ML in Fundamental Physics

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Exercise Sheet 11

Submission by Monday 12$^{\text{th}}$ 18:00 via Moodle.
Format for all questions: individual Jupyter notebooks .ipynb.

1 GAN (peer corrected)

1.1 Data

You can find a dataset on the Moodle website (*ising_data.zip*). These are some Monte Carlo samples of the standard ferromagnetic 2D Ising model on a square lattice of size 40x40 generated at different temperatures. For each temperature there are 1001 spin configurations. The factor indicates how close it is to the critical temperature (e.g. 1 corresponds to $0.1\beta_c$, $\beta_c = 1/(T_c k_B)$). It contains various numpy arrays so you can load the datasets using numpy.

Do not check the datasets in your git repo, either put it outside our write it to a .gitignore!

1.2 GAN Implementation

Build a GAN with a custom training loop (as in sheet 10) that aims at generating Ising samples below the critical temperature. Analyze the energy and magnetization of both the original dataset and the generated Ising samples.

Note that in case you do not have a local environment where you can calculate on a GPU, you can calculate online on `collab` on a GPU.