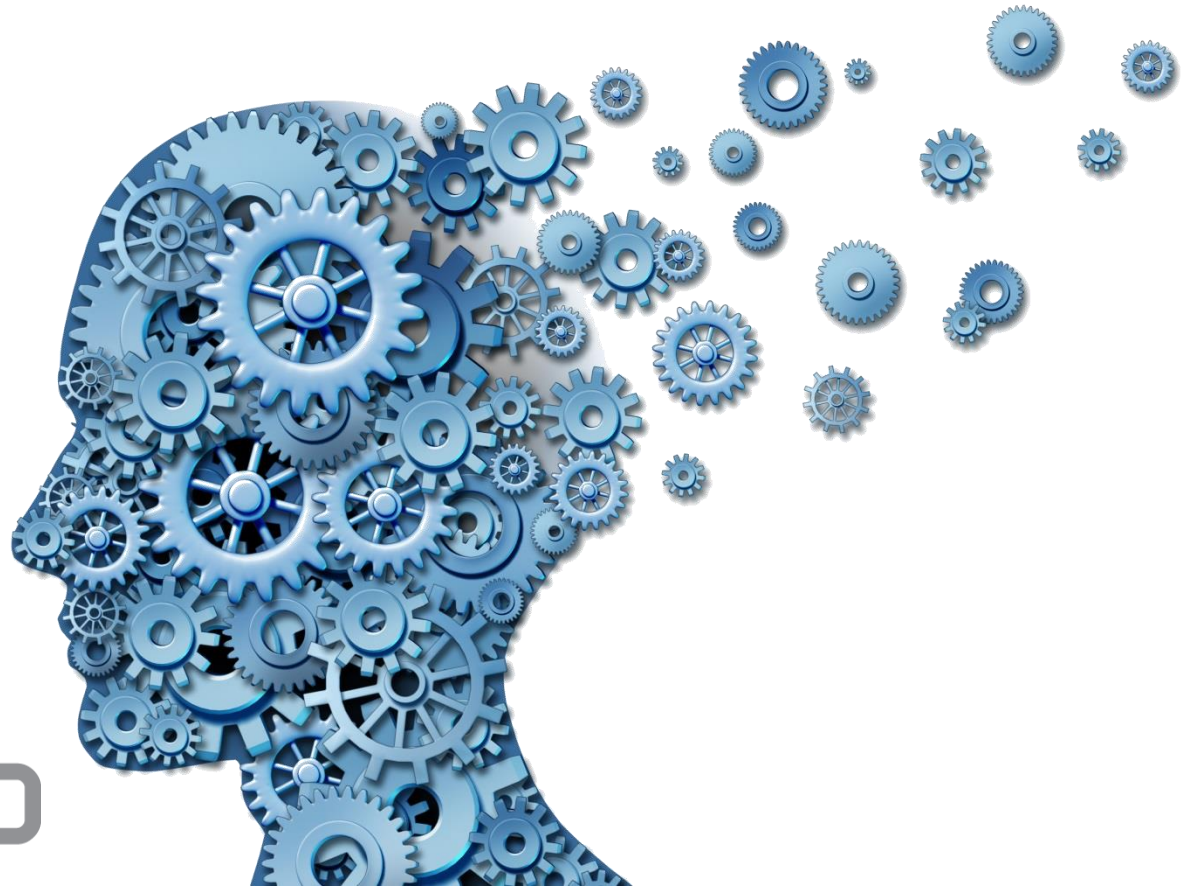
Zürcher Hochschule
für Angewandte Wissenschaften

Was kann Künstliche Intelligenz leisten?

Impulsreferat im CAS Digitale Technologien und Innovation, 02. März 2018

Thilo Stadelmann

Was ist KI?
Was gehört dazu?
Was geht heute schon?
Wie funktioniert das?
Was geht in Zukunft?



Swiss Alliance for Data-Intensive Services

swiss group for artificial intelligence and cognitive science

datalab
www.zhaw.ch/datalab

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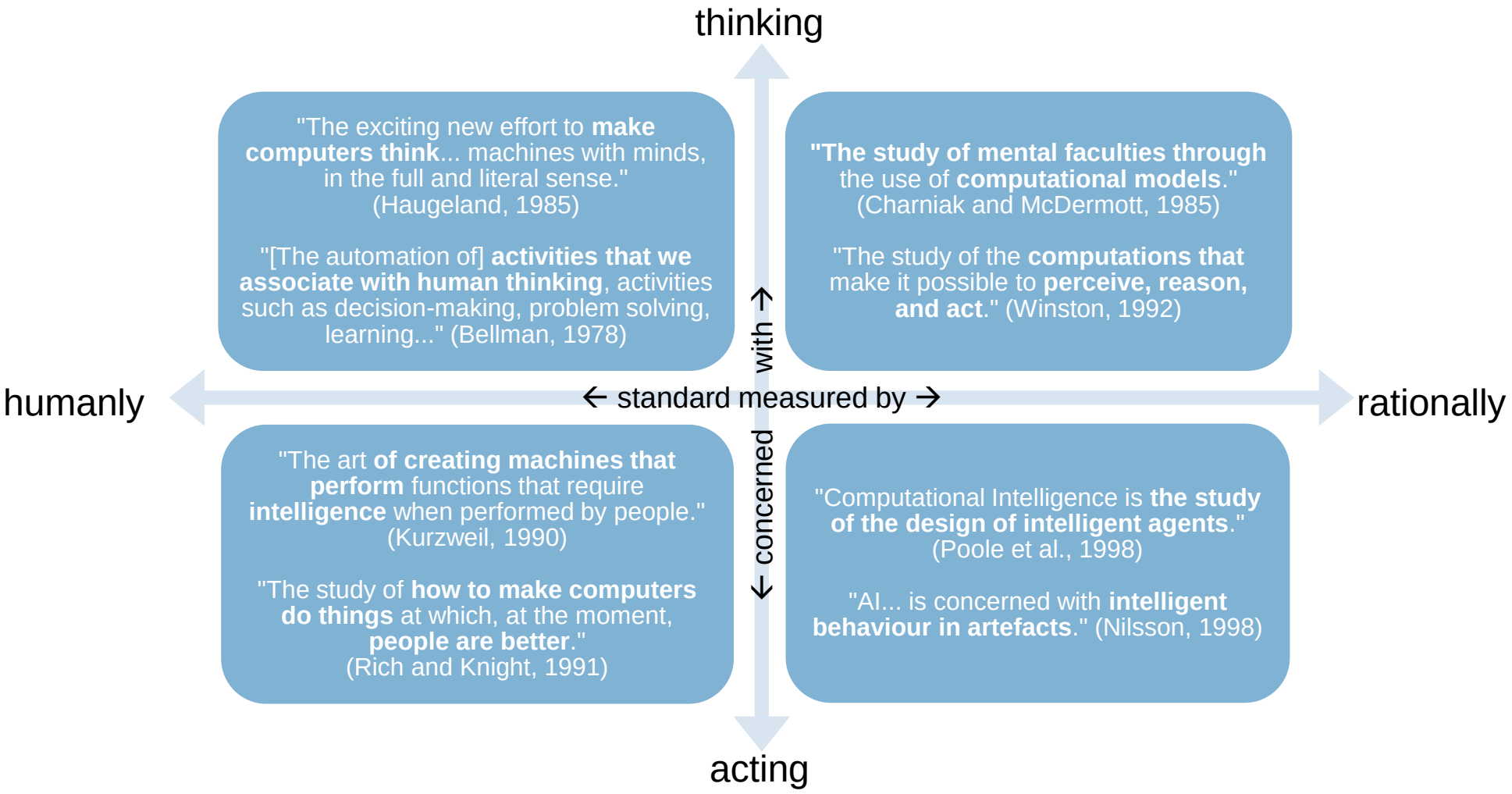

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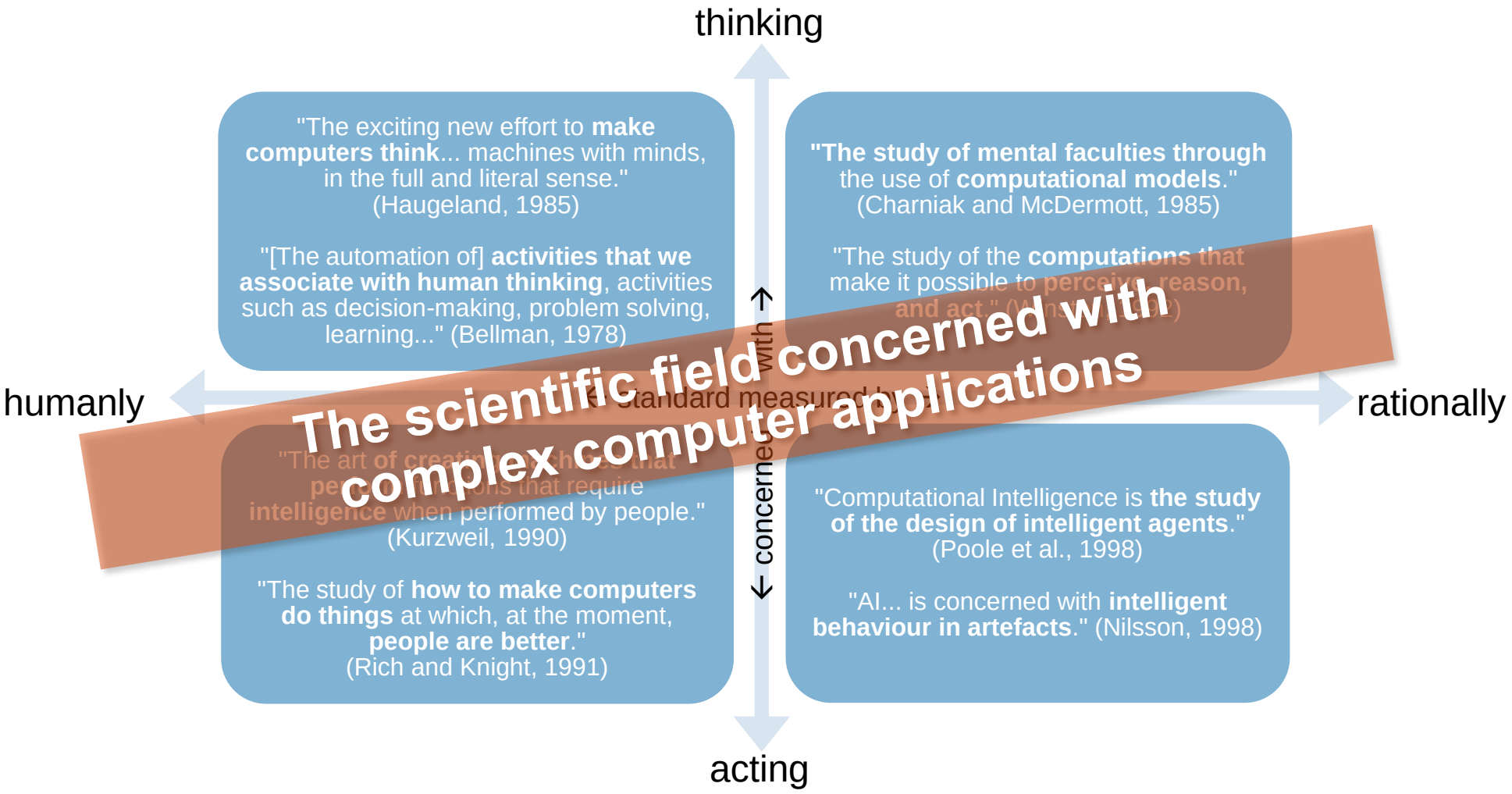
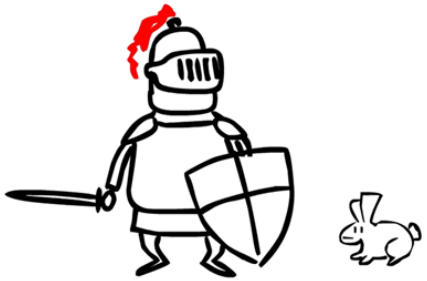
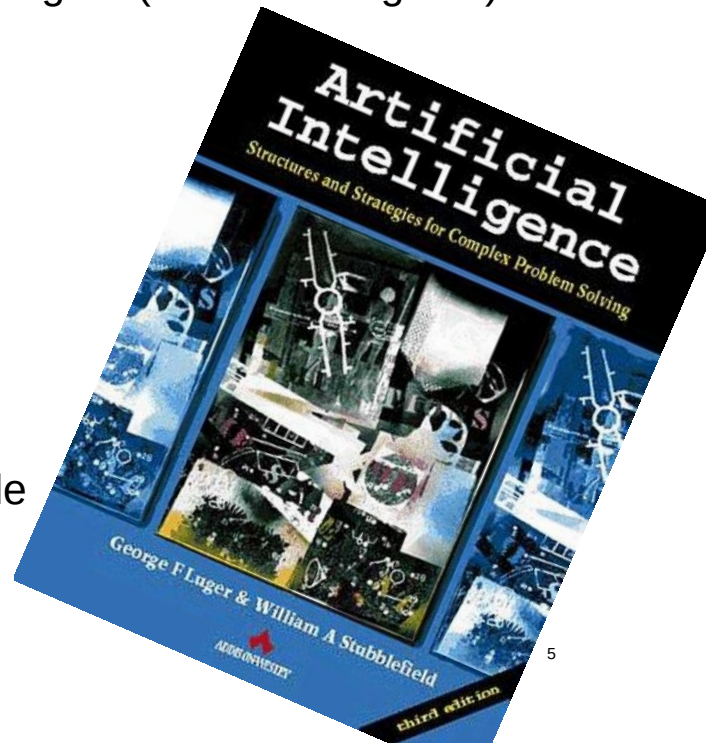


Pragmatisches Designparadigma: Rationale Agenten

Agents
- an **entity that perceives and acts**
- a **function from percept** histories **to actions** $f: P^* \rightarrow A$

