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A universal neural network for learning phases and criticalities

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A universal supervised neural network (NN) relevant to study phase transitions
is constructed. The validity of the built NN is examined by applying it to
calculate the criticalities of several three-dimensional (3D) and two-dimensional (2D) models including the 3D classical $O(3)$ model, the 3D 5-state ferromagnetic Potts model, a 3D dimerized quantum antiferromagnetic Heisenberg model as well as the 2D XY model. Particularly, while the considered NN is only trained once on a one-dimensional (1D) lattice with 120 sites, it has successfully determined the related critical points of the studied 3D and 2D systems with high accuracy. Moreover, the employed configurations for the prediction are constructed on a 1D lattice of 120 sites as well. As a result, our calculations are ultimately efficient in computation and the applications of the built NN is extremely broaden.

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