Generative Modeling with SDEs

Stochastic differential equation (SDE):\
\[ dx = [f(x, t) - g^2(t) \nabla_x \log p_t(x)] dt + g(t) dw \]

Solving Reverse SDEs for Sampling

Numerical SDE solvers:
- Example: Euler-Maruyama method
- Example: Reverse diffusion method (see paper)

Predictor-Corrector methods:
- Improves numerical SDE solvers with MCMC, at the cost of more computation and more hyperparameters.

Experimental results:
- CIFAR-10 sample quality
- CelebA-HQ 1024px samples

Controllable Generation

Probability Flow ODEs

Turning the SDE into an ODE with the same \( p_t(x) \)

Exact likelihood computation:

- Can sample from the same distribution by solving the ODE instead of the SDE.

Controllable Generation

We can perform conditional generation with an unconditional score-based model. No need of re-training.

Score function of \( p_t(x) \) approximates \( \text{Brownian motion} \)

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