AIL 7024
Machine Learning
Sem 1, 2026-27

Lec 39

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White Gaussian in the limit

$$\mathbf{x}_0 \sim p_0(\mathbf{x}) = \pi_1 \mathcal{N}(\mathbf{x}|\mu_1, \sigma_1^2) + \pi_2 \mathcal{N}(\mathbf{x}|\mu_2, \sigma_2^2).$$

$$\mathbf{x}_t = \sqrt{\alpha_t}\mathbf{x}_{t-1} + \sqrt{(1-\alpha_t)}\boldsymbol{\epsilon}, \qquad \text{where } \boldsymbol{\epsilon} \sim \mathcal{N}(0, \mathbf{I}).$$

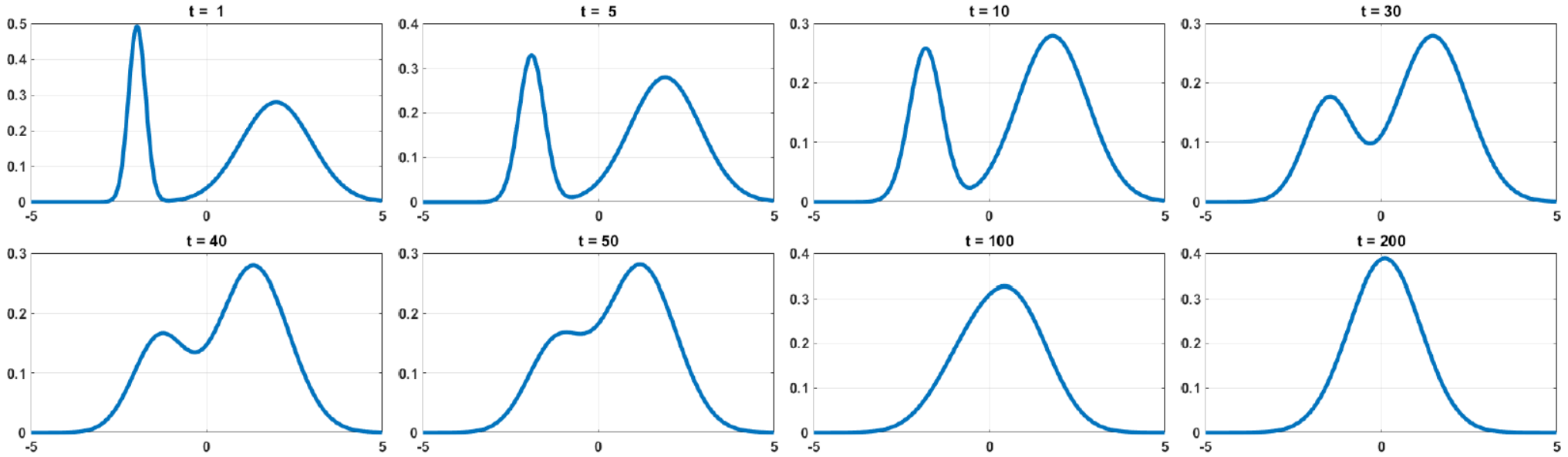


Figure 2.5: Evolution of the distribution $p_t(\mathbf{x})$. As time t progresses, the bimodal distribution gradually becomes a Gaussian.

