

Title: Analysis of magnetic skyrmions using machine learning methods

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Abstract: In this thesis, we were examining phases of ferromagnetic lattices obtained using Monte Carlo simulations and the Heisenberg hamiltonian with machine learning methods. Methods used were Nearest Centroid method, Support Vector machines method and deep convolutional neural networks. We compared and discussed their classification accuracy and used each one of them to create a phase diagram for parameters B and D of the Heisenberg hamiltonian (a magnetic field size and the parameter D of Dzyaloshinskii-Moriya interaction). Afterwards, we visualised outputs of convolutional layers in convolutional neural networks and used them to make an estimate of phase boundaries. In comparison with other articles, we used much larger lattices and more sophisticated machine learning methods. On some of these larger lattices appeared unusual variants of examined phases, which did not appear on smaller lattices. Some simpler machine learning methods had troubles with their classification, however, the final deep convolutional neural network we created was able to not only correctly classify lattices with typical examples of examined phases, but also these unusual lattices.

Keywords: magnetism, skyrmions, machine learning, neural networks