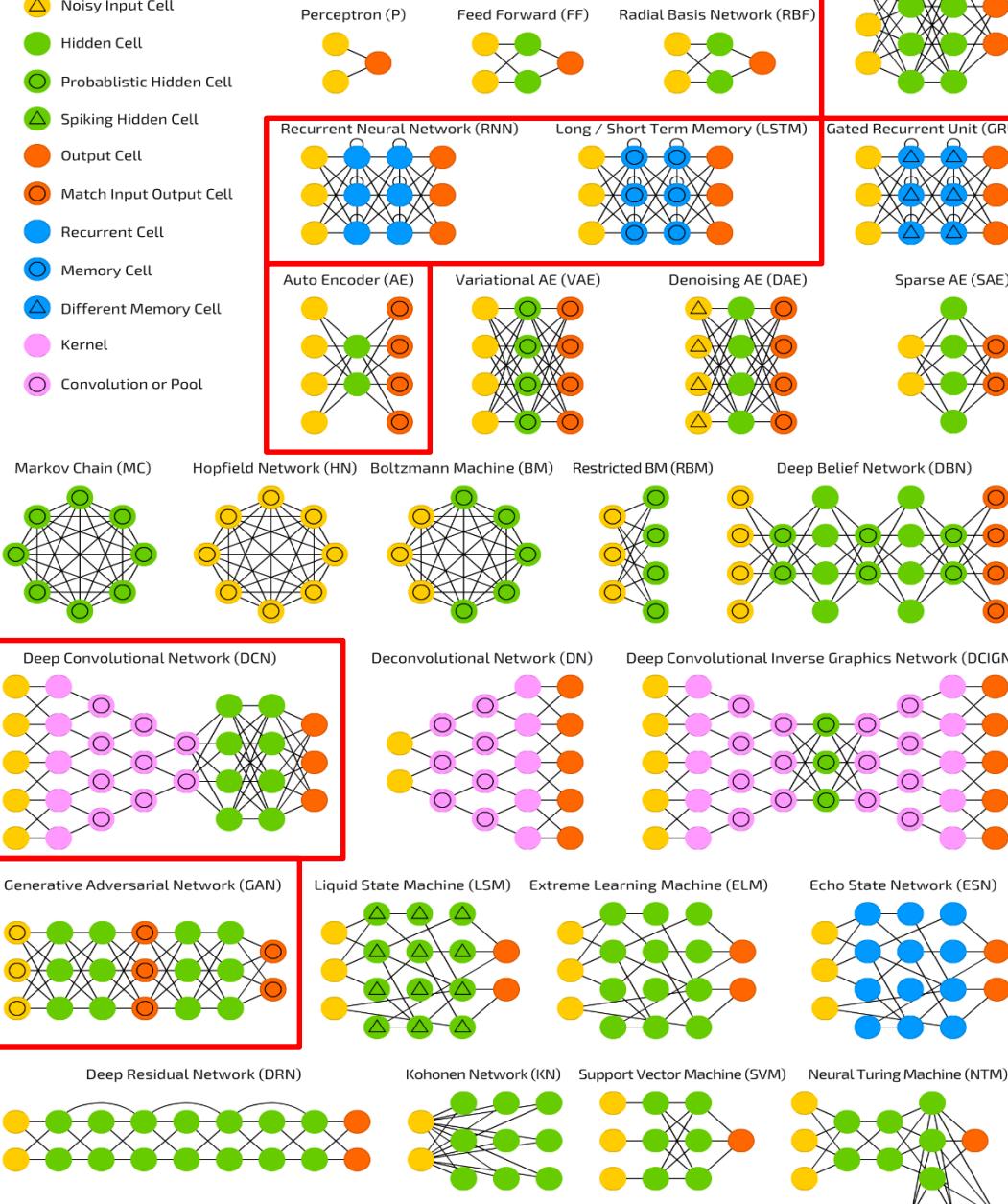


Neural Networks

©2016 Fjodor van Veen - [asimovinstitute.org](http://www.asimovinstitute.org)

- Backfed Input Cell
- Input Cell
- △ Noisy Input Cell
- Hidden Cell
- Probabilistic Hidden Cell
- △ Spiking Hidden Cell
- Output Cell
- Match Input Output Cell
- Recurrent Cell
- Memory Cell
- △ Different Memory Cell
- Kernel
- Convolution or Pool



Neuronale Netze stellen einen zentralen Baustein für Deep Learning dar.

Im Laufe der Jahre wurden zahlreiche **Architekturen** für Neuronale Netze entwickelt.

