Institute for Computer Science VI, Autonomous Intelligent Systems, University of Bonn

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http://www.ais.uni-bonn.de/WS2223/4204_L_NN.html

Exercises for module Technical Neural Networks (MA-INF 4204), WS22/23

Assignments Sheet 4, due: Monday 14.11.2022

7.11.2022

Group	Name	20	21	22	23	24	25	26	$\sum$ Sheet 4

Assignment 20 (2 Points)

Describe and draw a typical learning curve for an MLP that is trained with Backpropagation of Error, single step learning strategy. Make sure, that the diagram is completely labeled.

Assignment 21 (2 Points)

Draw the graph of an (unrealistic) learning curve $f(z) = 2^{(2-z+4*sin(z))}$ with 4 different ways to scale the axes.
A: both axes scaled linear; B: one axis linear and one logarithmic, C: the other axis logarithmic and the first one linear, and D: both axes with logarithmic scaling.
What does the different scaling tell us with respect to a learning curve and the learning process?

Assignment 22 (2 Points)

Explain how an MLP can solve the encoder-decoder tasks: *8-3-8* and *8-2-8*.
Explain further why an MLP is not capable to solve the *8-1-8* task.

Assignment 23 (3 Points)

Explain *Resilient Prop* (*R-Prop*). Describe the idea, and motivate the formulas to adjust the learning rate. It is not necessary to derive the fomulas, but you should know what each term within the formulas is standing for.
Please use scientific citation of the literature that you have used for this task.

Assignment 24 (2 Points)

Explain what *overfitting* means in the context of neural networks and explain at least one strategy to avoid it.

Assignment 25 (2 Points)

Explain the term *generalisation* in the context of neural networks using an example of your own.

Assignment 26 (4 Points)

It has been said, that a MLP (three or more layers) having the identity as transferfunction in all layers, can be completely replaced by a perceptron (2 layers) with identity as transferfunction. Prove it!

Show (by calculation), that the mapping $\underline{\mathbf{Y}} = \underline{\mathbf{Y}}(\underline{\mathbf{X}})$ that a MLP with three or more layers having just the identy $f(z) = z$ as transferfunction can be completly realized by a perzeptron (2 layers) with identity as transferfunction.

Hint:
Try to write the mapping of the MLP, and the perzeptron in vector-matrix notation:
N-dimensional input-vectors $\underline{\mathbf{X}}$, M-dimensional output-vectors $\underline{\mathbf{Y}}$, weightmatrics $\underline{\underline{\mathbf{W}}}$, or $\underline{\underline{\mathbf{U}}}, \underline{\underline{\mathbf{V}}}$, ...

If the BIAS is causing you problems, you have the special permission to ommit the BIAS (only) for this assignment.

Programming assignment PA-C (5 Points, Due date: Mon 14.11.2022)

Implement and train an MLP to solve so called encoder-decoder tasks.

Start to implement an MLP to do the *8-3-8* task, with 3 layers, having 8 input neurons, 3 hidden neurons and 8 output neurons. The input and teacher values shall be 0.0 or 1.0. Choose appropriate transfer functions and learning parameters (report them).
Train the network with Backpropagation of Error, until a resonable result is achieved.

Print or depict the resulting input and output values after you finished learning. While learning, show the learning curve, and try to visualize the states of the three hidden neurons for all 8 patterns.

Redo the above steps for the *8-2-8* task.

Redo the task for either the *50-2-50* case or the *64-6-64* case.