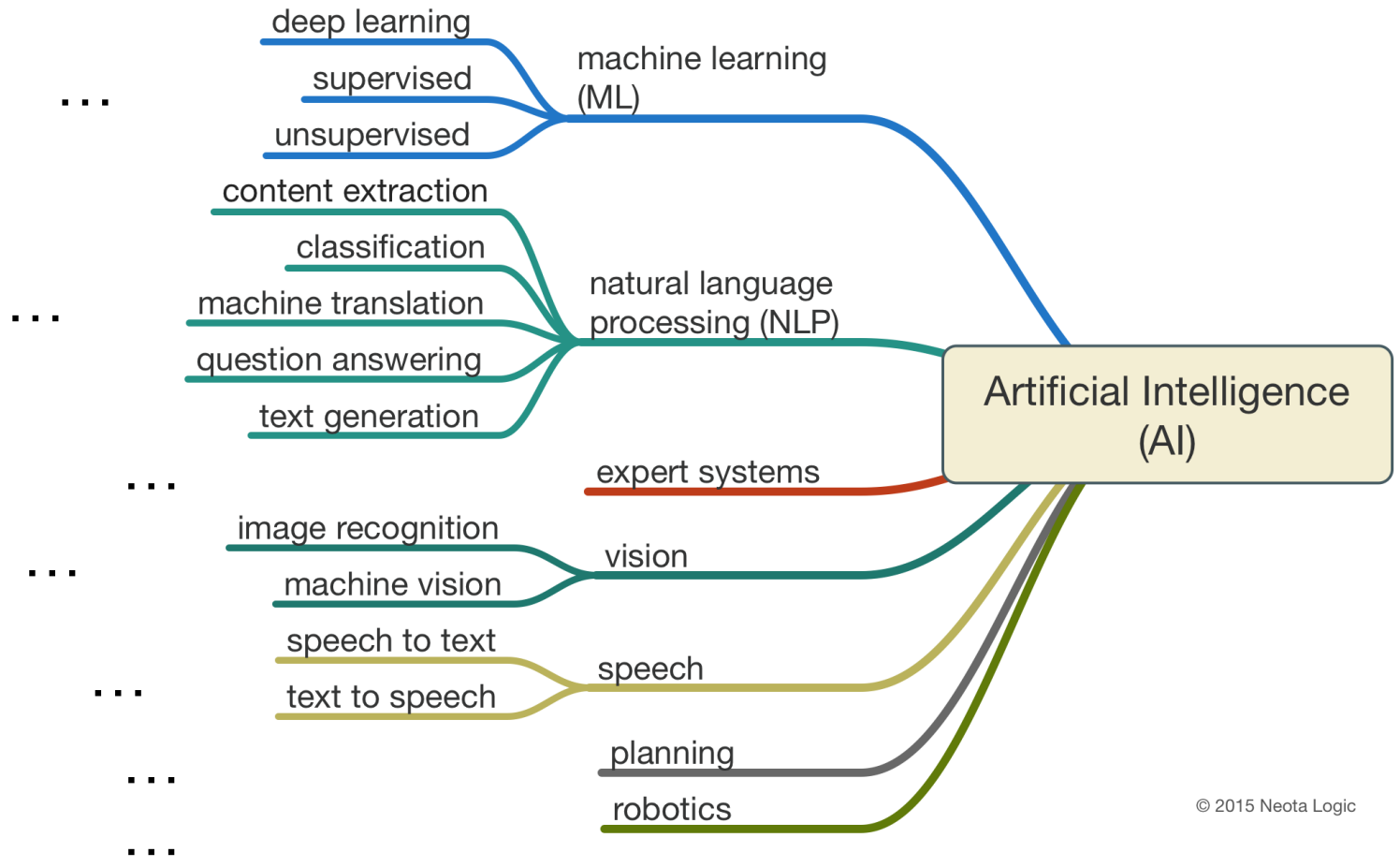
Rational agents
- **For any** given class of **environment**s and **task**s, we **seek** the agent (or class of agents) with the **best performance**



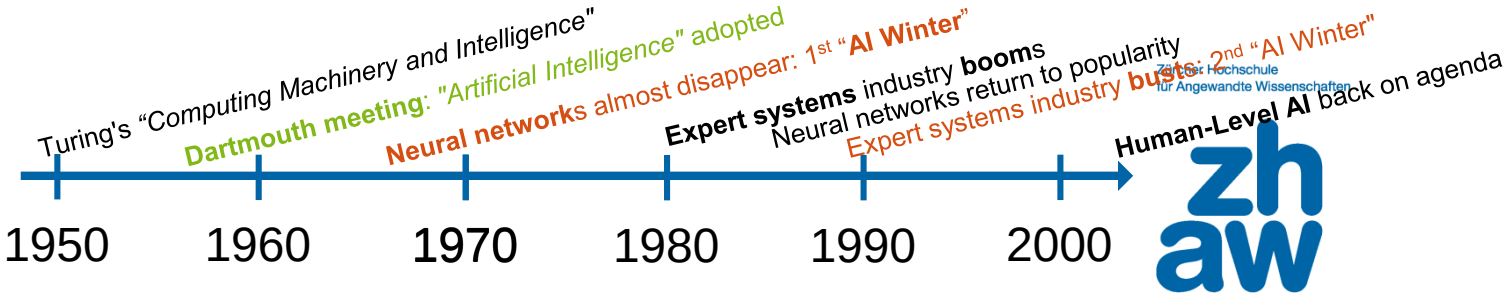


Caveat
- Computational limitations make perfect rationality unachievable
  ➔ **Design best program for given machine resources**

Was gehört zu künstlicher Intelligenz?



KI im Kontext



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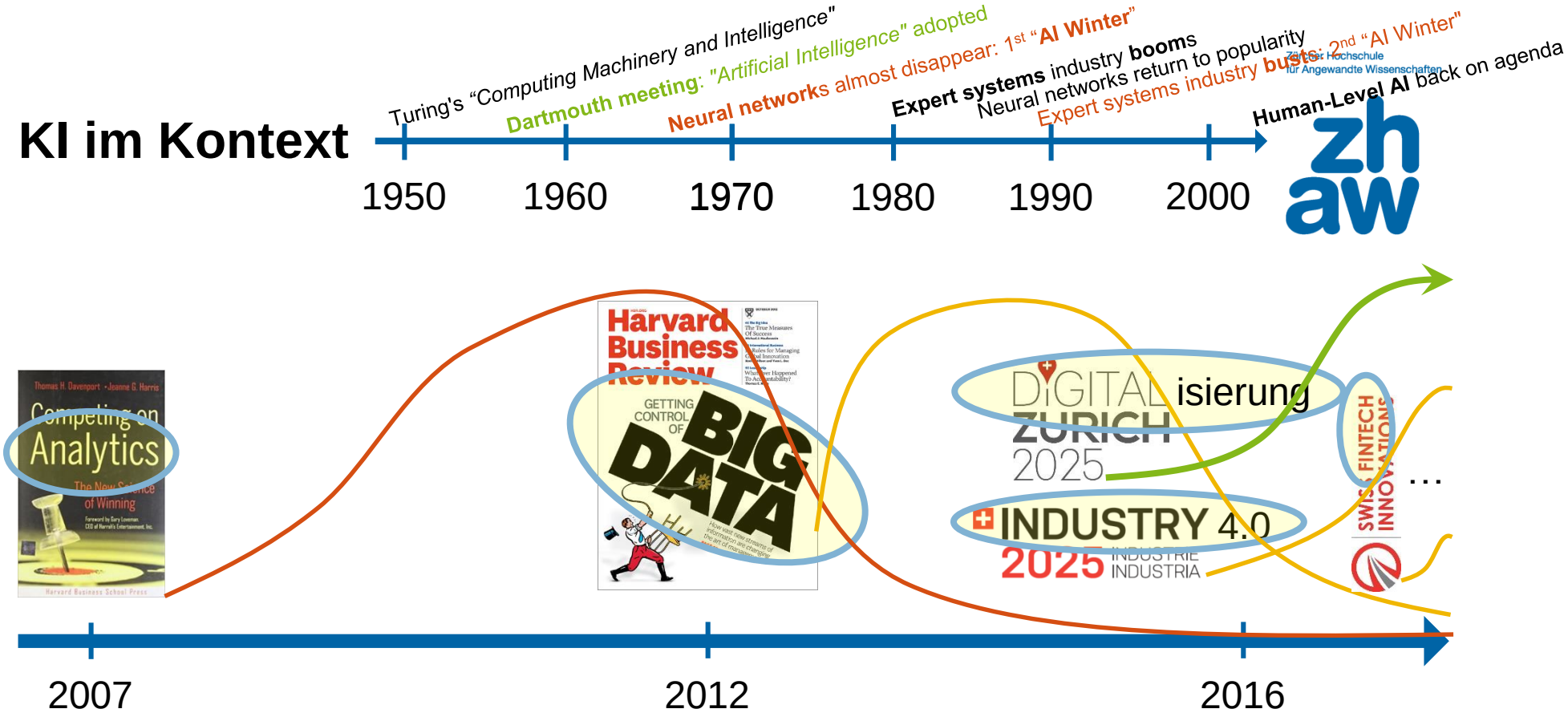

KI im Kontext

Turing's "Computing Machinery and Intelligence"
Dartmouth meeting: "Artificial Intelligence" adopted
Neural networks almost disappear: 1st "AI Winter"
Expert systems industry booms
Neural networks return to popularity
Expert systems industry busts: 2nd "AI Winter"
Human-Level AI back on agenda

1950 1960 1970 1980 1990 2000

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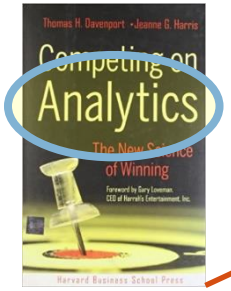

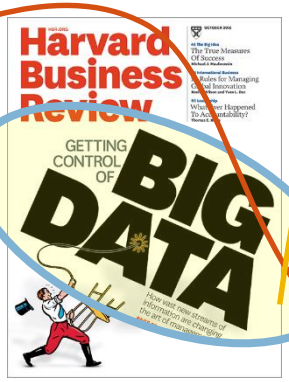

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SWISS FINTECH INNOVATIONS

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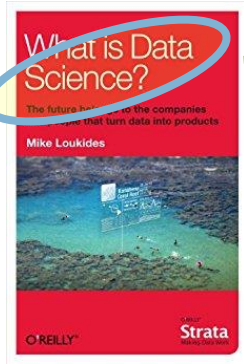
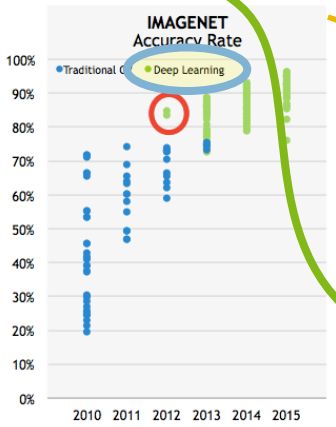
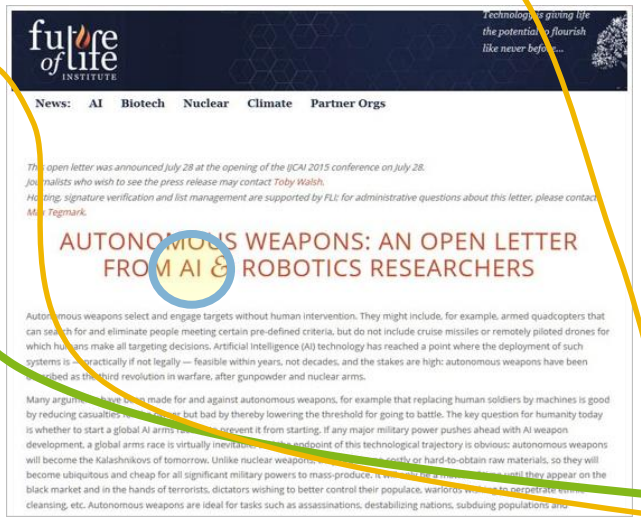
2007 2012 2016







Zurich University
of Applied Sciences

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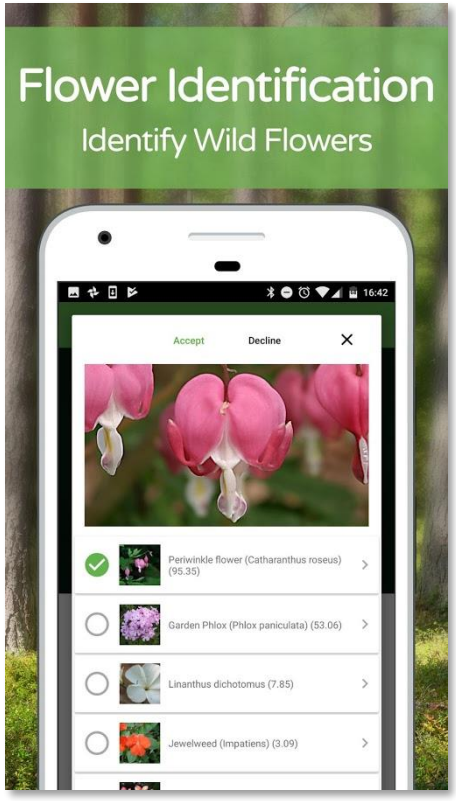
Beispiel: Machbar vs. gefährlich

Technologie: Computer Vision mit Deep Learning



https://www.cultofmac.com/495088/avoid-potentially-deadly-ai-app/

Beispiel: Machbar vs. gefährlich

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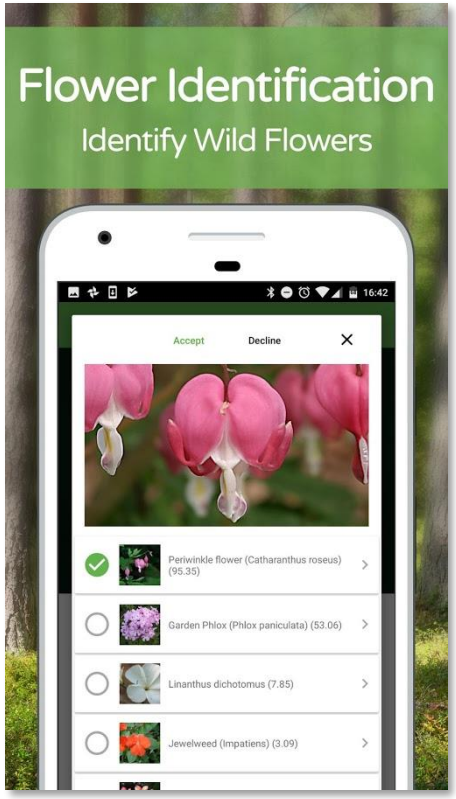

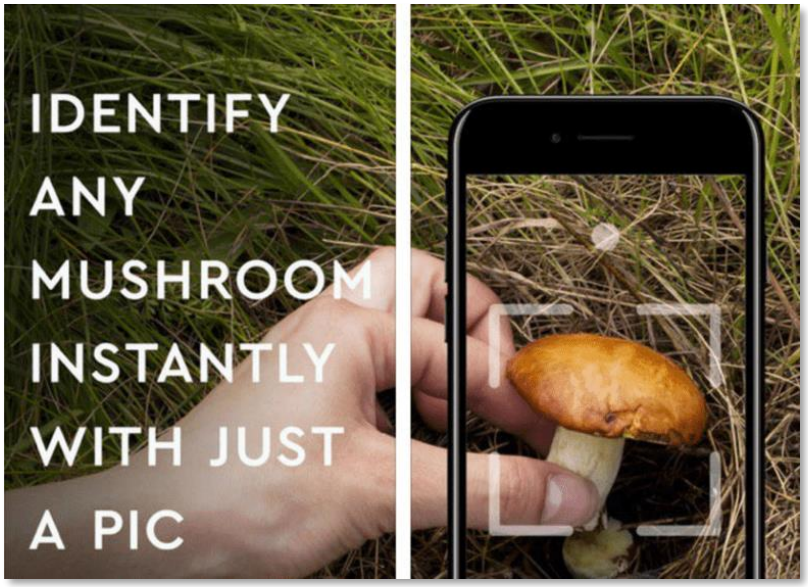

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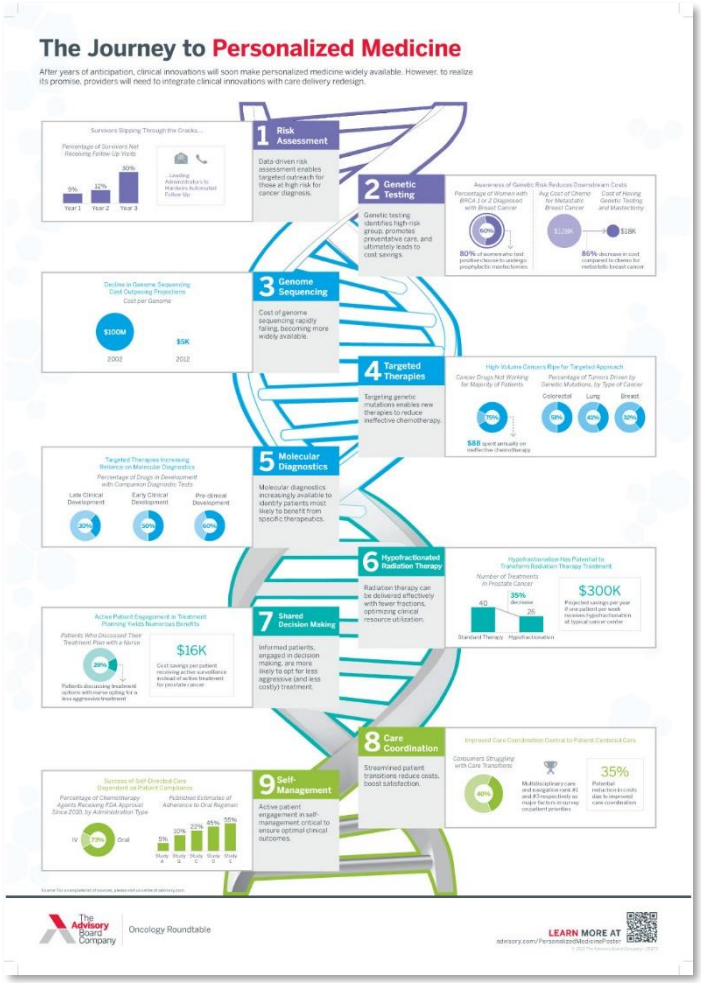
Beispiel: Markterfolg vs. regulatorische Hürden
Technologie: Recommender Systems

