

NSF Discovery Informatics Workshop

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Research Interests

Recently, I have become deeply immersed in the establishment of new field of Computational Sustainability. Computational Sustainability is a new interdisciplinary research field, with the overarching goal of studying and providing solutions to computational problems for balancing environmental, economic, and societal needs for a sustainable future. Such problems are unique in scale, impact, complexity, and richness, often involving combinatorial decisions, in highly dynamic and uncertain environments, offering challenges but also opportunities for the advancement of the state-of-the-art of computer and information science. Work in Computational Sustainability integrates in a unique way various areas within computer science and applied mathematics, such as constraint reasoning, optimization, learning, and dynamical systems. The research necessarily entails a cross-fertilization of approaches and ideas from several research communities, bringing together computer scientists, biologists and environmental scientists, biological and environmental engineers, sociologists, and economists. Concrete examples of computational sustainability challenges range from planning and optimization for wildlife preservation and biodiversity conservation, to spatial modeling for poverty mapping, to the design of intelligent or smart control systems for energy-efficient buildings, to balancing portfolios of renewable energy sources.

In the context of this workshop, I'm interested in the integration of reasoning, learning, human computation, and citizen science for mathematical discovery and scientific discovery. Examples of projects I'm involved in concerning this topic: (1) Citizen science for bird conservation (with the Lab of Ornithology at Cornell University); (2) Integration of reasoning, learning, and human computation for materials discovery (with the Center for Fuel Cell Technology at Cornell University); (3) Integration of reasoning, learning, and human computation for mathematical discovery (with applications to e.g., the design of scientific experiments, in particular for agronomic applications, in collaboration with Crop and Soil Science at Cornell University).