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The Merhav-Ziv Cross Entropy Estimator: Beyond Stationary Markov Measures

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Introduced in 1993 by Merhav and Ziv, the Merhav-Ziv estimator Q_n is an analogue of the well-known Lempel-Ziv estimator, which estimates the Cross Entropy of two unknown probability measures $\mathbb{P}$ and $\mathbb{Q}$. The algorithm takes as an input two strings y_1^n and x_1^n and does the following: it starts by considering the largest word y_1^m which appears inside x_1^n, then looks at the largest second word $y_{m+1}^{m'}$ which appears inside x_1^n and continues as such until the entire string y_1^n has been parsed into subwords. Q_n is then the number of parsed words created by this procedure. In their paper, Merhav and Ziv show the $\mathbb{P} \times \mathbb{Q}$ a.s convergence of $n^{-1}\log(n)Q_n$ to the cross entropy of $\mathbb{P}$ relative to $\mathbb{Q}$ under the seemingly restrictive assumption that both the probability measures are stationary Markov measures. Surprisingly, no rigorous generalisation of this result, covering more general measures, can be found. I will present the most recent generalisation of the result under fairly general decoupling assumption and talk about the next steps in getting the most general result we can hope for.

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