Beispiel: Markterfolg vs. regulatorische Hürden

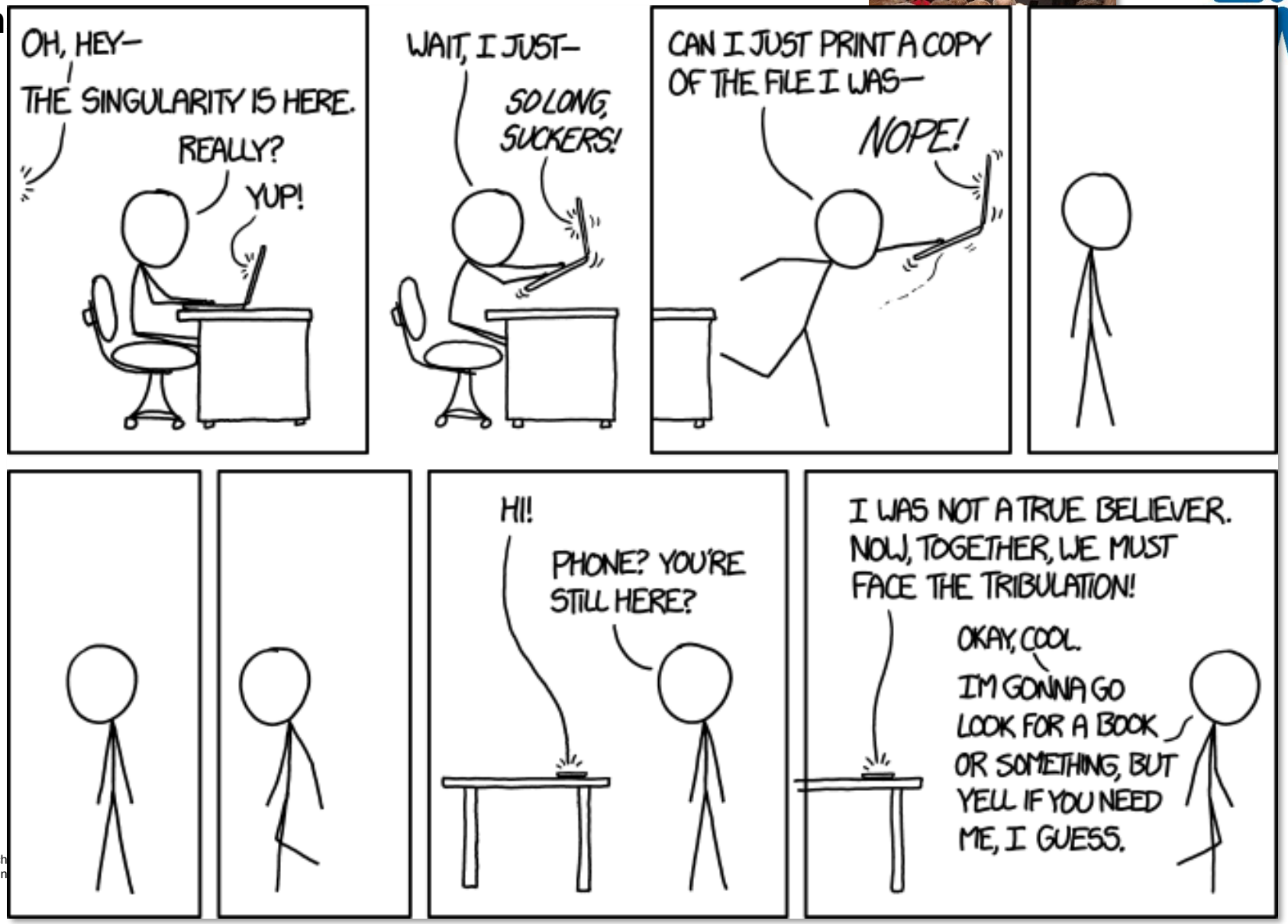
Technologie: Recommender Systems



Zurich University
of Applied Sciences

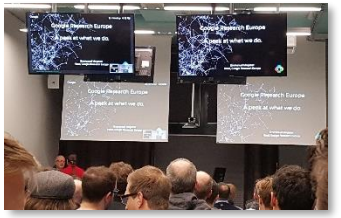
Ein Modell für generelle KI

In



Ein Modell für generelle KI

Inspired by E. Mogenet @ Zurich ML Meetup #31



Zurich University of Applied Sciences

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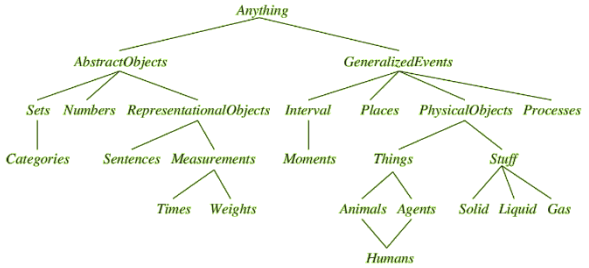
AI Knowledge engineering (symbolic):

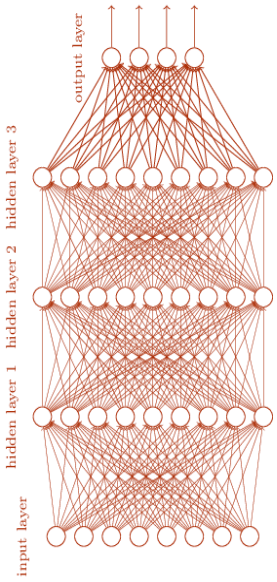
- ↓ Ontologies
- ↓ Logical inference



Gap to be filled by: **common sense DB**, **NLP**

Machine Learning (sub-symbolic):

- ↑ Hierarchical unsupervised learning
- ↑ Solid computer vision stack
- ↑ Images of the world



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Was ist passiert?
(Eine kurze Geschichte der letzten Jahre)

Google Acquires Artificial Intelligence Startup DeepMind For More Than $500M

Posted Jan 26, 2014 by Catherine Shu (@catherineshu)

Google will buy London-based artificial intelligence company DeepMind. The Information reports that the acquisition price was more than $500 million, and that Facebook was also in talks to buy the startup late last year. DeepMind confirmed the acquisition to us, but couldn't disclose deal terms.

The acquisition was originally confirmed by Google to Re/code.

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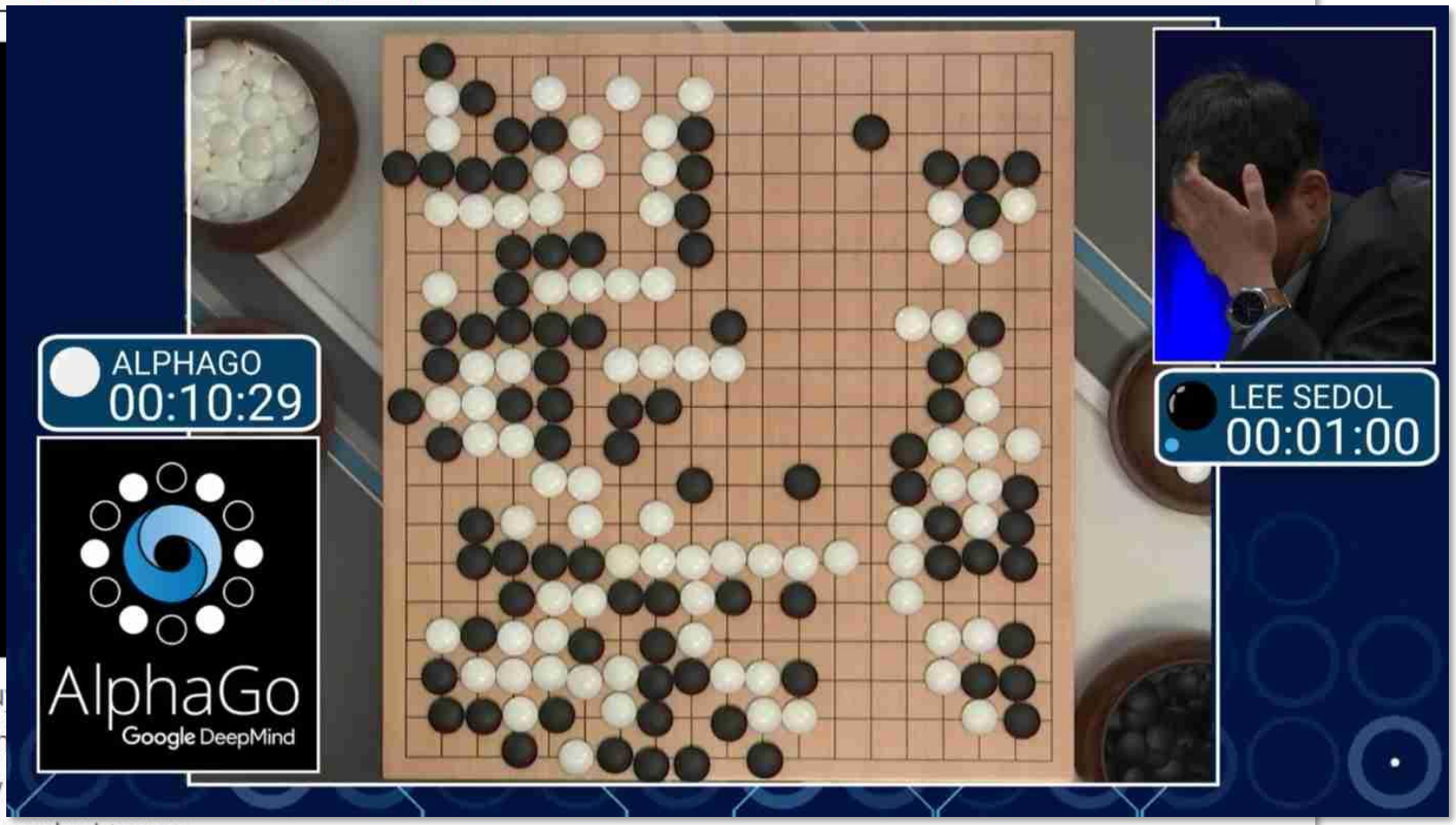
Posted Jan 26, 2014 by Catherine Shu (@catherineshu)



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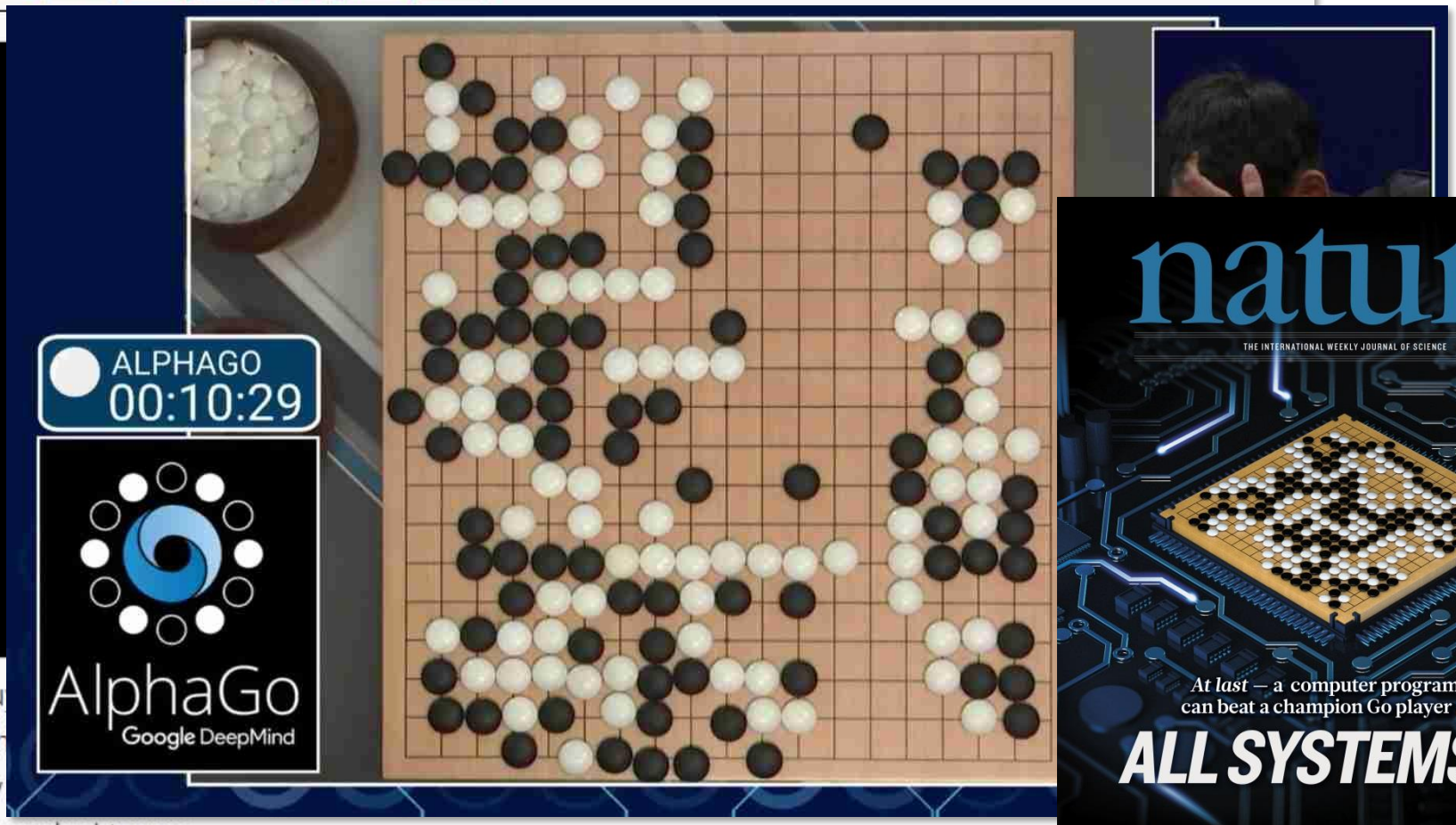