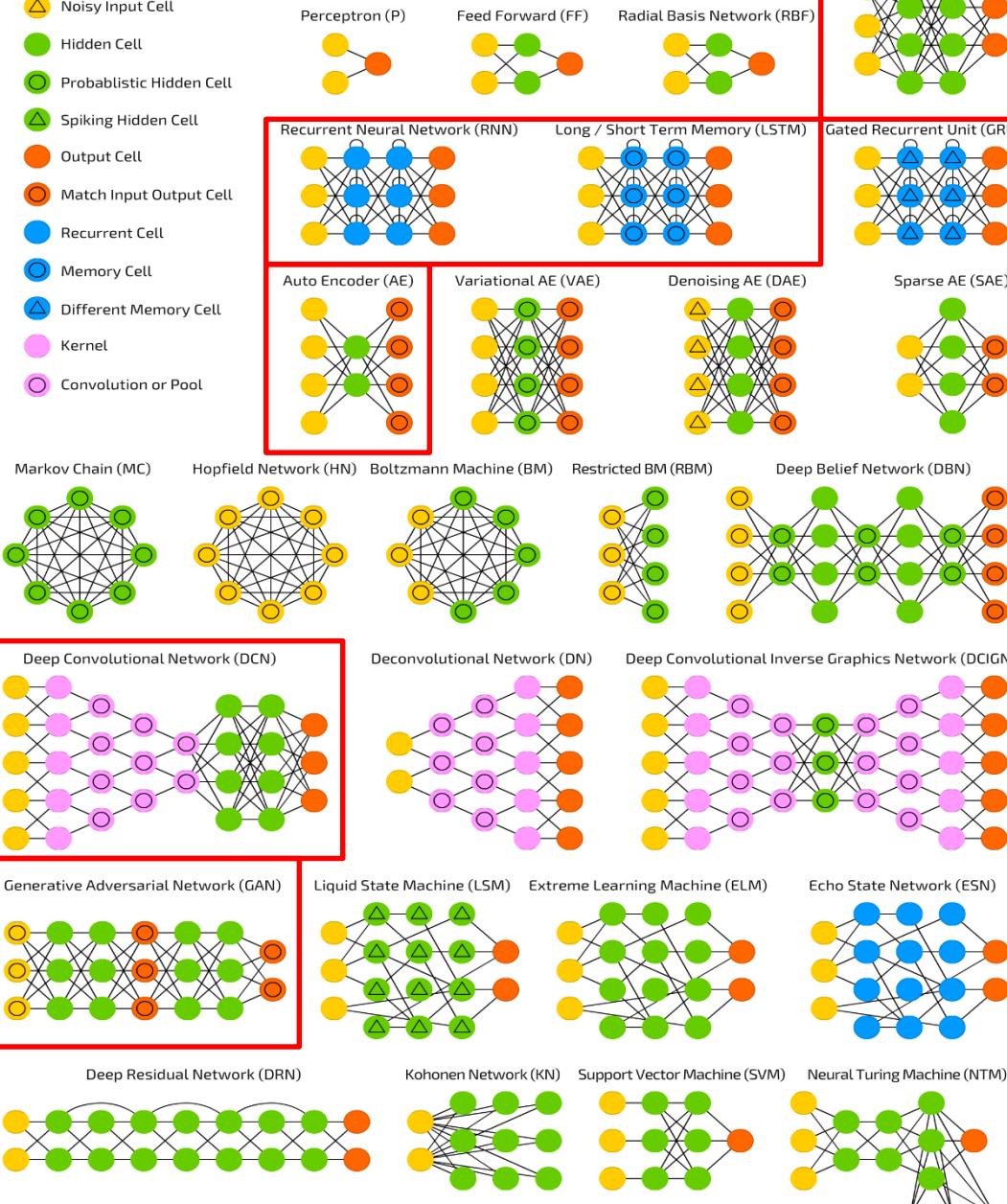
Die Wahl der **Architektur** hängt von der **Datenstruktur**, den **Dateninhalten** und der **Aufgabenstellung** ab.

Aktuell wichtige Klassen sind u.a. **Convolutional Neural Networks (CNN)**, **Recurrent Neural Networks (RNN)**, **Autoencoder**, **Generative Adversarial Networks (GAN)**.

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THE NEURAL NETWORK ZOO, www.asimovinstitute.org/neural-network-zoo/

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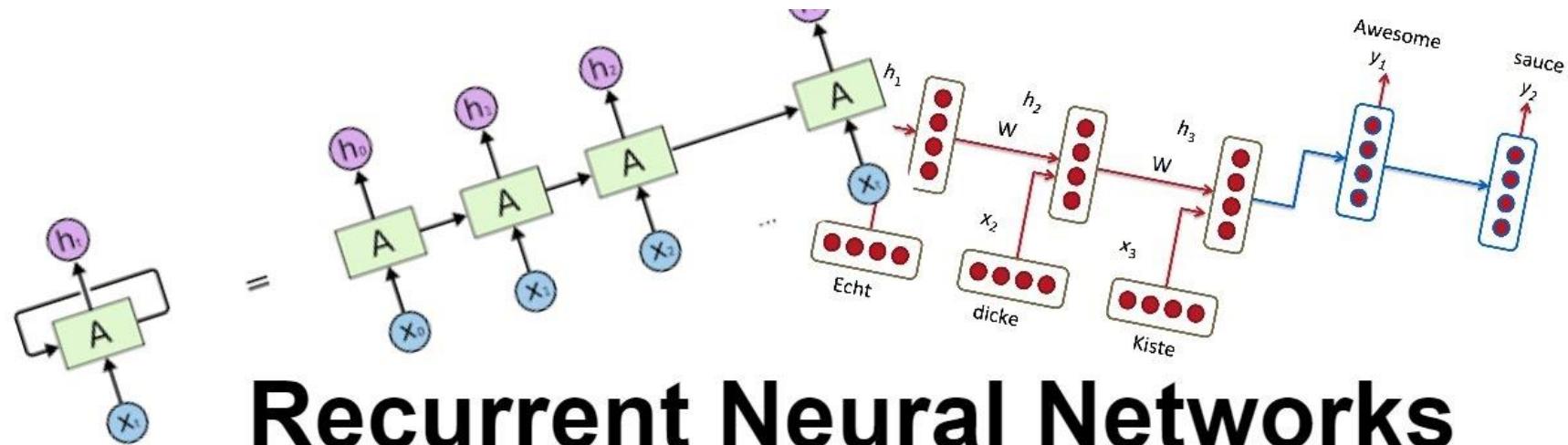
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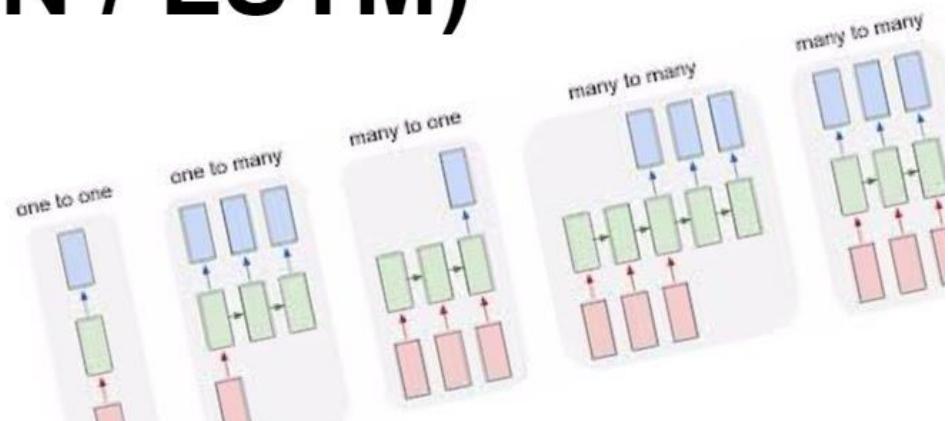
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8 Machine Learning II

- ML in Natural Language Processing (NLP) (3) RNN & LSTM Networks



Recurrent Neural Networks (RNN / LSTM)



