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Sampling SU(3) pure gauge theory with Stochastic Normalizing Flows

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Non-equilibrium Monte Carlo simulations based on Jarzynski's equality are a well-understood method to compute differences in free energy and also to sample from a target probability distribution without the need to thermalize the system under study. In each evolution, the system starts from a given base distribution at equilibrium and it is gradually driven out-of-equilibrium while evolving towards the target parameters. If the target distribution suffers from long autocorrelation times, this approach represents a promising candidate to mitigate critical slowing down. Out-of-equilibrium evolutions are conceptually similar to Normalizing Flows and they can be combined into a recently-developed architecture called Stochastic Normalizing Flows (SNF). In this contribution we first focus on the promising scaling with the volume guaranteed by the purely stochastic approach in the $\mathrm{SU}(3)$ lattice gauge theory in 4 dimensions; then, we define an SNF by introducing gauge-equivariant layers between the out-of-equilibrium Monte Carlo updates, and we analyse the improvement obtained as well as the inherited scaling with the volume. Finally, we discuss how this approach can be systematically improved and how simulations of lattice gauge theories in four dimensions for large volumes and close to criticality can be realistically achieved.

Primary author: NADA, Alessandro (Università di Torino)

Co-authors: BULGARELLI, Andrea (University of Turin and INFN Turin); CELLINI, Elia (University of Turin / INFN Turin)

Presenter: NADA, Alessandro (Università di Torino)

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