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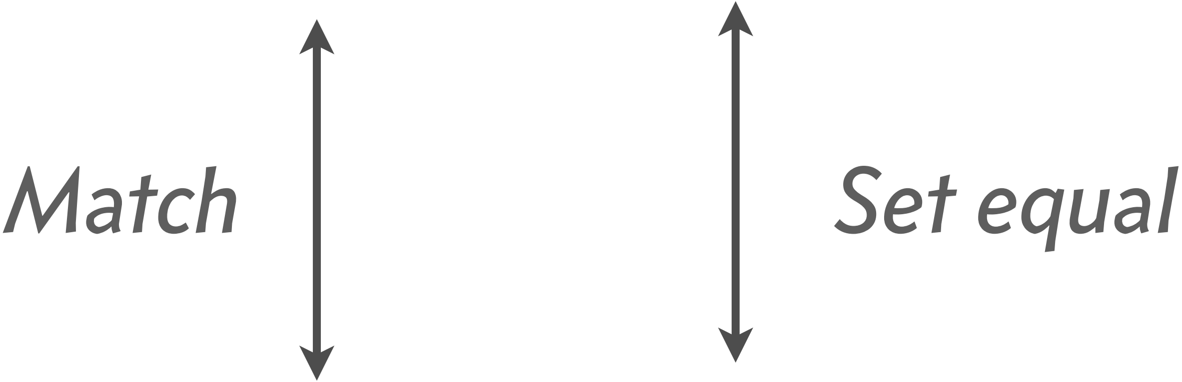
The denoising objective

Given the nature of the forward (noising) process, $q\left(z_{t-1} \mid z_t, x\right)$ can be computed analytically

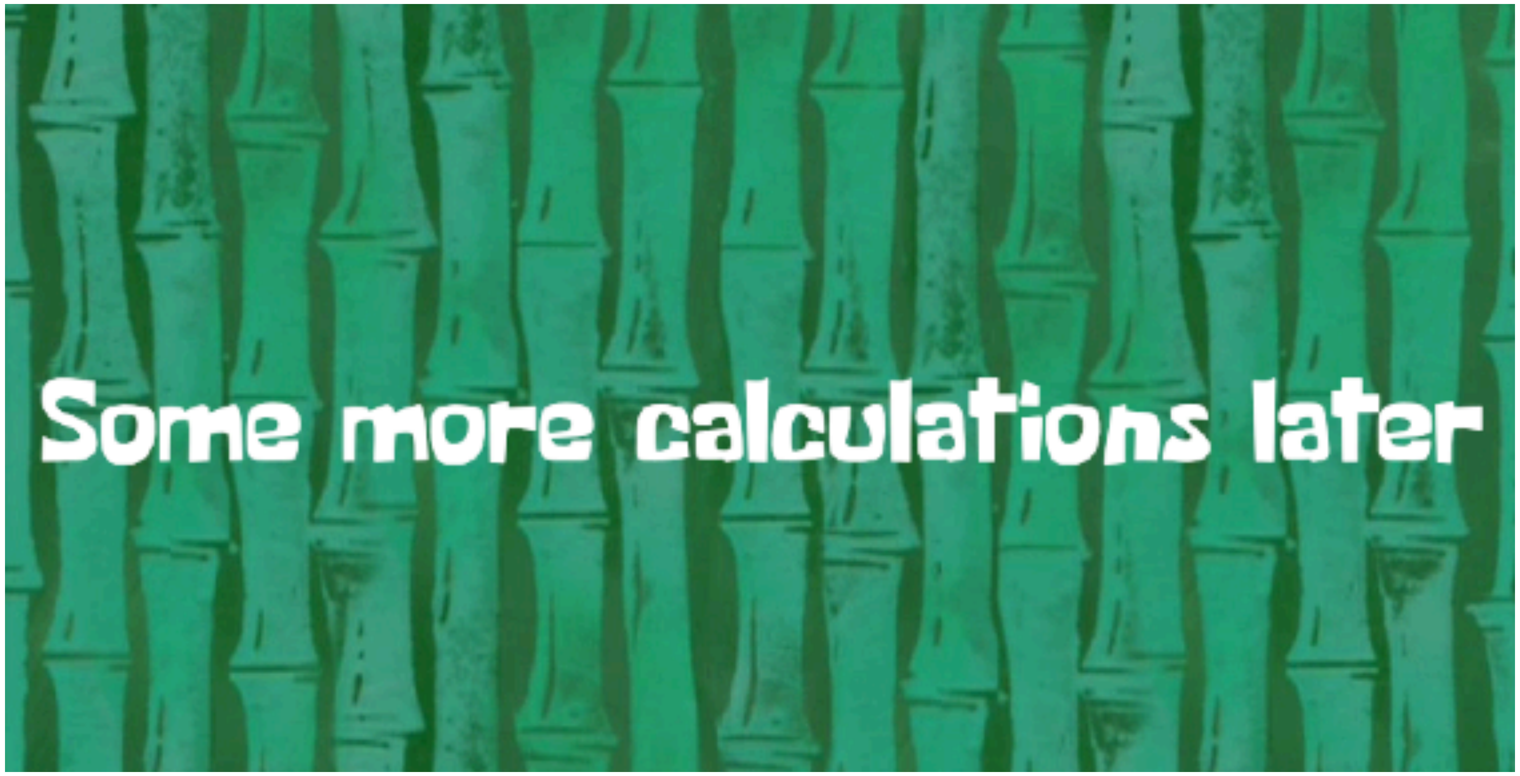
$$q\left(z_{t-1} \mid z_t, x\right) = \mathcal{N}\left(z_{t-1}; \mu_q(x_t, x_0), \sigma_q(t)\square\right)$$

$$p_\theta\left(z_{t-1} \mid z_t, x\right) = \mathcal{N}\left(z_{t-1}; \mu_\theta(x_t, x_0), \sigma_\theta(t)\mathbf{I}\right)$$

