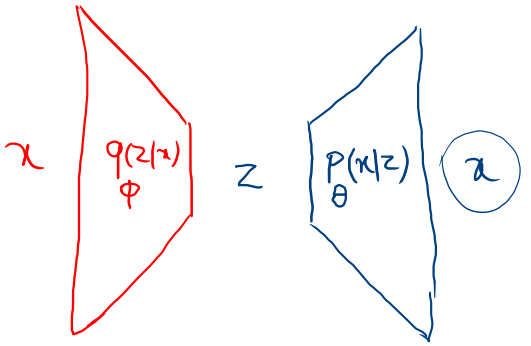

$$p_\theta(x,z) = p(z)\, p_\theta(x|z)$$

$$p(z) = \mathcal{N}(0, I)$$

$$p(z|x) = \frac{p_\theta(x,z)}{p(x)} = \frac{p(z)\, p_\theta(x|z)}{\int_z p(z)\, p_\theta(x|z)\, dz}$$

$$p(z|x) \simeq q(z|x)$$

$$\phi^* = \arg\min_\phi KL\left(q(z|x) \,\|\, p(z|x)\right) = \arg\min_\phi KL\left(q_\phi(z|x) \,\|\, p_\theta(x,z)\right)$$

$$\hat{\theta}_{ML} = \arg\max_\theta \underbrace{\log p(x)}_{\text{evidence}} = \arg\max_\theta \underbrace{-KL\left(q_\phi(z|x) \,\|\, p_\theta(x,z)\right)}_{\text{ELBO}} + \underbrace{KL\left(q(z|x) \,\|\, p(z|x)\right)}_{\geq 0}$$

$$\theta^* = \arg\max_\theta -KL\left(q_\phi(z|x) \,\|\, p_\theta(x,z)\right) = \arg\min_\theta KL\left(q_\phi(z|x) \,\|\, p_\theta(x,z)\right)$$

$$\theta^*, \phi^* = \arg\min_{\theta, \phi} KL\left(q_\phi(z|x) \,\|\, p_\theta(x, z) \right)$$