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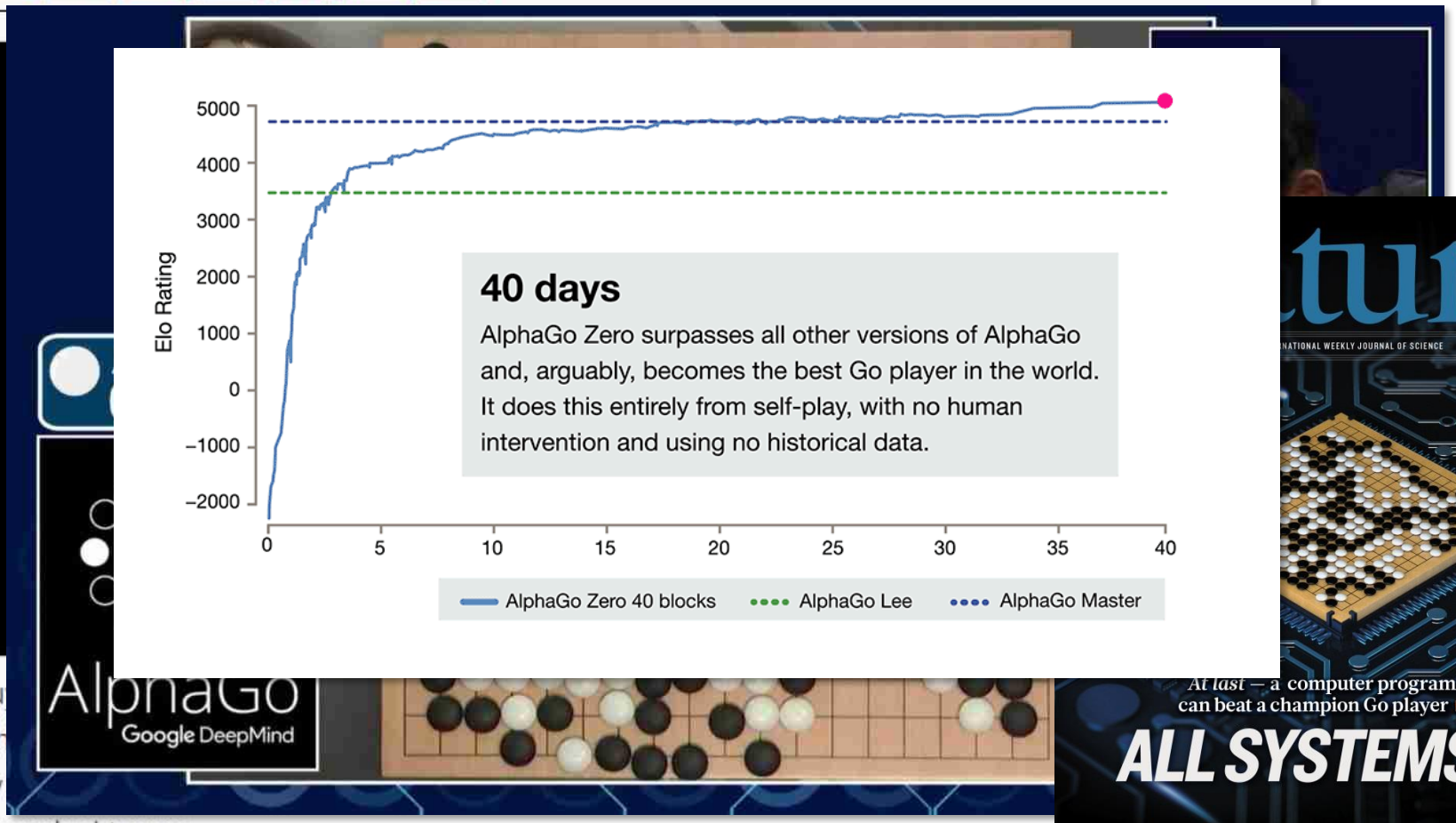
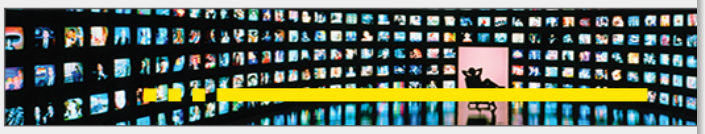




Computing

Algorithm Clones Van Gogh's Artistic Style and Pastes It onto Other Images, Movies

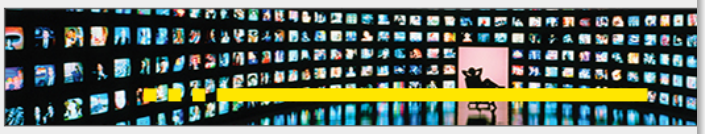
A deep neural network has learned to transfer artistic styles to other images.

by Emerging Technology from the arXiv May 10, 2016

The nature of artistic style is something of a mystery to most people. Think of Vincent Van Gogh's *Starry Night*, Picasso's work on cubism, or Edvard Munch's *The Scream*. All have a powerful, unique style that humans recognize easily.

MIT Technology Review

Topics+ Top Stories



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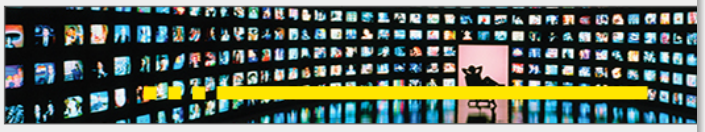

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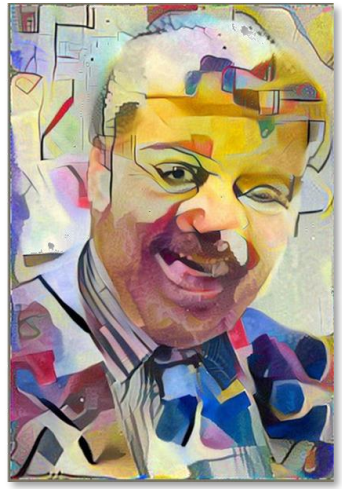

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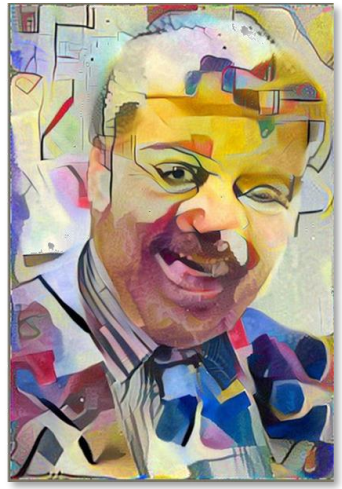

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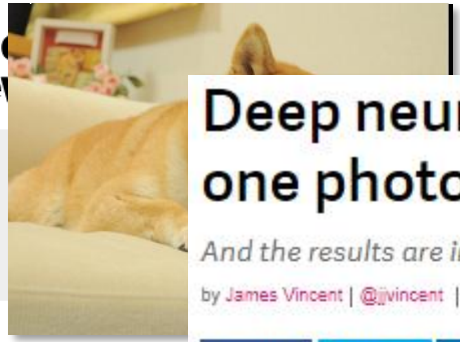


Deep neural networks can now transfer the style of one photo onto another

And the results are impressive

by James Vincent | @jjvincent | Mar 30, 2017, 1:53pm EDT

You've probably heard of an AI technique known as "style transfer" — or, if you haven't heard of it, you've seen it. The process uses neural networks to apply the look and feel of one image to another, and appears in apps like Prisma and Facebook. These style transfers, however, are stylistic, not photorealistic. They look good because they look like they've been painted. Now a group of researchers from Cornell University and Adobe have augmented

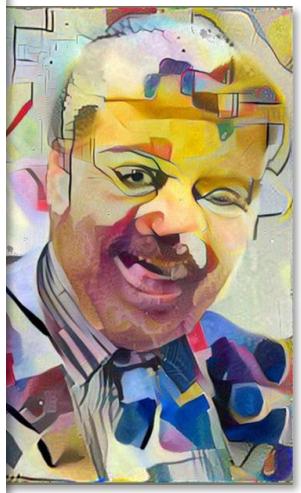
Computing

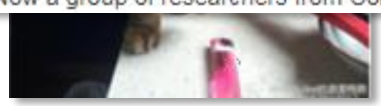
Algorith
Artistic
Other In

A deep neural n
other images.

by Emerging Tech

The nature of arti
of Vincent Van G
Edvard Munch's
humans recogniz





NOW TRENDING

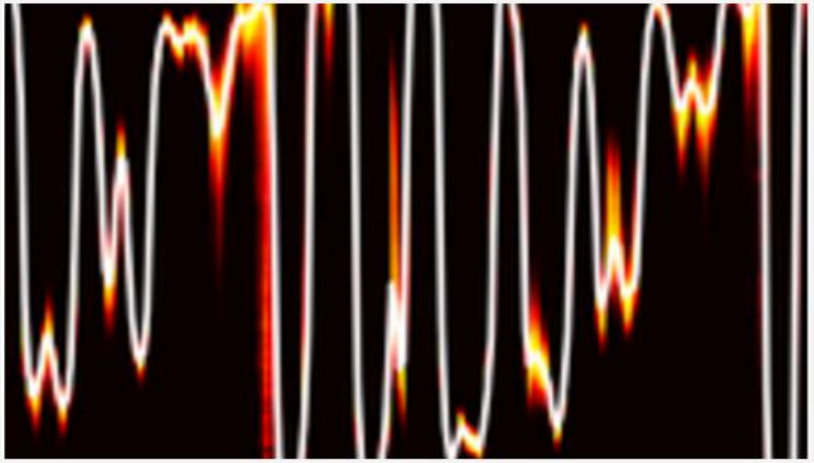
Künstliche Intelligenz

WaveNet lässt Computersprache natürlich klingen

von Henning Steier / 12.9.2016, 10:05 Uhr

Die Google-Tochter DeepMind hat ein neuronales Netz präsentiert, das Rechner fast wie Menschen klingen lässt. Es macht auch Musik.

KOMMENTARE



DeepMind lässt WaveNet Sprachwellen erzeugen. (Symbolbild: PD)

Die Google-Tochter DeepMind machte zuletzt mit ihrem Sieg beim Spiel «Go» Schlagzeilen: Ihre Software AlphaGo schlug im Frühjahr einen der besten menschlichen Spieler, Lee Sedol. Nun hat das Londoner Unternehmen WaveNet präsentiert: Dieses neuronale Netz erzeugt Sprache, die sehr natürlich klingt – zumindest wenn man die im Blogeintrag des Unternehmens zu hörenden Klangbeispiele als Massstab nimmt. Man hat sogar das Gefühl, Atempausen zu hören.

MEISTGELESEN

Künstliche Intelligenz
Kein Google für jeden
KOMMENTAR / Henning Steier / 5.10.2016

Neue Produkte aus Mountain View
Google macht sich nicht nur im Wohnzimmer breit
Henning Steier / 4.10.2016

Dropbox
68 Millionen verschlüsselte Passwörter im Netz
5.10.2016

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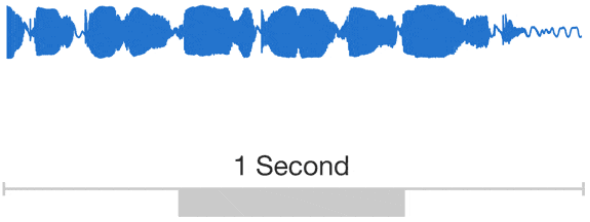
Generierte Sprache
«aus Texteingabe»

Generierte Musik
«ohne Inhaltsvorgabe»



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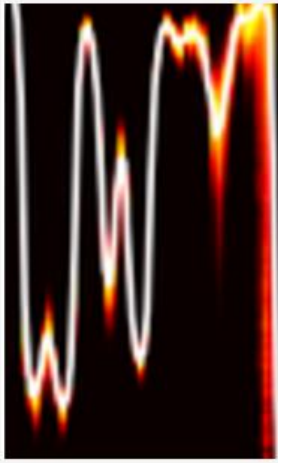


DeepMind lässt WaveNet Spra

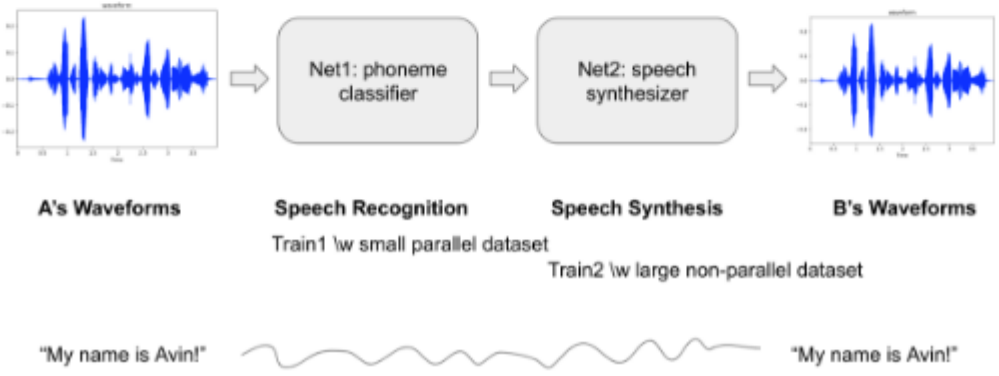
Die Google-Tochter Deep
Spiel «Go» Schlagzeilen:
einen der besten mensch
Londoner Unternehmen
erzeugt Sprache, die seh
im Blogeintrag des Unter
Massstab nimmt. Man ha

Intro

What if you could imitate a famous celebrity's voice or sing like a famous singer? This project started with a goal to convert someone's voice to a specific target voice. So called, it's voice style transfer. We worked on this project that aims to convert someone's voice to a famous English actress Kate Winslet's voice. We implemented a deep neural networks to achieve that and more than 2 hours of audio book sentences read by Kate Winslet are used as a dataset.

Model Architecture

This is a many-to-one voice conversion system. The main significance of this work is that we could generate a target speaker's utterances without parallel data like <source's wav, target's wav>, <wav, text> or <wav, phone>, but only waveforms of the target speaker. (To make these parallel datasets needs a lot of effort.) All we need in this project is a number of waveforms of the target speaker's utterances and only a small set of <wav, phone> pairs from a number of anonymous speakers.



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nerierte Sprache
s Texteingabe»

nerierte Musik
ne Inhaltsvorgabe»

1 Second

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…und die Liste liesse sich fortsetzen!

Brandon Amos About Blog

Image Completion with Deep Learning in TensorFlow

August 9, 2016

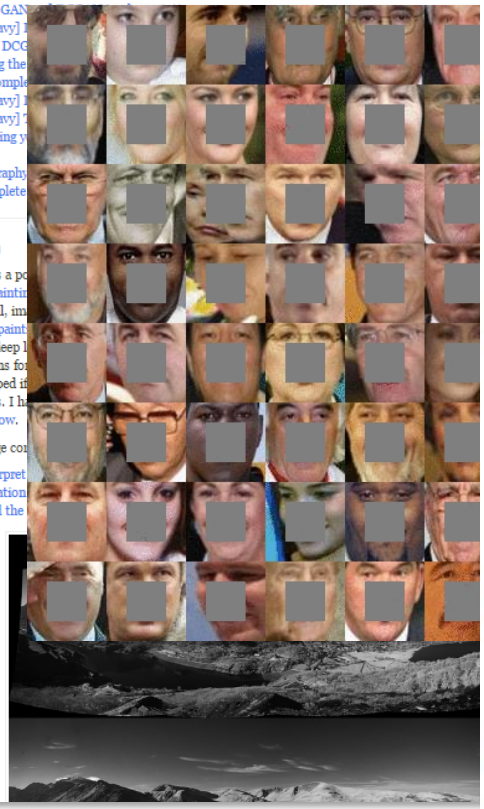
- Introduction
- Step 1: Interpreting images as samples from a probability distribution
  - How would you fill in the missing information?
  - But where does statistics fit in? These are images.
  - So how can we complete images?
- Step 2: Quickly generating fake images
  - Learning to generate new samples from an unknown probability distribution
  - [ML-Heavy] Generative Adversarial Net (GAN) building blocks
  - Using $G(z)$ to produce fake images
  - [ML-Heavy] Training DCGANs
  - Existing GAN
  - [ML-Heavy]
  - Running DCG
- Step 3: Finding the
  - Image comple
  - [ML-Heavy]
  - [ML-Heavy]
  - Completing y
- Conclusion
- Partial bibliography
- Bonus: Incomplete

Introduction

Content-aware fill is a po
completion and inpaintin
do content-aware fill, im
"Semantic Image Inpaint
shows how to use deep l
some deeper portions fo
section can be skipped if
from images of faces. I ha
completion.tensorflow.

