Statistical Perspectives in Teaching Deep Learning from Fundamentals to Applications

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Abstract

The use of Artificial Intelligence, machine learning and deep learning have gained a lot of attention and become increasingly popular in many areas of application. Historically machine learning and theory had strong connections to statistics; however, the current deep learning context is mostly in computer science perspectives and lacks statistical perspectives. In this work, we address this research gap and discuss how to teach deep learning to the next generation of statisticians. We first describe some backgrounds and how to get motivated. We discuss different terminologies in computer science and statistics, and how deep learning procedures work without getting into mathematics. In response to a question regarding what to teach, we address organizing deep learning contents and focus on the statistician's view; form basic statistical understandings of the neural networks to the latest hot topics on uncertainty quantifications for prediction of deep learning, which has been studied in the Bayesian frameworks. Further, we discuss how to choose computational environments and help develop programming skills for the students. We also discuss how to develop homework incorporating the idea of experimental design. Finally, we discuss how to expose students to the domain knowledge and help to build multi-discipline collaborations.

Keywords: artificial intelligence, curriculum development, machine learning, neural network, statistical education