

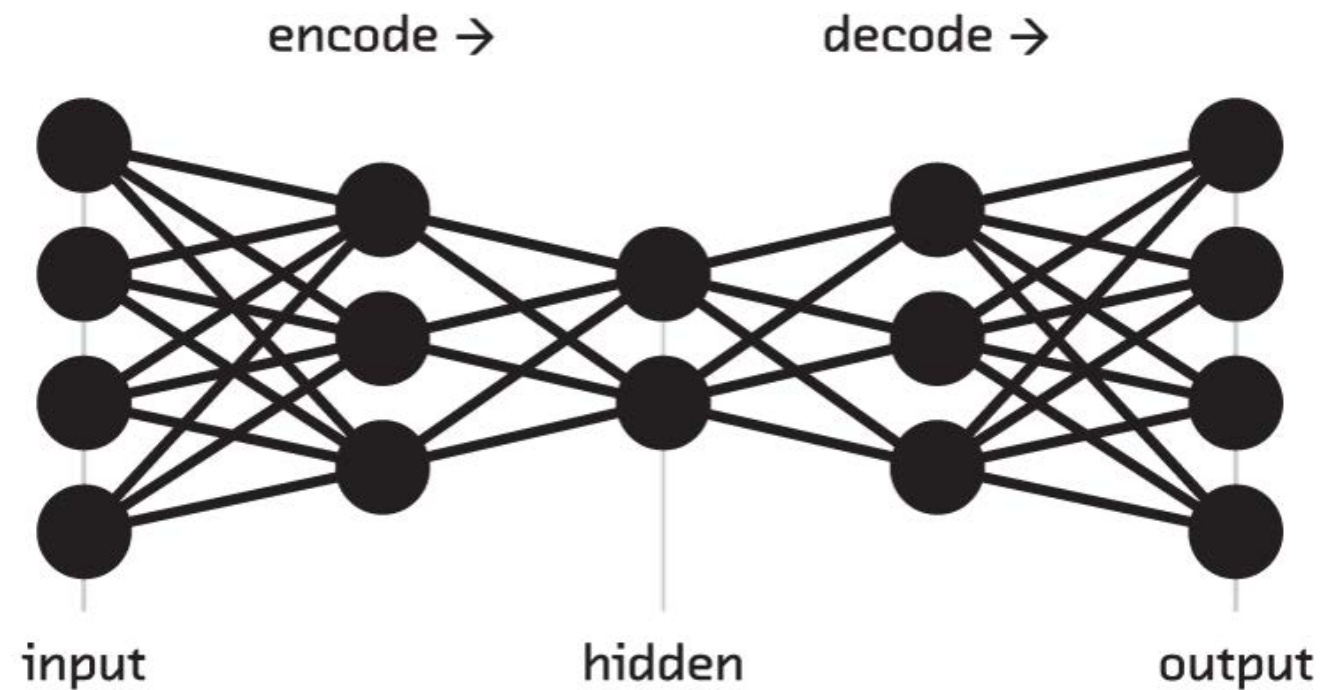
ENM 540: Data-driven modeling and probabilistic scientific computing

