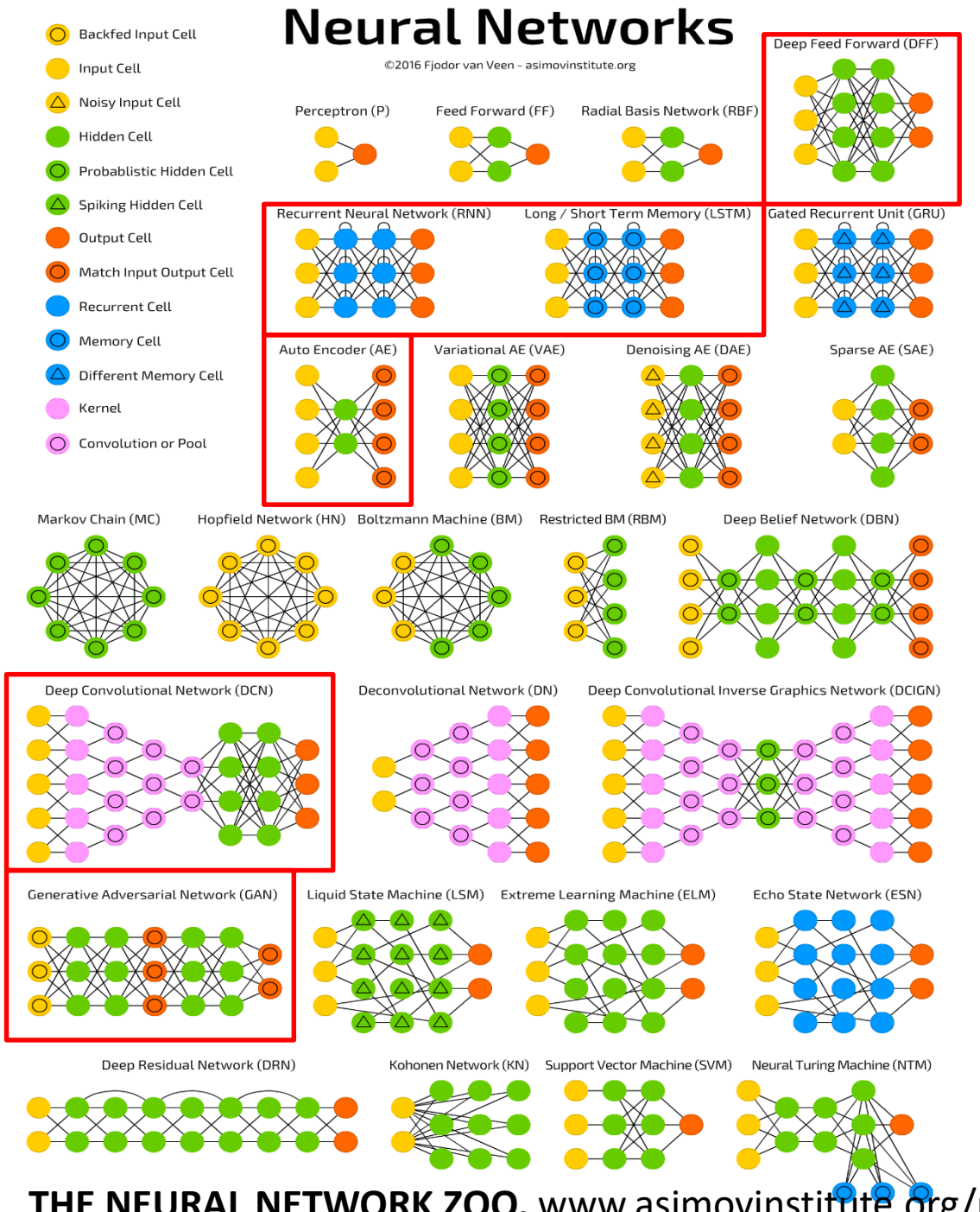


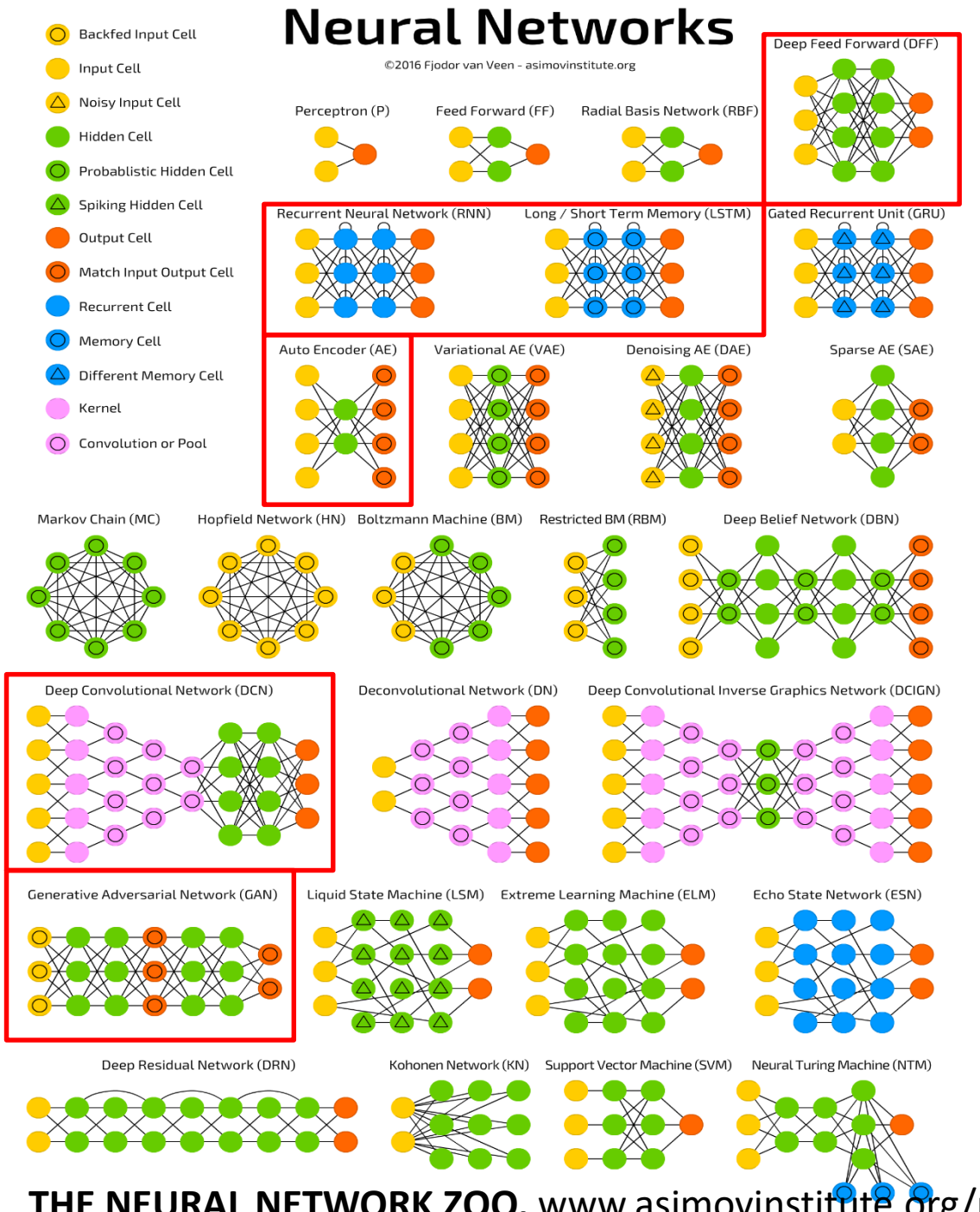
Neuronale Netze stellen einen zentralen **Baustein** für **Deep Learning** dar.

