Uncertainty Quantification in Causal Inference: Sharp and Efficient Bounds on Heterogeneous Causal Effects Under Hidden Confounding

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Abstract:
Estimating the heterogeneous effects of interventions from observational data is the cornerstone of data-driven decision making across many domains. While recent advances have yielded robust and efficient machine learning methods for estimating these treatment effects, the estimators often overlook the risk of unobserved confounders - latent variables with the potential to arbitrarily and unknowingly bias any causal estimate based on observational data.
When we allow for hidden confounding, we cannot obtain unbiased point estimates of the conditional average treatment effect (CATE); however, we can instead bound the true, unbiased CATE. In this talk, I introduce the B-Learner, a flexible meta-learner which can efficiently learn precise bounds on the CATE under limits on the level of hidden confounding. The B-Learner can use any function estimator such as random forests and deep neural networks, and I will show that it has desirable theoretical properties such as validity, sharpness, and efficiency. Experimental comparisons using both synthetic and real-world data support these theoretical claims, showcasing the practical utility of the B-Learner.

Bio:
Miruna Oprescu is a third year PhD candidate in Computer Science at Cornell University where she works on designing robust, reliable, and equitable machine learning algorithms for causal inference and data-driven decision making. Her research is supported by a Computational Science Fellowship from the Department of Energy. Prior to her PhD, Miruna was a Senior Data and Applied Scientist at Microsoft Research, where she researched and developed data science tools for diverse applications, including causal inference, cancer research, and weather forecasting. Miruna holds an A.B. in Physics and Mathematics with a minor in Computer Science from Harvard University.