From S. Chan

Forward Diffusion

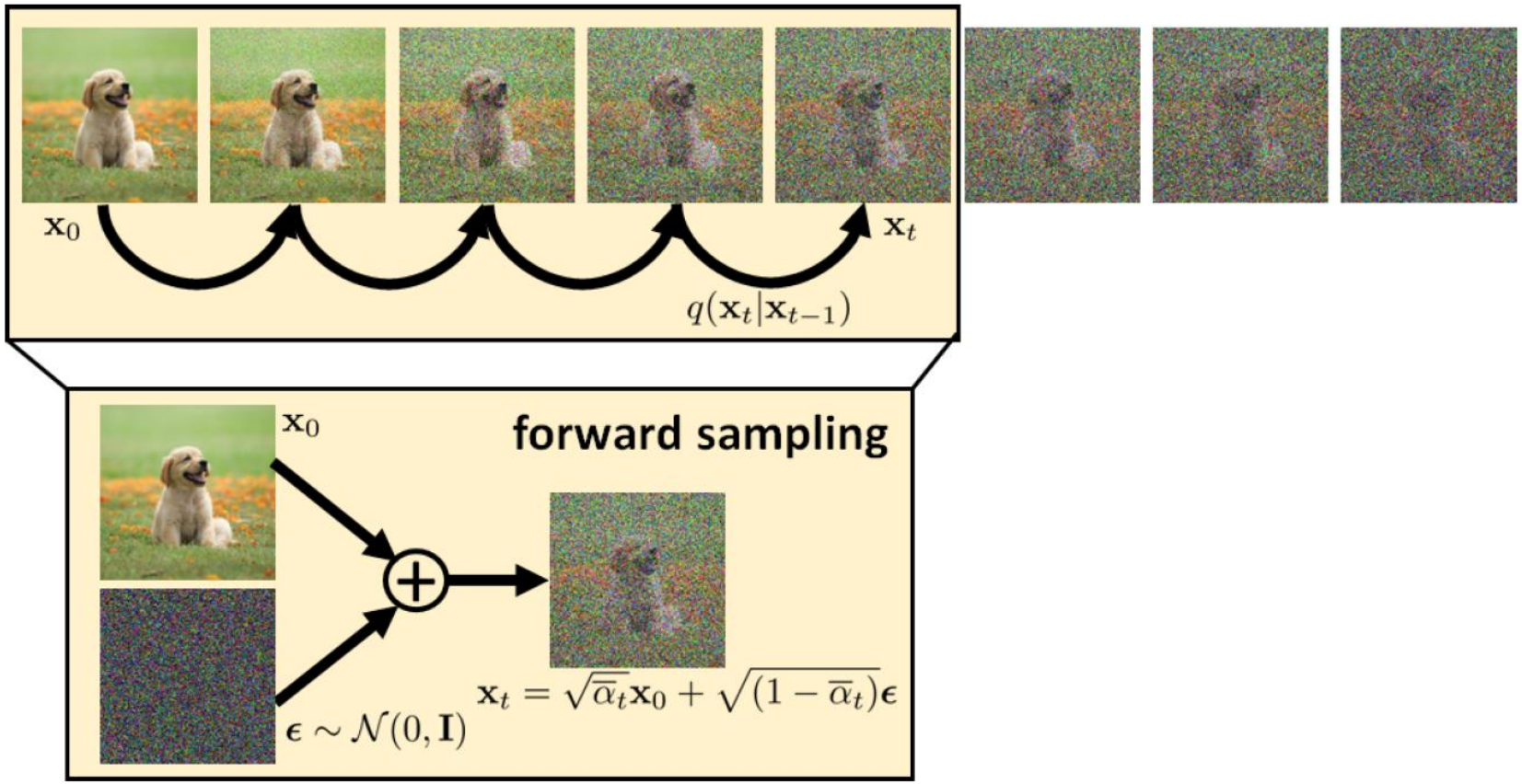


Figure 2.12: Forward diffusion process.