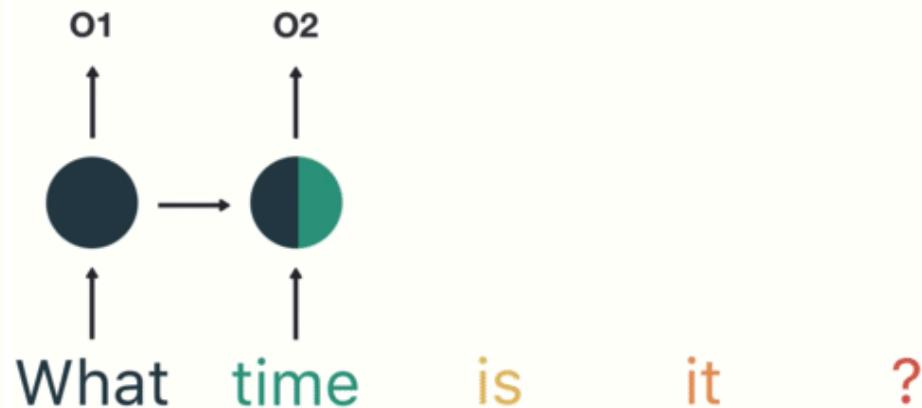
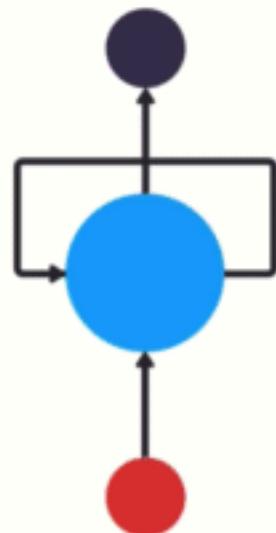
Recurrent Neural Networks (RNN)

Textanalyse mit einem RNN (Beispiel)

Output

Neuron

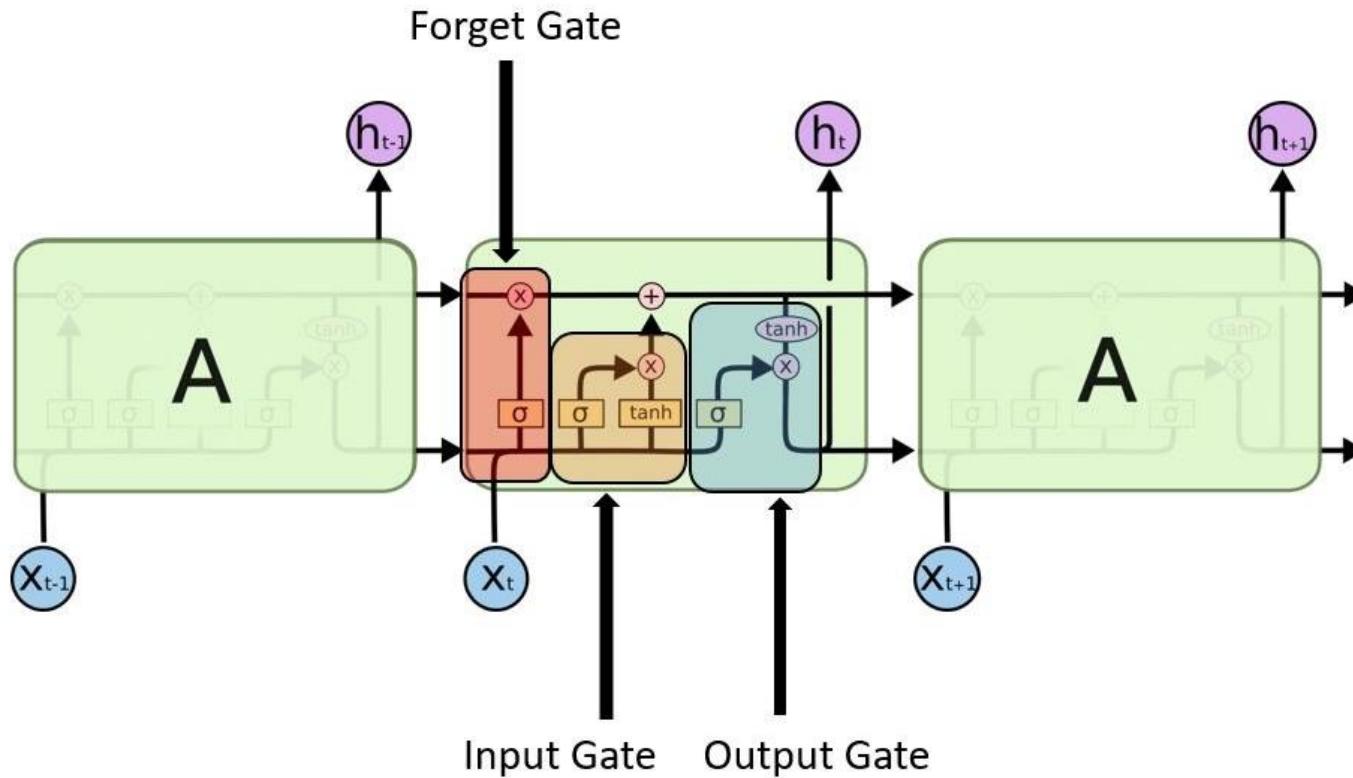
Input



Neuronen in RNNs haben jeweils einen Speicher (Internal Memory / Hidden State).

RNNs eignen sich gut für **kurzfristige Erinnerungen**,
weniger gut für **langfristige Erinnerungen** (Vanishing Gradient Problem).

Kernidee Long-Short Term Memory (LSTM)



LSTMs haben im Gegensatz zu RNN ein **Kurzzeit-** und ein **Langzeitgedächtnis**.

Ein **LSTM** enthält drei sogenannte **Gates**.

Das **Forget Gate** steuert, was **vergessen** werden soll.

