CAUSAL INFERENCE, CAUSAL DISCOVERY, AND MACHINE LEARNING

Jakob Runge
Causal Inference group, Institute of Data Science, German Aerospace Center, Jena, Germany
E-mail: Jakob.Runge@dlr.de

In the past decades machine learning has had a rapidly growing impact on many fields of natural-, life- and social sciences as well as engineering. Machine learning excels at classification and regression tasks from complex heterogeneous datasets and can answer questions like "What statistical associations or correlations can we see in the data?", "What objects are in this picture?", or "What is the most likely next data point?". But many questions in science, engineering, and politics are about "What are the causal relations underlying the data?" or "What if a certain variable changes or is changed?" or "What would have happened if some variable had another value?". Data-driven machine learning alone fails to answer such questions. Causal inference provides the theory and methods to learn and utilize qualitative knowledge about causal relations. Together with machine learning it enables causal reasoning given complex data. Furthermore, causal methods can be used to intercompare and validate physical simulation models. In this talk I will present an overview of this exciting and widely applicable framework and illustrate it with some examples from Earth sciences and beyond.