Abstract:

We consider prediction problems formulated as repeated games, without probabilistic assumptions. In each round of the prediction game, a strategy makes a decision, then observes an outcome and pays a loss. The aim is to minimize the regret, which is the amount by which the total loss incurred exceeds the total loss of the best decision in hindsight. We are interested in the minimax optimal strategy, which minimizes the regret. We focus on three cases where the optimal strategy is simple to compute. The first involves prediction with log loss, a formulation of sequential probability density estimation that is closely related to sequential compression, coding, gambling and investment problems. We present a simple characterization of problems for which the optimal strategy does not depend on the length of the game, and show that, for general parametric models, this occurs precisely when the optimal strategy is a Bayesian strategy. The second is the sequential least squares game, where decisions and outcomes lie in a subset of Euclidean space, and loss is squared distance (related to calibration of sequential probability forecasts and sequential density estimation problems). We show that the minimax optimal strategy is a simple shrinkage strategy. The third is fixed-design linear regression, where the aim is to sequentially predict real-valued labels as well as the best linear function of the covariates. For a variety of constraints on the adversary’s labels, we show that the minimax optimal strategy is linear, with a parameter choice that is reminiscent of ordinary least squares.

Bio:

Peter Bartlett is a Professor in Computer Science and Statistics at UC Berkeley and professor in Mathematics at the Queensland University of Technology. His research interests include machine learning, statistical learning theory, and adaptive control. He has been associate editor of Machine Learning, the Journal of Machine Learning Research, the Journal of Artificial Intelligence Research, the IEEE Transactions on Information Theory, Bernoulli, and Mathematics of Control Signals and Systems, and on the editorial boards of Machine Learning, JAIR, and Foundations and Trends in Machine Learning. He has been professor in the Research School of Information Sciences and Engineering at the Australian National University, Visiting Miller Professor at UC Berkeley, and Honorary Professor at the University of Queensland. He was awarded the Malcolm McIntosh Prize for Physical Scientist of the Year in Australia in 2001, was an IMS Medallion Lecturer in 2008, and is an Australian Laureate Fellow and a Fellow of the Institute of Mathematical Statistics.

Efficient Minimax Optimal Strategies For Online Prediction

Speaker:

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