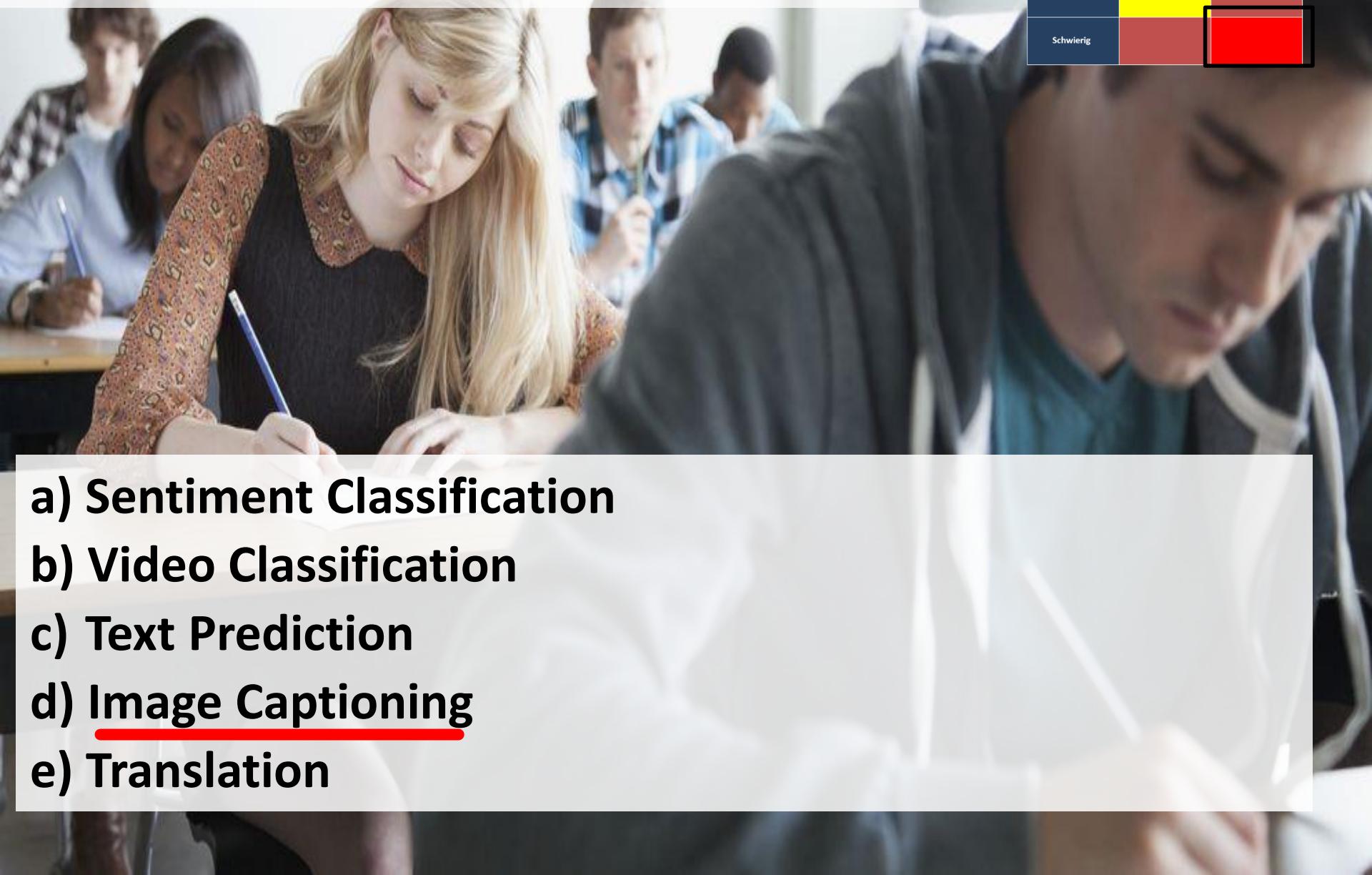
Das **Input Gate** bearbeitet, was **gemerkt** werden soll.

Das **Output Gate** steuert, was **weitergegeben** werden soll.

Es gibt auch **Gated Recurrent Units (GRUs)**.

Which Application is an Example of One-To-Many in RNN Structure?

Schwierigkeitsgrad	Art des Wissens	Abfragewissen (Vorlesung)	Anwendungswissen (Literatur)
Einfach		Green	Yellow
Mittel		Yellow	Red
Schwierig		Red	Red

- 
- A photograph showing several students in a classroom setting, focused on writing in their notebooks. This visual metaphor represents the "many" outputs of an RNN, where each student's response is a separate output from the model.
- a) Sentiment Classification
 - b) Video Classification
 - c) Text Prediction
 - d) Image Captioning
 - e) Translation

Experimente & Demos mit Machine Learning

The screenshot shows the homepage of magenta.tensorflow.org. At the top, there's a navigation bar with links to Get Started, Studio, Demos, Blog, Research, Talks, and Community. Below the navigation is a large section titled "Make Music and Art Using Machine Learning". It features two buttons: "Get Started" and "Try the Demos". On the left, under "WHAT IS MAGENTA?", there's a brief description: "An open source research project exploring the role of machine learning as a tool in the creative process." To the right, there are three main demo sections: "Sorting" (a game where you sort melodies), "Magic Sketchpad" (a doodle completion tool), and "Piano Genie" (a piano transcription tool). Each demo has a small image, a title, and a brief description.

magenta.tensorflow.org

Get Started Studio Demos Blog Research Talks Community

magenta

Make Music and Art Using Machine Learning

Get Started Try the Demos

WHAT IS MAGENTA?

An open source research project exploring the role of machine learning as a tool in the creative process.

Sorting

Vibert Thio vibertthio vibertthio
A web-based game based on interpolations of melodies with [MusicVAE](#). Listen to the music to find out the right order, or “sort” the song.

Magic Sketchpad

Monica Dinculescu notwaldorf notwaldorf
Every time you start drawing a doodle, Sketch RNN tries to finish it and match the category you've selected.

Piano Genie

Monica Dinculescu notwaldorf notwaldorf
Chris Donahue chrisdonahue chrisdonahue
Have some fun pretending you're a piano

Piano Scribe

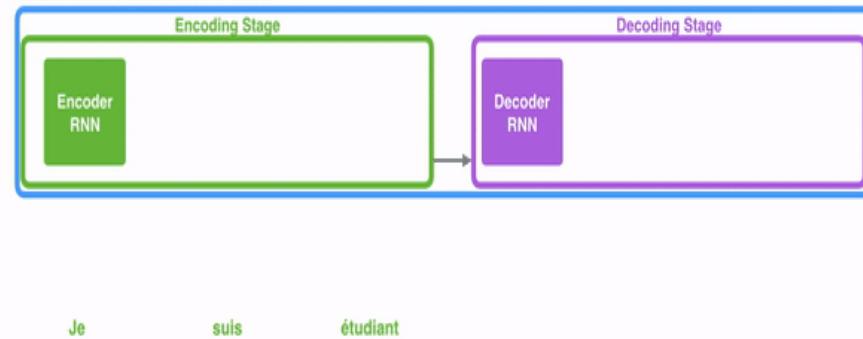
Converts raw audio to MIDI using [Onsets and Frames](#), a neural network trained for polyphonic piano transcription.