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 Adverserial Networks (GAN)**.

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



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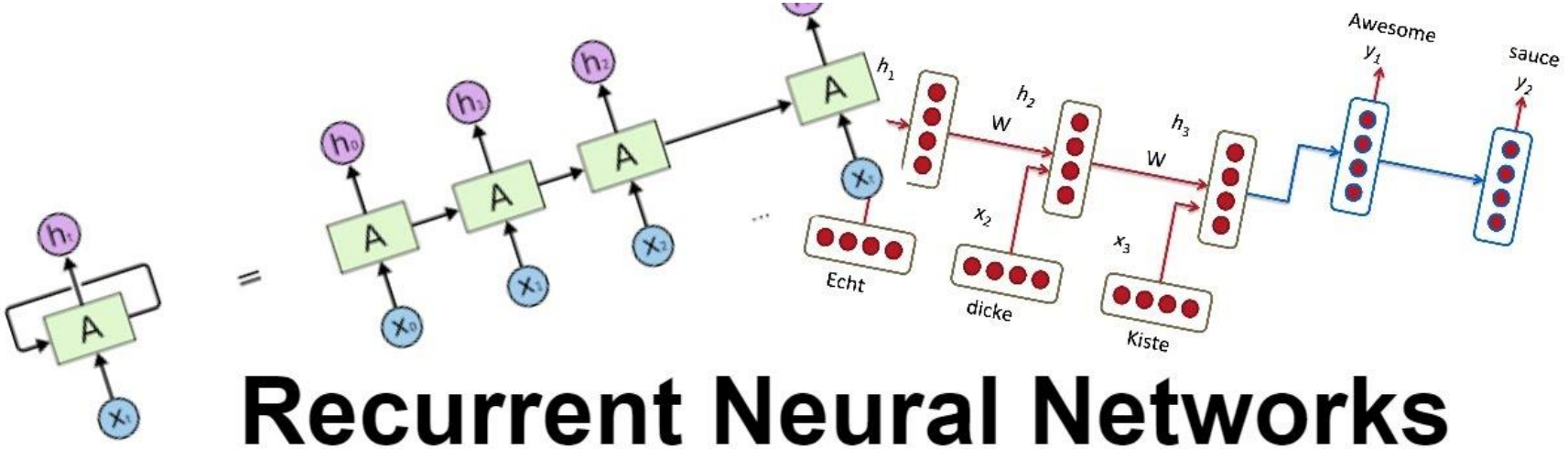
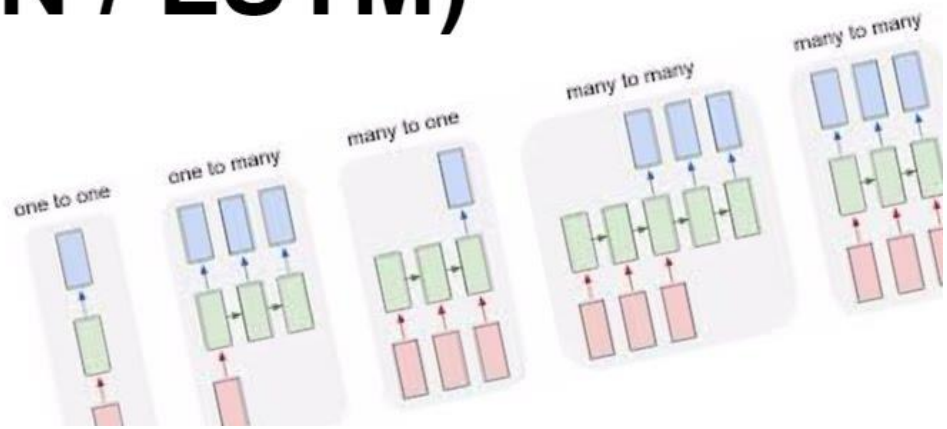
THE NEURAL NETWORK ZOO, www.asimovinstitute.org/neural-network-zoo/

8 Machine Learning II
- ML in Natural Language Processing (NLP)
(3) RNN & LSTM Networks



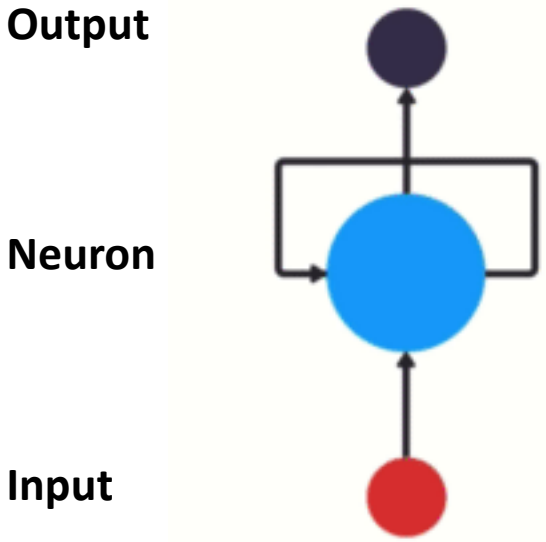
Recurrent Neural Networks

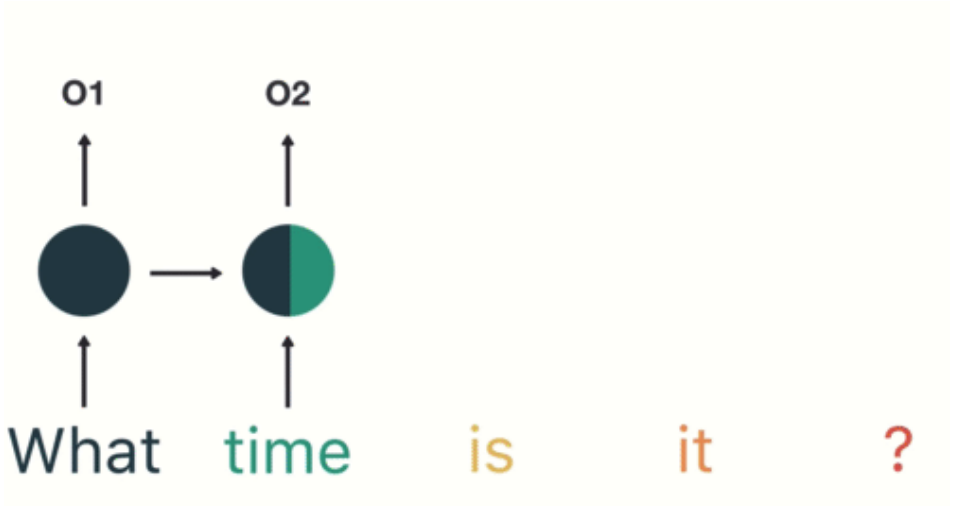
(RNN / LSTM)



