# Reinforcement learning for rare trajectories in stochastic systems

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Understanding the way in which rare events occur in stochastic systems is of key importance in many fields, ranging from fundamental statistical physics to chemical systems and climate modelling. We have previously demonstrated how the problem of creating a dynamics which generates rare trajectories of some stochastic process can be formulated as a reinforcement learning problem, applying the approach to discrete time stochastic processes [1], and diffusion processes [2]. In this work, we discuss several extensions of this earlier research. First, we consider how to adapt the approach to continuous time jump processes. Next, we show how this approach can be extended to cases in which the rare dynamics must be non-Markovian in order to achieve a perfect solution, for example, when the original stochastic process is itself non-Markovian. Finally, we look at how to scale up the method to many-body systems, making use of tensor networks as the ansatz for the dynamics [3].

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[1] D. C. Rose et al. New J. Phys. 23 013013 (2021).

[2] A. Das et al. J. Chem. Phys. 155, 134105 (2021).

[3] E. Gillman et al. arXiv:2209.14089 (2023).

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