

Report
The seminar series “Mathematics for Systems Biology”
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The first seminar in the series “Mathematics for Systems Biology” was held on February 22 at the **University of Chicago** Computation Institute. It was attended by over 150 participants.

This seminar focused on the phenomenon of *Emergence in Complex Systems*.

Synopsis: In 1999 Jeffrey Goldstein defined emergence as “the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems”. An emergent behavior appears when a number of simple entities (e.g. cellular components) operate in an environment, forming more complex behaviors as a collective. Emergence occurring over disparate size scales is usually based on causal relations across different scales formed by top-down feedback in the systems with emergent properties.

The study of emergence in biology provides valuable information about the organization of cellular processes. Oscillations are the simplest case of emergent coherence found in complex systems. They can emerge as the collective dynamic behavior of an ensemble of interacting components in the cell. Genetic oscillators form the basis of circadian clocks [A. Winfree, 2002]. The key characteristics of this dynamic state can be quantitatively determined in experiments. The emergence of oscillations in a complex system is subtle as it depends crucially on the dynamic properties of the interacting components and their collective behaviors.

The seminar has featured presentation by 3 invited speakers as well as short presentations. The video report for the seminar is available at <http://press.mcs.anl.gov/sysbio/>

The following invited talks were presented:

Prof. Michael Berry, Physics Department, Bristol University
Emergence and Asymptotics in Physics: How One Theory Can Live inside Another

Prof. Orly Alter (University of Texas at Austin)
Discovery of Principles of Nature from Mathematical Modeling of DNA Microarray Data

Prof. Evgeni Selkov (Encyclopedia Genomica, Austria; the University of Chicago). *Metabolic Incompatibility and Square Waveform of the Cell Clock*

Short Presentations

Prof. Yves A. Lussier (Center for Biomedical Informatics, Cancer Research Center , The University of Chicago). *Emerging Systems Properties in a Comprehensive Genomic Network of Prokaryotic Traits*

Dr. Julius Jellinek (Chemistry Division, Argonne National Laboratory, Computation Institute, University of Chicago/Argonne)
Complexity and Emergence: A New Paradigm for Scientific Inquiry and Education

The seminar has generated a lot of interest and positive feedback from the scientific community.