

ABSTRACT

Statistical Understanding of Deep Learning with Big Data

Deep learning has profoundly impacted science and society as it has successfully applied data-driven artificial intelligence. One of the key features of deep learning is that its accuracy improves as the size of the model and the amount of training data increases. This property has significantly improved state-of-the-art learning architectures across various fields in the past decade. However, the lack of a mathematical/statistical foundation has limited the development of deep learning to specific applications and has prevented it from being more broadly applied with high confidence. This foundational gap becomes even more apparent when applied to statistical estimation and inference under limited training sample regimes. To address this issue, we aim to develop statistically principled reasoning and theory that can validate the application of deep learning and pave the way for interpretable deep learning. Our approach is based on Bayesian statistical theory and methodology and scalable computation. We demonstrate the methods with a wide range of applications.