University of Zurich[UZH]

Faculty of Science

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PROF. ROBERTO TROTTA SISSA & Imperial College London

The Promise of Machine Learning for Cosmology and Astroparticle Physics

Cosmological and astrophysical data are becoming sufficiently large and complex to soon prove intractable by traditional statistical techniques. Unravelling the twin mysteries of dark energy and dark matter will require new data analysis methods capable of extracting knowledge from upcoming data streams, including the Euclid satellite, the Nancy Grace Roman space telescope and LSST/Vera Rubin observatory. The recent rise of machine learning to prominence in the physical sciences promises to deliver the necessary tools — but questions remain about the scalability, interpretability and trustworthiness of the approach.

After an accessible introduction to machine learning in cosmology, I will present recent advances in simulation-based inference techniques for fast, scalable inference with guaranteed coverage. I will discuss a general, statistically principled solution to the ubiquitous problem of covariate shift in supervised learning, which achieves gold standard performance in a variety of settings, including supernova classification, photometric redshift estimation and weak lensing calibration. I will then give example applications in supernova type Ia cosmology, dark matter direct detection and gravitational waves astronomy.

A series of special physics colloquia in honor of Erwin Schrödinger, who was a professor at UZH from 1921 – 1927.
Lectures are intended for a broad audience from the Faculty of Science, aiming at experts and non-experts.