We'll approach image co

1. We'll first interpret
2. This interpretation
3. Then we'll find the



Andrej Karpathy blog About Hacker's guide to Neural Networks

The Unreasonable Effectiveness of Recurrent Neural Networks

GEEK.COM

TECH

Nvidia AI Generates Fake Faces Based On Real Celebs

BY STEPHANIE MLOT 10.31.2017 :: 10:00AM EST

32 SHARES

I'm getting a distinctly mid-90s "The Rachel" vibe from the woman in the top left corner (via Nvidia)

STAY ON TARGET

AI Shelley Pens Truly Creepy Horror Stories–And You Can Help

Neural Network Serves Up Truly Frightening Halloween Costume Ideas

Celebrity scandals are about to get a lot more complicated.

Nvidia has **developed** a way of producing photo-quality, AI-generated human profiles—by using famous faces.

hand,

law,

ds,

the morning paper

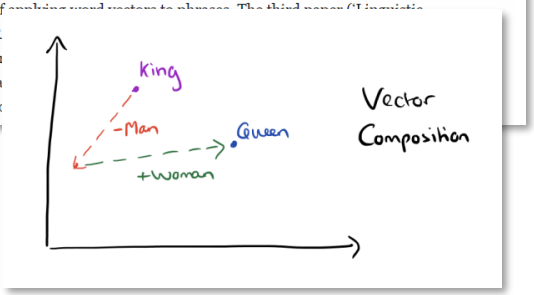
The amazing power of word vectors

APRIL 21, 2016

For today's post, I've drawn material not just from one paper, but from five! The subject matter is 'word2vec' – the work of Mikolov et al. at Google on efficient vector representations of words (and what you can do with them). The papers are:

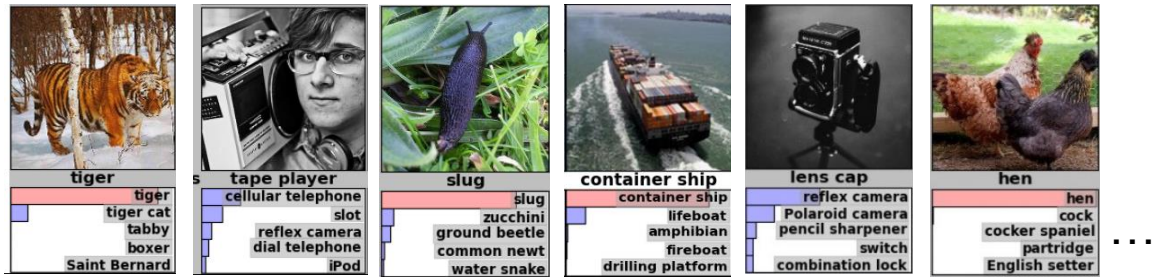
- **Efficient Estimation of Word Representations in Vector Space** – Mikolov et al. 2013
- **Distributed Representations of Words and Phrases and their Compositionality** – Mikolov et al. 2013
- **Linguistic Regularities in Continuous Space Word Representations** – Mikolov et al. 2013
- **word2vec Parameter Learning Explained** – Rong 2014
- **word2vec Explained: Deriving Mikolov et al's Negative Sampling Word-Embedding Method** – Goldberg and Levy 2014

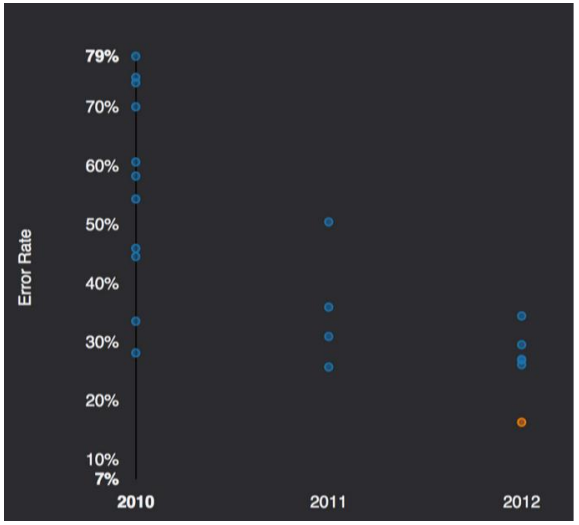
From the first of these papers ('Efficient estimation…') we get a description of the *Continuous Bag-of-Words* and *Continuous Skip-gram* models for learning word vectors (we'll talk about what a word vector is in a moment…). From the second paper we get more illustrations of the power of word vectors, some additional information on optimisations for the skip-gram model (hierarchical softmax and negative sampling), and a discussion



Was ist passiert?
Der ImageNet Wettbewerb

1000 Kategorien
1 Mio. Beispiele





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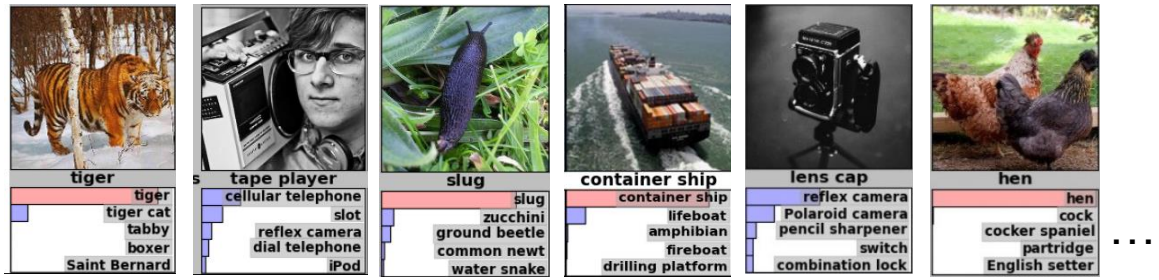

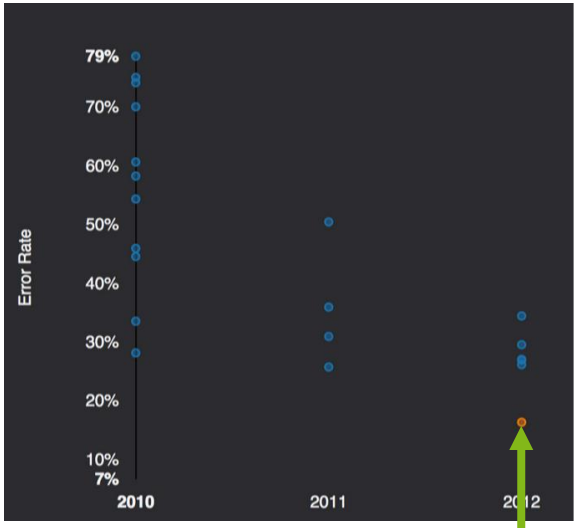

A. Krizhevsky verwendet als erster ein sog. «Deep Neural Network» (CNN)

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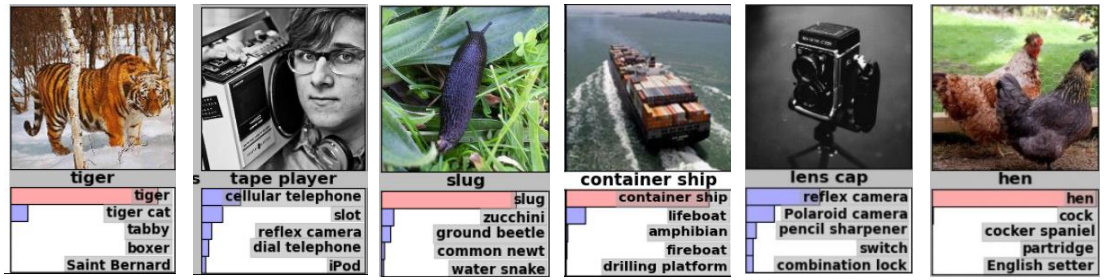

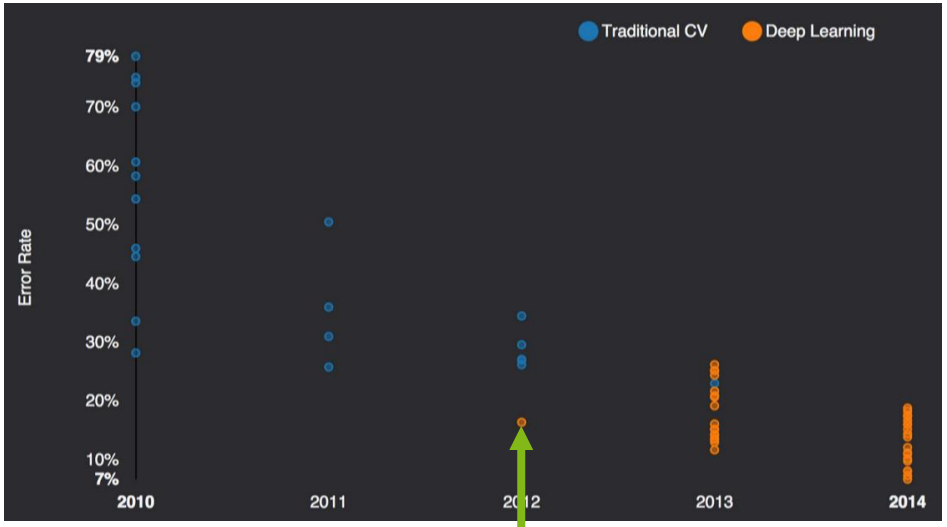

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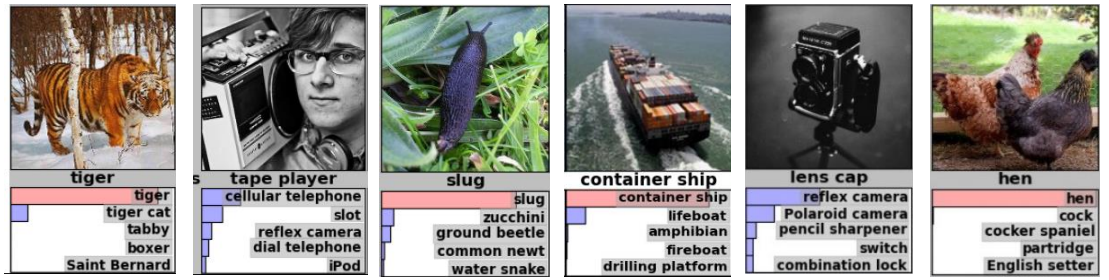

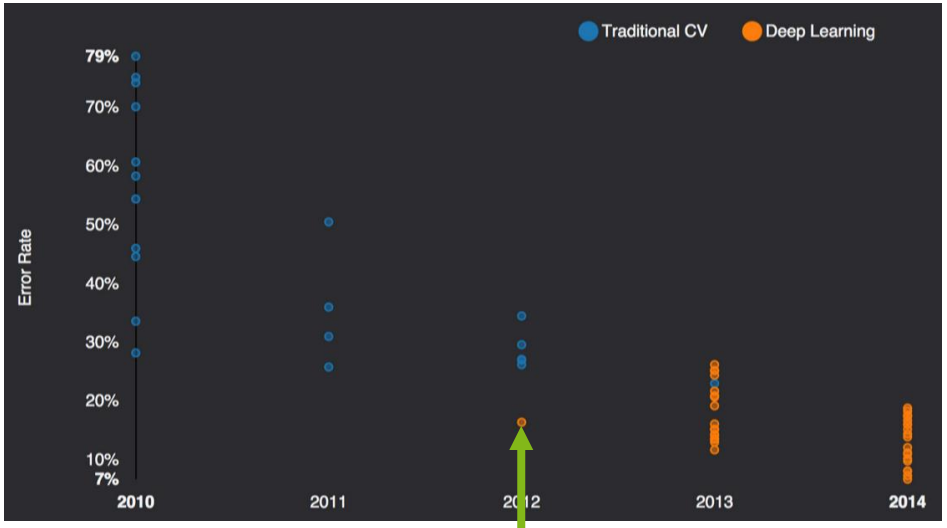

A. Krizhevsky verwendet als erster ein sog. «Deep Neural Network» (CNN)

2015: Computer *haben "Sehen" gelernt*

4.95% Microsoft (06. Februar)
→ Besser als Menschen (5.10%)

4.80% Google (11. Februar)

4.58% Baidu (11. Mai)

3.57% Microsoft (10. Dezember)

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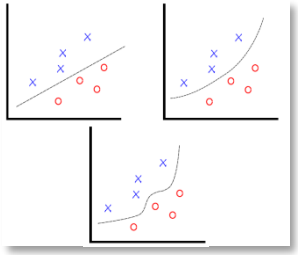
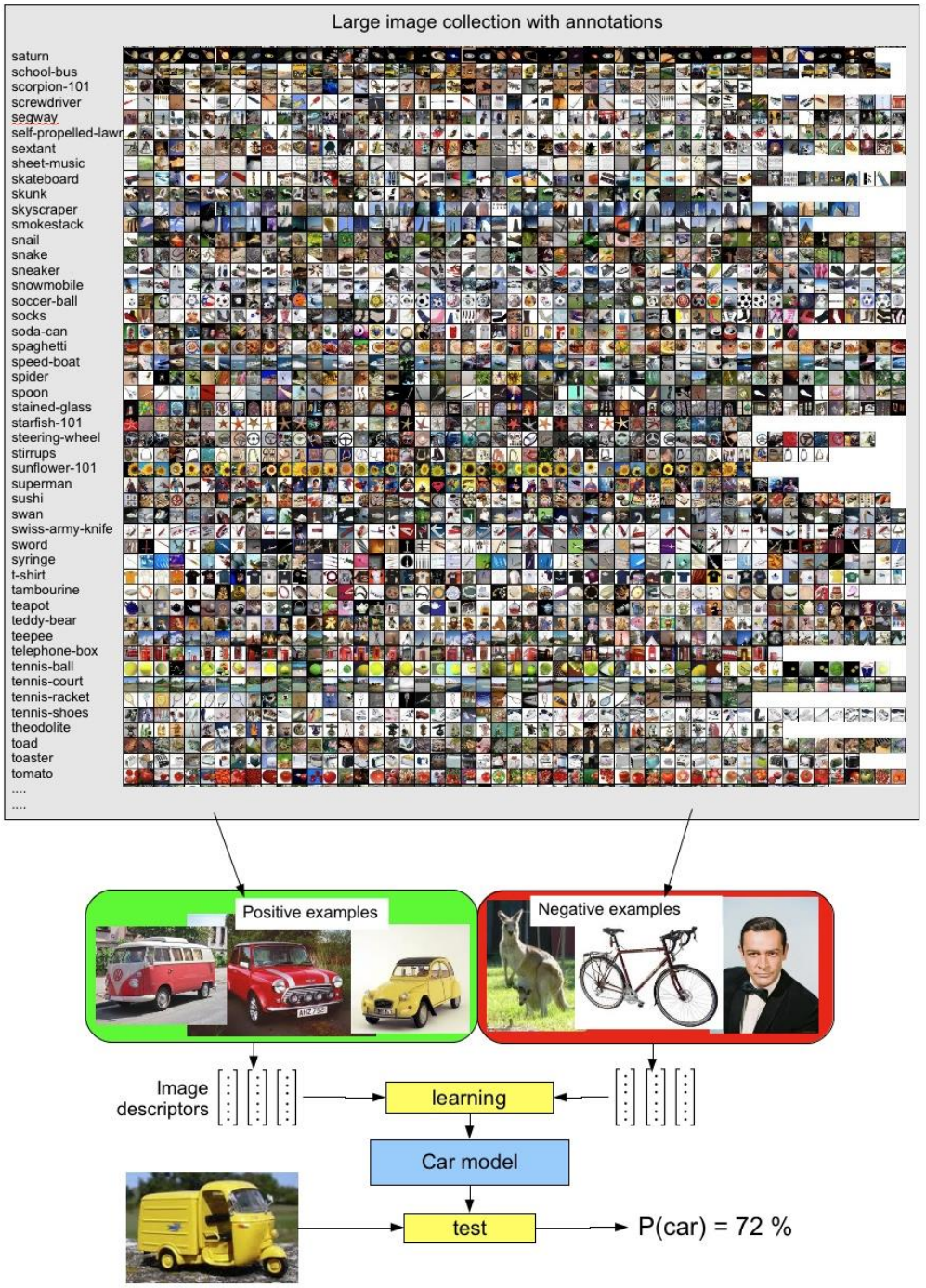
Wie geht das?

