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Combined research approach for determining the ground state of spin glass[1] ALENA KOROL, DMITRII KAPITAN, ALEXEY RYBIN, EGOR VASILIEV, KONSTANTIN SOLDATOV, YURIY SHEVCHENKO, VITALII KAPITAN, KONSTANTIN NEFEDEV, Far Eastern Federal University (FEFU), Far Eastern Branch, Russian Academy of Science(FEB RAS) — Monte Carlo simulation is one of the most powerful approaches in statistical physics. However, the ability of modern machine learning techniques to classify, identify, or interpret massive data sets provides a complementary paradigm to the above approach. In our research, we studied the Edwards-Anderson (EA) spin glass (SG) model in a square two-dimensional (2D) lattice of Ising spins with a bimodal distribution of bonds. In present work, for simulation we used a combination of our Hybrid Multispin Method (HMM) and the Restricted Boltzmann Machine (RBM) to predict the ground states for the Edwards–Anderson spin glass model. To predict the GS, we used the data of the HMM to train our neural network and to predict spin glass state with a lower energy level than in the training data sets. Our research has shown that the ground states of spin glass systems can be predicted using a neural network. However, given the absence of an exact solution to determine the number of degenerations at the ground energy level for big systems, it is impossible to check whether our algorithms reach the global energy minimum. Nonetheless, machine-learning algorithms can make a significant contribution to solving NP-complete problems in the future.

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Alena Korol
Far Eastern Federal University (FEFU), Far Eastern Branch, Russian Academy of Science(FEB RAS)

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