Variational auto-encoders

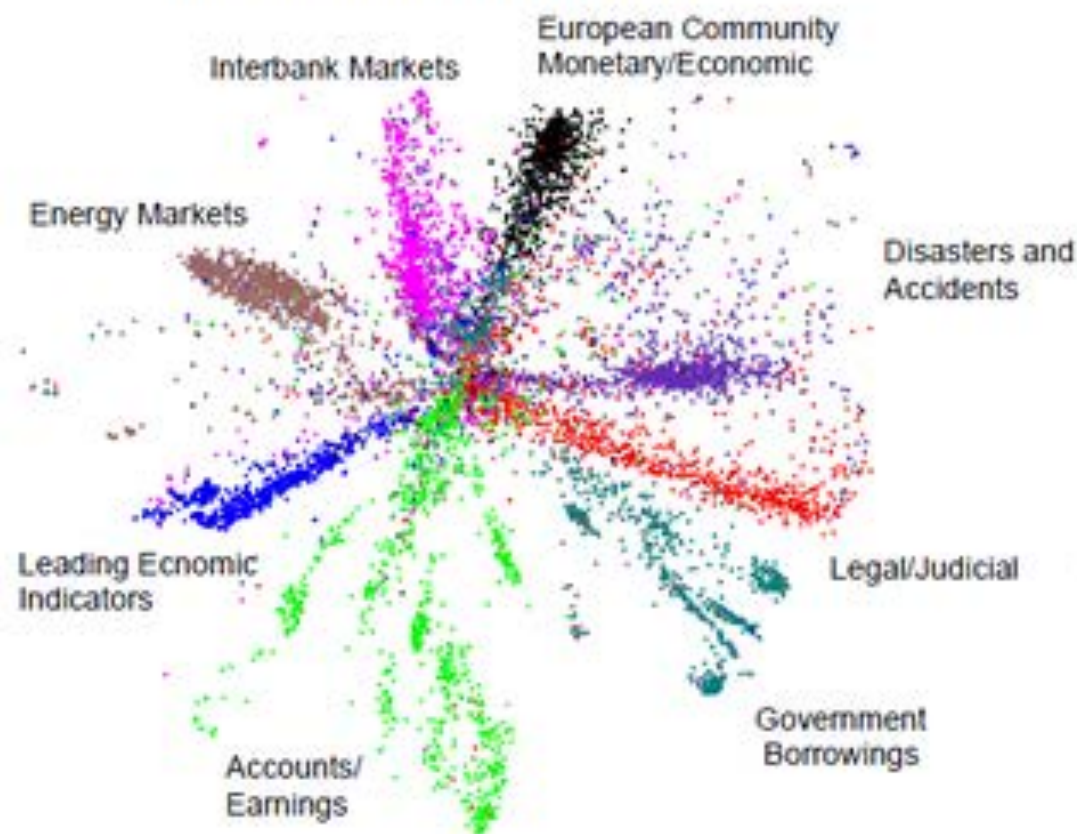
Paris Perdikaris
April 3, 2018



