

## **When Computation Meets Statistics: The Theoretical Foundations of True Scalability**

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Statistical Machine learning is an effective tool for predicting structured outputs, such as those arising from holistic scene understanding or 3D protein folding. As these problems grow in size, scalable and efficient methods are important for accurate prediction. In this talk I will present how to use duality theory to decompose large-scale prediction problems to many small-scale problems interdependent by messages that are sent along its correlated variables. The use of duality enabled us to handle efficiently web-scale data and achieve several improvements over existing prediction methods for indoor scene understanding, 3D depth estimation and 3D protein folding. In some cases, such as pose estimation, prediction is ambiguous. In this talk I will also present efficient methods for statistically reasoning about the Gibbs distribution over the set of possible predictions. This approach is based on new approximations and bounds for weighted counting which emerge from the max-statistics of stochastic processes.