

Project #1

Convolutional Neural Network

For the first project you should implement a CNN in a group of up to three students. You should train and test your developed CNN architecture to classify handwritten digits in the MNIST dataset. Submit your analysis in the style of a scientific paper (max. 6 pages, pdf format) along with any code and/or jupyter notebooks (.ipynb and .py files are fine). Present your best CNN architecture. For achieving that, try to answer the following questions in your analysis.

1. Code up a CNN. Please explain your chosen architecture, e.g. the number of convolutional and pooling layers, size of fully connected layer, activation functions etc.
2. Train your CNN. Explain all implemented steps, possible performance measurements and training algorithms in use.
3. Test and evaluate your CNN. Explain your result.
4. Do you get the exact same results if you run the CNN multiple times without changing any parameters? What are the sources of randomness?
5. Run more optimization iterations. Are the results better? How long do the computations take?
6. What effect has a change of the learning-rate for the optimizer?
7. What is the CNN learning? Can you e.g. visualize some of the learned features in the convolutional layer?
8. Change the configuration of the layers, such as the number of convolutional filters, the size of those filters, the pooling window and the number of neurons in the fully-connected layer. What is the effect on the performance?
9. What is the smallest possible configuration that still gives good results?
10. Try not using pooling in the convolutional layers. Does it change the classification accuracy and training time?

100 points