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MATHEMATICAL OPTIMIZATION FOR LANGUAGE, LIFE SCIENCES, AND SOCIETY: THEORY, METHODS, AND APPLICATIONS

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ABSTRACT

Mathematical optimization provides a common framework for developing models, learning from data, and addressing complex problems across scientific disciplines. Computational linguistics and the life sciences offer challenging settings in which theoretical advances and application needs can inform each other, with implications for human health, communication, and society. This invited session brings together researchers in optimization, numerical analysis, machine learning, computational and theoretical linguistics, and the life sciences. Its aim is to connect mathematical foundations and algorithmic developments with applications, encouraging contributions ranging from theoretical investigations to interdisciplinary case studies. Methodological topics include stochastic and nonconvex optimization, regularization, constrained and multiobjective formulations, inverse problems, parameter estimation, and structured representation learning. Theoretical contributions may address convergence, stability, identifiability, computational complexity, and robustness, as well as the development and analysis of efficient numerical algorithms. In linguistics, computational applications include natural language processing, semantic representations, multilingual language technologies, and the analysis of textual data and public discourse; theoretically and methodologically oriented work develops tools to explore the universal structure of language diversity and change. In the life sciences, the scope includes mathematical modelling and data analysis for neurodegenerative diseases, including Alzheimer's disease, cancer research, and pharmacology. These applications motivate questions about heterogeneous data, limited observations, uncertainty, and the interpretation of computational results. Particular attention will be given to how application-specific knowledge can inform mathematical formulations, and how theoretical properties translate into reliable computational behaviour. Contributions examining predictive performance, computational efficiency, interpretability, and the effects of data quality are welcome. By bringing these perspectives together, the session aims to identify shared mathematical challenges and promote exchanges between methodological research and applications with scientific and societal relevance.