



Medical Imaging meets Deep Learning

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Lecture 1: Using deep learning as priors in generative models for image analysis

Generative modeling has proven to be an extremely useful approach in medical image analysis over the last two decades. Many of the most widely used research software, such as Freesurfer, SPM and FSL, use generative modeling in some way or the other. One of the weak spots of generative modeling is construction of the prior distribution for which atlas-based approach has been the main tool. On the other hand, recent advances in deep learning allows learning approximate prior distributions from the data. In this lecture, we will first describe these methods briefly and then study how they can be integrated in generative models for medical image analysis. We will focus on Magnetic Resonance Image (MRI) reconstruction as the application problem.

Lecture 2: From random (decision) forests to neural networks

Machine learning is changing the field of medical image computing. Today, we tackle many of the hardest problems with a learning algorithm, most possibly a multi-layered neural network. Integration of machine learning however, has started much earlier than the rise of deep learning in medical image computing. This lecture will first present a brief historical overview of the integration of machine learning in medical image computing. We will then focus on Random Decision Forests, the algorithm that proposed an alternative to atlas-based approaches for analyzing medical images, and discuss the main algorithmic components behind its success. Then we will build the link to neural networks, compare the two algorithms focusing on why we believe neural networks achieve higher performance and what we can learn from random forests moving forward.