Make Music and Art Using Machine Learning
magenta.tensorflow.org/demos/web/

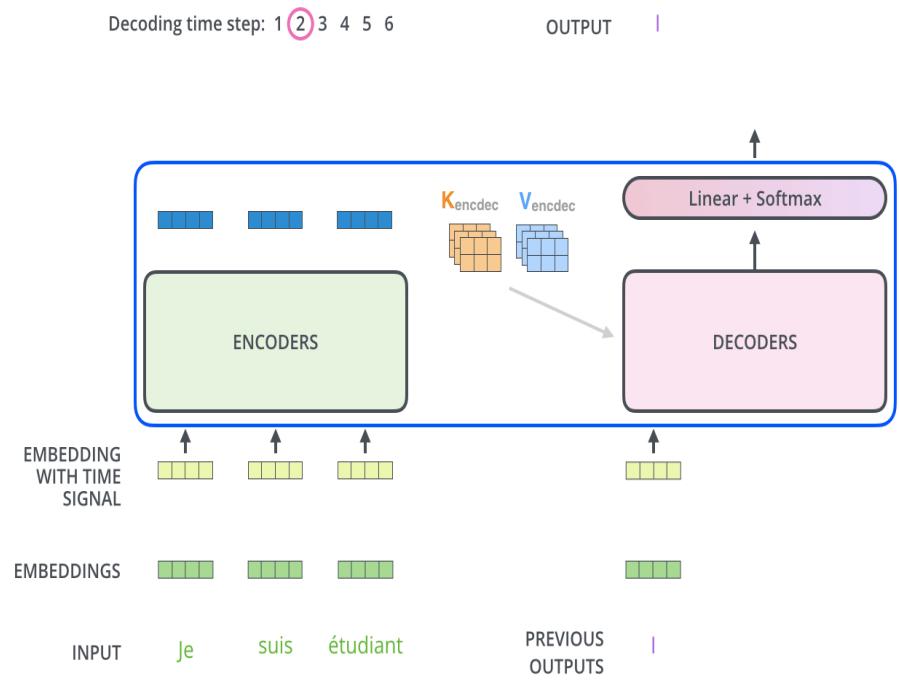
Transformer Networks vs RNN / LSTM

RNN & LSTM:

Neural Machine Translation
SEQUENCE TO SEQUENCE MODEL



Transformer:



8 Machine Learning II

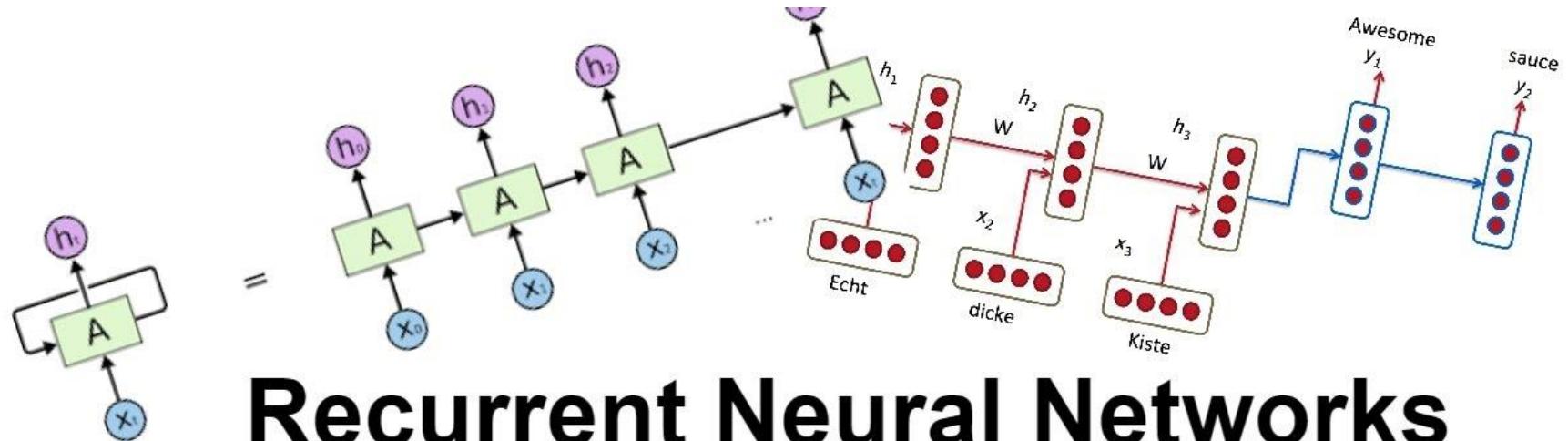
- ML in Natural Language Processing (NLP)

Content:

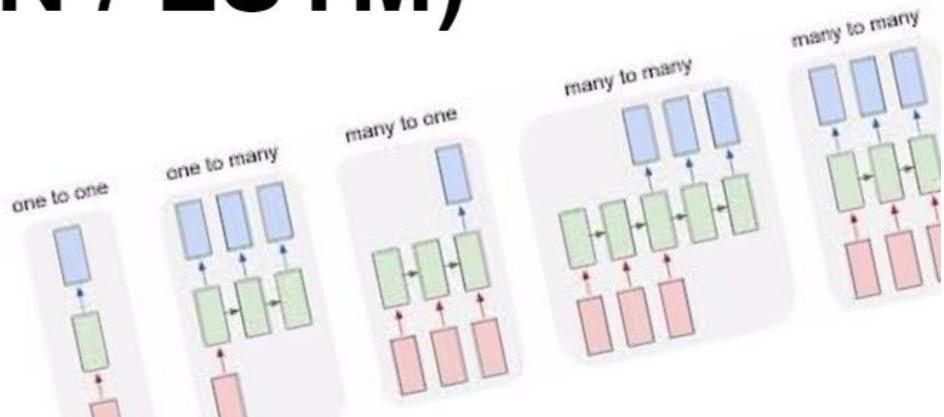
1. Motivation
2. IBM Watson
3. RNN & LSTM Networks
4. Transformer Models
5. Transformer BERT
6. Transformer GPT-3
7. Summary



