THE UNIVERSITY OF CHICAGO | DEPARTMENT OF STATISTICS

Master's Thesis Presentation

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"DDSTPP: Denoising Diffusion Spatial Temporal Point Process"

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Abstract

Spatio-temporal data arises in a variety of domains, including epidemiology, environment, transportation and ecology. Generating realistic synthetic data is motivated in many of these domains to assist researchers in generating scientifically-interesting hypotheses and further studying underlying patterns without the risk of privacy violation. Traditionally, autoregressive modeling of point processes has been the primary framework for generative modeling of such data. Although excelling in near-term generating and forecasting, such methods suffer from error accumulation thus often fail to generate realistic synthetic sequences over longer-term horizons. We introduce a novel score-based diffusion model to generate whole sequences for spatio-temporal point processes, named Denoising Diffusion Spatio-Temporal Point Process (DDSTPP). This model is capable of synthesizing data in parallel, as well as forecasting sequences conditioned on real history. To tailor a diffusion model to point processes, we base our approach on the Jacobi diffusion and propose a probabilistic loss for training. To furthermore allow our model to leverage the history, we develop a novel score-based imputation importance sampling (SIIS) algorithm. Experimental results on different datasets demonstrate that our model matches the performance of state-of-the-art STPP models, showcasing its efficacy and versatility.

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