Recurrent Neural Networks (RNN)

Textanalyse mit einem **RNN** (Beispiel)



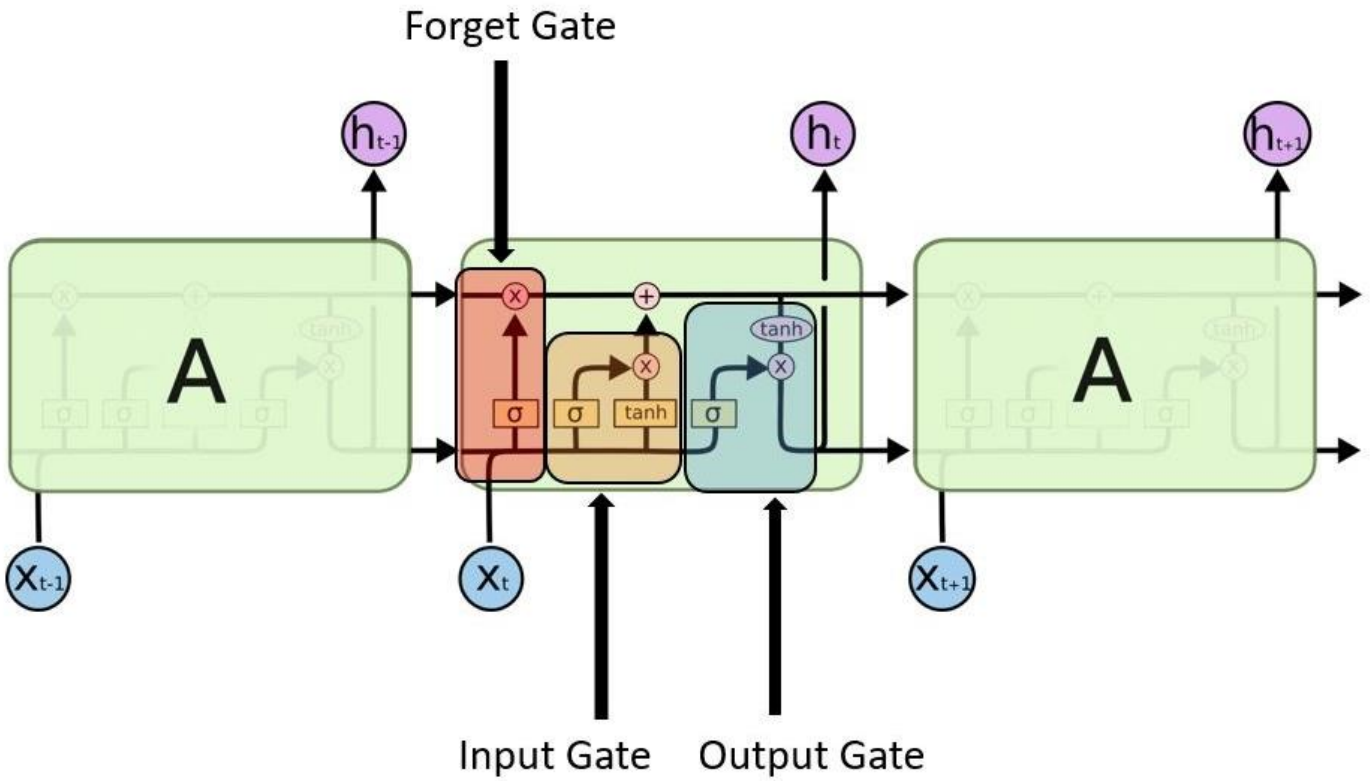


Neuronen in **RNNs** haben jeweils einen **Speicher (Internal Memory / Hidden State).**

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

Illustrated Guide to Recurrent Neural Networks, 2018
towardsdatascience.com/illustrated-guide-to-recurrent-neural-networks-79e5eb8049c9

Kernidee Long-Short Term Memory (LSTM)

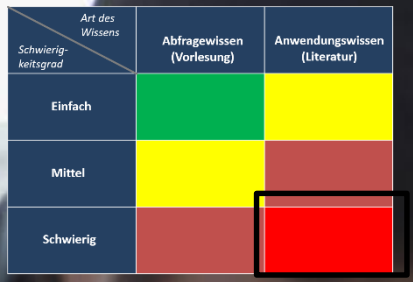


LSTMs haben im Gegensatz zu **RNN** ein **Kurzzeit-** und ein **Langzeitgedächtnis**.

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.

