北京理工大學

数学与统计学院学术报告

DEMA: Data-Enhanced Model Aggregation with Dual Uncertainty for Heterogeneous Data Integration

DEMA：双重不确定性下面向异质数据融合的数据增强模型聚合方法

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摘 要： Model aggregation offers a robust ensemble alternative to traditional model selection, yet its effectiveness dete_x0002_riorates in high-dimensional, small-sample settings. To overcome this challenge, we introduce Data-Enhanced Model Aggregation (DEMA), a novel data integration framework that explicitly accounts for the dual uncertainty inher_x0002_ent in model specification and auxiliary information from external data. Unlike existing statistical transfer learning paradigms, DEMA employs a localized information transfer mechanism through joint penalization during candidate model construction. This allows fine-grained and adaptive utilization of external data, even under potential model misspecification. To combine these candidates, we design a modified Q-aggregation criterion that scales the penalty with an augmented sample size, thereby promoting concentration of weight on correctly specified structures. We derive non-asymptotic error bounds for the resulting estimators and provide weight convergence guarantees under regularity conditions. Extensive numerical experiments demonstrate that DEMA substantially outperforms state-of-the-art al_x0002_ternatives. Finally, we validate its practical utility through an analysis of TCGA lung cancer datasets, confirming the feasibility and effectiveness of the proposed framework in real-world applications.

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