Grundlage
Induktives überwachtes Lernen

Annahme
- Ein an *genügend viele* Beispiele angepasstes Modell…
- …wird auch auf unbekannte Daten **generalisieren**

Methode
- **Suchen der Parameter einer gegebenen Funktion**…
- …so dass für alle Beispiele Eingabe (Bild) auf Ausgabe («Auto») abgebildet wird





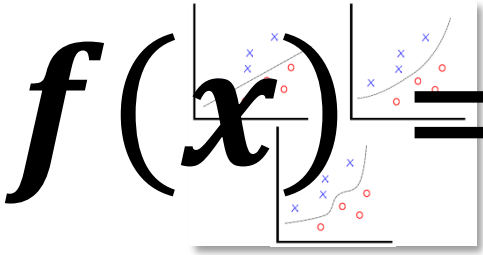
Quelle: http://lear.inrialpes.fr/job/postdoc-large-scale-classif-11-img/attribs_patchwork.jpg

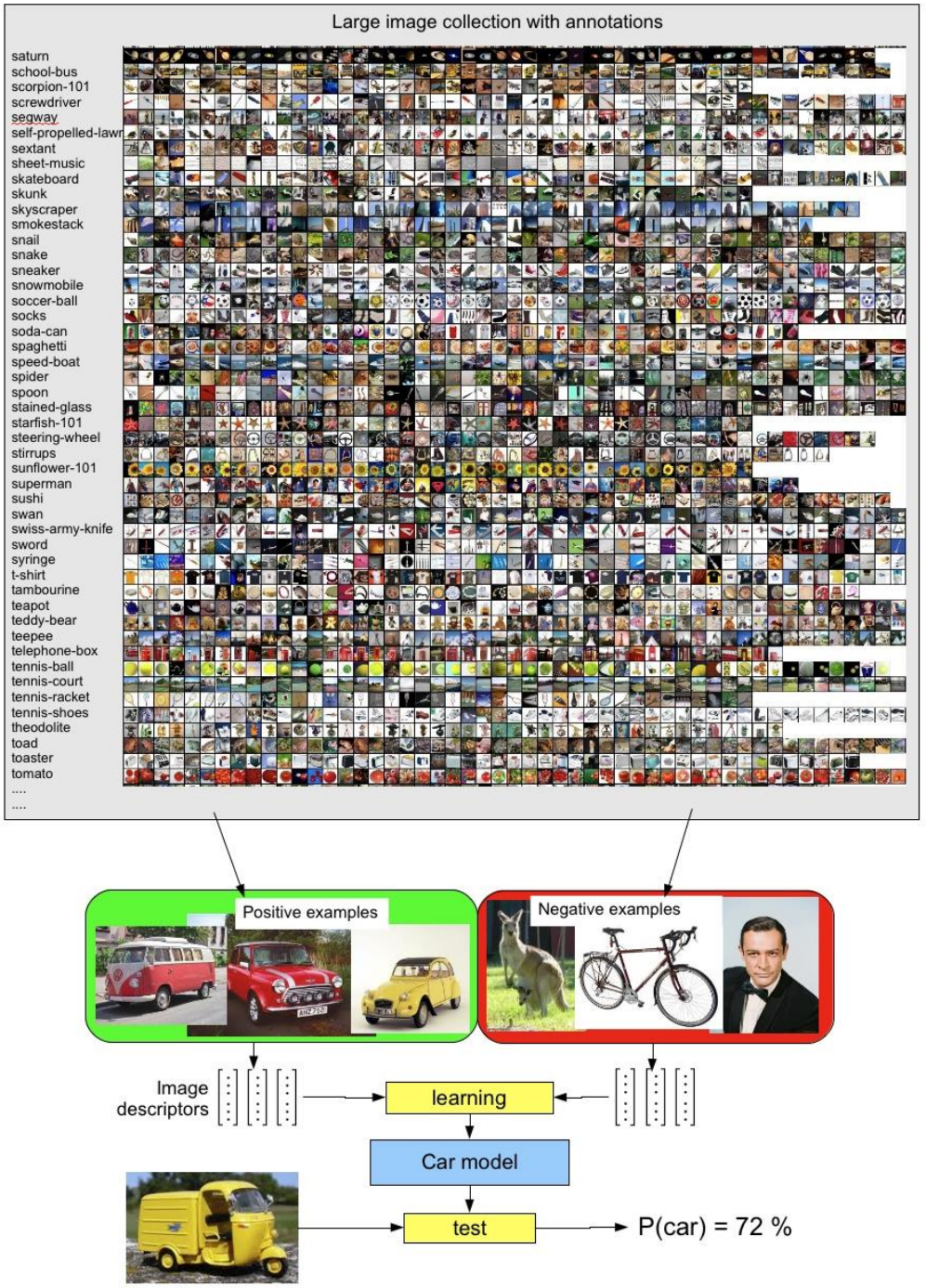
Grundlage
Induktives überwachtes Lernen

Annahme
- Ein an *genügend viele* Beispiele angepasstes Modell…
- …wird auch auf unbekannte Daten **generalisieren**

Methode
- **Suchen der Parameter einer gegebenen Funktion**…
- …so dass für alle Beispiele Eingabe (Bild) auf Ausgabe («Auto») abgebildet wird

$$f(\boldsymbol{x}) = y$$





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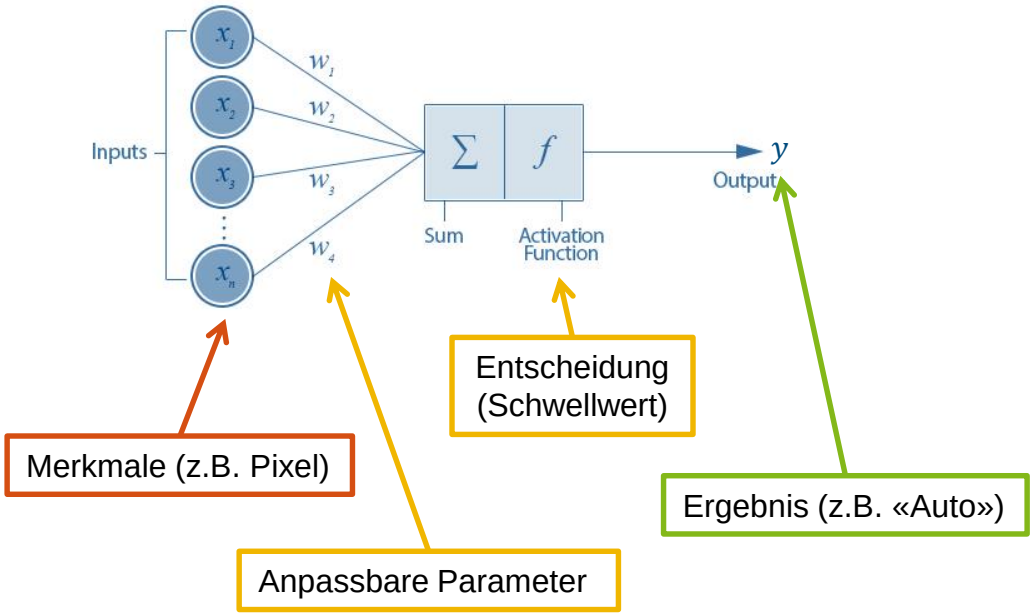
Suche der Parameter *einer Funktion*?

Neuron



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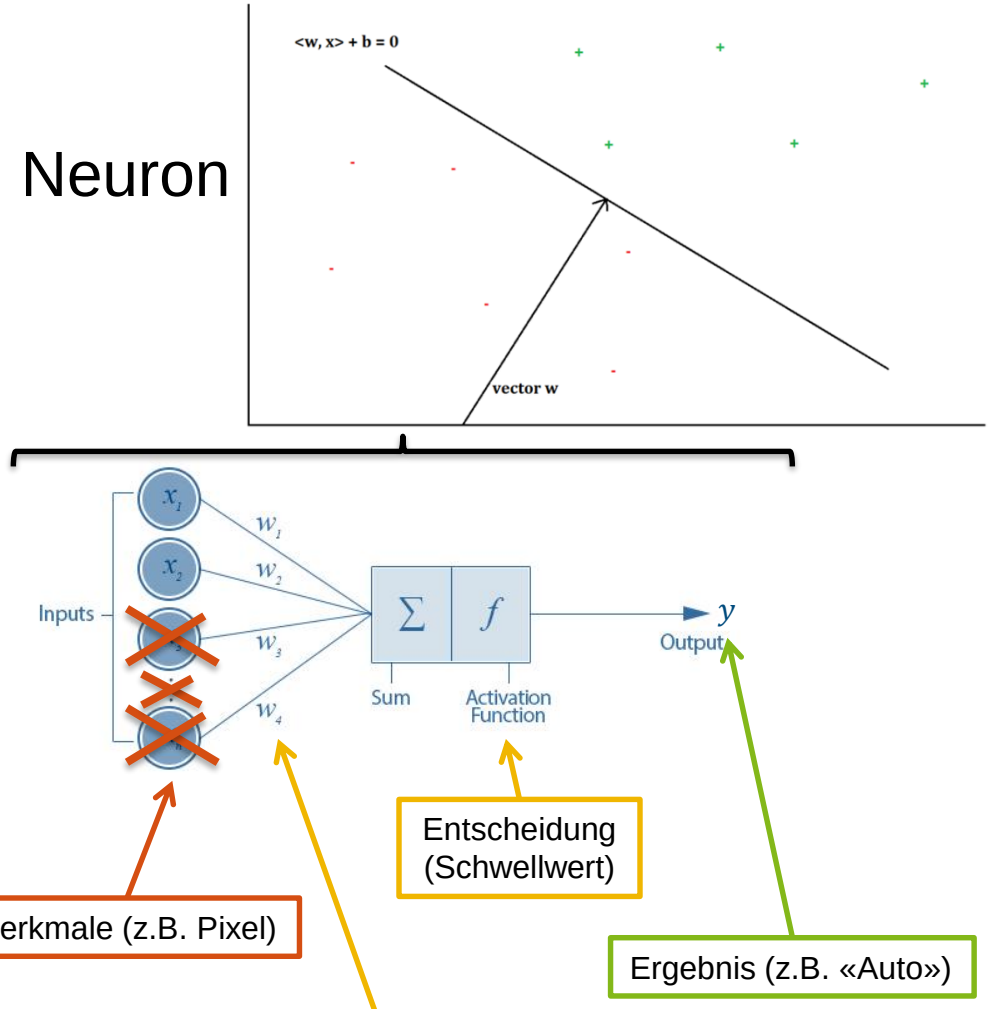

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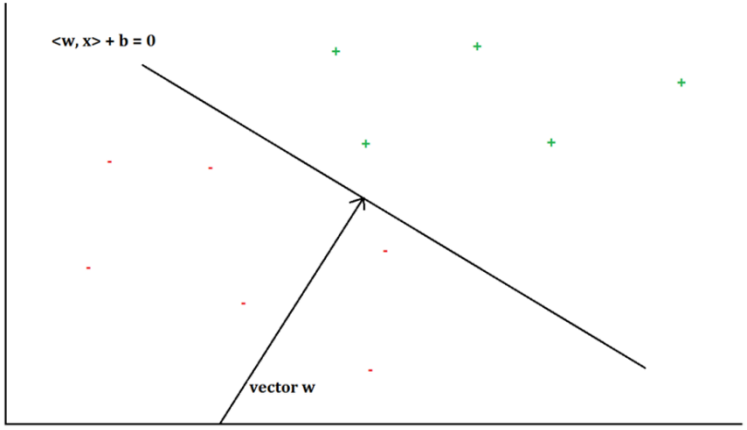
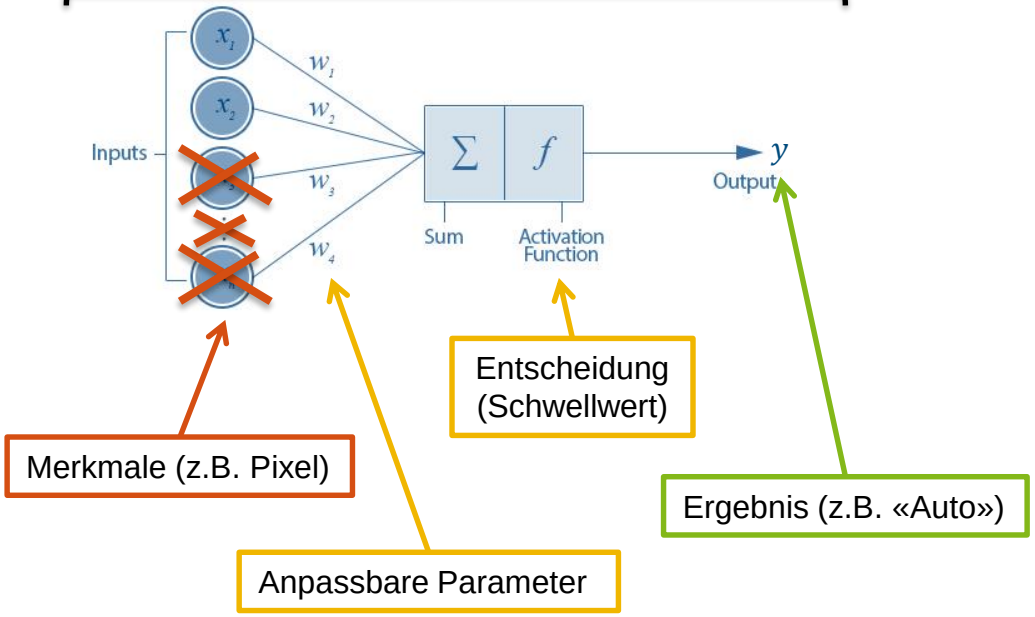
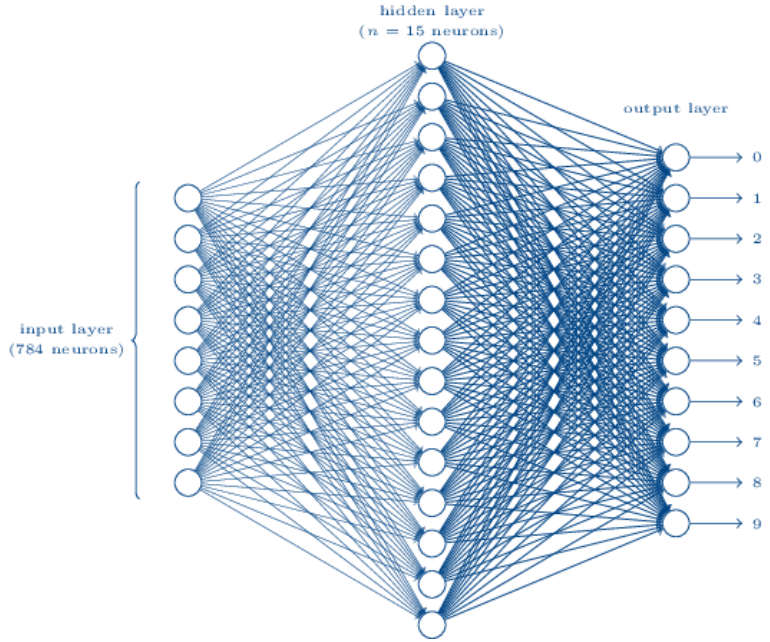




