

New England Complex Systems Institute

Winter School 2010

We are pleased to announce the dates of our upcoming courses on complex systems.

Jan 4-8, 2010 / Complex Physical, Biological & Social Systems Jan 10, 2010 / Computer Programming and Complex Systems Jan 11-15, 2010 / Complex Systems Modeling and Networks

TARGET AUDIENCE

These courses are intended for faculty, graduate students, post-doctoral fellows and others who would like to gain an understanding of the fundamentals of complex systems for application to research in their respective fields, or as a basis for pursuing complex systems research.

Each week is the equivalent of a one semester course in a one week format. They may be taken independently or consecutively. If desired, arrangements for credit at a home institution should be made in advance.

See course descriptions below or online at:
<http://www.necsi.edu/events/winter2010.html>

WEEK ONE

CX201: Complex Physical, Biological and Social Systems

Dates: January 4-8, 2010
Location: MIT, Cambridge, MA

This course offers an introduction to the essential concepts of complex systems and related mathematical methods and simulation strategies with application to physical, biological and social systems. The course will particularly focus on the use of multiscale representations as a unifying approach to complex systems concepts, methods and applications.

Concepts to be discussed include: emergence, complexity, networks, self-organization, pattern formation, evolution, adaptation, fractals, chaos, cooperation, competition, attractors, interdependence, scaling, dynamic response, information, and function.

Methods to be discussed include: statistical methods, cellular automata, agent-based modeling, pattern recognition, system representation and informatics.

LAB

CX102: Computer Programming and Complex Systems

Date: January 10, 2010
Location: MIT, Cambridge, MA

This course introduces computer programming in the Python language for those with little or no computer programming experience. It is designed as a precursor to CX202.

The course will present programming concepts and hands-on exercises. Topics to be covered include: data structures, algorithms, variables and assignments, numerical and logical operations, lists and dictionaries, user-defined functions, flow control, loops, and visualization.

WEEK TWO

CX202: Complex Systems Modeling and Networks

Dates: January 11-15, 2010

Location: MIT, Cambridge, MA

This course provides (a) an introduction to building models of complex systems (physical, biological, social and engineered), and (b) the study of networks, including topologies and dynamics of real world networks.

The course will cover the basic construction and analysis of models including identifying what is to be modeled, constructing a mathematical representation, analysis tools and implementing and simulating the model in a computer program. Particular attention will be paid to choosing the right level of detail for the model, testing its robustness, and discussing which questions a given model can or cannot answer. The study of networks will introduce the use of network topologies and the characterization of networks describing complex systems, including such concepts as small worlds, degree distribution, diameter, clustering coefficient, modules, and motifs. Different types of network topologies and network behaviors that model aspects of real complex systems will be described including: modular, sparse, random, scale-free, influence, transport, transformation, and structure.

Comments from past students:

"Excellent course... useful thematic overview... applications in diverse contexts were exciting. Particularly appreciated the group project - excellent experiential pedagogy."

"The course was an eye-opening framework to analyze my work through a different lens."

"Presentations were extremely useful for me in understanding how to begin modeling complex systems and assessing them. Helped me understand a lot of things I have been doing so far without clearly understanding the principles."

"This class very much stretched my mind to apply the ideas of complexity to the world... I believe I learned more on a grander scale... will help enrich my vocabulary and the way of thinking in the world with respect to complexity."

"Excellent class. I hope to take a more active role in the community."