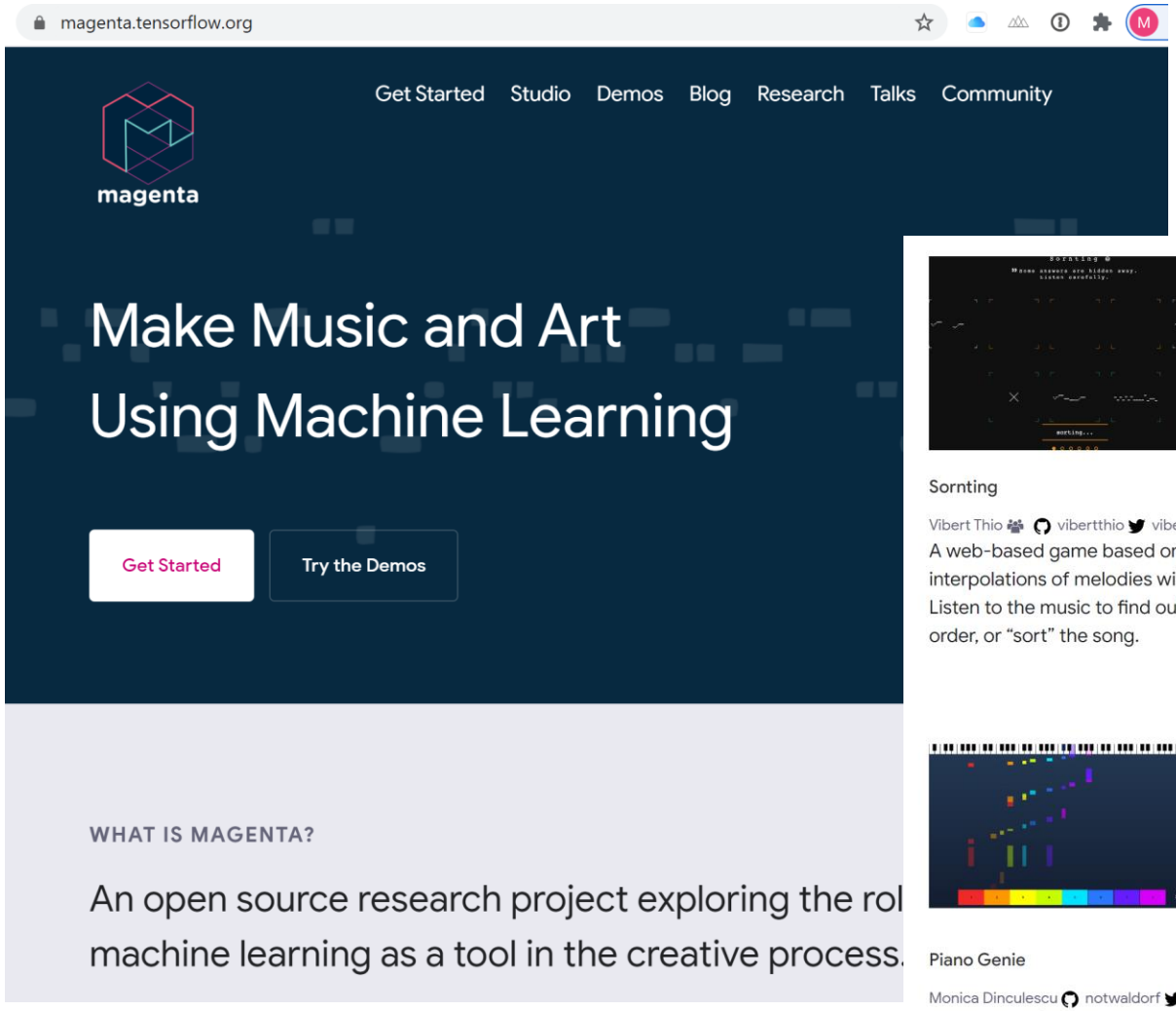
Es gibt auch **Gated Recurrent Units** (GRUs).

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



a) Sentiment Classification
b) Video Classification
c) Text Prediction
d) Image Captioning
e) Translation

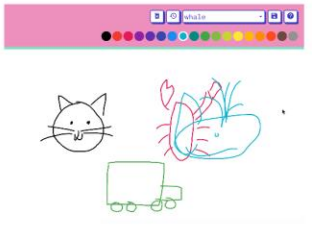
Experimente & Demos mit Machine Learning



Sornting

Vibert Thio viberthio viberthio

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 chrisdonahuey

Have some fun pretending you're a piano

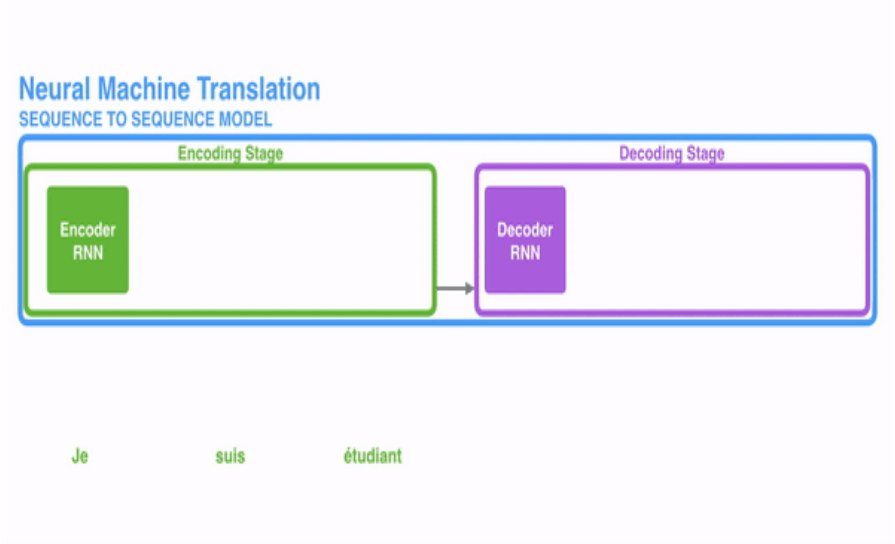
Piano Scribe

Converts raw audio to MIDI using Onsets and Frames, a neural network trained for polyphonic piano transcription.

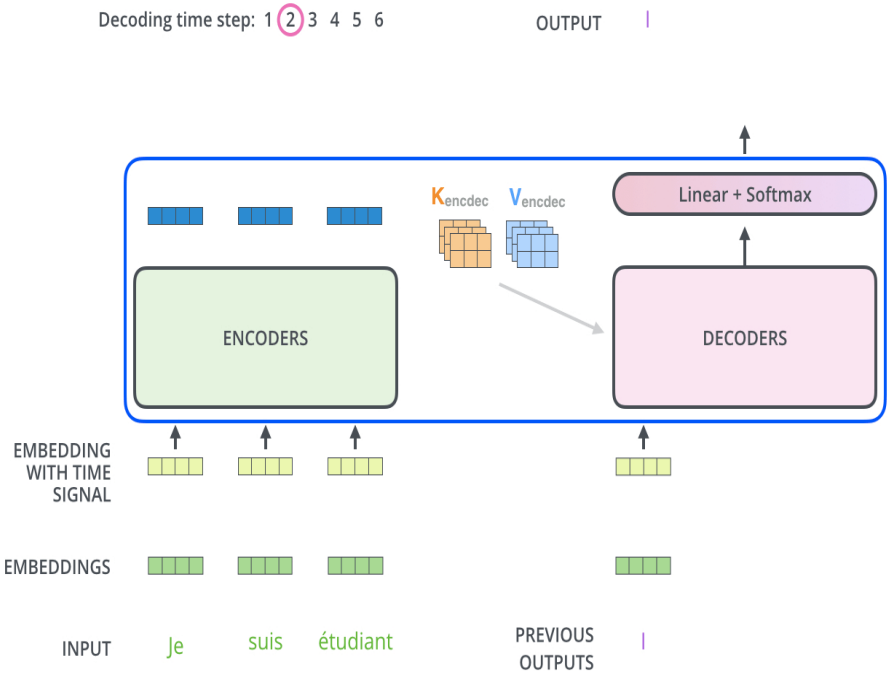
Make Music and Art Using Machine Learning
magenta.tensorflow.org/demos/web/