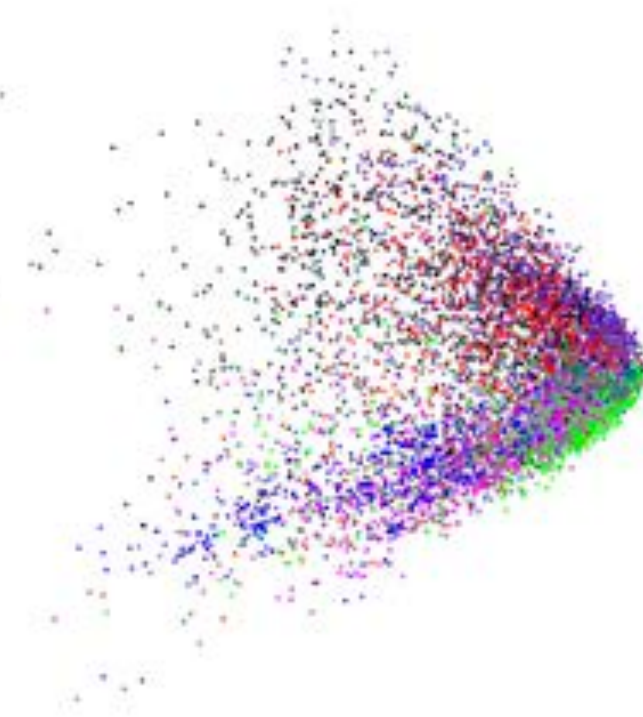
Neural network auto-encoders



