Machine Learning for Image Analysis, SoSe 2023
Exercise Sheet #6: Convolutional Neural Networks
Due date: June 6, 2017, before 11 am

Problem 1 (Receptive Field) (15 pt).
Consider a CNN consisting of one input layer and three consecutive convolutional layers, each of them having kernel size 3x3, stride 1, number of filters 128, and ReLU activation functions.

(a) (6pt) Assume that the size of the input layer is 225x225x128. Calculate the output size and number of parameters for each of the layers. Employ *valid* padding.

(b) (2pt) Explain the notion of the receptive field of a neuron in a layer.

(c) (2pt) What is the size of the effective receptive field of a neuron in the last convolutional layer with respect to the input? Explain why.

(d) (2pt) Your friend suggests to use a different architecture of the CNN with only one convolutional layer instead of the three above, where the kernel size is 7×7 and stride is 1. Calculate the output size and number of parameters for each of the layers. Employ *valid* padding.

(e) (3pt) We want to compare both architectures for a general input size and number of channels. Which of both architectures is more efficient in general? Name 2 reasons.

Problem 2 (Activation functions) (10 pt).
Which of the following functions are useful activation functions in practice? Justify your answer.

(a) (2pt) $f(z) = \begin{cases} 0 & , z \leq 0 \\ 1 & , z > 0 \end{cases}$

(b) (2pt) $f(z) = -\min(0, -z)$

(c) (2pt) $f(z) = \min(0, 0.1z) + \max(0, z)$

(d) (2pt) $f(z) = \log(z)$

(e) (2pt) $f(z) = \exp(z)$