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Prediction of nuclear masses with an artificial neural network

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The many-body Hamiltonian that describes atomic nuclei is exceedingly complex and remains unknown. Thus, the lowest energy state cannot be calculated directly from first principles for heavy nuclei. This has lead to many theoretical endeavors to predict the ground-state properties based on the mean-field concept. In a novel and alternative approach, we show that it is possible to predict nuclear masses directly from a probabilistic artificial nuclear network. We use approximately ~25% of the Atomic Mass Evaluation for training and predict the remaining ~75%. We achieve extraordinary accuracy on the order of ~250 keV for the predictions. In contrast to contemporary mass models, each mass prediction is associated with a corresponding uncertainty. We discuss the interpretability of our model and impactful trends observed in our mass and uncertainty predictions.

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