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Statistical Mechanics of Deep Learning - Problem set 2

Winter Term 2024/25

Hand in Python code: Before **Monday 28.10.2024, 9:15**, only submit the Python code you have written. Share a Google Colab Notebook with your code and send the link via email to itpleipzig@gmail.com.

3. Training with PyTorch on FashionMNIST *8 Points*

(a) Follow this link "quickstart tutorial" to train a neural network on the FashionMNIST dataset.

(b) Remove one of the two hidden layers of the example network. Now vary the size of the hidden layer (10, 20, 40, 50, 100, 300) and train for 5 Epochs on FashionMNIST and store the final validation accuracy. Then plot the accuracy as a function of the hidden layer size.

(c) Use the same network with fixed hidden layer size of 30 to estimate the impact of random initialisation. Run the network 10 times with different weight initialisation. Compute standard deviation and mean. Visualize the datapoints in a plot to make the fluctuations of the final test accuracy visible.

4. Training with PyTorch on MNIST *8 Points*

In this exercise we will create our own neural network on the MNIST dataset.

(a) Start by finding the dataset in the pytorch library. Create a neural network with three hidden layers with widths of your choice. Train the model with a batch size of 32 for 25 epochs. Use a decaying learning rate schedule of your choice.

(b) Now split the training data into a training (45000 examples) and a validation data set (15000 exxamples. Optimise the batch size and the learning rate schedule via a small grid search by training the network on the 45000 train examples and validating on the 15000 validation examples (such that the computational effort remains reasonable). Plot the resulting 2D data as a heatmap.

(c) Use the parameters which yield the best validation accuracy and train the network again now using the full training dataset (60000 examples) and test on the test dataset. Did you improve your result in (a)?