Exercise Sheet 9

Due: 30.01.2019, 09:00

Exercise 9.1

The MLP in Fig. 1 takes a one dimensional input $x \in \mathbb{R}$, has one hidden layer with two neurons with Sigmoid activation function and an ouput layer with one neuron with linear activation function.

a) Specify the function $h(x)$
b) Describe the influence of the model parameters (weights and biases) on the function h.
c) Plot the function h for interesting model parameters.

Exercise 9.2

Consider the MLP $h(x)$ from Fig. 1 and the loss function $\ell(\hat{y}, y) = \frac{1}{2}(\hat{y} - y)^2$. Given a training example (x, y), specify the three partial derivatives of the loss $\ell(h(x), y)$ with respect to w_{11}, b_{11}, w_{21}. Link the results to the delta rule. For this, specify which terms correspond to the deltas and which terms to the output activations from layer $l - 1$. Hint: Note that the index scheme is not consistent with the lecture!

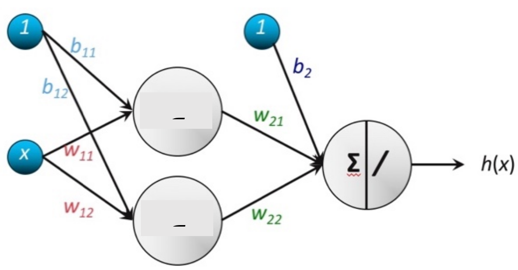

Fig. 1: MLP for one-dimensional input x

Exercise 9.3 (1 bonus point)

Verify the form of $\delta_j^{(l)}$ as specified in the lecture for a hidden layer l by computing the delta based on the definition $\delta_j^{(l)} := \frac{\partial J_t}{\partial a_j^{(l)}}$. Hint: Consider the chain rule with respect to the input activations $a_k^{(l+1)}$.

Exercise 9.4 (2 bonus points, 1 for forward pass, 1 for backward pass)

State a matrix formulation of the backpropagation algorithm with linear output neurons and squared-error loss.