Exercises for the course
Deep Neural Networks
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Exercise Sheet 3

Exercise 1: Backprop in the Convolution (15+15 P)

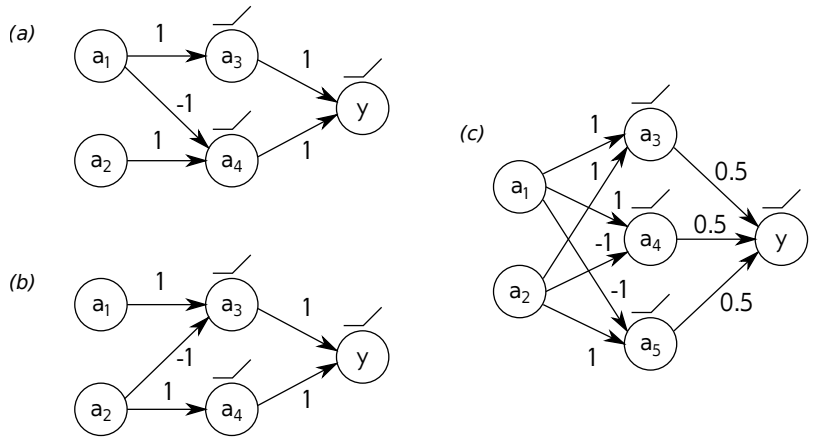
In the slides, the forward computation of a 1D convolutional layer is defined by the cross-correlation: $y = w \star x$, and the corresponding error gradients with respect to its input x and weights w have been computed. We now assume that the forward computation is defined by the convolution $y = w * x$, and that E is an error function that depends on y.

(a) *Express* the gradient $\frac{\partial E}{\partial x}$ as a function of $\frac{\partial E}{\partial y}$ and w.

(b) *Express* the gradient $\frac{\partial E}{\partial w}$ as a function of $\frac{\partial E}{\partial y}$ and x.

Exercise 2: Layer-Wise Relevance Propagation (30 P)

We would like to test the dependence of layer-wise relevance propagation (LRP) on the structure of the neural network. For this, we consider the function $y = \max(a_1, a_2)$, where $a_1, a_2 \in \mathbb{R}^+$ are the input activations. This function can be implemented as a ReLU network in multiple ways. Three examples are given below.



Because of the positive activations, an appropriate rule for both layers is LRP-$\alpha_1\beta_0$ defined in Section 5.1 of the paper "*Methods for interpreting and understanding deep neural networks*" linked via ISIS.

(a) *Give* for each network an analytic solution for the obtained scores R_1 and R_2 obtained by application this propagation rule at each layer.

(b) *Discuss* which implementation of the "max" function (a, b, or c) gives the most intuitive explanations.

Exercise 3: Programming (40 P)

Download the programming files on ISIS and follow the instructions.