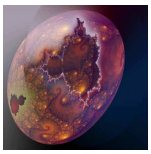
UCDAVIS UNIVERSITY OF CALIFORNIA Hydrologic Sciences Graduate Group Presents

Special Colloquium Series, Spring & Fall 2005:

Between Nature and Science:
Advanced Modeling Concepts for Environmental Sciences



Raissa M. D'Souza

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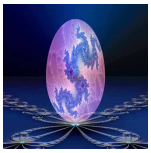

Networks, power laws and phase transitions

October 27th
4:00-5:00pm
PES 3001
Light refreshments provided

We are beginning to understand how pervasive network structures are in natural and engineered systems, and to formulate mathematical theories of network growth. A common observation in technological, biological and social networks is the existence of "scale-free" probability distributions, and of phase transitions (abrupt changes in behavior, such as the emergence of a giant connected core). Mathematical models of random graphs based on the paradigm of preferential attachment (PA) have been used extensively to model network growth as they reproduce some of the observed scale-free properties. Furthermore, PA has a long tradition of use from economics to biology, where it is taken as a fundamental axiom.

Rather than assuming PA, we begin with a more basic mechanism, of competition between opposing forces, and show that PA can arise as the solution to the optimization problem. In addition, certain aspects of Internet growth, that have not been captured by previous models, emerge from our framework.
This talk will begin by surveying characteristic structures for different types of networks. Then our optimization model of "competition induced preferential attachment" will be presented, along with how PA emerges. Time permitting, I will digress to a discussion of phase transitions, and present a computational study of "traffic" on a lattice, which shows a sharp transition from free flowing to fully jammed. It is a simple model whose behavior remained elusive for over a decade.

Raissa D'Souza is a new faculty member in the MAE Department and the CCSE. She received a PhD in statistical physics from MIT in 1999, then was a postdoctoral researcher at Bell Laboratories and later Microsoft Research, where, amongst other things, she worked on building a large-scale WWW search engine. She has also been a short-term visiting scientist at Caltech, MSRI, IPAM, The Santa Fe Institute, and ENS in Lyon France. Raissa's research focuses on self-organization and growth in both natural and engineered systems, and her current work and publications span the fields of physics, computer science and applied math.

Upcoming Speakers:

11/3	**Don Turcotte**	TBA
11/10	**Melanie Mitchell**	The prospects and perils of complex systems modeling
11/17	**Michelle Girvan**	Insights into Complex Networks
12/1	**Elizabeth Bradley**	Nonlinear dynamics, modeling, and the environmental sciences: ideas and tools

Sponsored By: John Muir Institute for the Environment, Computational Science and Engineering Center, Department of Civil and Environmental Engineering, Department of Land, Air, and Water Resources, Department of Chemical Engineering and Materials Science, Soil Sciences, Atmospheric Sciences, and Hydrologic Sciences Graduate Groups, College of Agriculture and Environmental Sciences, U.C. Cooperative Extension