

Workshop III: Naturalistic Approaches to Artificial Intelligence

November 4 - 8, 2024

Scientific Overview

Many approaches to artificial intelligence are inspired by natural systems; for example, deep learning draws inspiration from biological neural networks. In recent years, researchers have looked to alternative biological inspiration. One paradigm develops distributed architectures for artificial intelligence, looking to biological evolution, insect swarms, and immune systems for models. Another paradigm argues that many forms of thinking are essentially equivalent to programming; this paradigm emphasizes the inference of (latent) programs from experience.

These paradigms have many appealing features. For example, evolutionary programming provides a powerful framework for search over machine learning architectures. Program synthesis approaches (in the “thinking as programming” paradigm) can learn latent, interpretable programs for complex tasks beyond conventional deep learning approaches.

These naturalistic approaches lack a detailed theory that explains their power. Both cases involve optimization (sometimes, combinatorial optimization) over high dimensional, complex objective functions. Both also involve basic objects (like string-based representations or programs) with rich structure and few obvious symmetries, which have only recently been studied as mathematical objects in their own right.

This workshop will draw together researchers creating new algorithms and architectures (e.g., active symbol architectures, evolutionary programming approaches, neural program synthesis) with mathematicians and theoretical computer scientists who specialize in non-convex optimization, the theory of programming languages, type theory, proof theory, and category theory. It aims to promote cross-fertilization between these paradigms and more traditional approaches, while stimulating the development of rigorous foundations for evolutionary computing, program synthesis, and other naturalistic approaches to AI.

This workshop will include a poster session; a request for posters will be sent to registered participants before the workshop.

Long Program Schedule

This workshop is part of the long program Mathematics of Intelligences.

- Mathematics of Intelligences Opening Day : September 9, 2024
- Mathematics of Intelligences Tutorials : September 10-13, 2024
- Workshop I: Analyzing High-dimensional Traces of Intelligent Behavior : September 23-27, 2024
- Workshop II: Theory and Practice of Deep Learning : October 14-18, 2024
- **Workshop III: Naturalistic Approaches to Artificial Intelligence : November 4-8, 2024**
- Workshop IV: Modeling Multi-Scale Collective Intelligences : November 18-22, 2024
- Mathematics of Intelligences Culminating Workshop at Lake Arrowhead : December 8-13, 2024

Participation

Additional information about this workshop including links to register and to apply for funding, can be found on the webpage listed below. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission, and we welcome their applications.



Organizers

Stephanie Forrest (Arizona State University)
Tom Griffiths (Princeton University)
Sumit Gulwani (Microsoft Research)
Martha Lewis (University of Bristol)
Josh Tenenbaum (MIT)

Speakers

Andrew Barron (Macquarie University)
Tai-Danae Bradley (The Master's University)
Bob Coecke (University of Oxford)
Ishita Dasgupta (Google)
Kevin Ellis (Cornell University)
Stephanie Forrest (Arizona State University)
Tom Griffiths (Princeton University)
Sumit Gulwani (Microsoft Research)
Levi Lelis (University of Alberta)
Michael Levin (Tufts University)
Martha Lewis (University of Bristol)
Rupak Majumdar (DFKI)
Pronita Mehrotra (MindAntix)
Melanie Mitchell (Santa Fe Institute)
Una-May O'Reilly (MIT)
Aishni Parab (UCLA)
Mehrnoosh Sadrzadeh (UC London)
David Spivak (Topos Institute)
Josh Tenenbaum (MIT)
Erik Winfree (CalTech)
David Wolpert (Santa Fe Institute)



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For more information, visit the program webpage:
www.ipam.ucla.edu/MOIWS3