Deep Learning
Exercise Sheet 1

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Exercise 1: Forward Propagation (12 Points)

Given is a neural network with **one** hidden layer. The network takes as input a 2-dimensional vector $x = (x_1, x_2) \in \mathbb{R}^2$ and outputs a single value $\hat{y} \in \mathcal{Y}$. The number of neurons in the hidden layer is set to be **two**.

a) Make a scetch of the whole network architecture. Do not forget the biases in the input and the hidden layer. To make your life a little bit easier, use different variables for the network inputs and weights by using x and W for the input layer; h and v for the hidden layer and $\hat{y}$ for the final prediction.

b) Write down the formulas how to compute h and $\hat{y}$ when using ReLU as activation function for both a regression output and a binary classification output.

c) Predict the network output for $x = (1 \ -1)$ for parameters:

$$W = \begin{pmatrix} 1 & 2 & 1 \\ -1 & 1 & 2 \end{pmatrix} \qquad v = \begin{pmatrix} 1 & -1 & 2 \end{pmatrix}$$

when using ReLU as activation function for both a regression output and a binary classification output.

Exercise 2: Backpropagation (8 Points)

For the network given in Exercise 1, compute the partial derivates of $\mathcal{L}(\hat{y}, y)$ with respect to all network parameters W and v using a general activation function g! Do this for the target being a regression value and use the least-squares loss.