Submission for an invited session, organized by Afonso Bandeira

Lower Bounds on the Generalization Error of Deep Learning Models

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Deep learning algorithms operate in regimes that defy the traditional statistical machine learning. Neural networks architectures often contain more parameters than training samples. Despite their huge complexity, the generalization error achieved on real data is small.In this talk, we aim to study generalization properties of algorithms in high dimension. Interestingly, we show that algorithms in high dimension require a small bias for good generalization. We show that this is indeed the case for deep neural networks in the over parametrized regime.In addition, we derive explicit lower bounds on the generalization error in various settings for any algorithm. These bounds are particularly useful when the analytic evaluation of standard performance bounds is not possible due to the complexity and nonlinearity of the model.The bounds can serve as a benchmark for testing performance and optimizing the design of actual learning algorithms. The analysis uses elements from the theory of large random matrices

The preprint of this work is available at

https://arxiv.org/abs/2103.14723