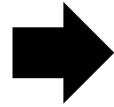


確率数理工学 補足資料

拡散モデル

「An astronaut riding a horse in a photorealistic style」



DALL·E: [Aditya Ramesh, Mikhail Pavlov, Gabriel Goh, Scott Gray, Chelsea Voss, Alec Radford, Mark Chen, Ilya Sutskever: Zero-Shot Text-to-Image Generation. ICML2021.]
DALL·E2:[Aditya Ramesh, Prfulla Dhariwal, Alex Nichol, Casey Chu, Mark Chen: Hierarchical Text-Conditional Image Generation with CLIP Latents. arXiv:2204.06125]



Stable diffusion, 2022.



Jason Allen "Théâtre D'opéra Spatial" generated by **Midjourney**. Colorado State Fair's fine art competition, 1st prize in digital art category



Generated by NovelAI

拡散モデル (確率微分方程式)

[Sohl-Dickstein et al., 2015; Song & Ermon, 2019; Song et al., 2020; Ho et al., 2020; Vahdat et al., 2021]

順過程 : 所望の分布からノイズに変換 (e.g., Gaussian)

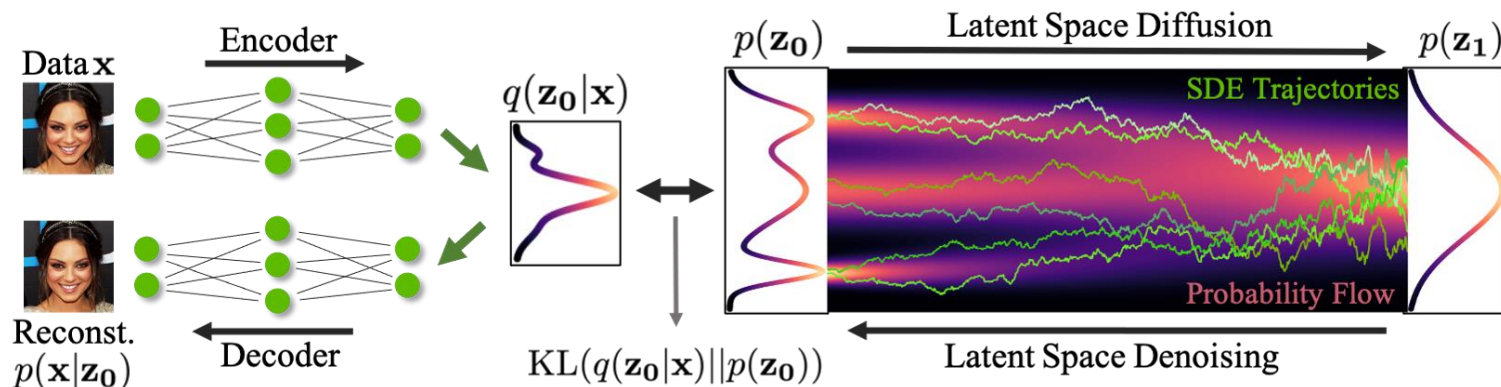
$$dX_t = -X_t dt + \sqrt{2}dB_t$$



$$dY_t = (Y_t + 2\nabla \log(p_{\bar{T}-t}(Y_t)))dt + \sqrt{2}dB_t$$

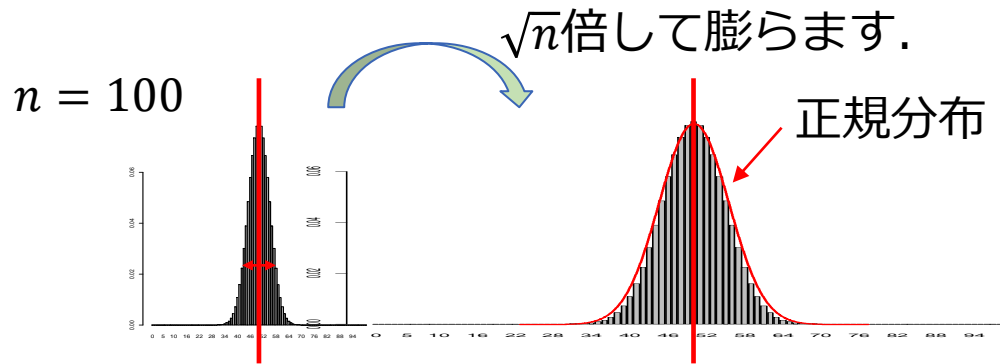
$(Y_t \sim X_{\bar{T}-t})$ データから推定

逆過程 : ノイズから所望の分布へ変換



[Vahdat, Kreis, Kautz: Score-based Generative Modeling in Latent Space. arXiv:2106.05931]

