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On the Generalization Ability of Online Learning Algorithms for Pairwise Loss Functions

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In this paper, we study the generalization properties of online learning based stochastic methods for supervised learning problems where the loss function is dependent on more than one training sample (e.g., metric learning, ranking). We present a generic decoupling technique that enables us to provide Rademacher complexity-based generalization error bounds. Our bounds are in general tighter than those obtained by Wang et al (COLT 2012) for the same problem. Using our decoupling technique, we are further able to obtain fast convergence rates for strongly convex pairwise loss functions. We are also able to analyze a class of memory efficient online learning algorithms for pairwise learning problems that use only a bounded subset of past training samples to update the hypothesis at each step. Finally, in order to complement our generalization bounds, we propose a novel memory efficient online learning algorithm for higher order learning problems with bounded regret guarantees.

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