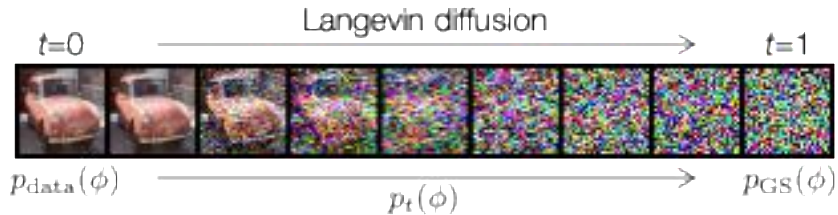


Generative Modeling with Inverse Renormalization Group Flows

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■ Generative modeling (diffusion model, flow matching, etc.)



Machine Learning technique to generate complex data
Use probability flow connecting “UV” data distribution to noise distribution



Cf. Stable Diffusion, 2025

Main Challenges: high computational cost

- Noise schedules are important but are determined heuristically
- Computational cost grows rapidly with system size (=image size) L

■ Generative modeling based on the exact RG flow

(Conceptual figure)



Effective theory in the Polchinski RG

We construct generative model that uses probability flow in the exact RG, i.e., $p_\Lambda[\phi] \propto e^{-S_\Lambda[\phi]}$.

- ✓ Based on the inverse RG flow, the models create data from outline to detail.
- ✓ Noise schedules are determined by the RG theory, which improves efficiency/quality
- ✓ The quasi-locality and scale separation of the RG enable scalable computational cost.