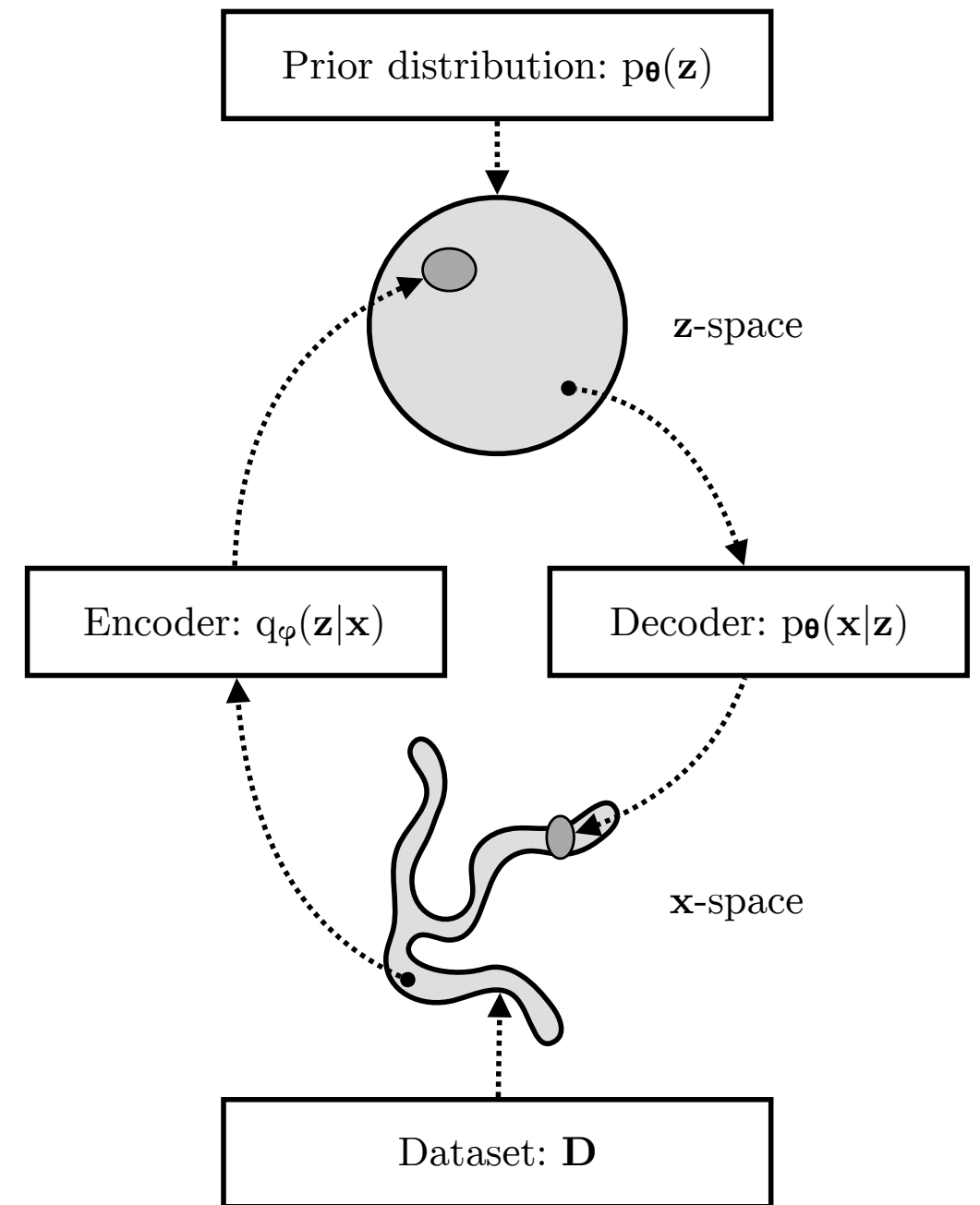
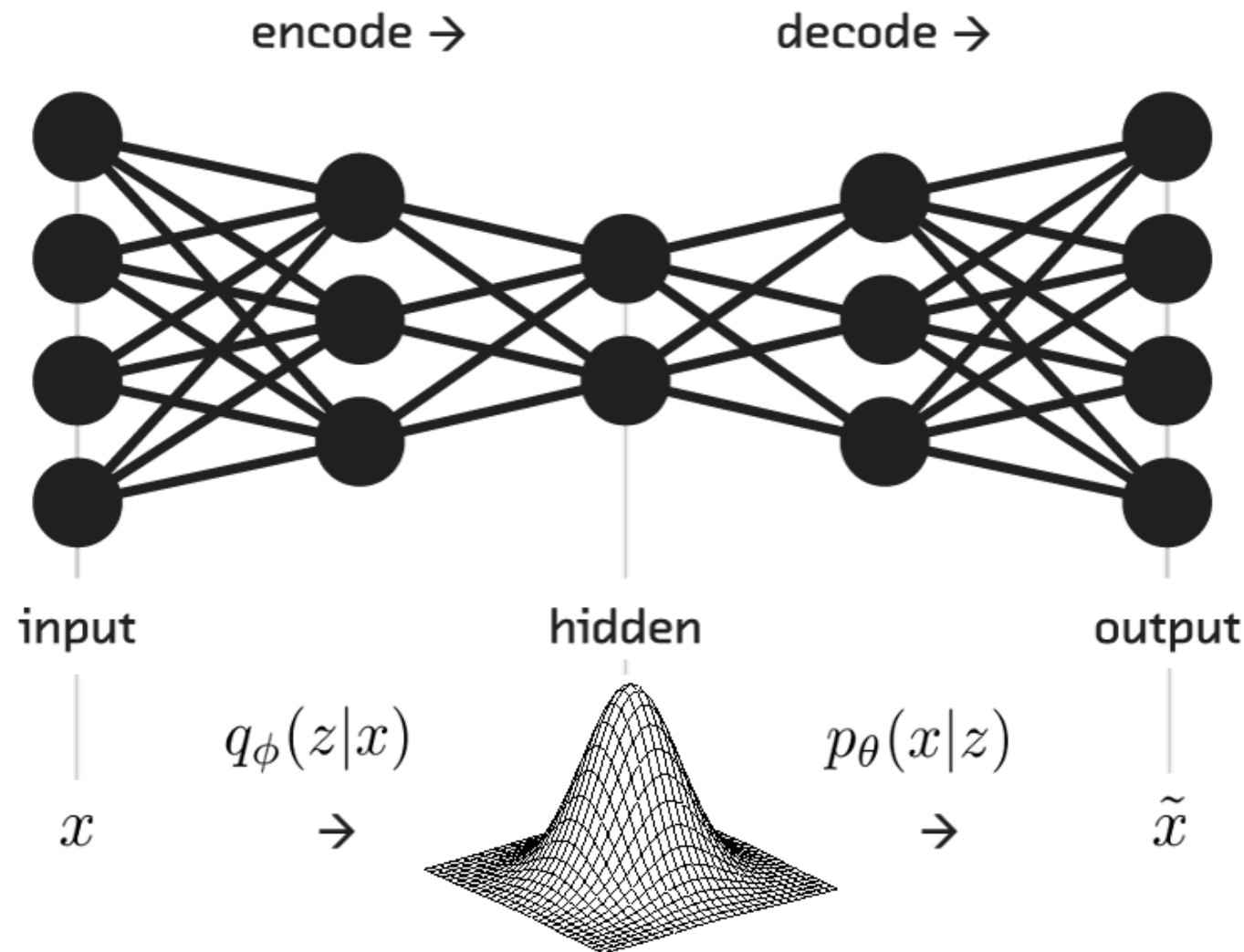
Autoencoder 2-D Topic Space



