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Deep learning study on the Dirac eigenvalue spectrum of staggered quarks

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We study chirality of staggered quarks on the Dirac eigenvalue spectrum using deep learning techniques. The theory expects a characteristic pattern (we call it "leakage pattern") in the matrix elements of the chirality operator sandwiched between two eigenstates of staggered Dirac operator. Deep learning analysis gives 99.4(24)% accuracy per a single normal gauge configuration and 0.998 AUC (Area Under ROC Curve) for classifying non-zero eigenmode quartets in the Dirac eigenvalue spectrum. It confirms that the leakage pattern is universal on normal gauge configurations. We choose the multi-layer perceptron (MLP) method which is one of the deep learning models. It happens to give the best performance in our study. Numerical study is done using HYP staggered quarks on the 20^4 lattice in quenched QCD.

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