

# Optimal Probability Estimation with Applications to Prediction and Classification

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**Abstract:** Probability estimation, prediction, and classification, are at the core of statistics, information theory, and machine learning. Using a unified approach, we derive several results on these three related problems. We present a combined-probability estimator with optimal  $L_1$  accuracy of  $n^{-1/4}$ , construct a classifier whose error is at most  $n^{-1/5}$  higher than that of the best possible label-invariant classifier, and improve the redundancy of pattern prediction and compression to  $n^{-1/2}$ . All results hold uniformly for all discrete distributions over any alphabet size.

This is a joint work with Jayadev Acharya, Ashkan Jafarpour and Ananda Theertha Suresh.