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Exploring the flavor structure of quarks and leptons with reinforcement learning

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We propose a method to explore the flavor structure of quarks and leptons with reinforcement learning, which is a type of machine learning. As a concrete model, we focus on the Froggatt-Nielsen model with $U(1)$ flavor symmetry. By training neural networks on the $U(1)$ charges of quarks and leptons, the agent finds 21 models to be consistent with experimentally measured masses and mixing angles of quarks and leptons. In particular, The normal ordering of neutrino masses is well fitted with the current experimental data in contrast to the inverted ordering. Moreover, a specific value of effective mass for the neutrinoless double beta decay and a sizable leptonic CP violation. Our finding results indicate that the reinforcement learning can be a new method for understanding the flavor structure. The reference is JHEP12(2023)021 (arXiv:2304.14176 [hep-ph]).

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