

# Deep learning models: Auto-Encoders and Generative Adversarial Networks for learning multivariate joint probability distributions

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## Abstract

In recent years Deep Learning (DL) has witnessed remarkable advancements in understanding complex data representations, and its applications have permeated various domains. The talk will start with a brief introduction to the fundamentals of DL, providing a foundational understanding for exploring some advanced DL architectures, such as Variational Auto-Encoder (VAE) and Generative Adversarial Network (GAN).

I will then discuss our first steps for developing a GAN model capable of learning the multivariate joint probability distribution of link speeds on a road network, using real data collected from sensors. The work originated by the fact that when making decisions with lasting implications over a medium to long timeframe, it is essential to consider not only the most probable scenario, possibly obtained through a forecasting model but also a range of potential outcomes.

The proposed model has shown its ability to generate samples that preserve correlations among variables, while faithfully representing the empirical marginal distributions. To enhance the performance of our GAN model, a Variational Auto-Encoder (VAE) for pre-training the generator network is employed. Some preliminary results, conducted on some benchmark datasets, will be presented.