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Estimating the parameters of gravitational lenses with deep learning

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Machine learning methods have seen a rapid expansion in the last few years. In particular, deep learning has made several breakthroughs, including beating a champion of game of Go and outperforming practicing dermatologists in the visual diagnosis of skin cancer. Although in most applications these networks have been used for classification tasks, they can also be made to predict real-valued model parameters. In this talk, I will discuss our results on using deep convolutional neural networks to estimate the parameters of strong gravitational lenses from telescope data. Estimating these parameters with traditional maximum-likelihood modeling methods is a time and resource consuming procedure, involving several data preparation steps and a difficult optimization process. With deep convolutional neural networks we are able to estimate these parameters in a fully automated way 10 million times faster than traditional modeling methods and with a similar accuracy. I will also discuss how to robustly quantify the uncertainties of these networks. This allows them to be a fast alternative to MCMC sampling. With the advent of large volumes of data from upcoming ground and space surveys and the remarkable speed offered by these networks, deep learning promises to become an indispensable tool for the analysis of large survey data.

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