

1 Basic Operations for Deep Learning

1.1 Basic Neural Networks

Implement the basic LeNet-5 neural network for the classification of hand written digits e.g. with TensorFlow and its Kera API. It contains fully connected, convolutional, and pooling layers. Train this network with the MNIST dataset and inspect the results. Try experimenting with loss functions, filter sizes, and other parameters. Make sure you understand the operations required to run the model.

1.2 Implementation of the Fundamental DL Operations

Implement the basic deep learning operations for inference by yourself in C/C++ (matrix-matrix multiplication, 2D convolution, max-pooling). It will be the base for your future optimizations. Make sure your code is generic such that you can use it for networks with different parameters.

1.3 Running the own Neural Network Implementation

Export the weights of your trained LeNet-5 neural network (e.g. to a file) such that you can read them in with your own C/C++ implementation. If you want to be the most flexible, you can also use a standardized format for neural networks e.g. *Open Neural Network Exchange (ONNX)*¹. Use this data to call your previously implemented own functions. After this exercise your code should be functionally equivalent to the DL framework operations and be able to correctly classify the hand written digit images. Finally, measure the runtime of your first implementation.

¹<https://github.com/onnx/tensorflow-onnx>