The World of Mathematics and Statistics

SWARTHMORE COLLEGE • DEPARTMENT OF MATHEMATICS AND STATISTICS

DRESDEN LECTURES 2018-2019

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April 3, 2019

Synchronization in nature

Every night along the tidal rivers of Malaysia, thousands of male fireflies congregate in the mangrove trees and flash on and off in unison. This display extends for miles along the river and occurs spontaneously; it does not require any leader or cue from the environment. Similar feats of synchronization occur throughout the natural world and in our own bodies. This lecture will provide an introduction to the math and science of spontaneous synchronization. Amazing videos of synchronous fireflies, coupled metronomes, and London's wobbly Millennium Bridge will also be shown.

April 4, 2019

An unexpected phase transition in a growing graph

Networks are all around us, from the World Wide Web to the gene networks inside our cells. In many cases, these networks change over time, as nodes and edges are added, deleted, or rewired. The math problems raised by such evolving networks are of interest not just to graph theorists and computer scientists, but also to people working in dynamical systems and statistical physics.

In this talk, I'll discuss what may be the simplest model of a randomly growing network. At each time step, a new node is added; then, with probability δ, two nodes are chosen uniformly at random and joined by an undirected edge. This process is repeated for t time steps. In the limit of large t, the resulting graph displays surprisingly rich characteristics. In particular, a giant connected component emerges in an infinite-order phase transition at $\delta = 1/8.$

No knowledge of graph theory is needed to follow this talk; the main ideas come from undergraduate-level probability and differential equations, and all the jargon will be explained as we go.

This is joint work with Duncan Callaway, John Hopcroft, Jon Kleinberg, and Mark Newman.

Wednesday, April 3rd & Thursday, April 4th
REFRESHMENTS 4:00PM, TALK AT 4:30 @ SCIENCE CENTER 101