



## Why

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### Definition

A *variational autoencoder* (VAE) from latent set  $Z$  to observation set  $X$  is an ordered pair  $((p_z^{(\theta)}, p_{x|z}^{(\theta)}), q_{z|x}^{(\phi)})$  whose first coordinate is a deep latent generation pair from  $Z$  to  $X$  (with parameters  $\theta$ ) and whose second coordinate is deep conditional distribution from  $X$  to  $Z$  (with parameters  $\phi$ ).

A VAE inherits its *joint function* from its deep latent generation pair.  $p_z^{(\theta)}$  is called the *latent distribution* (or *prior distribution*, *latent model*).  $p_{x|z}^{(\theta)}$  is called the *decoder distribution*.  $q_{z|x}^{(\phi)}$  is called the *encoder distribution* (or *inference distribution*, *recognition distribution*).

A *variational autoencoder family*, from  $Z$  to  $X$ , is a family of autoencoders  $\{((p_z^{(\theta)}, p_{x|z}^{(\theta)}), q_{z|x}^{(\phi)})\}_{(\theta, \phi) \in \Theta \times \Phi}$ .

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<sup>1</sup>Future editions will include. Future editions may also change the name of this sheet. It is also likely that there will be added prerequisite sheets on variational inference.