LSA 2-D Topic Space



Variational auto-encoders

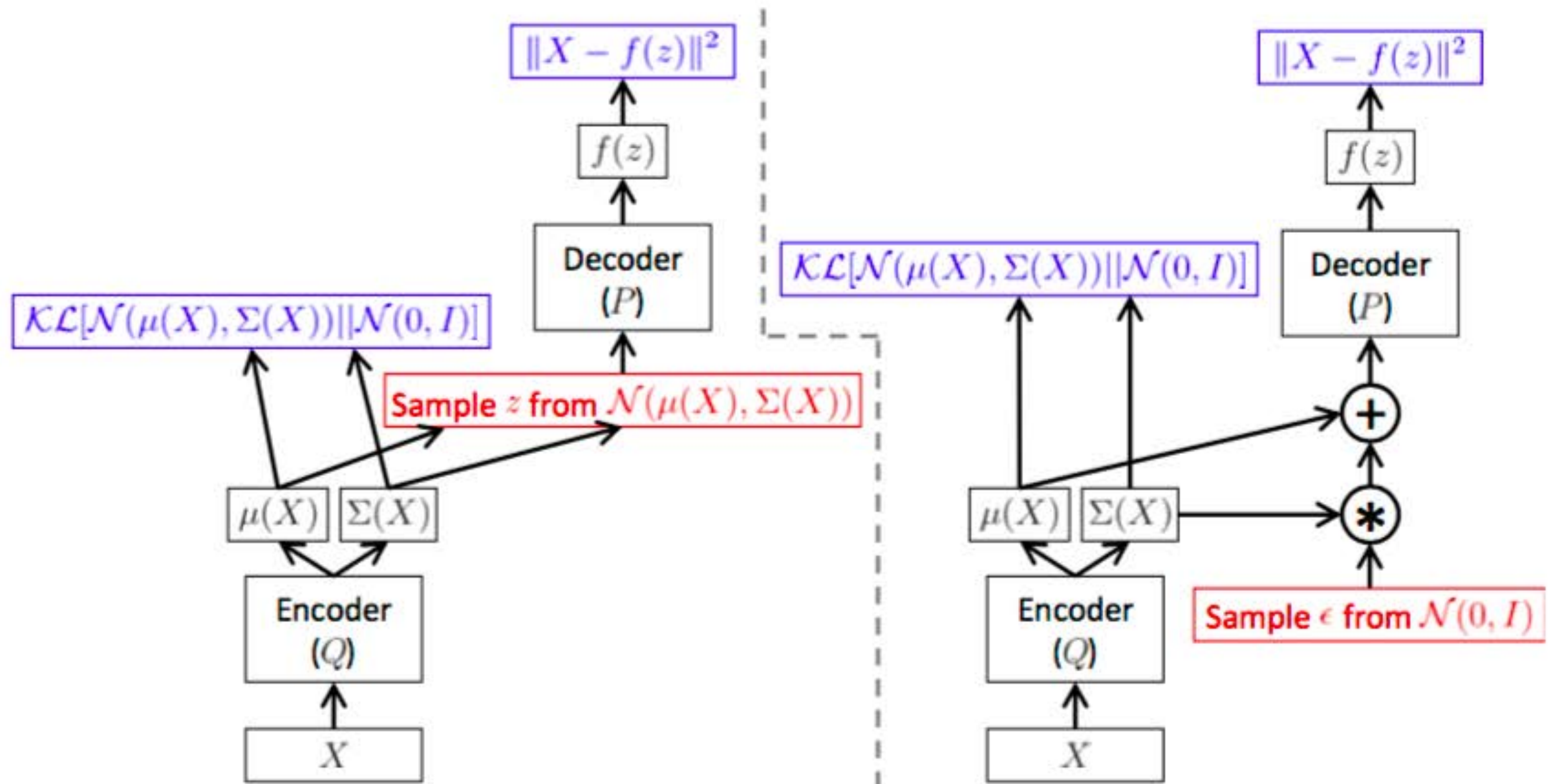


A VAE learns stochastic mappings between the observed \mathbf{x} -space, whose empirical distribution $q_D(\mathbf{x})$ is typically complicated, and a latent \mathbf{z} -space, whose distribution can be relatively simple (such as spherical, as in this figure). The generative model learns a joint distribution $p_\theta(\mathbf{x}, \mathbf{z}) = p_\theta(\mathbf{x}|\mathbf{z})p_\theta(\mathbf{z})$, factorized into a prior distribution over latent space, $p_\theta(\mathbf{z})$, and a stochastic decoder $p_\theta(\mathbf{x}|\mathbf{z})$. The stochastic encoder $q_\phi(\mathbf{z}|\mathbf{x})$, also called inference model, approximates the true but intractable posterior $p_\theta(\mathbf{z}|\mathbf{x})$ of the generative model.

Variational auto-encoders

Before re-parametrization

After re-parametrization



Kingma, D. P., & Welling, M. (2013). Auto-encoding variational bayes. *arXiv preprint arXiv:1312.6114*.

Doersch, C. (2016). Tutorial on variational autoencoders. *arXiv preprint arXiv:1606.05908*.

