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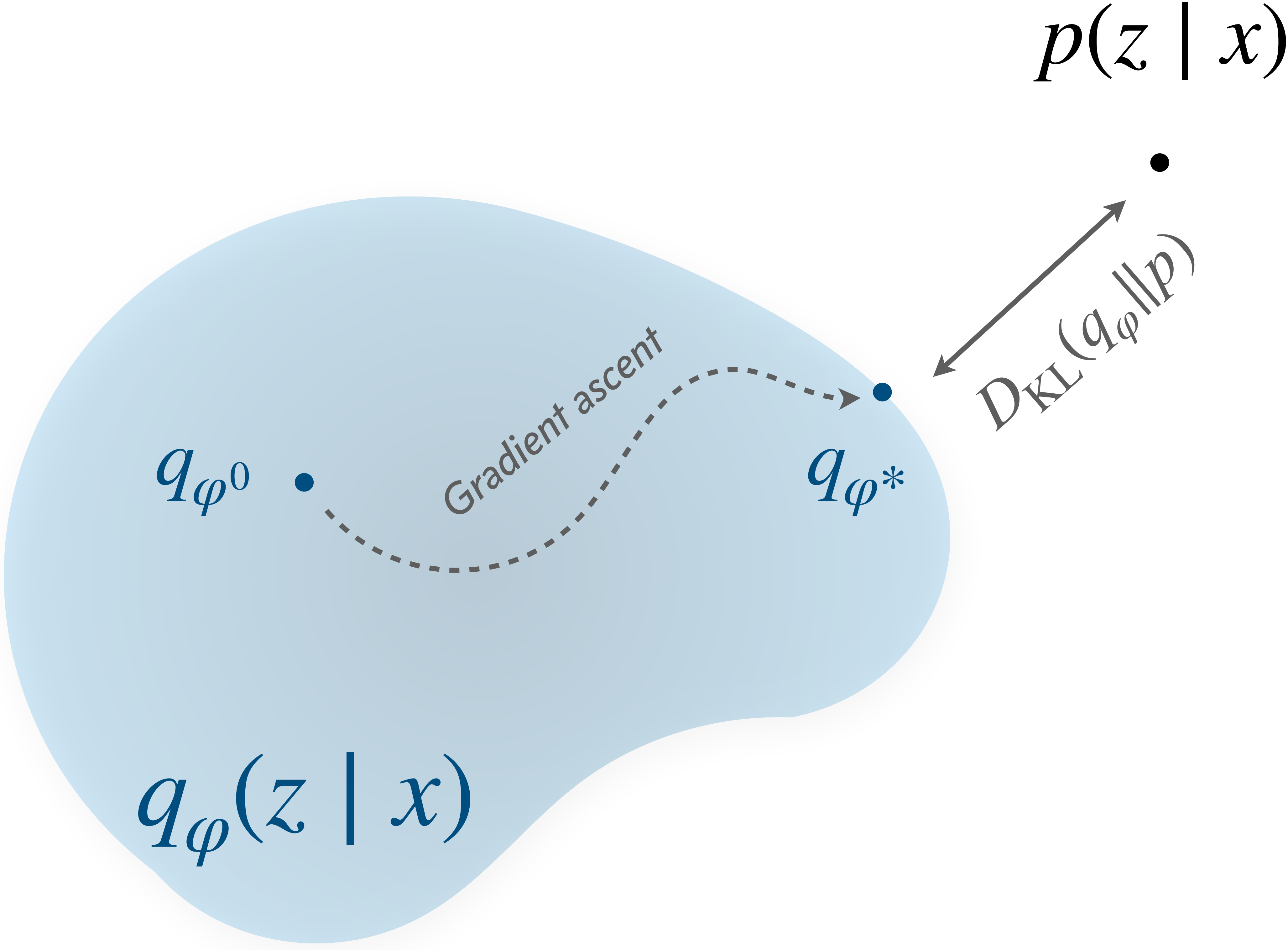
Variational inference

The intractability of $p(x)$ is closely related to the intractability of the *posterior* $p(z \mid x)$

$$p(z \mid x) = \frac{p(x, z)}{p(x)}$$

(Bayes' theorem)



$p(z \mid x)$
$D_{KL}(q_\varphi \| p)$
Gradient ascent
q_{φ^0}
q_{φ^*}
$q_\varphi(z \mid x)$

$$\underbrace{D_{\mathrm{KL}}\left(q_\varphi(z)\|p(z \mid x)\right)}_{\geq 0} = \underbrace{\log p(x)}_{\text{Evidence}} - \underbrace{\left\langle \log p_\vartheta(x, z) - \log q_\varphi(z) \right\rangle_{q_\varphi(z)}}_{\text{Evidence Lower BOund (ELBO)}}$$

A two-for-one!

