



Deep Neural Networks

Assignment 7

Assignment due by: 11.12.2019, Discussions on: 18.12.2019

Note: All further programming exercises in this course have to be done in Python 3.5 or later versions. You are not allowed to import further libraries or use the high-level API Keras (`tf.keras`), except for the functions already provided.

Question 1 Depths, Widths and Learning Rates (20 Points)

As we have seen in last week's assignment, tracking weights in global variables is messy and tiresome. We will now start implementing layers in an object oriented way. In addition, we will analyze how our results change if we use different depths (amount of layers), widths (amount of neurons per layer), and learning rates (gradient descent step size). Complete the provided *nn.py*. If you are lacking processing power to run the code efficiently, you can use your TCML-Cluster account.

- (a) Implement *ReLU*Layer, *Dense*Layer and *SoftMax*Layer. (1+2+3 points)
- (b) Implement *SequentialModel* as a layer that contains other layers. (3 points)
- (c) Implement the *train_model* and *test_model* functions. If your code runs correctly, you should achieve roughly 91% test accuracy now. (3+1 points)
- (d) Now run the provided grid search, add the plot to your pdf. Briefly comment on your results based on *width* and *depth*. (2 points)
- (e) Now implement the *normalize_dataset* function. Run the provided grid search again. How have the results changed? Add the plot to your pdf. (3 points)
- (f) Now implement a new function *grid_training2* which performs a grid search over learning rates and widths. Set the depth to 1. Use the following learning rates: [1, 0.1, 0.001]. Briefly comment on your results. Add the plot to your pdf. (2 points)

TCML-Cluster:

We will hand out the cluster accounts in the tutorial session today. Each student will get a login. If you are unable to attend the tutorial, then please send an email to the tutors. A documentation on how to use the cluster is available under: <https://docs.google.com/document/d/1AgtLy28VVZaPe79Tw0b9jjC4F1KVzffb8y1vZoURZE8/>

The amount of jobs that can be submitted and the amount of graphic cards that can be used is limited to 2 for student accounts