Contribution ID: **70** Type: **Oral**

Conditional Born machine for Monte Carlo events generation

Tuesday, October 25, 2022 5:00 PM (20 minutes)

The potential exponential speed-up of quantum computing compared to classical computing makes it to a promising method for High Energy Physics (HEP) simulations at the LHC at CERN.
Generative modeling is a promising task for near-term quantum devices, the probabilistic nature of quantum mechanics allows us to exploit a new class of generative models: quantum circuit Born machine (QCBM).
These models use the stochastic nature of quantum measurement as random-like sources and have no classical analog.
More specifically, they produce samples from the underlying distribution of a pure quantum state by measuring a parametrized quantum circuit with probability given by the Born rule
This work presents an application of Born machines to Monte Carlo simulations and extends their reach to multivariate and conditional distributions.
Even if generating multivariate distributions with Born machines has already been explored, we propose an alternative circuit design with a reduced connectivity, better suited for NISQ devices.
Indeed, models are run on (noisy) simulators and IBM Quantum superconducting devices.
More specifically, Born machines are used to generate muonic force carriers (MFC) events resulting from scattering processes between muons and the detector material in high-energy-physics colliders experiments. MFCs are bosons appearing in beyond the standard model theoretical frameworks, which are candidates for dark matter. Empirical evidences suggest that Born machines can reproduce the underlying distribution of datasets coming from Monte Carlo simulations, and are competitive with classical machine learning-based generative models of similar complexity.

Significance

The submitted idea represents an extension of a prior work that incorporate important updated coming from external review and multidisciplinary discussion.

References

https://arxiv.org/abs/2205.07674

Experiment context, if any

Authors: KAJOMOVITZ MUST, Enrique (Technion, Israel Institute of Technology); GROSSI, Michele (CERN); KISS, Oriel Orphee Moira (Universite de Geneve (CH)); Dr VALLECORSA, Sofia (CERN)

Presenter: GROSSI, Michele (CERN)

Session Classification: Track 3: Computations in Theoretical Physics: Techniques and Methods

Track Classification: Track 3: Computations in Theoretical Physics: Techniques and Methods