41059 SPECIAL TOPICS IN STATISTICS 2 2023/24

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Statistical theory of deep learning

Recently a lot of progress has been made regarding the theoretical understanding for deep artificial neural networks. One of the very promising directions is the statistical approach, which interprets deep learning as a statistical method and builds on existing techniques in mathematical statistics to derive theoretical error bounds and to understand phenomena such as overparametrization. The lecture surveys this field and describes future challenges.

Preliminary outline:
Lecture 1 introduction, perceptron convergence theorem, universal approximation theorem
Lecture 2 approximation rates for shallow neural networks, Barron spaces
Lecture 3 advantages of additional hidden layers
Lecture 4 deep ReLU networks
Lecture 5 optimization in machine learning
Lecture 6 benign overfitting, misclassification error for image deformation models

Resources:
https://mjt.cs.illinois.edu/dlt/
https://www.cs.princeton.edu/courses/archive/fall19/cos597B/lecnotes/bookdraft.pdf
https://www.di.ens.fr/%7Efbach/ltfp_book.pdf

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