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Medical Imaging meets Deep Learning

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Unsupervised, universal and understandable deep learning

While many would argue that recent progress in deep learning has allowed machines to approach and sometimes surpass human intelligence, this is true only in a very limited sense. In practice, machines are still far behind humans in many ways. For example, where humans learn universal models, applicable to a staggering variety of diverse problems, machines only learn narrow ones, with limited generalization capability. Furthermore, where humans can learn from raw data, machine still require explicit data annotations to perform well. In this talk, I will discuss our recent progress in universal and unsupervised learning. I will show how deep networks can generalize across apparently very diverse domains by means of residual adapters. I will also introduce the idea of factor learning and how this can be used to learn the geometry of objects by means of random data transformations.

I will also argue that, besides intrinsic limitations in the capabilities of machine learning algorithms and models as such, the area of machine learning is also limited in the sense that we still do not have a great deal of understanding of what machine learns to do. This is particularly important in safety-centric applications such as medical data processing, where the cost of machine errors to the public can be very high. I will summarize some of the current work in visualizing and understanding deep networks, focusing in particular on the techniques of natural pre-image and meaningful perturbations, and what we can (and cannot) learn from such an analysis.