3. RNN & LSTM Networks



Recurrent Neural Networks (RNN / LSTM)



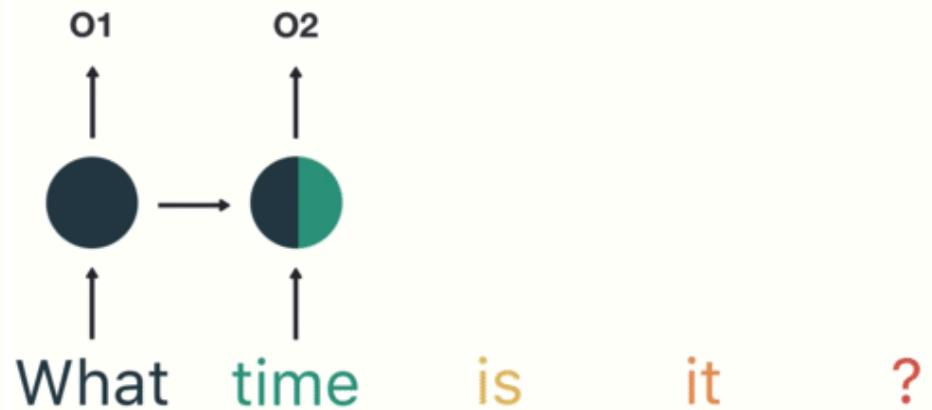
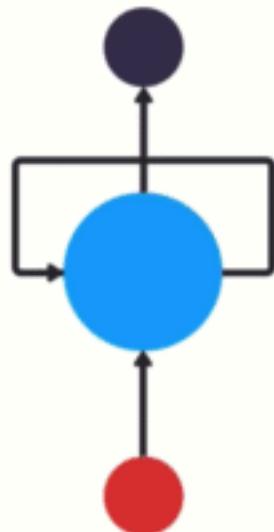
Recurrent Neural Networks (RNN)

Textanalyse mit einem RNN (Beispiel)

Output

Neuron

Input



Neuronen in RNNs haben jeweils einen Speicher (Internal Memory / Hidden State).

Es gibt verschiedene Arten von RNN-Netzen.

Illustrated Guide to Recurrent Neural Networks, 2018

towardsdatascience.com/illustrated-guide-to-recurrent-neural-networks-79e5eb8049c9

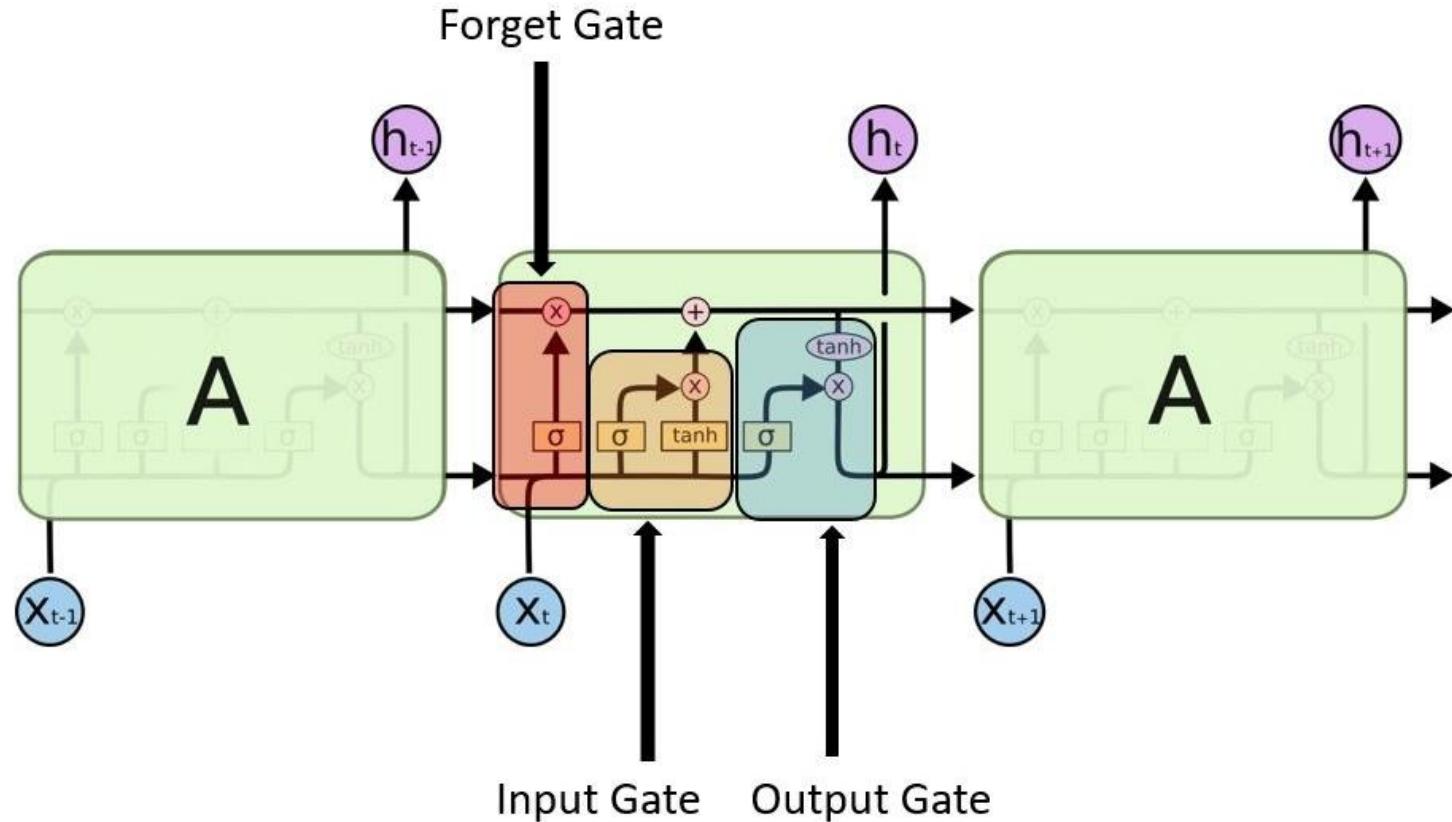
Michael Amberg

Todays Content:

- 1. Motivation**
- 2. IBM Watson**
- 3. RNN & LSTM Networks**
- 4. Transformer Models**
- 5. Transformer BERT**
- 6. Transformer GPT-3**
- 7. Summary**



Kernidee Long-Short Term Memory (LSTM)

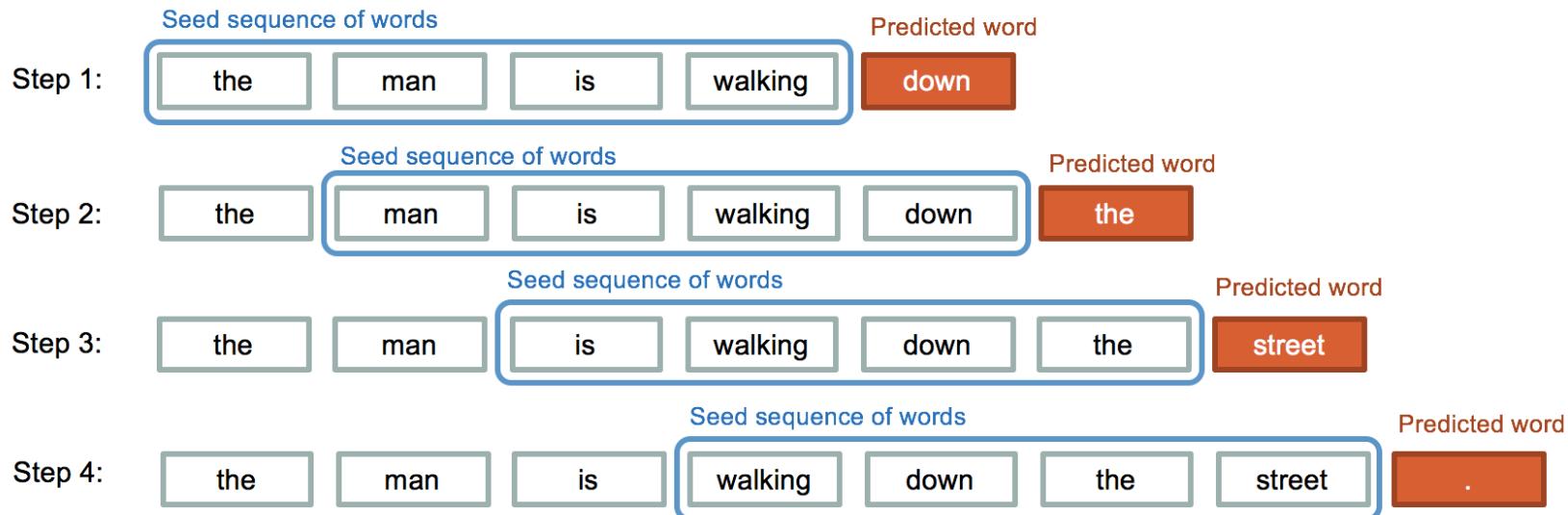


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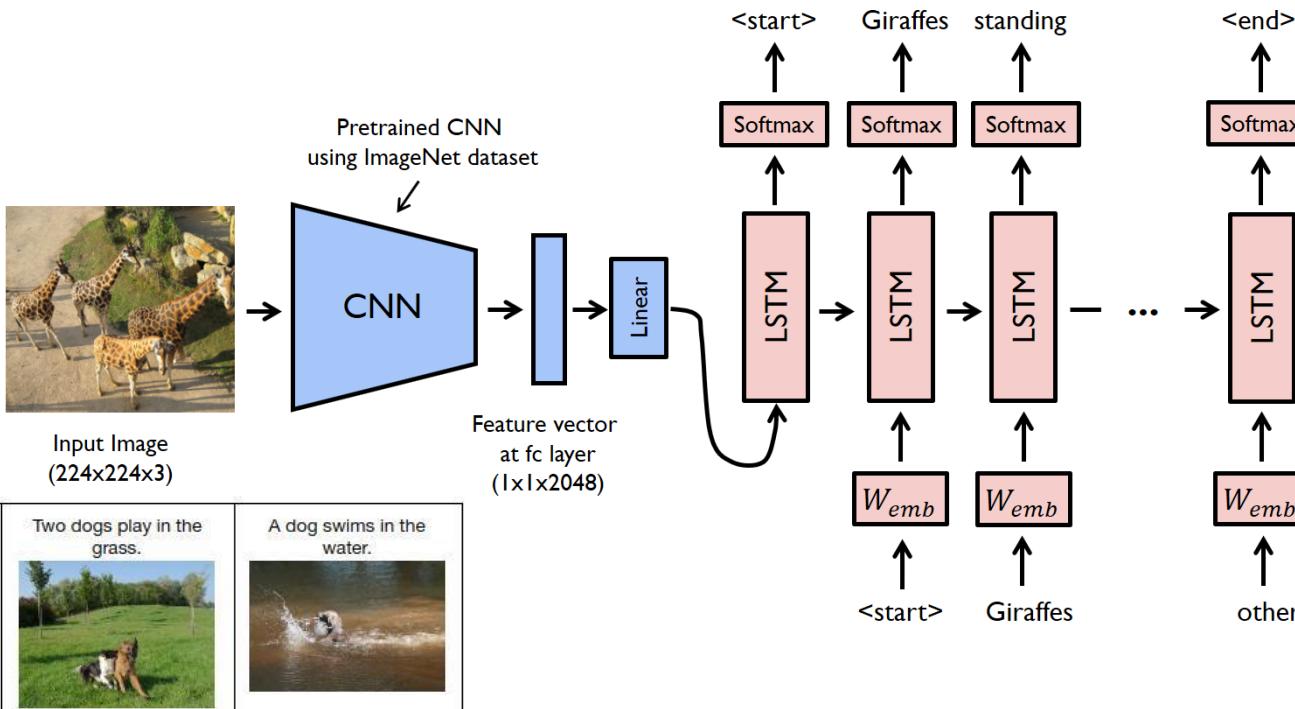
Es gibt verschiedene Arten von **LSTM-Architekturen**.

Textgenerierung mit RNN und LSTM



The **phrases** in **text** are nothing but **sequence of words**. So, LSTM can be used to **predict the next word**. The neural network take **sequence of words** as **input** and **output** will be a **matrix of probability** for **each word** from **dictionary** to be next of given sequence. The model will also learn how much **similarity** is between each words or characters and will calculate the probability of each. Using that we will **predict** or **generate next word** or character of sequence.