- ☑ Estimate approximate posterior $q_\phi(z) \approx p(z \mid x)$
- ☑ Estimate likelihood/evidence $\mathrm{ELBO} \approx p(x)$

Variational inference

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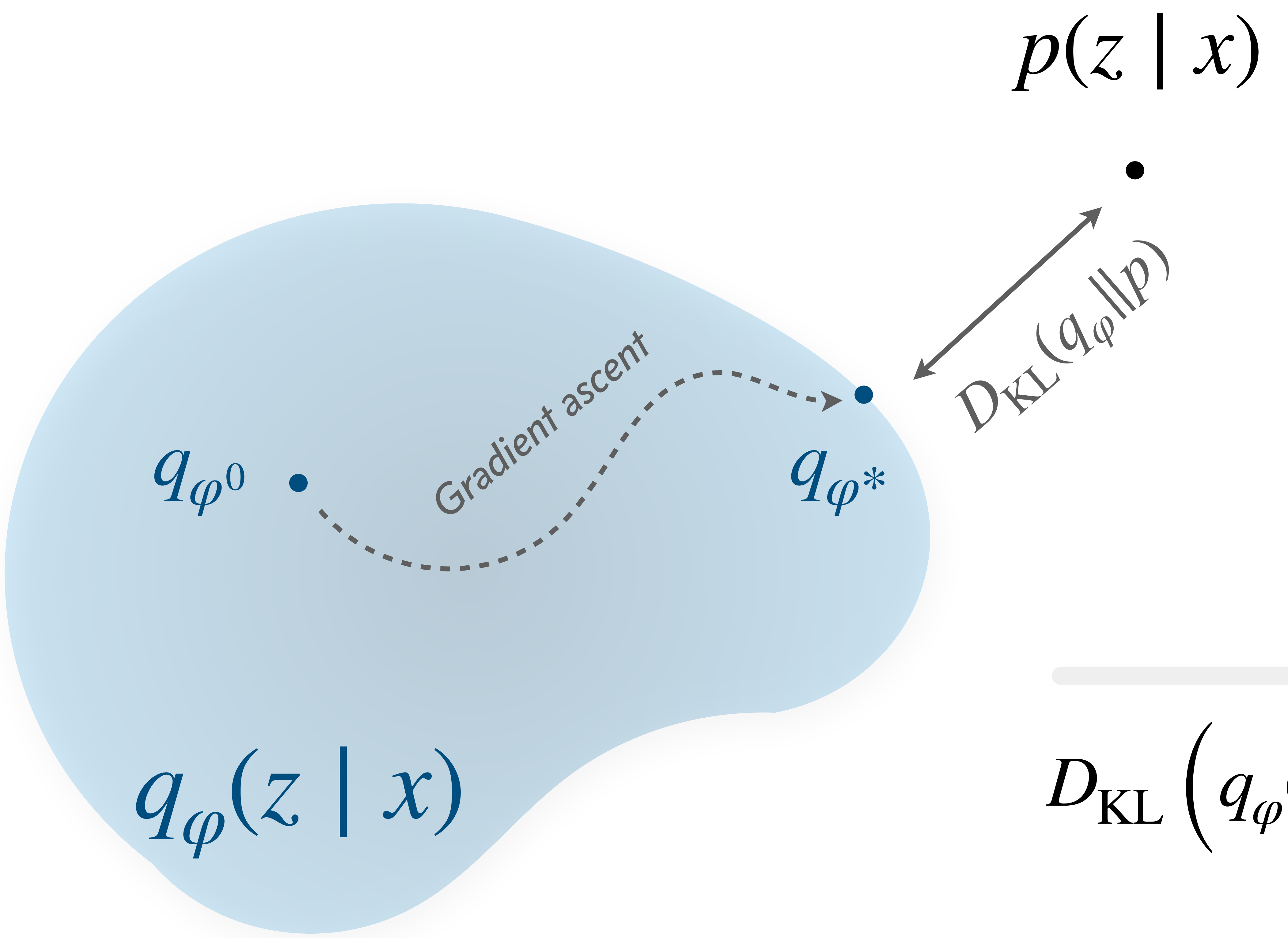

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Variational inference

A general-purpose technique for posterior estimation

$$\underbrace{D_{\mathrm{KL}}\left(q_\varphi(z) \| p(z \mid x)\right)}_{\geq 0} = \underbrace{\log p(x)}_{\text{Evidence}} - \underbrace{\left\langle \log p_\vartheta(x, z) - \log q_\varphi(z) \right\rangle_{q_\varphi(z)}}_{\text{Evidence Lower BOund (ELBO)}}$$