Basics of Complex Systems

Special Topics Math Course 295C; Instructor: Prof. Peter Dodds
Tuesdays & Thursdays, 3:30 to 4:45 pm in 309 Lafayette
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? The basic aim of this introductory interdisciplinary course is to present a suite of theories and ideas that have evolved over the last couple of decades in the pursuit of understanding complex systems. The central focus will be on understanding small-scale mechanisms that give rise to observed systemic phenomena. Students will be encouraged to see how different areas connect to each other and, just as importantly, where analogies break down.

Potential topics:

- Measures of Complexity
- Scaling Phenomena
- Growth Processes
- Hierarchies and Modularity
- Complexity from Simple Rules
- Robustness & Fragility
- Complex Networks
- Complex Social Phenomena
- Social & Biological Contagion
- Collective Decision Making
- Cooperation
- Information & Search
- Network Analysis and Visualization
- Distribution Systems

Please visit http://www.uvm.edu/~pdodds/teaching/ for more information and/or send email to pdodds@uvm.edu.