Transformer Networks vs RNN / LSTM

RNN & LSTM:

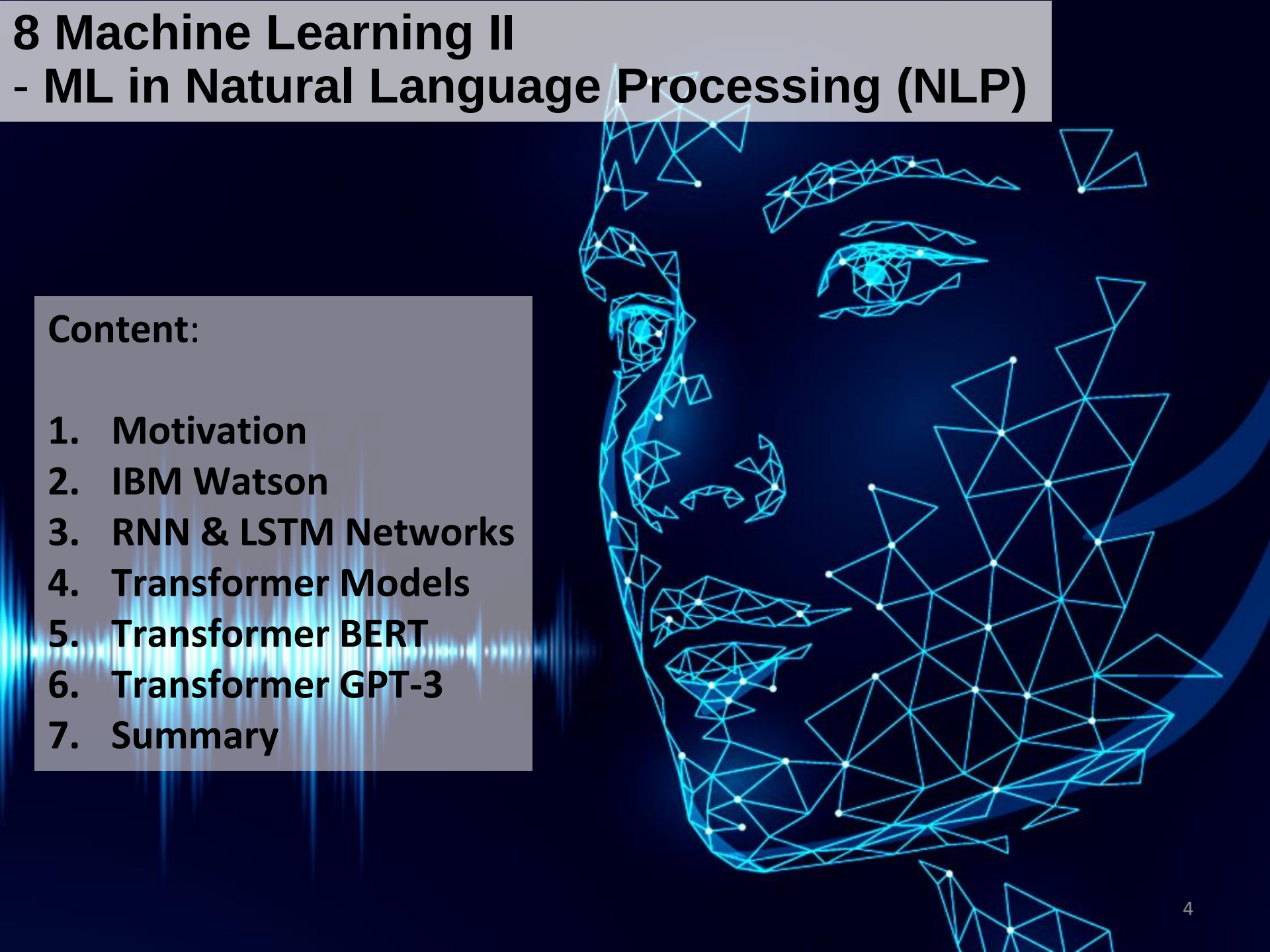


Transformer:



The Illustrated Transformer,
jalammar.github.io/illustrated-transformer/

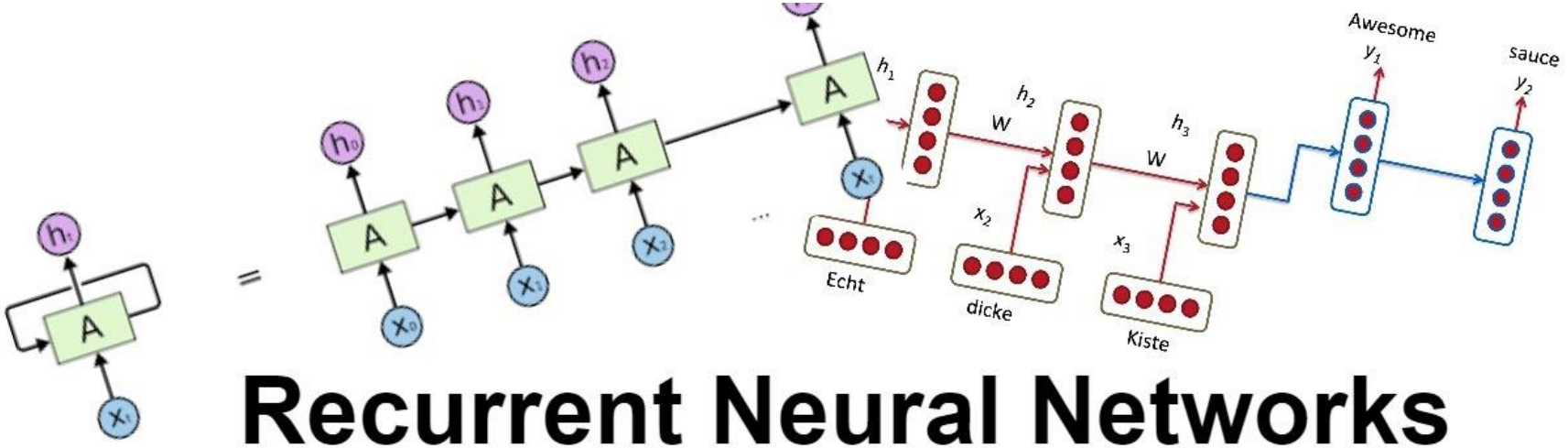
8 Machine Learning II
- ML in Natural Language Processing (NLP)



