Special Issue

New Advances in the Mathematical Foundations of Modern Statistical Machine Learning

Message from the Guest Editor

The topical scope of this Special Issue includes, but is not limited to, the following:

- **Algebraic and structural foundations:** Ring-theoretic and category-theoretic learning, the role of **morphisms and isomorphisms** in representation learning
- **Singular learning theory (SLT):** Algebraic geometry in statistics, resolution of singularities in model selection, and the study of non-identifiable parameter spaces.
- **Geometric and topological insights:** Sheaf-theoretic data fusion, topological data analysis (TDA), and the manifold structure of learning machines.
- **Deep learning theory:** Mathematical foundations of neural networks, the geometry of function composition, and the convergence of over-parameterized models.
- **The ninefold path to SML:** from data representation and optimization to generalizability and ethical foundations.
- **Statistical mechanics of AI:** Foundations of large language models (LLMs), kernel alignment, ensemble learning, and the generalizability of complex learning machines.
- **Computational statistics:** Advanced Bayesian inference, variational methods, and the interplay between computational complexity and statistical efficiency.

Guest Editor

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Message from the Editor-in-Chief

The journal *Mathematics* publishes high-quality, refereed papers that treat both pure and applied mathematics. The journal highlights articles devoted to the mathematical treatment of questions arising in physics, chemistry, biology, statistics, finance, computer science, engineering and sociology, particularly those that stress analytical/algebraic aspects and novel problems and their solutions. One of the missions of the journal is to serve mathematicians and scientists through the prompt publication of significant advances in any branch of science and technology, and to provide a forum for the discussion of new scientific developments.

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