AI for Scientific Discovery and a Sustainable Future

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ABSTRACT

Artificial Intelligence (AI) is a rapidly progressing field, achieving remarkable breakthroughs in areas ranging from computer vision and machine translation to world champion-level Go gameplay, autonomous vehicles, and Chat-GPT. The continuously expanding capabilities of AI present promising opportunities for advancements in various domains. I will discuss our AI research directed at accelerating scientific discovery for a sustainable future. Specifically, I'll delve into our work in the emerging interdisciplinary field of Computational Sustainability, which focuses on developing computational methods to tackle pressing sustainability challenges. I will illustrate examples of computational sustainability challenges, including biodiversity conservation, strategic planning for hydropower dams in the Amazon basin, and the discovery of renewable energy materials. I will highlight cross-computational themes and AI challenges, emphasizing the potential for groundbreaking advancements in our pursuit of a sustainable future.

CCS CONCEPTS

• **Computing methodologies → Machine learning**. • **Computing methodologies → Artificial intelligence.**

KEYWORDS

computational sustainability, multi label classification, multi-target regression, multi-objective Pareto optimization, fast polynomial time approximation schemes, dynamic programming, unsupervised and supervised learning, deep learning, deep reasoning networks

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1 AUTHOR BIO

Carla Gomes is the Ronald C. and Antonia V. Nielsen Professor of Computing and Information Science, the director of the Institute for Computational Sustainability at Cornell University, and co-director of the Cornell University AI for Science Institute. Gomes received a Ph.D. in computer science in artificial intelligence from the University of Edinburgh. Her research area is Artificial Intelligence with a focus on large-scale constraint reasoning, optimization, and machine learning. Recently, Gomes has become deeply immersed in research on scientific discovery for a sustainable future and, more generally, in research in the new field of Computational Sustainability. Computational Sustainability aims to develop computational methods to help solve some of the key environmental, economic, and societal challenges to help put us on a path toward a sustainable future. Gomes was the lead PI of two NSF Expeditions in Computing awards. Gomes has (co-)authored over 200 publications, which have appeared in venues spanning Nature, Science, and a variety of conferences and journals in AI and Computer Science, including five best paper awards. Gomes was named the "most influential Cornell professor" by a Merrill Presidential Scholar (2020). Gomes was also the recipient of the Association for the Advancement of Artificial Intelligence (AAAI) Feigenbaum Prize (2021) for "high-impact contributions to the field of artificial intelligence, through innovations in constraint reasoning, optimization, the integration of reasoning and learning, and through founding the field of Computational Sustainability, with impactful applications in ecology, species conservation, environmental sustainability, and materials discovery for energy" and of the 2022 ACM/AAAI Allen Newell Award, for contributions bridging computer science and other disciplines. Gomes is a Fellow of the Association for the Advancement of Artificial Intelligence (AAAI), a Fellow of the Association for Computing Machinery (ACM), and a Fellow of the American Association for the Advancement of Science (AAAS).

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