Fisher information of deep neural networks with random weights

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Abstract: Investigating deep neural networks (DNNs) with random weights has given promising results in both theory and practice. When such random DNNs are sufficiently wide, we can formulate their behavior by using simple analytical equations through coarse-graining of the random weights. In this talk, we briefly overview recent advances on the random DNNs and adopt them to the analysis of the Fisher information matrix (FIM). We reveal that the usual setting of wide DNNs leads to pathological distortion of the FIM's eigenvalue spectrum. In particular, we show that the FIM has pathologically large eigenvalues and they determine a learning rate necessary for gradient methods to converge. Our FIM's statistics also provide suggestions to deep learning methods such as batch normalization and neural tangent kernel.