Kombinierter Einsatz von RNN und LSTM



RNN und LSTM können auch mit **Feed-Forward-Netze** (z.B. **Convolutional Neural Networks**) kombiniert werden. Sie bringen damit „Memory“ hinein.

Anwendungen sind z.B.:
Textuelle Beschreibung von Bildern (**Image Captioning**) oder Automatische Generierung von Untertiteln (**Video Captioning**).

Sketch-RNN Demos

A Neural Representation of Sketch Drawings

David Ha
Google Brain
hadavid@google.com

Douglas Eck
Google Brain
deck@google.com

Abstract

We present sketch-rnn, a recurrent neural network (RNN) able to construct stroke-based drawings of common objects. The model is trained on a dataset of human-drawn images representing many different classes. We outline a framework for conditional and unconditional sketch generation, and describe new robust training methods for generating coherent sketch drawings in a vector format.

1 Introduction

Recently, there have been major advancements in generative models for image synthesis. Variational Autoencoders (VAE) [15], and Autoregressive (AR) [19] models have been proposed to generate images from latent variables. Most of the work thus far has been targeted towards modeling images as grids of pixels. However, we do not understand the world as a grid of pixels; we represent what we see. From a young age, we develop our understanding of the world by drawing on paper with a pencil or crayon. In this work, we propose a new way of representing an image as a short sequence of strokes, similar to traditional pixel image modelling approaches, and propose

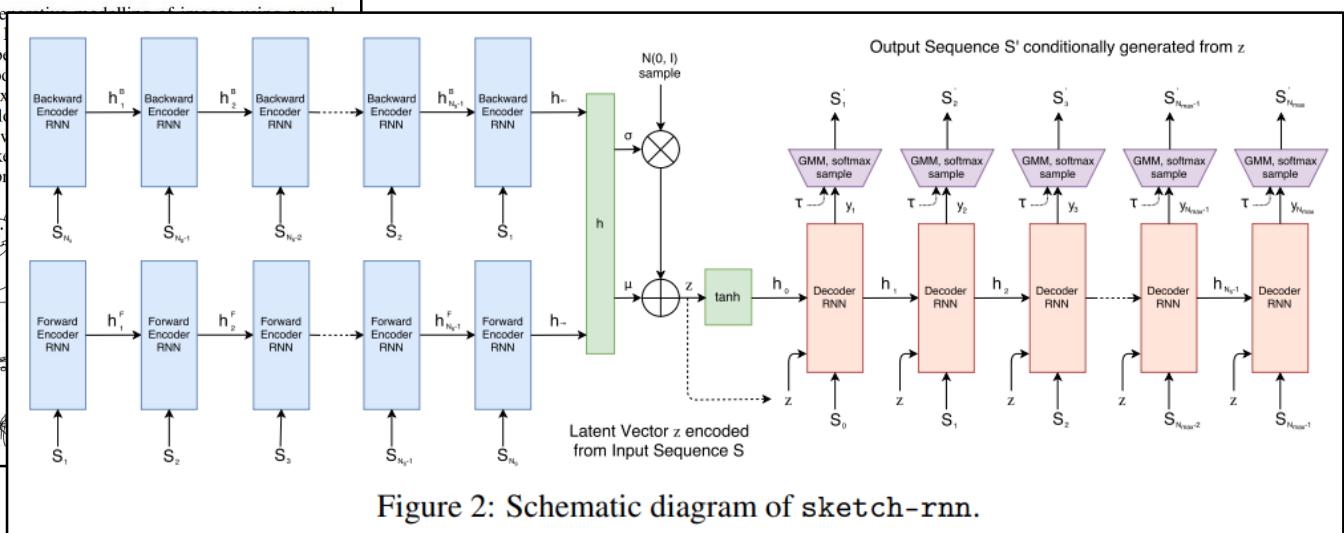
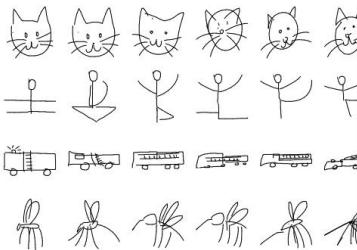


Figure 2: Schematic diagram of sketch-rnn.

Generierung von Musik mit RNN und LSTM

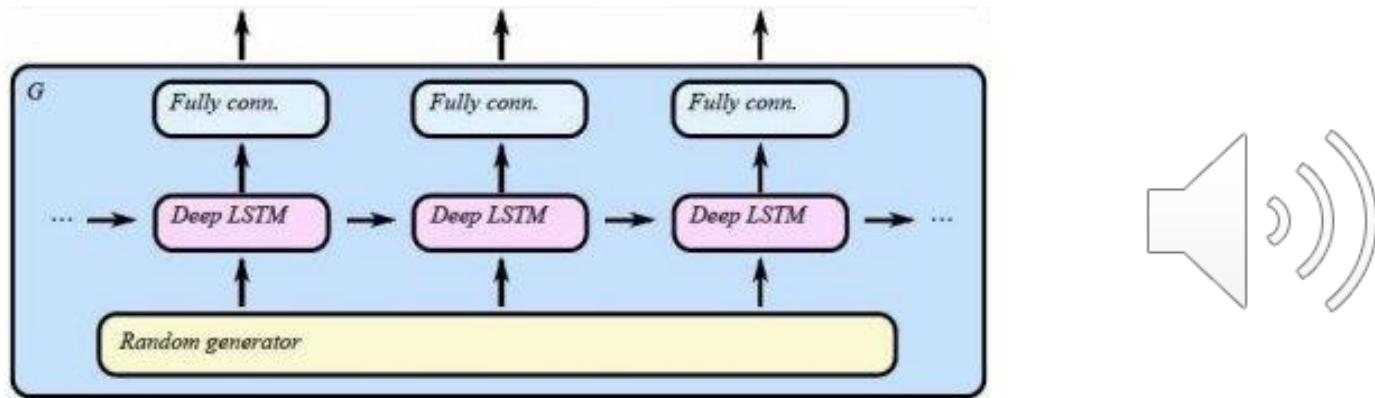


Fig. 7.27 C-RNN-GAN architecture.



Fig. 7.28 C-RNN-GAN generated examples.

Musik ist auch eine Sequenz (Sequence). Mit RNN und LSTMs kann man Musik generieren.

RNN & LSTM Summary: Sequence to Sequence

