Convolutional Neural Networks

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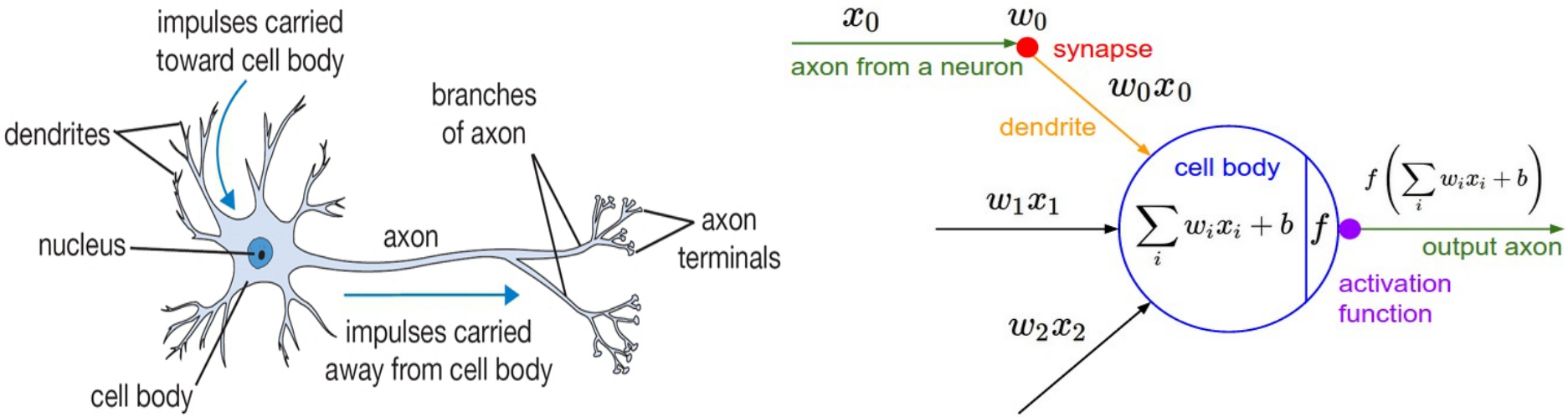
Background and Motivation - Neural Networks

Primary motivation: Neural Networks mathematically simulate biological functionalities of the human brain



(a) biological model

(b) mathematical representation

Figure: neuronal model and computational abstraction

Background and Motivation - Principle

Neural Networks generally contain:

- an n-dimensional input
- one or many layers of interconnected neurons
- an output-layer

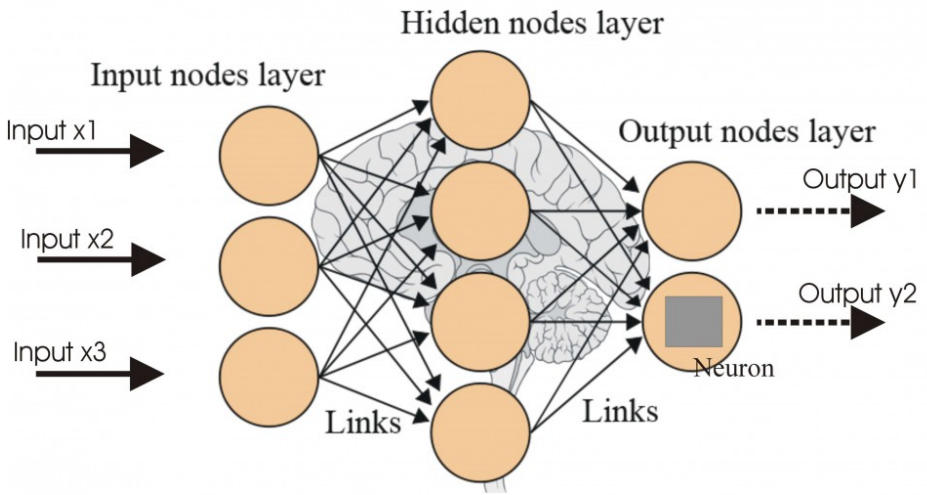


Figure: Basic concept of a Neural Network

Background and Motivation - Convolutional Neural Networks

Convolutional Neural Networks (CNNs) are a subtype of Neural Networks:

