

Transfer learning of phase transitions in percolation and directed percolation

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The latest advances of statistical physics have shown remarkable performance of machine learning in identifying phase transitions. In this paper, we apply domain adversarial neural network (DANN) based on transfer learning to studying nonequilibrium and equilibrium phase transition models, which are percolation model and directed percolation (DP) model, respectively. With the DANN, only a small fraction of input configurations (two-dimensional images) needs to be labeled, which is automatically chosen, to capture the critical point. To learn the DP model, the method is refined by an iterative procedure in determining the critical point, which is a prerequisite for the data collapse in calculating the critical exponent ν . We then apply the DANN to a two-dimensional site percolation with configurations filtered to include only the largest cluster which may contain the information related to the order parameter. The DANN learning of both models yields reliable results which are comparable to the ones from Monte Carlo simulations. Our study also shows that the DANN can achieve quite high accuracy at much lower cost, compared to the supervised learning.