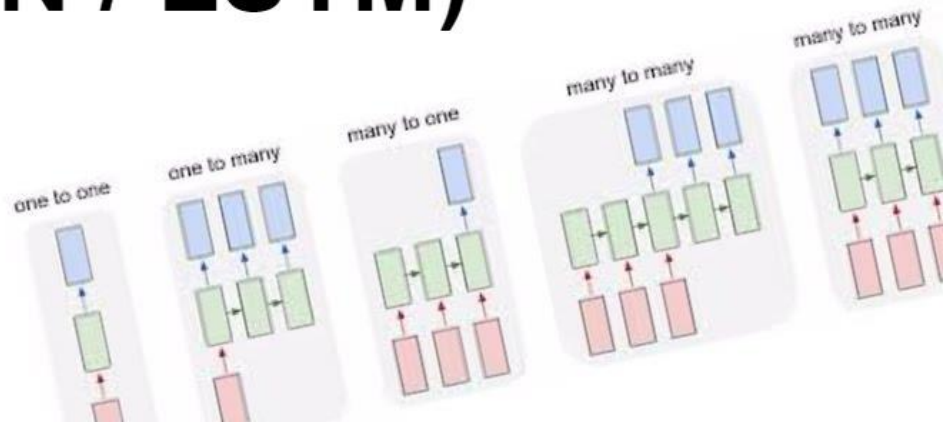
Content:

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

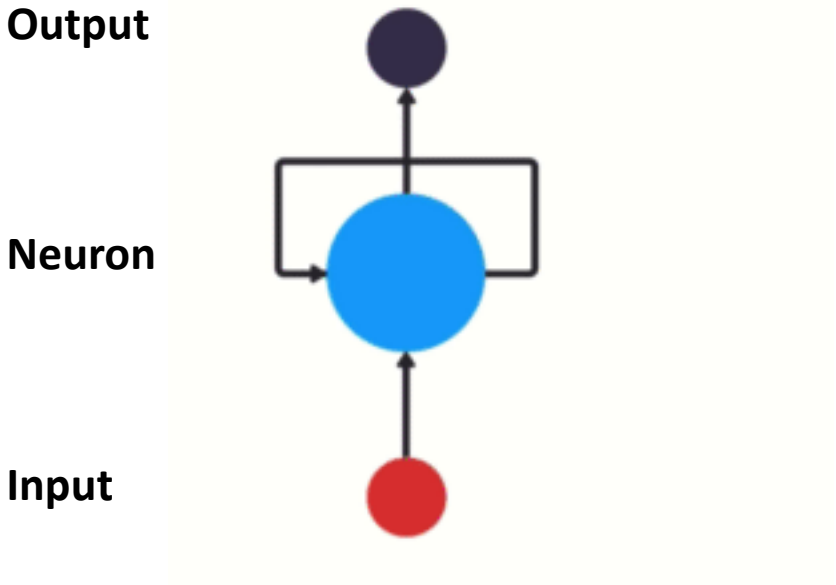


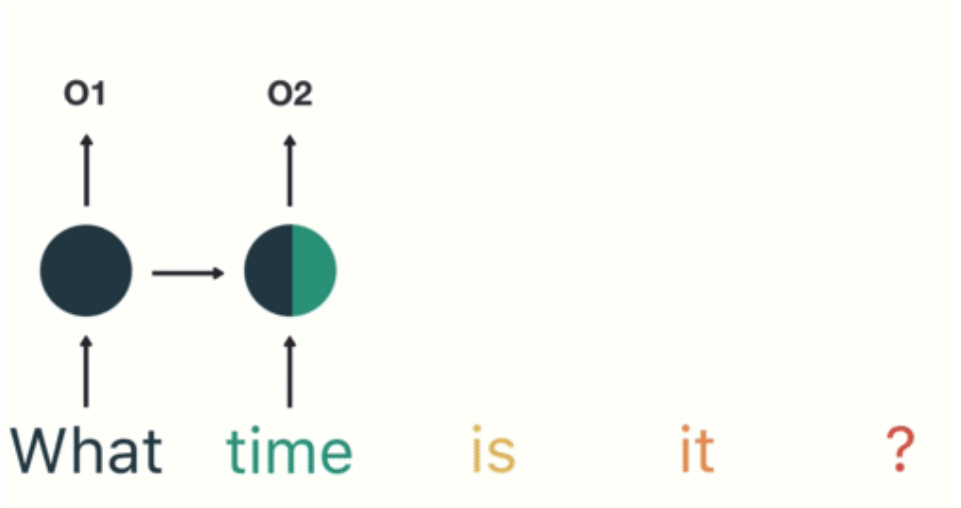
Recurrent Neural Networks (RNN / LSTM)



Recurrent Neural Networks (RNN)

Textanalyse mit einem **RNN** (Beispiel)





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**
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5. **Transformer BERT**
6. **Transformer GPT-3**
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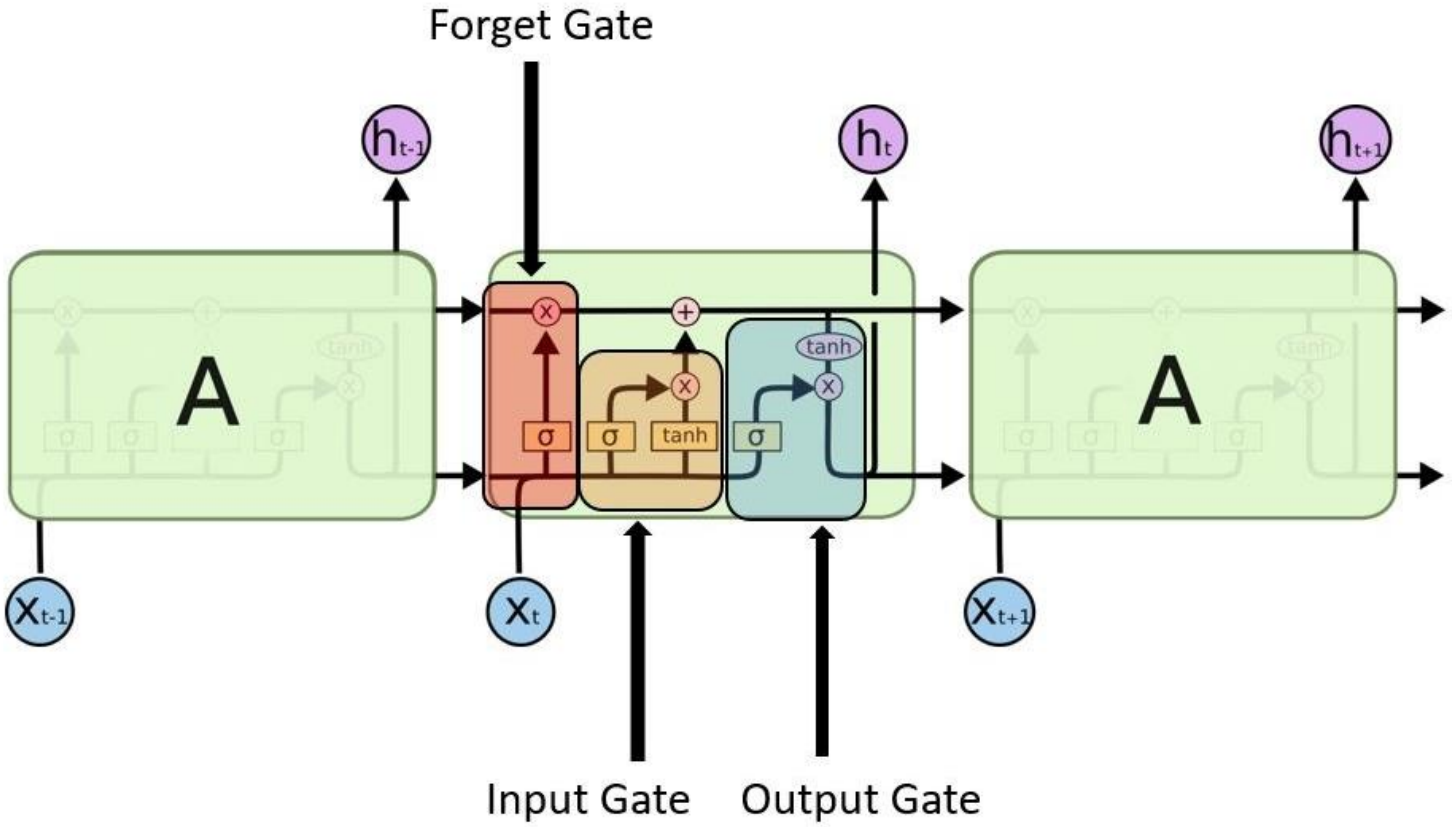
Kernidee Long-Short Term Memory (LSTM)