- all neurons in a layer are identical
- layers are interconnected through a kernel function
- different types of layers are used

Background and Motivation - Convolutional Neural Networks

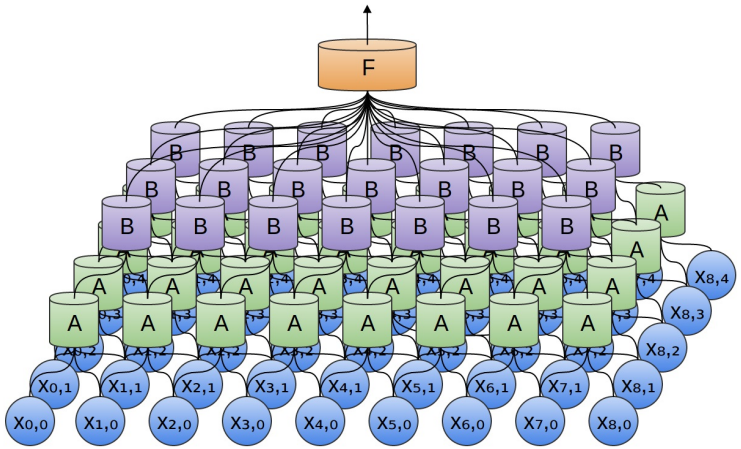


Figure: 2-dimensional CNN

1. Using identical copies of the same neuron allows for complex models with few parameters
2. Convolutional layers are not fully connected; each neurons is locally connected with a subsection of the previous layer

Background and Motivation - Application

Visual Object Recognition

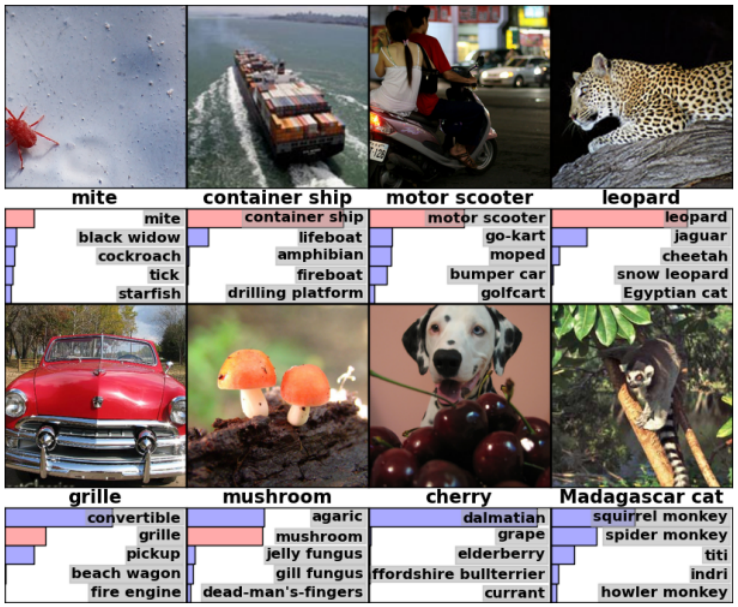


Figure: ImageNet Classification with Deep Convolutional Neural Networks

ImageNet by Krizhevsky et al (2012) classified 1.2 million high-resolution images in the ImageNet LSVRC-2010 into 1000 different classes. It achieves error rates of 37.5% for the top result and 17.0% for the top-5 results

