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RMS:311

Assignment 1

Summary of the introduction.

The introduction explains that diffusion models have become one of the most powerful generative modeling techniques, achieving state-of-the-art results in image, audio, and text generation. However, most existing explanations focus on diffusion in Euclidean spaces (like images represented as pixel grids)

Name of the paper and author.

Paper Title: Foundations of Diffusion Models in General State Spaces: A Self-Contained Introduction

Authors: Vincent Pauline, Tobias Höppe, Kirill Neklyudov, Alexander Tong, Stefan Bauer, Andrea Dittadi

Summary of the Problem Statement.

What is known

Current diffusion models assume data lives in Euclidean space (e.g., images as pixel arrays).

Problem

No unified theoretical framework that explains how diffusion model should operate in these more general space(graphs,categorical variables).

Prepared solution

To extent the diffusion the researcher should find the mathematical tools.

Objective of the paper.

Main objective is

To provide a unified, self-contained theoretical foundation for diffusion models that works across general state space.

Specific objectives are

- i. To unify diffusion model across continuous and discrete state.
- ii. To provide self-contained introduction to diffusion process.
- iii. To formalize diffusion using mathematical tools such as infinitesimal generators.
- iv. To connect discrete time diffusion formulation to continuous time limit.

Paper gap.

Difficult extending models without a general theory that's hard to adapt diffusion model to graphs, discrete data. Structured data.