Learnable denoising distribution; assume Gaussian


Match
Set equal

$$\sum_{t=2}^{T} \left\langle D_{\mathrm{KL}} \left(q\left(z_{t-1} \mid z_t, x\right) \| \, p_\theta\left(z_{t-1} \mid z_t\right) \right) \right\rangle_{q(z_t|x)}$$



Denoising loss

$$\frac{1}{2\sigma_q^2(t)}\frac{\bar{\alpha}_{t-1}\left(1-\alpha_t\right)^2}{\left(1-\bar{\alpha}_t\right)^2}\left[\left\| \hat{x}_\theta\left(z_t, t\right) - x \right\|^2\right]$$

The denoising objective

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Match ↕ ↕ *Set equal*

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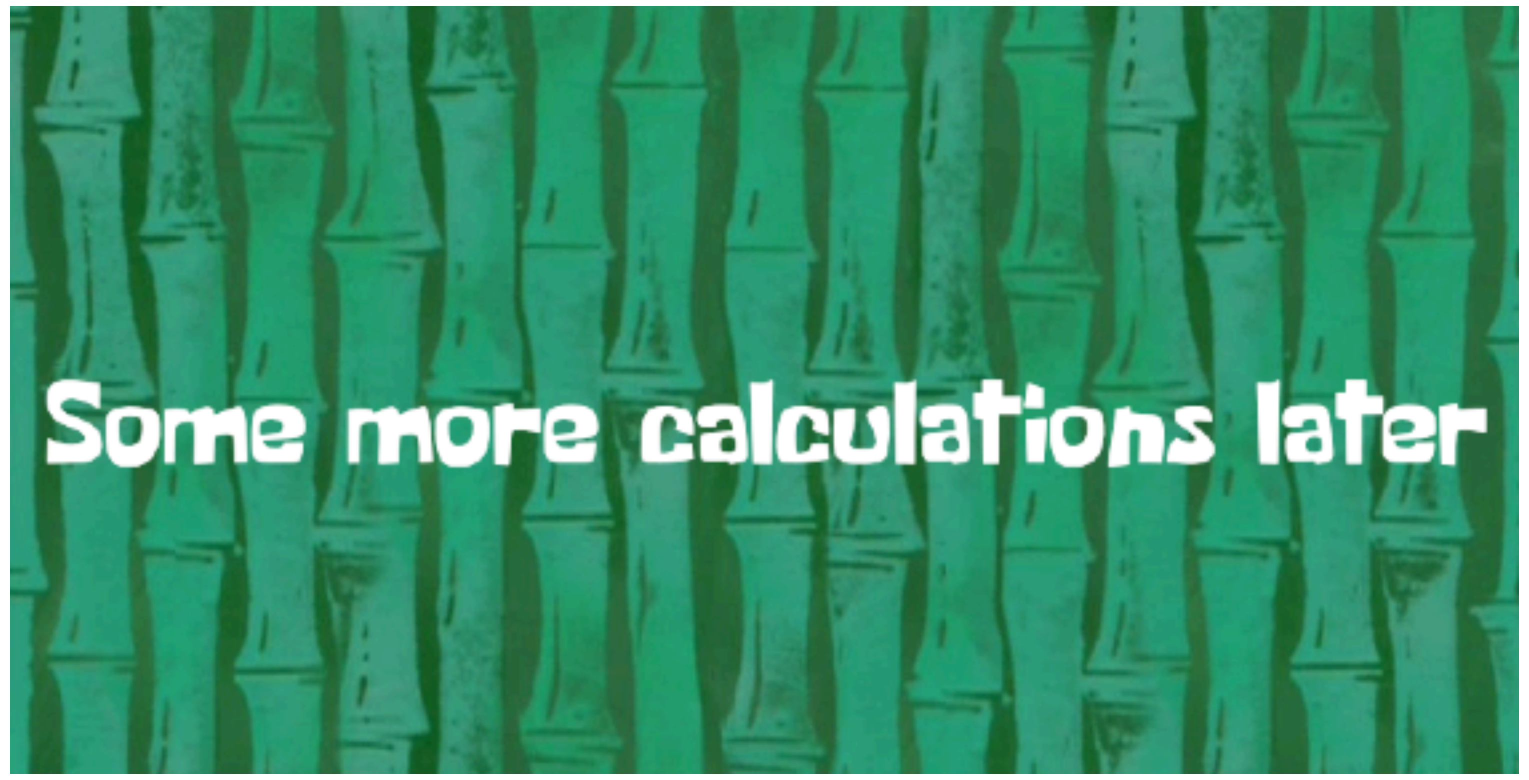
$$\sum_{t=2}^{T} \left\langle D_{\mathrm{KL}}\left(q\left(z_{t-1} \mid z_t, x\right) \| p_\theta\left(z_{t-1} \mid z_t\right)\right)\right\rangle_{q(z_t|x)}$$



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The denoising objectives

x-prediction; MLE

$$\frac{1}{2\sigma_q^2(t)}\frac{\bar{\alpha}_{t-1}\left(1-\alpha_t\right)^2}{\left(1-\bar{\alpha}_t\right)^2}\left[\left\|\hat{x}_\theta\left(z_t,t\right)-x\right\|^2\right]$$