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## Harnessing Differentiable and Probabilistic Programming for Scalable and Robust Statistical Analysis of Astronomical Surveys

*Tuesday, November 28, 2023 4:52 PM (3 minutes)*

I present a novel, general-purpose Python-based framework for scalable and efficient statistical inference by means of hierarchical modelling and simulation-based inference.

The framework is built combining the JAX and NumPyro libraries. The combination of differentiable and probabilistic programming offers the benefits of automatic differentiation, XLA optimization, and the ability to further improve the computational performance by running on GPUs and TPUs as well. These properties allow for efficient sampling through gradient-based methods, and for significantly enhanced performance of neural density estimation for simulation-based inference, augmented by the simulator gradients.

The framework seamlessly integrates with the recently developed COSMOPOWER-JAX and JAX-COSMO libraries, making it an ideal platform to solve Bayesian inverse problems in cosmology. Beyond cosmology, the framework is designed to be a versatile, robust tool for cutting-edge analysis of astronomical surveys. I demonstrate its practical utility through applications to various domains, including but not limited to weak lensing, supernovae, and galaxy clusters.

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