A model of online learning as a Linear Quadratic Gaussian (LQG) optimal control problem with random matrices

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Abstract - Machine learning and optimal control are combined to develop and solve in closed form an optimal-control formulation of online learning from supervised examples. In the proposed framework, the examples are used to learn an unknown vector parameter that models the relationship between inputs and outputs. The connections with the classical Linear Quadratic Gaussian (LQG) optimal control problem are investigated. The proposed problem is a non-trivial variation of the latter, as it involves random matrices. The optimal solution is compared with the Kalman-filter estimate of the parameter vector to be learned and the improvements in terms of smoothness and robustness to outliers are shown. These properties are useful, e.g., for the extension of the proposed online-learning framework to the case of a slowly-time-varying parameter vector.