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DeepTreeGAN: Fast Generation of High Dimensional Point Clouds

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In High Energy Physics, detailed and time-consuming simulations are used for particle interactions with detectors. To bypass these simulations with a generative model, it needs to be able to generate large point clouds in a short time while correctly modeling complex dependencies between the particles.
For non-sparse problems on a regular grid, such a model would usually use (De-)Convolution layers to up/down-scale the number of voxels.
In this work, we present novel methods to up/down-scale point clouds. For the up-scaling, we propose the use of a feed-forward network to project each point to multiple. For the down-scaling, we propose a Message Passing Layer that connects a variable number of input points to a fixed number of trainable points.
These operations allow us to construct a Graph GAN that is able to generate such point clouds in a tree-based manner. Particle showers are inherently tree-based processes, as each particle is produced by decays or detector interaction of a particle of the previous generation. We demonstrate the model's performance on the public JetNet and CaloChallange datasets.

Brainstorming idea [title]

Up/downscaling of Point Clouds

Brainstorming idea [abstract]

Up- and down-scaling are critical for generative Neural Networks. While there are established methods for image generation, the generation of point clouds lacks such methods. Which approaches could be worth investigating?

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