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Encoding large scale cosmological structure with Generative Adversarial Networks

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Recent progresses in Machine Learning have unlocked new possibilities to tackle scientific problems by means of neural networks, and already many applications have been developed both in astrophysics and cosmology. In this presentation, using a Generative Adversarial Network (GAN), an unsupervised learning model, we demonstrate the possibility to learn the distribution of dark matter of the cosmic web, using as input the results of large-scale -dark matter only- simulations. We provide a statistical analysis showing that the neural networks learn the underlying distribution. Finally, we show that, using the generator learned by the GAN it is possible to design an Auto-Encoder. The AE is then capable of both inferring the latent code of the GAN from a snapshot of dark energy density, therefore opening the way to new applications such as inferring missing values on a corrupted dataset or deducing from density distribution at lower z its possible evolution at higher redshift.

Presenter: DECELLE, Aurélien (Universidad Complutense de Madrid)

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