Deep Learning

Course Description

Neural networks and deep learning approaches have revolutionized the fields of data science and artificial intelligence in recent years, and applications built on these techniques have reached or surpassed human performance in many specialized applications. After a short review of the origins of neural networks and deep learning, this course will cover the most common neural network architectures and discuss in detail how neural networks are trained using dedicated data samples, avoiding common pitfalls such as overtraining. The course includes a detailed overview of alternative methods to train neural networks and further network architectures that are relevant in a wide range of specialized application scenarios.

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1. Introduction to Neural Networks and Deep Learning
   1. The Biological Brain
   2. Perceptrons and Multi-Layer Perceptrons
2. Network Architectures
   1. Feed-Forward Networks
   2. Convolutional Networks
   3. Recurrent Networks, Memory Cells, and LSTMs
3. Neural Network Training
   1. Weight Initialization and Transfer Function
   2. Backpropagation and Gradient Descent
   3. Regularization and Overtraining
4. Alternative Training Methods
   1. Attention
5. Feedback Alignment
6. Synthetic Gradients
7. Decoupled Network Interfaces
8. Further Network Architectures
   1. Generative Adversarial Networks
9. Autoencoders
10. Restricted Boltzmann Machines
11. Capsule Networks
12. Spiking Networks