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Random features and polynomial rules

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Random features models play a distinguished role in the theory of deep learning, describing the behavior of neural networks close to their infinite-width limit. In this contribution, I will present a recent analysis of the generalization performance of random features models for generic supervised learning problems with Gaussian data. Our approach, built with tools from the statistical mechanics of disordered systems, maps the random features model to an equivalent polynomial model, and allows us to plot average generalization curves as functions of the two main control parameters of the problem: the number of random features N and the size P of the training set, both assumed to scale as powers in the input dimension D. Our results extend the case of proportional scaling between N, P and D, are in accordance with rigorous bounds known for certain particular learning tasks and are in quantitative agreement with numerical experiments performed over many orders of magnitudes of N and P.