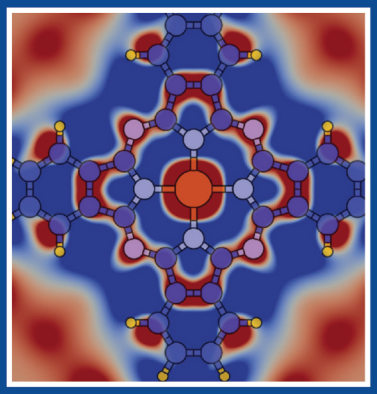
INSTITUTE FOR PURE AND APPLIED MATHEMATICS



Understanding Many-Particle Systems with Machine Learning

September 12 – December 16, 2016 | Los Angeles

Organizers: Alán Aspuru-Guzik (Harvard University), **Gabor Csanyi** (University of Cambridge), **Mauro Maggioni** (Duke University), **Stéphane Mallat** (École Normale Supérieure), **Marina Meila** (University of Washington), **Klaus-Robert Müller** (Technische Universität Berlin), and **Alexandre Tkatchenko** (Fritz-Haber-Institut der Max-Planck-Gesellschaft).

SCIENTIFIC OVERVIEW

Interactions between many constituent particles (bodies) generally give rise to collective or emergent phenomena in matter. Even when the interactions between the particles are well defined and the governing equations of the system are understood (for example the Coulomb interaction between protons and electrons and the Dirac/Schrödinger equation in quantum mechanics), the collective behavior of the system as a whole does not trivially emerge from these equations. Examples of collective behavior are abundant in nature, manifesting themselves at all scales of matter, ranging from atoms to galaxies. Machine learning methods have been used extensively in a wide variety of fields ranging from, for example, the neurosciences, genetics, multimedia search to drug discovery. Machine learning models can be thought of as universal approximators that learn a (possibly very complex) nonlinear mapping between input data (descriptor) and an output signal (observation).

It is the goal of this IPAM long program to bring together experts in many particle problems in condensed-matter physics, materials, chemistry, and protein folding, together with experts in mathematics and computer science to synergetically address the problem of tackling emergent behavior and understanding the underlying collective variables in many particle systems.

WORKSHOP SCHEDULE

- Understanding Many-Particle Systems with Machine Learning Opening Day: September 12, 2016
- Understanding Many-Particle Systems with Machine Learning Tutorials: September 13-16, 2016
- Workshop I: Machine Learning Meets Many-Particle Problems: September 26-30, 2016
- Workshop II: Collective Variables in Classical Mechanics: October 24-28, 2016
- Workshop III: Collective Variables in Quantum Mechanics: November 14-18, 2016
- Workshop IV: Synergies between Machine Learning and Physical Models: December 5-9, 2016
- Culminating Workshop at Lake Arrowhead Conference Center: December 11-16, 2016

PARTICIPATION

This long program will involve senior and junior researchers from several communities relevant to this program. You may apply for financial support to participate in the entire fourteen-week program, or a portion of it. We prefer participants who stay for the entire program. Applications will be accepted through **June 12, 2016**, but offers may be made up to one year before the start date. We urge you to apply early. Mathematicians and scientists at all levels who are interested in this area of research are encouraged to apply for funding. Supporting the careers of women and minority researchers is an important component of IPAM's mission and we welcome their applications. More information and an application is available online.

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