Background and Motivation - Application

Text Classification

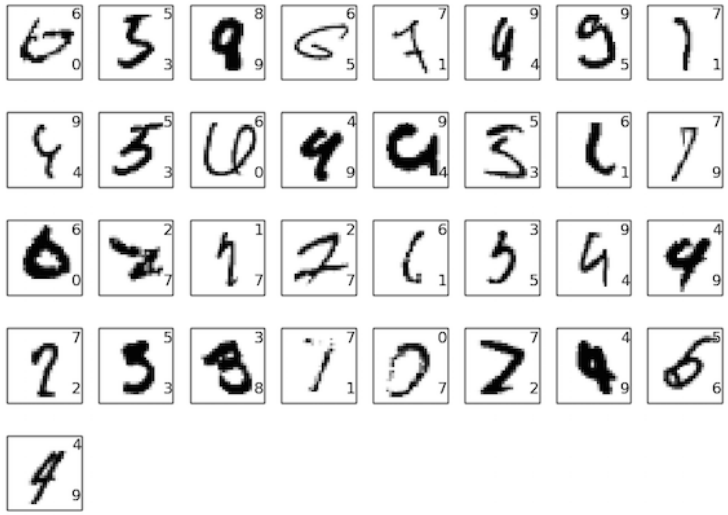


Figure: Excerpt of mnist

fehlt: etwas Erklärung hierzu

Components

hier Bild eines CNNs unseres Typs mit Komponenten

1. Neuron
2. Kernel-Function
3. Sigmoid function
4. softmax

Components - Neuron

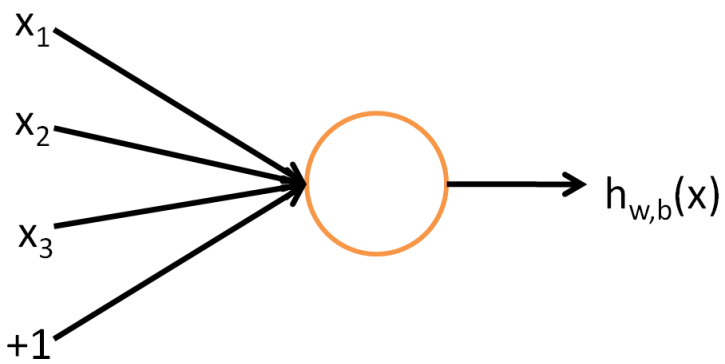


Figure: Single neuron of a fully connected layer

Input: connected neurons from the previous layer Output: $f \sum i w_i * x_i$

Propagation - Forward Propagation

Forward propagation is the process of computing the output of a network for a given input

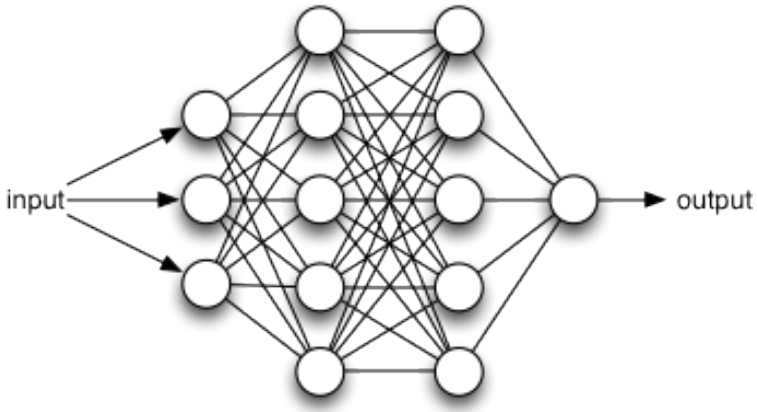


Figure: Forward propagation in a complex neural network

The


Leslie Lamport, *LaTeX: a document preparation system*, Addison Wesley, Massachusetts, 2nd edition, 1994. @miscbworld, author = Christian Perone, title = Deep learning – Convolutional neural networks and feature extraction with Python, howpublished = "http://blog.christianperone.com/2015/08/convolutional-neural-networks-and-feature-extraction-with- year = 2015, note = "[Online; accessed 21.01.2017]" http://cs231n.github.io/convolutional-networks/ http://colah.github.io/posts/2014-07-Conv-Nets-Modular/ http://www.cs.toronto.edu/ fritz/absps/imagenet.pdf