MSE | MASTER OF SCIENCE IN ENGINEERING

HES-SO

Machine Learning

Practical work 09 - Artificial Neural Networks (ANN)

Teachers: A. Perez-Uribe (Email: andres.perez-uribe@heig-vd.ch) & J. Hennebert
Assistant: H. Satizabal (Email: hector-fabio.satizabal-mejia@heig-vd.ch)

Summary for the organization:

- Submit the solutions of the practical work before Monday 26.11.18, 23h55 via Moodle.
- Modality: PDF report (max. 6 pages)
- The file name must contain the number of the practical work, followed by the names of the team members by alphabetical order, for example 09_dupont_muller_smith.pdf.
- Put also the name of the team members in the body of the notebook (or report).
- Only one submission per team.

0. Notebooks

Download the notebook material from the Moodle platform

1. The Perceptron and the Delta rule

Read each notebook material (see list below), follow the instructions, play with the code, program the proposed problems and answer the questions.

List of notebooks associated with this exercise:

1_activation_function.ipynb
2_perceptron.ipynb
3_MLP.ipynb
4_delta_rule.ipynb or 4_1_delta_rule_points.ipynb (if the right-click doesn't work)

2. Backpropagation

Read each notebook material, follow the instructions, play with the code, program the proposed problems and answer the questions.

List of notebooks associated with this exercise:

5_backpropagation.ipynb
6_backpropagation_MLP.ipynb

4. Crossvalidation

To proceed with this part you must have finished the implementation of Backpropagation with momentum by modifying the "basic" Backpropagation code we provided.
The objective of this part is to run some experiments using a hold-out validation procedure and understand the limits of such approach. Then you are asked to use a cross-validation approach to see its advantages.
Please, read each notebook material, follow the instructions, play with the code: e.g., modify the number of hidden neurons, the datasets, the number of splits for validation, etc.

List of notebooks associated with this exercise:

7_hold_out_validation.ipynb
8_cross_validation.ipynb

5. Model building

When training a neural network to solve a problem, e.g., to develop a classification system, you will need to evaluate diverse models (neural net configurations, complexities, diverse parameters,etc) and select the "best" one. The following notebook presents a methodology iterating over the number of epochs (learning duration) and number of hidden neurons (model complexity). When selecting the final model, that is, defining the number of epochs for training and the number of hidden neurons, you will need to evaluate the performance of the final model, by crossvalidation, and you might also compute the confusion matrix, which illustrates if the system confuses certain inputs while attempting to classify them.

List of notebooks associated with this exercise:

9_model_selection.ipynb

Summary of work to include in the report

- Implementation of the ReLu activation function (source code) + example of visualization
- Answer questions 1-3 from the 4_delta-rule notebook and present the resulting plot when the option SHOW_VIDEO is set to False
- Answer questions 1-4 from the 5_backpropagation notebook and present the resulting plot when the option SHOW_VIDEO is set to False
- Implementation (source code of the modified function) of the Backpropagation with momentum algorithm
- Run notebooks 7 and 8, provide the final plots *MSE vs spread* and comment the difference between results
- Run notebook 9 for three different spread values (e.g., 0.3, 0.5 and 0.7), describe the final model chosen and justify your selection (e.g., based on the plots of MSE vs parameters)