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

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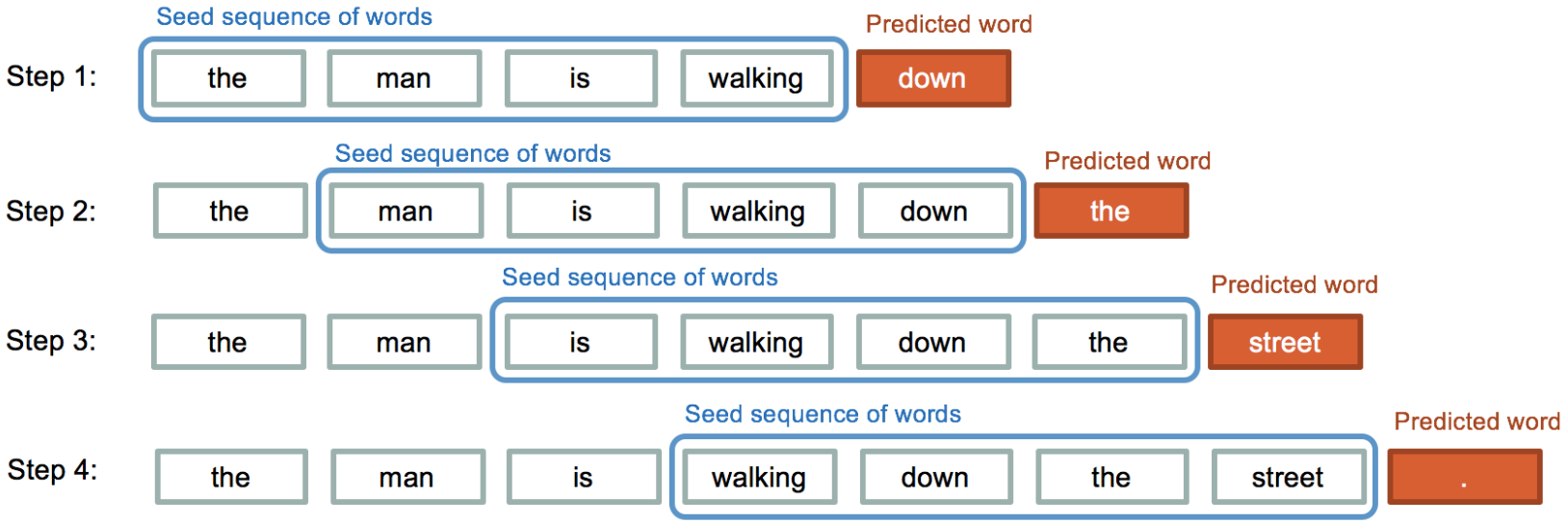
Es gibt verschiedene Arten von **LSTM-Architekturen**.

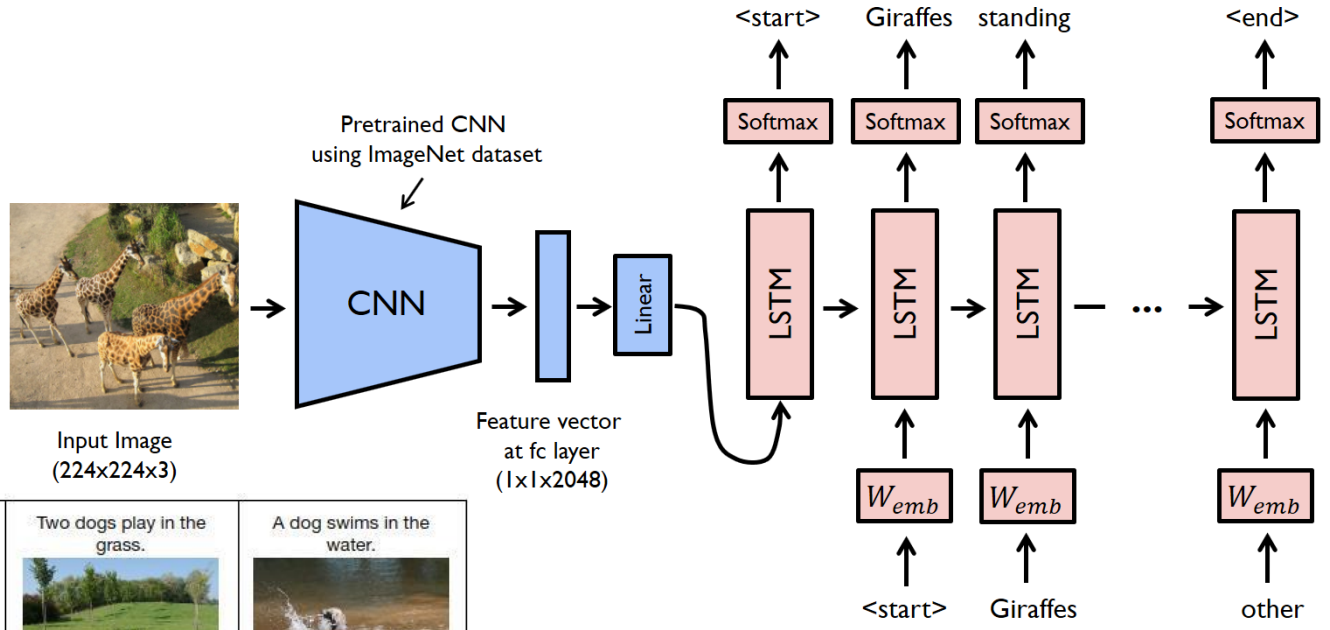
Textgenerierung mit RNN und LSTM



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.