中心極限定理



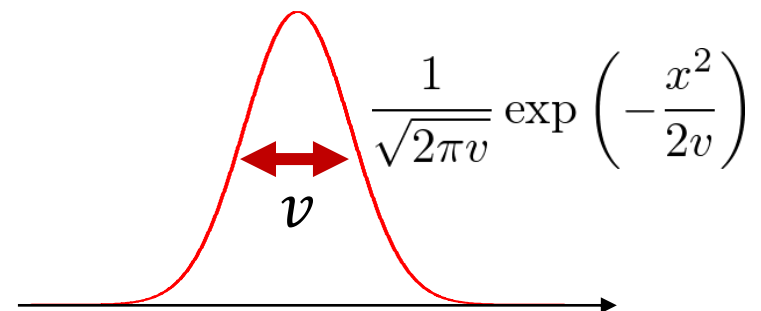
X_1, \dots, X_n ある分布からたくさんサンプルを得る.
(コイン投げの場合：たくさんコインを投げる)

$$\sqrt{n} \left(\underbrace{\frac{1}{n} \sum_{i=1}^n X_i}_{\text{サンプル平均}} - \underbrace{\mu}_{\text{本当の平均}} \right)$$

正規分布

(平均0分散 v)

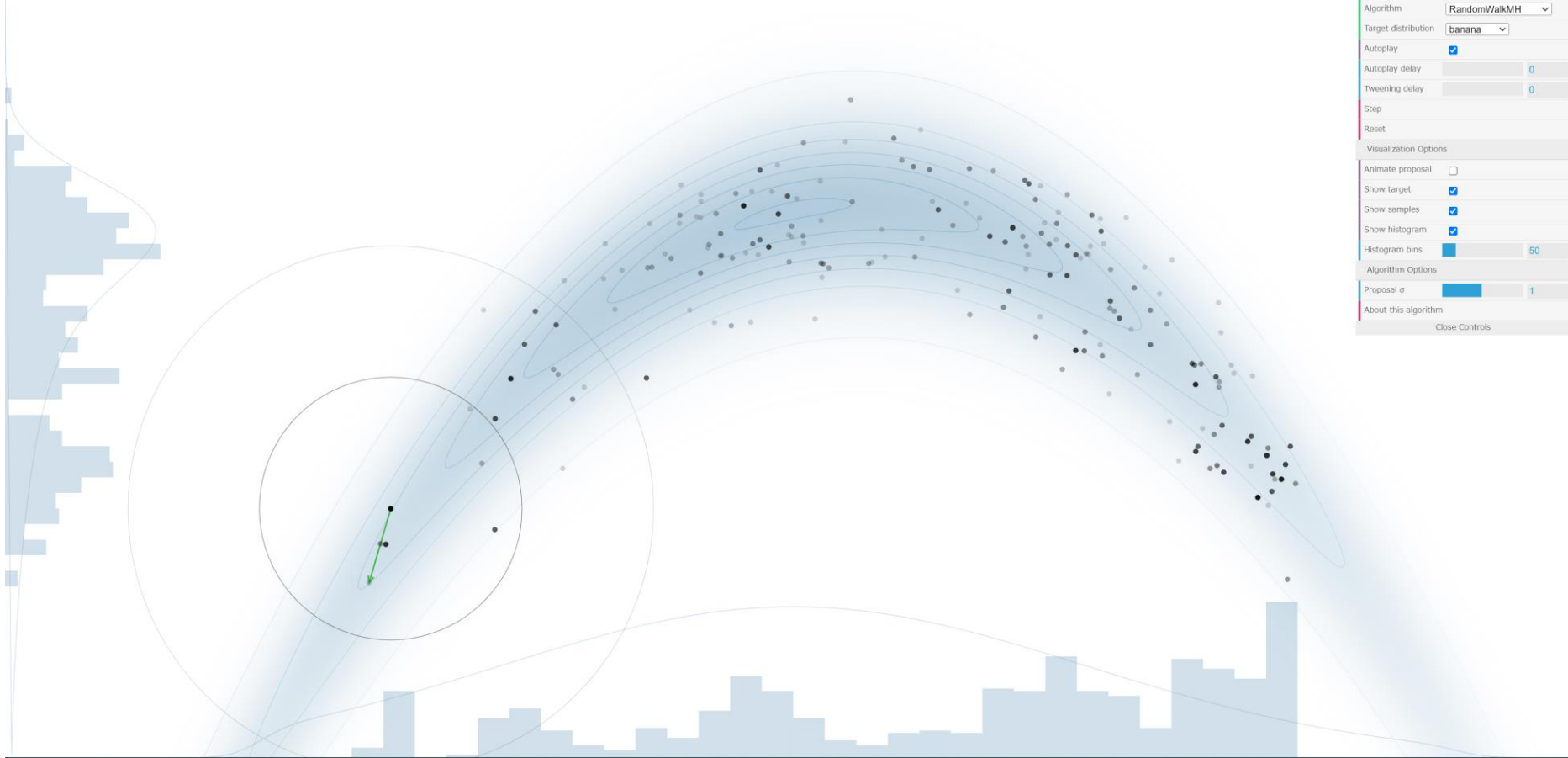
v は1サンプルの分散



普遍性

MCMC法 (マルコフ過程)

Random walk Metropolis-Hastings



[<https://chi-feng.github.io/mcmc-demo/app.html?algorithm=RandomWalkMH&target=banana>]

- ベイズ統計
- 数値シミュレーション