

MATH MATTERS 2006-07 IMA Public Lecture Series

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Institute for Mathematics and its Applications

 UNIVERSITY OF MINNESOTA

November 2, 2006

How Hard Can It Be?

Margaret H. Wright

Silver Professor of Computer Science
Courant Institute of
Mathematical Sciences
New York University

Willey Hall 125 at 7:00 PM

January 18, 2007

**Making Sense of a
Complex World**

Christopher J. Budd

Professor in Applied Mathematics
and Director of the Centre for
Nonlinear Mechanics
University of Bath, England

Willey Hall 125 at 7:00 PM

March 7, 2007

**Patterns Patterns
Everywhere**

Martin Golubitsky

Cullen Distinguished
Professor of Mathematics
University of Houston

Willey Hall 125 at 7:00 PM

April 18, 2006

**Epidemics in Technological
and Social Networks:
The Downside of Six Degrees of Separation**

Jennifer Chayes

Manager of the Theory Group and
Research Area Manager for
Mathematics and Theoretical
Computer Science
Microsoft Research

Willey Hall 125 at 7:00 PM

How Hard Can It Be?

Some problems in life are very hard (achieving world peace) while others are, at least for many of us, pretty easy (eating a good breakfast). How can we figure out which are which? Math can often tell us precisely how hard real-world problems are—but not always. We'll look at easy problems, hard problems, the sources of hardness, and puzzling instances where problems are invariably easier than today's math says they should be.

Making Sense of a Complex World

The world around us often seems terribly complex, chaotic and difficult to understand. We encounter this everyday: in the weather, social networks, sophisticated machinery, the internet. Frequently this complexity arises from the interaction of widely diverse scales in time and space. For example, the weather can turn in minutes, while the climate persists for many many years. Can math and science help us to make sense of all this complexity, or is it a study doomed from the start? Illustrating with many examples, Professor Budd will show that all is not lost. He will explain how simple properties often emerge from seemingly very complex systems, and how we can use these properties to gain understanding.

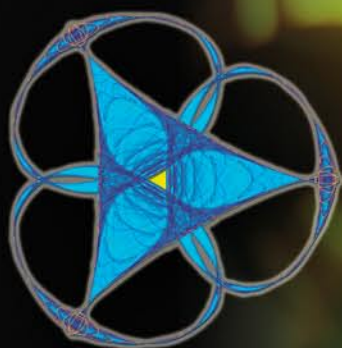
Patterns Patterns Everywhere

Regular patterns appear all around us: from vast geological formations to the ripples in a vibrating coffee cup, from the gaits of trotting horses to tongues of flames, and even in visual hallucinations. The mathematical notion of symmetry is a key to understanding how and why these patterns form. In this lecture Professor Golubitsky will show some of these fascinating patterns and explain how mathematical symmetry enters the picture.

Epidemics in Technological and Social Networks:

The Downside of Six Degrees of Separation

During the past decade, complex networks have become increasingly important in communication and information technology. Vast, self-engineered networks, like the Internet, the World Wide Web, and Instant Messaging Networks, have facilitated the flow of information, and served as media for social and economic interaction. In social networks, the ease of information flow goes by many names: the "small world" phenomenon, the "Kevin Bacon phenomenon," and "six degrees of separation"—the claim that any two people on earth can be connected through a chain of acquaintances with at most five intermediaries. Unfortunately, many of the properties that facilitate information transmission also facilitate the spread of viruses in both technological and social networks. Dr. Chayes uses simple mathematical models to explain these epidemics and to examine strategies for their containment.



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