Generative models

BOLD

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ITALIC

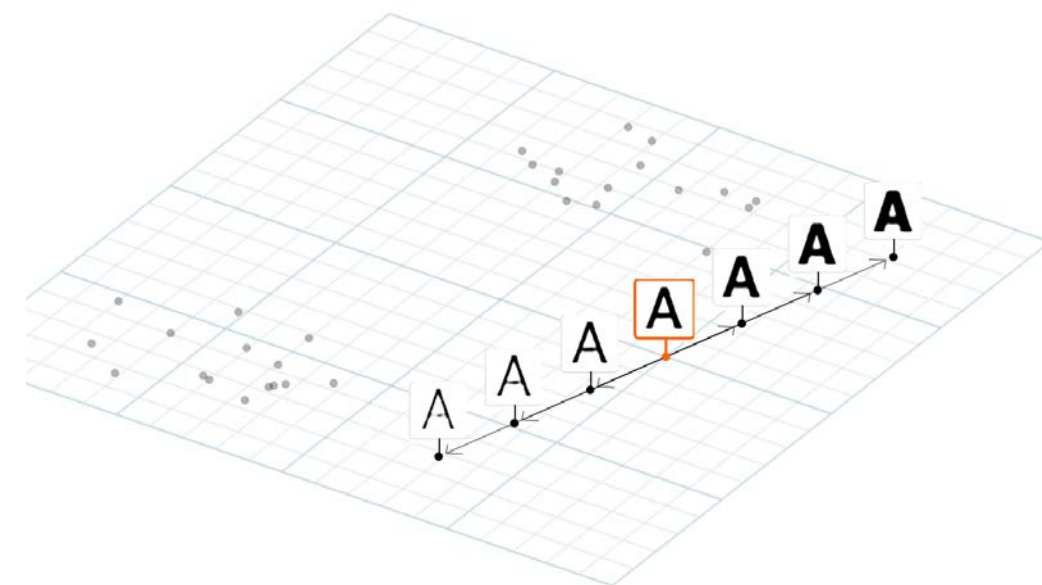
