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Do not measure correlated observables, but train an artificial intelligence to predict them

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In lattice QCD calculations, many different observables are measured on a gauge field, and their statistical fluctuations are correlated. By exploiting the correlation, one observable can be reconstructed from other observables, without expensive direct calculation. This idea is applied to two nucleon matrix element calculations using machine learning technique.

(1) The calculations of nucleon charges and form-factors need observables at multiple separations of nucleon source and sink in Euclidean time (t_{sep}) to remove excited state contamination. We trained a boosted decision tree regression machine learning algorithm to predict observables at $t_{\text{sep}} = 8a$ and $10a$ from the observables at $t_{\text{sep}} = 12a$ on a $a = 0.09$ fm lattice. (2) In the Schwinger source method for the quark chromo-electric dipole moment (cEDM), nucleon matrix elements are calculated from the quark propagators including CP-violating operators. We trained a machine to predict two-point correlation functions of the cEDM- and γ_5-inserted quark propagators from those of normal quark propagators without CP-violating operators.

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