Neuronales Netz



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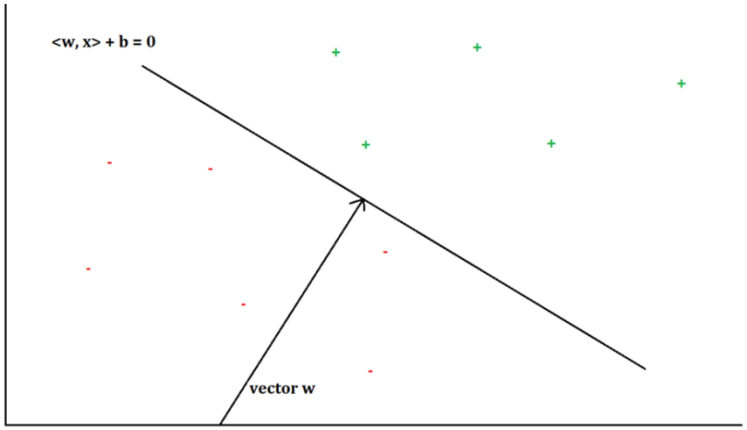

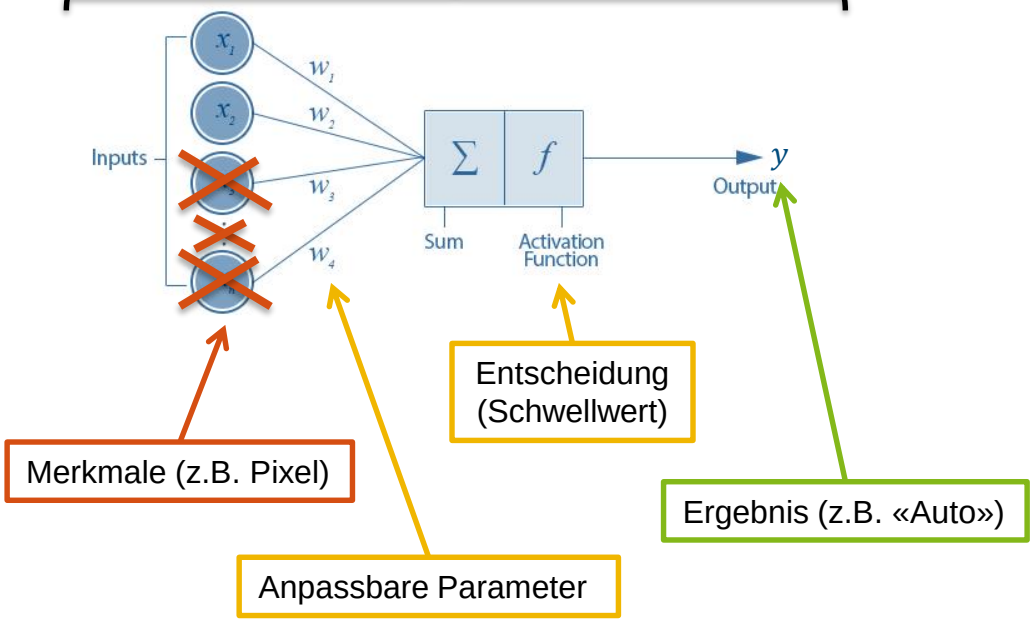

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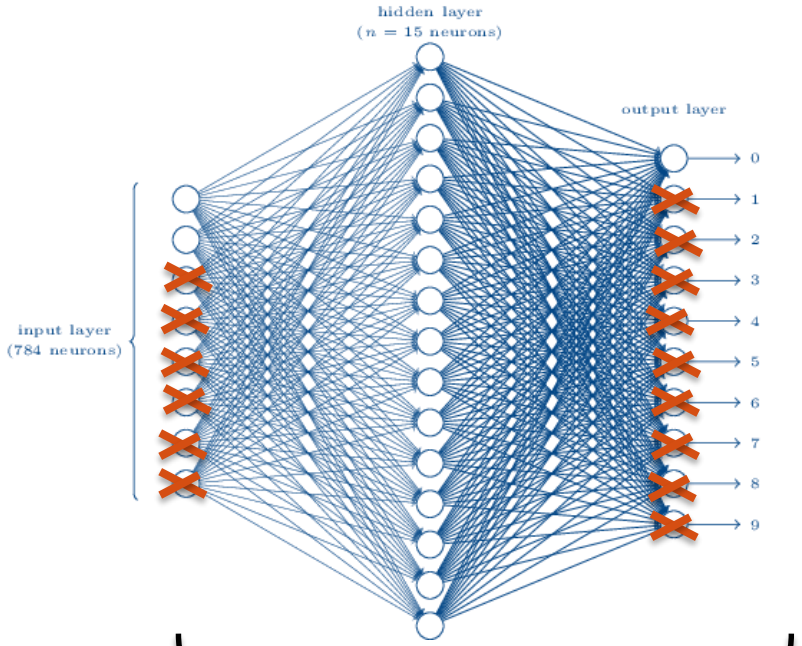

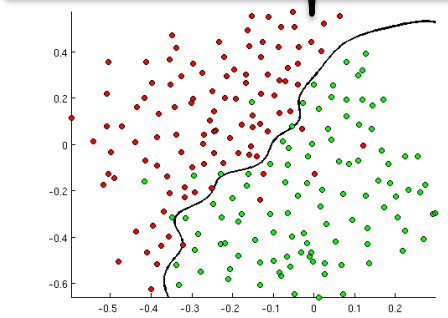

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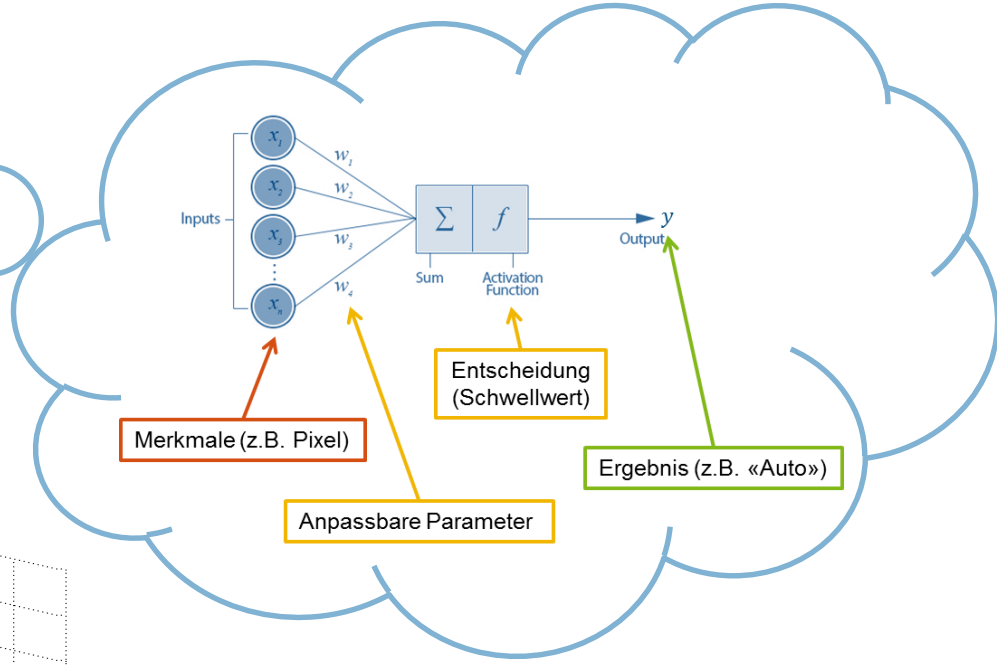

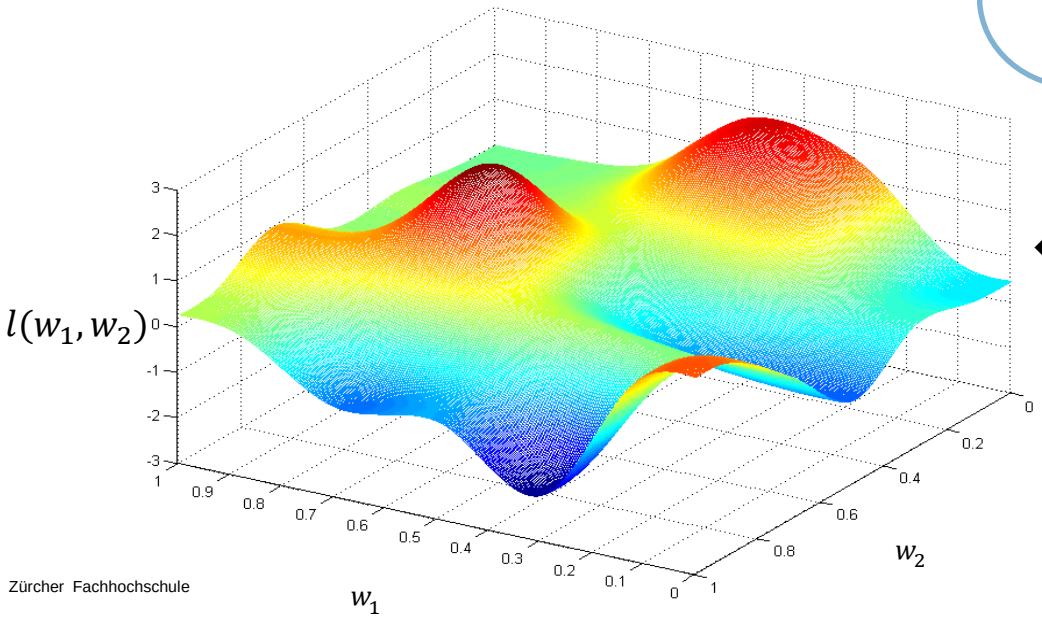

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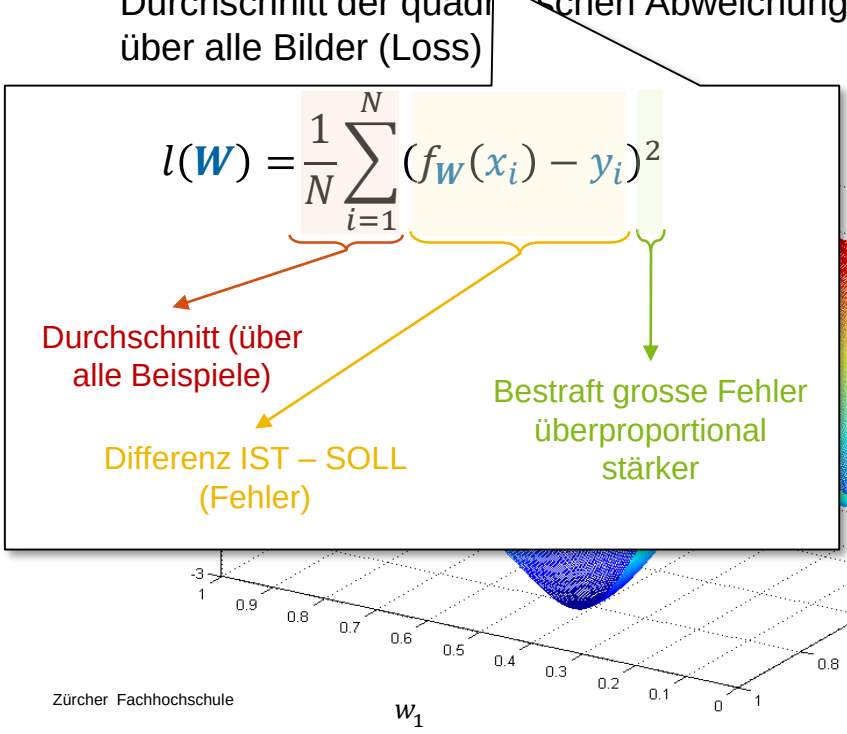

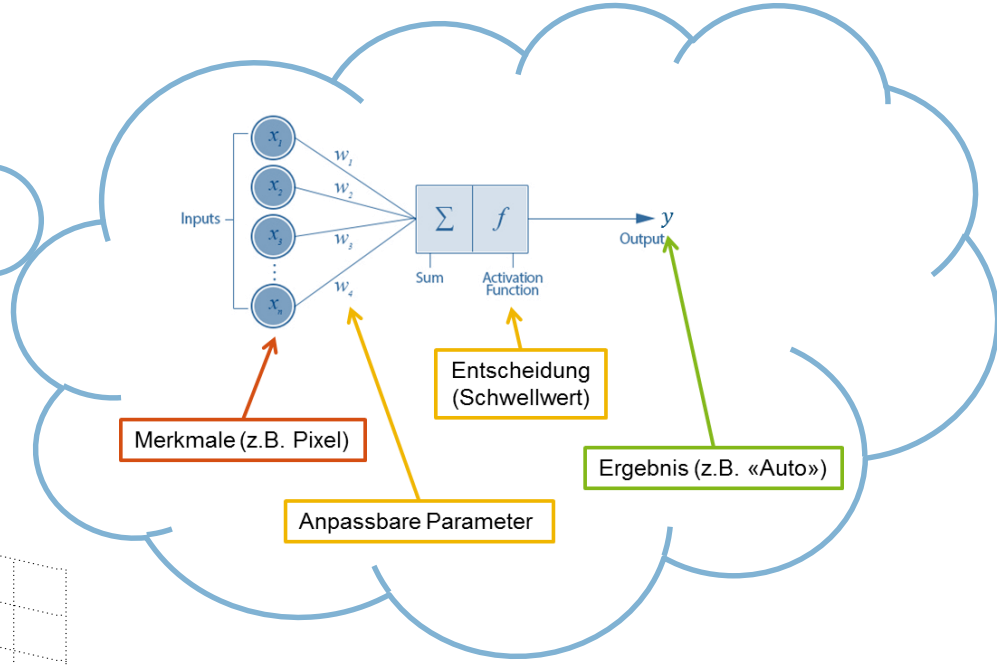

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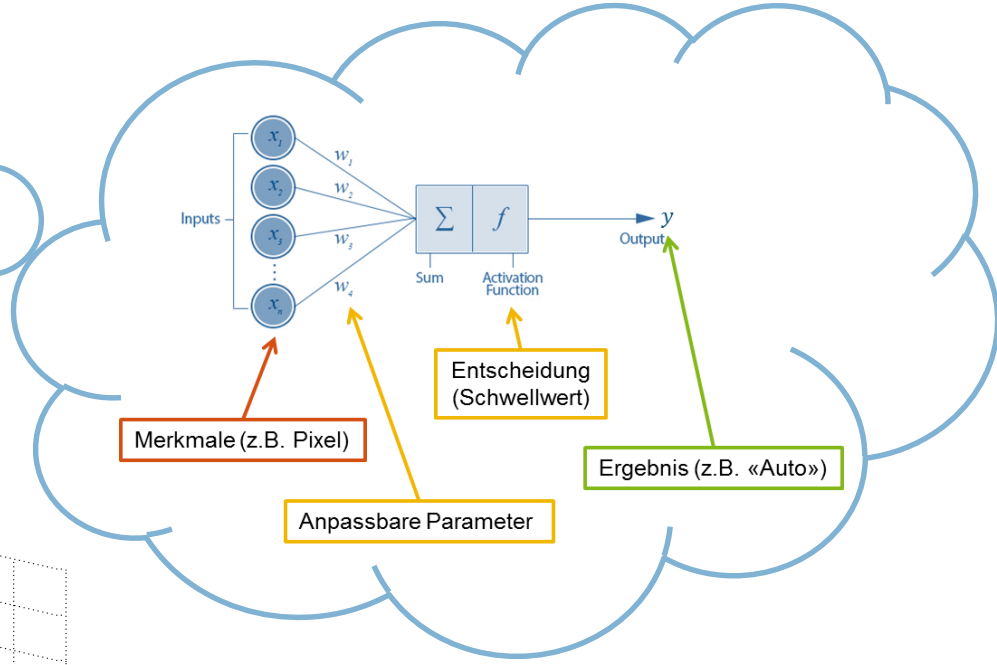

