence and Universality	Complex Sociotechnical Phenomena
Scaling Phenomena	Social & Biological Contagion
Complex Networks	Network Analysis and Visualization
Hierarchies and Modularity	Collective behavior
Complexity from Simple Rules	Information & Search
Robustness & Fragility	Language and knowledge
Statistical Mechanics	Stories
Inevitability and Path Dependence	The Theory of Anything



http://www.uvm.edu/∼pdodds/teaching/courses/2013-01UVM-300