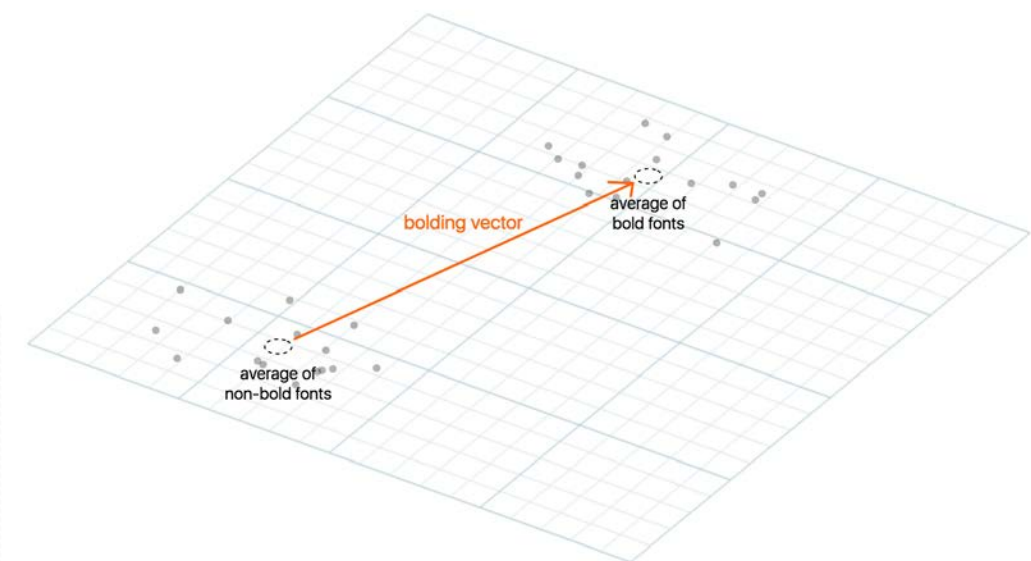
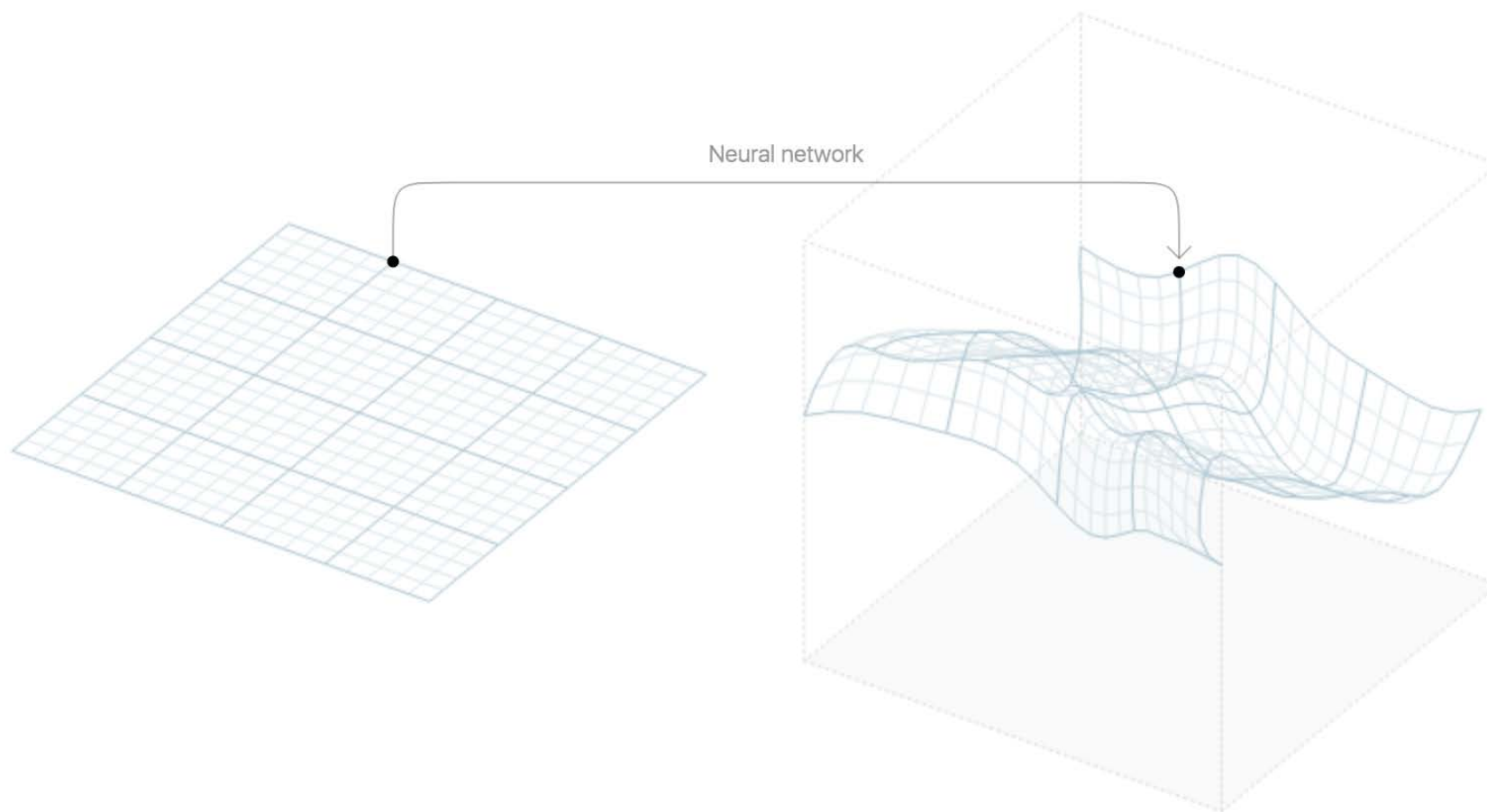
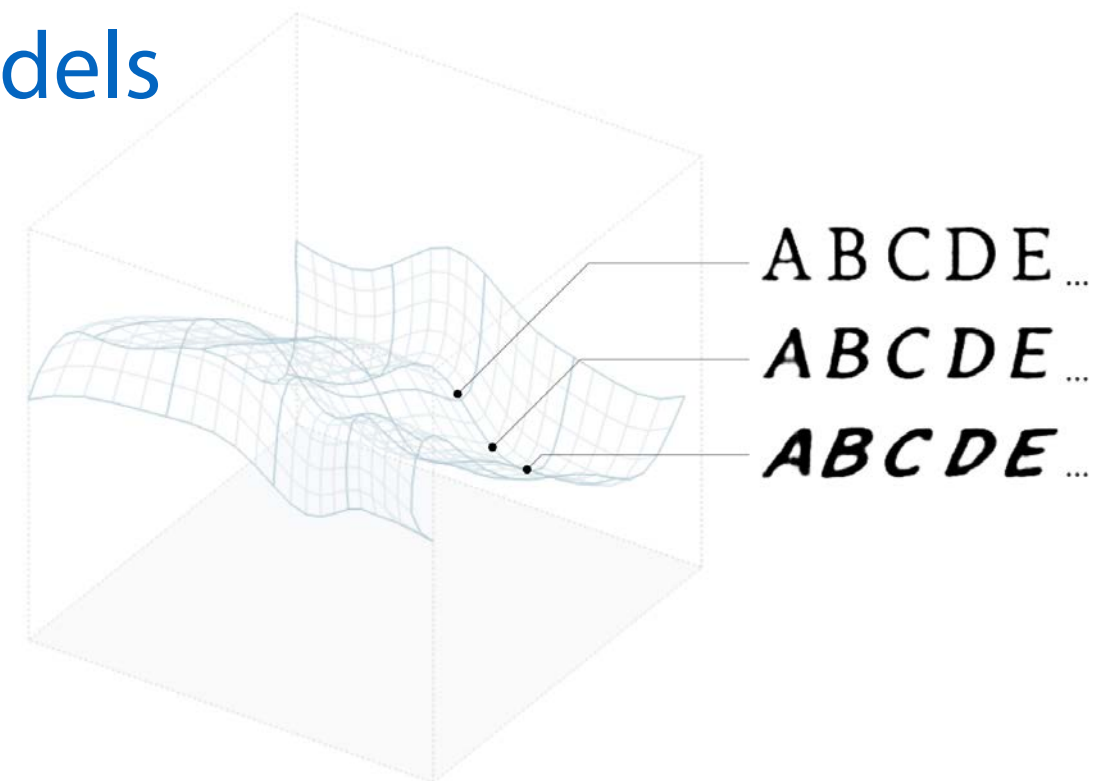
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