Forward Process Definition

Part 2/7: Forward Process

🎯 Goal: Gradually transform data into pure Gaussian noise

🔗 Markov Chain: $q(x_t \mid x_{t-1})$

$t = 1, 2, \ldots, T$

x_0
Original Data

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x_t
$\sim N(0, I)$

📐 Gaussian Transition (Distribution Form)

$$q(x_t \mid x_{t-1}) = N(x_t; \sqrt{\alpha_t} \cdot x_{t-1}, (1-\alpha_t)I) \text{ where } \alpha_t = 1 - \beta_t$$

🎲 Sampling Form (Reparameterization)

$$x_t = \sqrt{\alpha_t} \cdot x_{t-1} + \sqrt{(1-\alpha_t)} \cdot \varepsilon, \text{ where } \varepsilon \sim N(0, I)$$

⚙️ Noise Schedule (β_t)

Controls amount of noise at step t

📈 Fixed Schedule

β_t increases from 0.0001 to 0.02

⏱️ Time Steps (T)

Usually T = 1000 steps

✨ End Result

$x_t \sim N(0, I)$ is pure Gaussian noise