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Causal inference for extremes on river networks

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Causal inference for extreme aims to discover cause and effect relation between large observed values of random variables. This is a fundamental problem to in many applications, from finance, engineering risks, nutrition to hydrology, to name a few. Unique challenges to
extreme values are lack of data and lack of model smoothness due to the max operator. Existing methods in extreme value statistics for dimensions $d \geq 3$ are limited due to an intractable likelihood, while techniques for learning Bayesian networks require a large amount of data to fit nonlinear models. This talk showcases the max-linear model and new algorithms for fitting them. Our method performs well on real data, recovering a directed graph for both the Danube and the Lower Colorado with high accuracy purely through extreme measurements. We also compare our method to state-of-the-art algorithms for causal inference for nonlinear models, and outline open problems in hydrology, extreme value statistics and machine learning.