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Deep Generative Models : high-dimensional sampling revisited

Abstract
Generative models (GM) provide a mean to construct statistical models (family of probability distribution) for the high dimensional observations with complex structure which are typical of modern AI. Generative models can also be used to sample new examples, connecting inference problem with sampling.

Learning Deep Generative Models (DGM) that are capable of capturing rich distributions from vast amounts of unlabeled data appears nowadays as one of the major challenges of AI. DGM have many exciting applications to solve the data scarcity by generating "new" examples, to preserve privacy by releasing the generative model instead of the data but also to detect outlying observations.

In this talk, I will cover three directions of research on which I am currently working on.

A first approach is based on the minimization of the cross-entropy (Kullback-Leibler divergence) between the distribution of the observations and a model parameterized using either Deep NN or more suitable energy functions, connecting generative with energy-based models. This approach is appealing yet it poses wicked hard computational problems, linked to the need to estimate the normalizing constant of the EBM and its gradient.

A second approach is relies on maximum entropy methods. This approach originates in statistical physics amounts to learn a distribution maximizing the entropy under moment constrained, which are constructed from deep representation.

A third approach is to use variation autoencoders (VAE) a special instance of variational inference. VAEs jointly learn both an algorithm for generating samples from the distribution together with a latent space that summarize the distribution of the observations. VAE aim to minimize the reconstruction error while regularizing the distribution of the latent representation to match some parametric prior.

I will illustrate these approaches with examples and discuss the methodological and numerical challenges

Short biography

Éric Moulines is a French researcher in statistical learning and signal processing.

He entered the École Polytechnique in 1981, then went to study at Télécom ParisTech.

He began his career at the Centre National d'Etudes des Télécommunications where he worked on speech synthesis from text. He is involved in the development of new waveform synthesis methods called PSOLA (pitch synchronous overlap and add).

After defending his thesis in 1990, he joined the École Nationale Supérieure des Telecommunications as a lecturer. He then became interested in different problems of statistical signal processing. In particular, it contributes to the development of subspaces methods for the identification of multivariate linear systems and source separation and develops new algorithms for adaptive system estimation.

He received the authorization to direct research in 2006 and became a professor at Télécom Paris. He then devoted himself mainly to the application of Bayesian methods with applications in signal processing and statistics.

He also received the silver medal from the CNRS in 2010,[1] the France Télécom prize awarded in collaboration with the French Academy of Sciences in 2011. He was appointed a Fellow of the European Association for Signal Processing in 2012 and of the Institute of Mathematical Statistics in 2016.[2] He is General Engineer of the Corps des Mines.

Éric Moulines directed 21 theses, was president of the jury for 9 theses, was rapporteur for 10 theses, was member of the jury for 6 theses.