Text Generation Using LSTM, 2020
bansalh944.medium.com/text-generation-using-lstm-b6ced8629b03

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

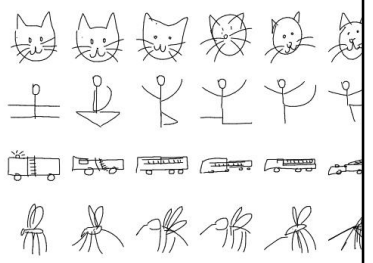
Douglas Eck
Google Brain
deck@google.com

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 ge
networks as a generative tool. Generative Adversarial
(VI) [15], and Autoregressive (AR) [19] models have b
Most of the work thus far has been targeted towards mo
however, do not understand the world as a grid of pix
represent what we see. From a young age, we develo
by drawing on paper with a pencil or crayon. In this
representation of an image as a short sequence of stroke
to traditional pixel image modelling approaches, and pr



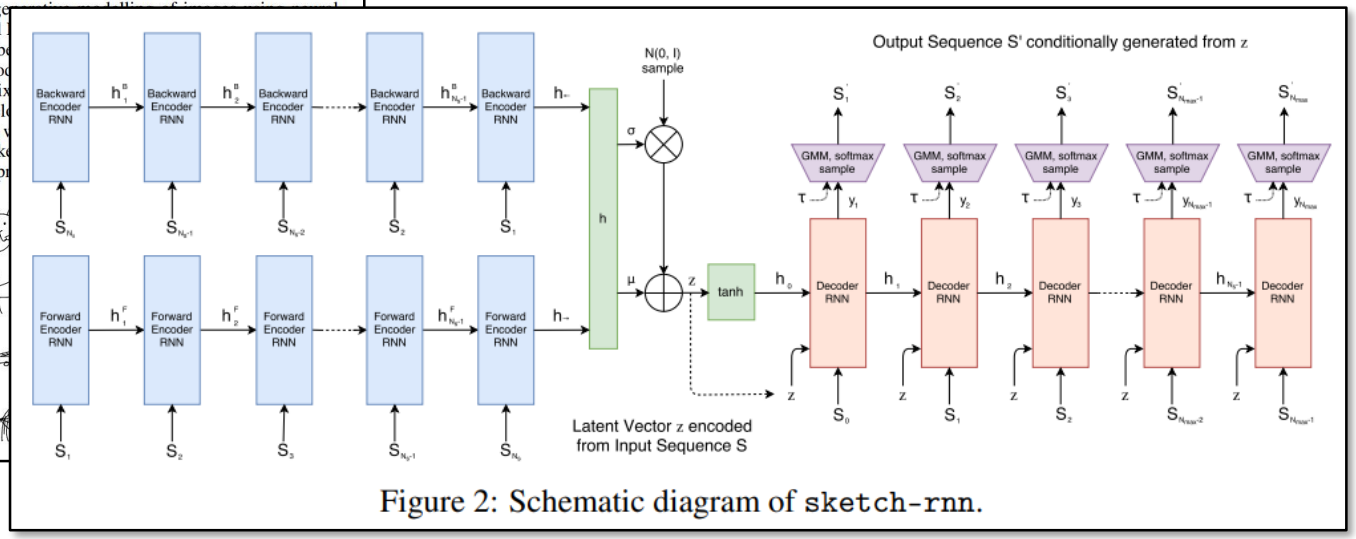


Figure 2: Schematic diagram of sketch-rnn.

A Neural Representation of Sketch Drawings, 2017
arxiv.org/pdf/1704.03477.pdf

Generierung von Musik mit RNN und LSTM

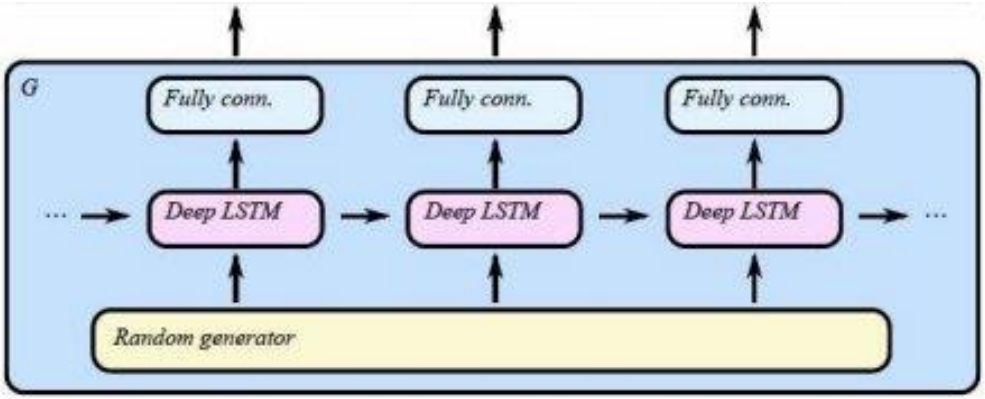


Fig. 7.27 C-RNN-GAN architecture.

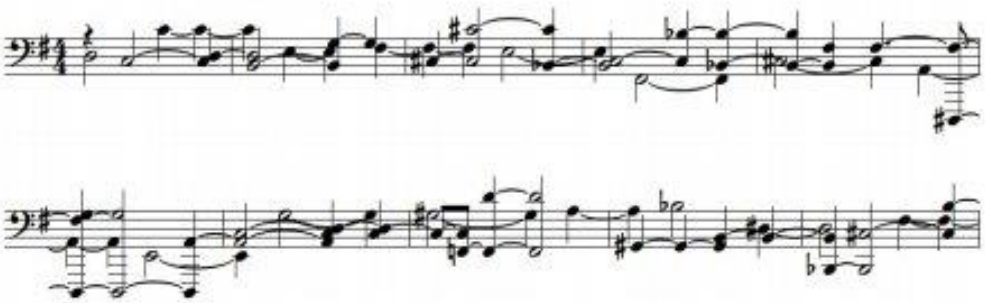


Fig. 7.28 C-RNN-GAN generated examples.

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

Music Composition using Recurrent Neural Networks
web.stanford.edu/class/archive/cs/cs224n/cs224n.1174/reports/2762076.pdf

RNN & LSTM Summary: Sequence to Sequence