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Twofold Universal Prediction Schemes for Achieving the Finite-State Prtedictability of a Noisy Individual Binary Sequence

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ABSTRACT

The problem of predicting the next outcome of an individual binary sequence corrupted by noise using finite memory, is considered. The conditional finite-state (FS) predictability of an infinite individual sequence given its noisy version is defined as the minimum fraction of errors that can be made by any finite-state predictor fed by the noisy version. It is proved that the conditional FS predictability can be attained almost surely by universal sequential prediction schemes in the case where the noisy version is the output of a binary symmetric channel (BSC) whose input is the clean individual sequence. In particular, universal predictors of the original noise-free setting, which operate on the noisy sequence, have this property. Moreover, these universal predictors do not depend on the crossover probability characterizing the BSC. It is seen that the noisy setting gives rise to additional criteria by which the performance of prediction schemes can be assessed. Finally, a closer look is taken at the conditional FS predictability, and this quantity is proposed as an additional measure of the complexity of a sequence, perhaps finer and more informative than the predictive complexity of the noise-free setting.