

line search

$$r' = \underset{r \in [0, 1]}{\operatorname{argmin}} \quad \underset{\tilde{D}_{KL}(r)^\uparrow}{KL(q^t + r(s - q^t) \| p)} = \nabla_r f(\tilde{q}_t)$$

grad descent,  $r \leftarrow r - \eta \nabla_r \tilde{D}_{KL}(r)$

func. grad,  
 $\nabla_{\tilde{q}} f(\tilde{q})$

$$\nabla_r KL(q^t + r(s - q^t) \| p)$$

$$= \log \frac{q}{p}$$

$$\int \underbrace{(q^t + r(s - q^t))}_{\tilde{q}_t} \log \left( \frac{q^t + r(s - q^t)}{p} \right) d\alpha$$

$$-g_n = \langle \nabla f(n), s \rangle - \langle \nabla f(n), n \rangle$$

$$= \nabla_r \int \tilde{q}_t \log \frac{\tilde{q}_t}{p}$$

$$= \int \left( \nabla_r \tilde{q}_t \right) \log \frac{\tilde{q}_t}{p} + \cancel{\tilde{q}_t \nabla_r \log \frac{\tilde{q}_t}{p}}$$

$\downarrow$   $\perp$   $s - q^t$        $\downarrow$   $\frac{1}{\tilde{q}_t} \nabla_r \tilde{q}_t$   $\downarrow$   $(s - q^t)$

$$= \int (s - q^t) \log \frac{\tilde{q}_t}{p} + (s - q^t)$$

$$= \int (s - q^t) \left( 1 + \log \frac{\tilde{q}_t}{p} \right)$$

$$= \int s \log \frac{\tilde{q}_t}{p} - \int q^t \log \frac{\tilde{q}_t}{p}$$

$$= \langle s, \log \frac{\tilde{q}_t}{p} \rangle - \langle q^t, \log \frac{\tilde{q}_t}{p} \rangle$$

$$= \mathbb{E}_s [\log \tilde{q}_t - \log p] - \mathbb{E}_{q^t} [\log \tilde{q}_t - \log p]$$

$$= \mathbb{E}_s \left[ \nabla_{\tilde{q}_t} f(\tilde{q}_t) \right] - \mathbb{E}_{q^t} \left[ \nabla_{\tilde{q}_t} f(\tilde{q}_t) \right]$$