

Homework 02

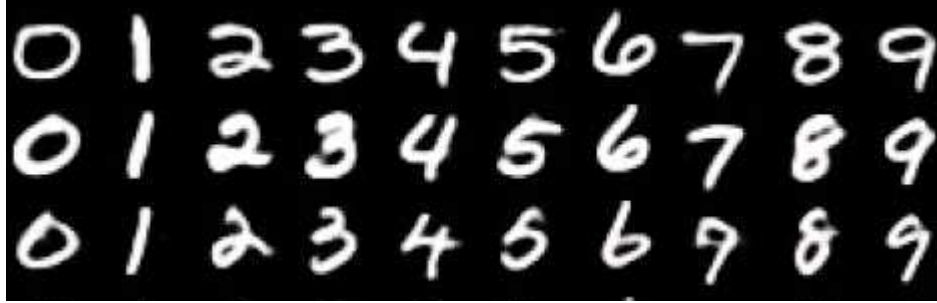
Neural Networks and Deep Learning

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Handwritten digit classification



- Download the MNIST dataset from the e-learning page
(NB: it is not the same dataset that you can find in other websites)
- Train, validate and test your neural network using PyTorch
- Write the report (as always, 3 pages length + Appendix for additional figures/tables)
- We will run your model on a separate (hidden) test set to create the rankings

Don't worry, rankings are just for fun!

Handwritten digit classification

Before next Lab (November 19th), all of you should:

1. Extend the available PyTorch script (Lab03) or create a brand-new one, in order to:
 - Make it possible to load the MNIST dataset from the provided MATLAB file (“MNIST.mat”)
 - Train feed-forward neural network:
 - Using a proper cross-validation scheme to avoid overfitting (choose yourself the test set)
 - Exploring the best hyperparameters /architecture using search procedures (grid, random, ad-hoc...)
 - NB: the input size is 784 (28x28 pixels); the output size is 10 (possible digit classes), but the network should also return as output a single integer number representing the chosen class (from 0 to 9)
 - Analyze the trained network by:
 - Calculating the mean classification accuracy over the chosen test set
 - Visualizing the receptive fields of (a subset of) hidden neurons
2. [Optional] Implement a more advanced method to visualize the feature encoded by a neuron (e.g., gradient descent over the image pixels to maximize the neuron’s activation)
3. Write a short report describing your work and the results achieved (figures are appreciated)
4. Send the Homework through the Moodle platform:
 - make sure you include both the report (PDF) and the necessary Python scripts and data [no more than 15 files!]
 - the script **MUST** work by running the following command: `python trained_model.py`
 - the script **MUST** return the mean accuracy of the images in the file: `“MNIST.mat”`
mean accuracy = correct classifications / total number of patterns

How to load and save data

- The idea is that your code should work on a “standard” Python environment (which means, don’t use exotic saving/loading libraries)
- Options include:
 - Pickle
 - Libraries for loading and saving MATLAB files (scipy.io, loadmat, h5py...)
 - PyTorch loading/saving routines