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Training

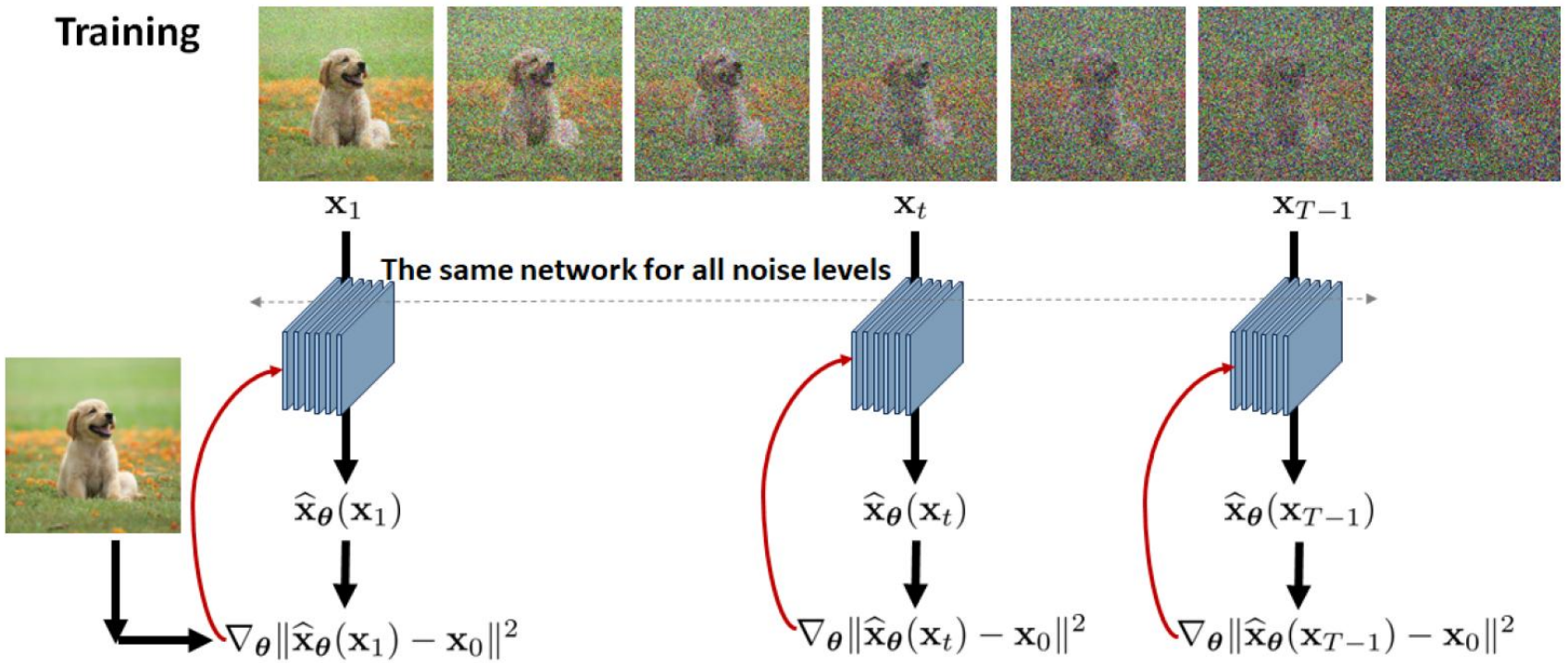


Figure 2.13: Training of a denoising diffusion probabilistic model. For the same neural network $\widehat{\mathbf{x}}_{\boldsymbol{\theta}}$, we send noisy inputs $\mathbf{x}_t$ to the network. The gradient of the loss is back-propagated to update the network. Note that the noisy images are not arbitrary. They are generated according to the forward sampling process.

From S. Chan

Generating Samples

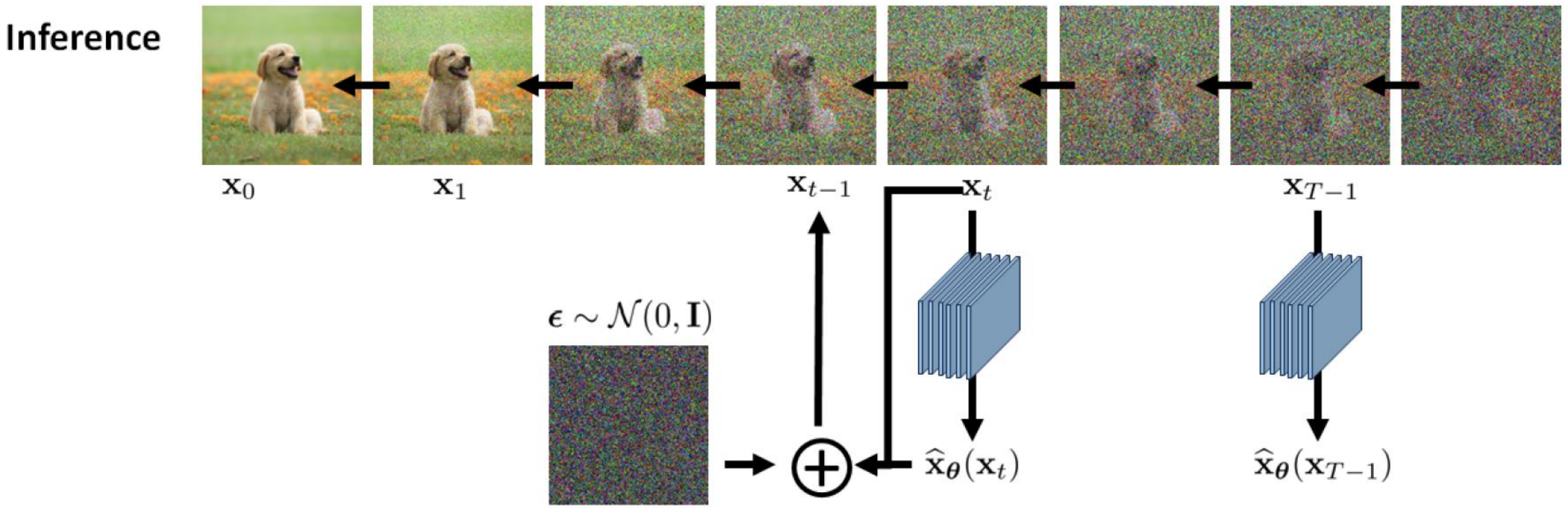


Figure 2.14: Inference of a denoising diffusion probabilistic model.

From S. Chan