

# Gradients

$$\begin{aligned}\nabla_{\phi} f(w, \phi) &= \sum_i \int \nabla_{\phi} q(t_i \mid x_i, \phi) \log p(x_i \mid t_i, w) dt_i \\&= \sum_i \int \frac{q(t_i \mid x_i, \phi)}{q(t_i \mid x_i, \phi)} \nabla_{\phi} q(t_i \mid x_i, \phi) \log p(x_i \mid t_i, w) dt_i \\&= \sum_i \int q(t_i \mid x_i, \phi) \nabla_{\phi} \log q(t_i \mid x_i, \phi) \log p(x_i \mid t_i, w) dt_i\end{aligned}$$

$$\nabla \log g(\phi) = \frac{\nabla g(\phi)}{g(\phi)}$$