

# Pattern Recognition

## Exercise 2

Mario Kaufmann  
Ramona Imhof  
Jakob Schärer  
Adrian Wälchli  
Jan Luca Liechti

April 10, 2017

## 1 SVM

Using the *libsvm*<sup>1</sup> SVM library, we used the following parameters to obtain the best possible results:

- $k = 10$  (for k-fold cross-validation)
- $C = 2^{-5}, \dots, 2^{15}$  (10 different values in total)
- $\gamma = 2^{-15}, \dots, 2^3$  (10 different values in total)

With these values, we are following the *libsvm* guide to support vector machines<sup>2</sup>. We also normalize all values to the interval  $[0, 1]$ .

## 2 MLP

### 2.1 Implementation with standard MATLAB tools

### 2.2 Implementation with NN Toolbox

As an alternative approach, we used the Neural Network toolbox from MATLAB to implement the MLP. We used cross-validation to find the optimal number of neurons in the hidden layer as well as the optimal learning rate. We adapted a grid search on the following search space:

---

<sup>1</sup><https://www.csie.ntu.edu.tw/~cjlin/libsvm/>

<sup>2</sup><https://www.csie.ntu.edu.tw/~cjlin/papers/guide/guide.pdf>, p. 5-8.

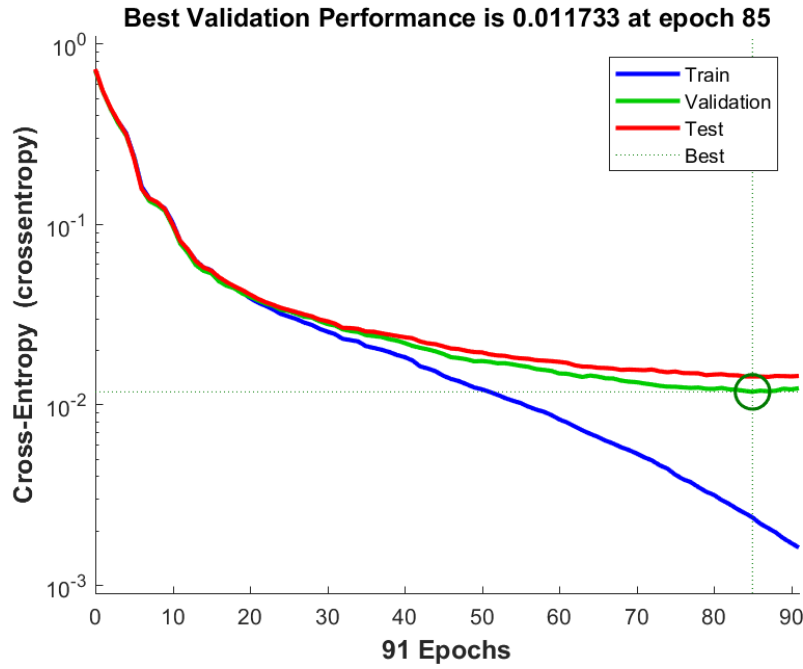


Figure 1: Cross-entropy error vs. epochs. The test set in this figure is not the same as the test set we use for the final evaluation. These are the three splits to verify the performance during training. We abort after 6 validation checks (when the performance does not improve anymore).

- Layer size: 50, 60, 70, ..., 150
- Eight learning rates on the interval  $[0.001, 0.05]$

We found the optimal parameters are 140 neurons and 0.001 for the learning rate. On the full training set, the runtime for the parameter search is about 25 minutes. We save the performance for the best network and show it in figure 1. The classification accuracy on the test set with these parameters is **96.2736** percent.