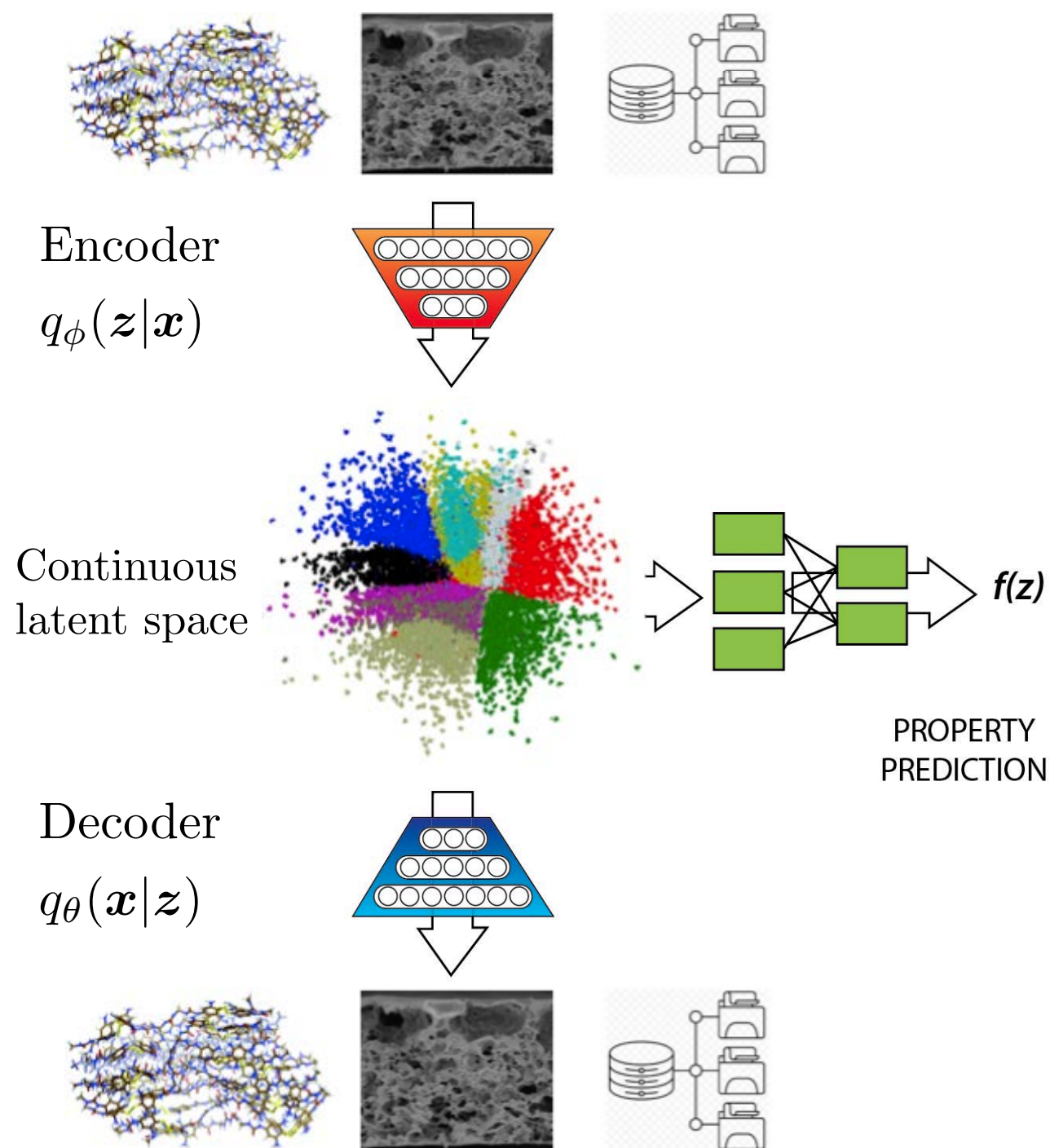
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Generative models



Bayesian
optimization