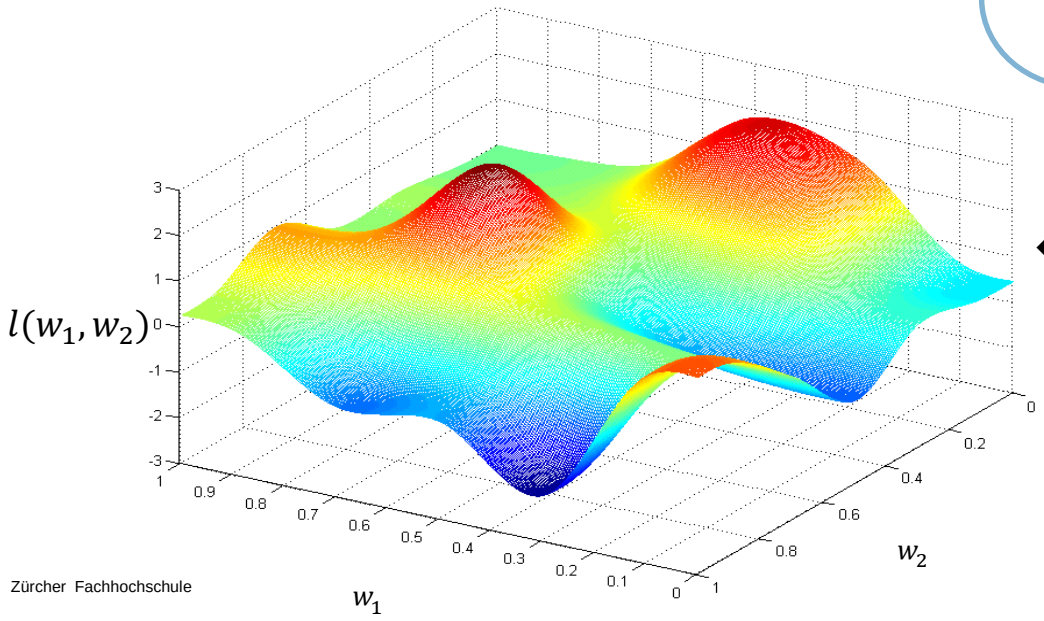

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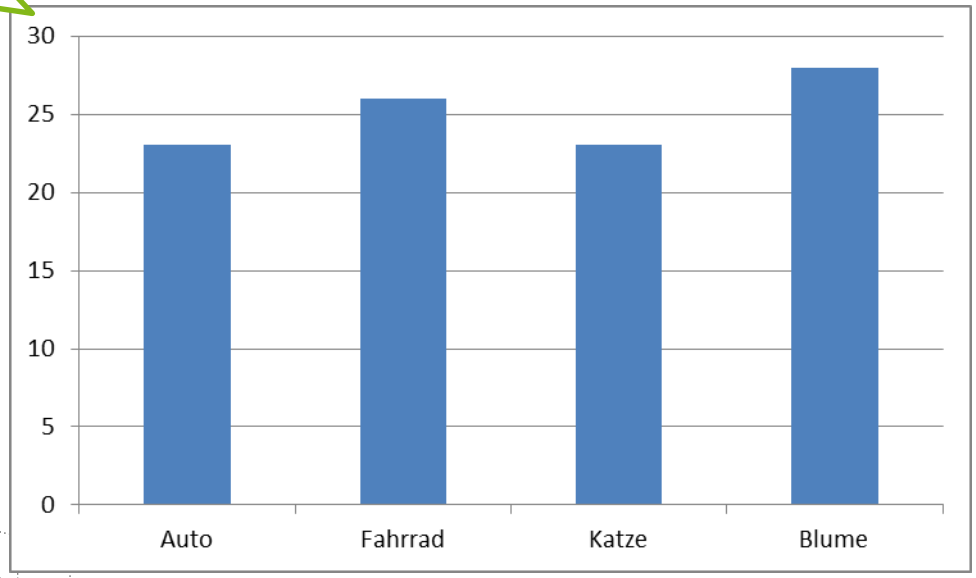

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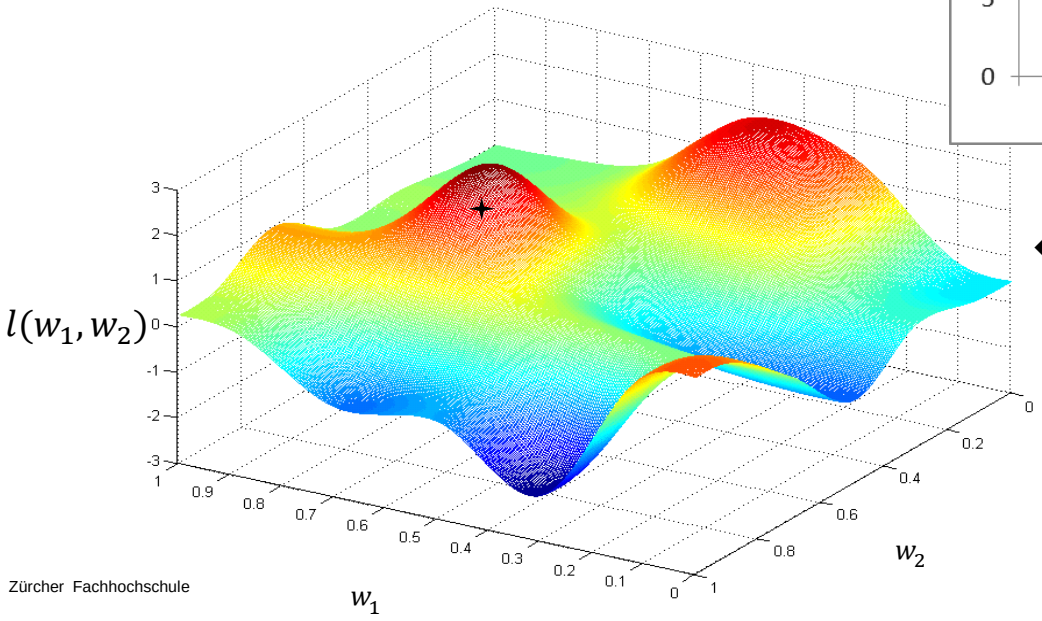

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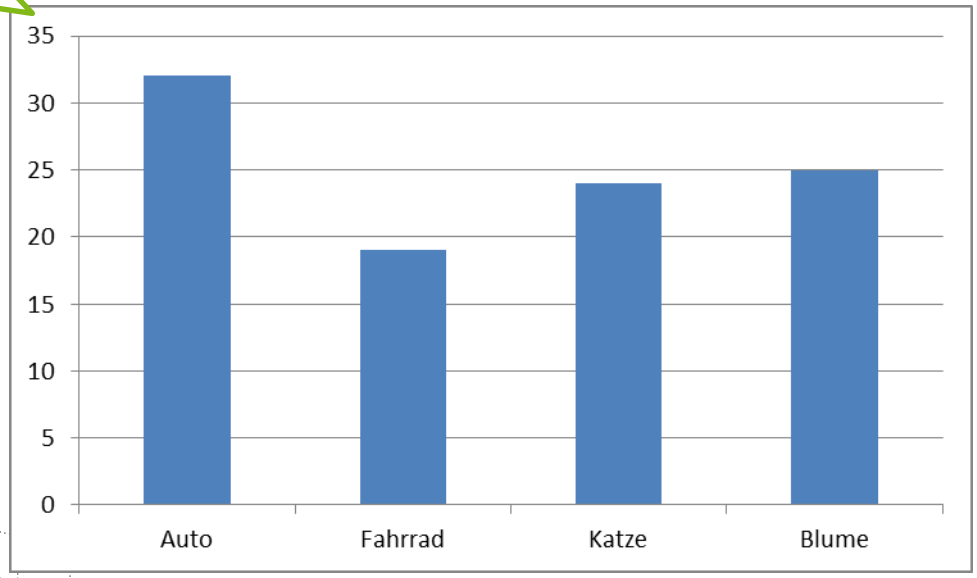

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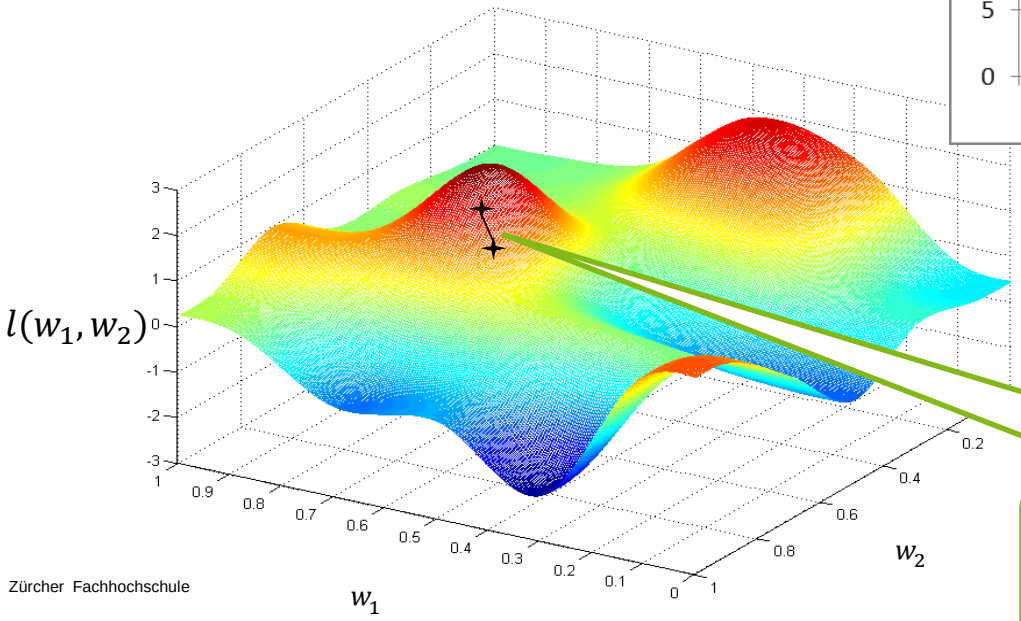

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Methode: Anpassung der Gewichte von f in Richtung der steilsten Steigung (abwärts) von J

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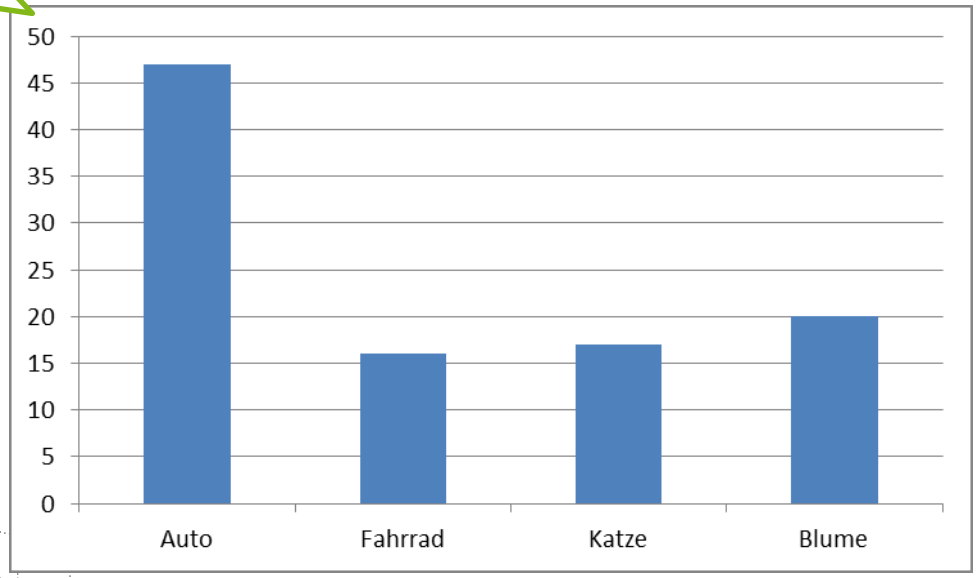

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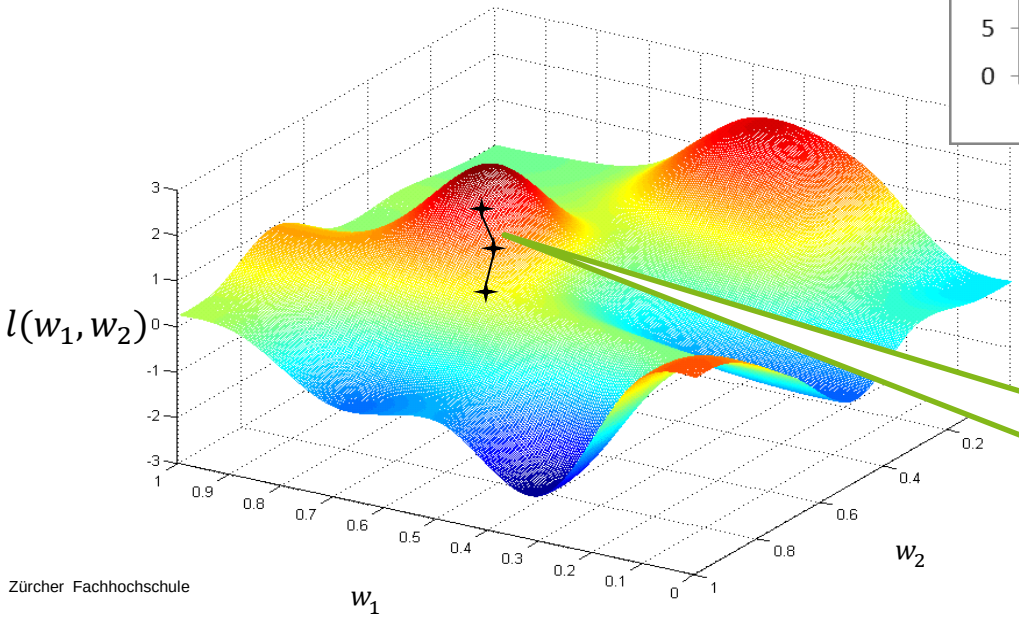

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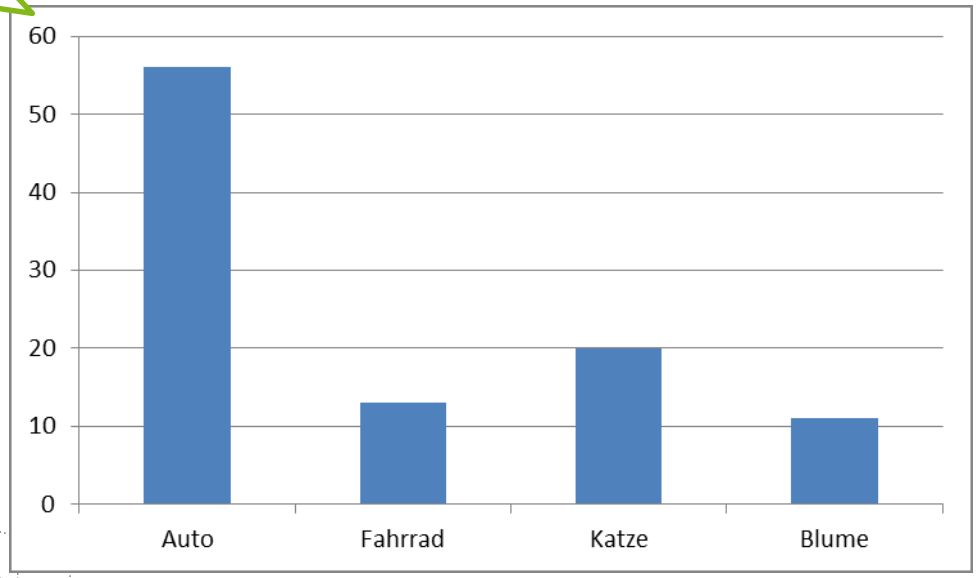

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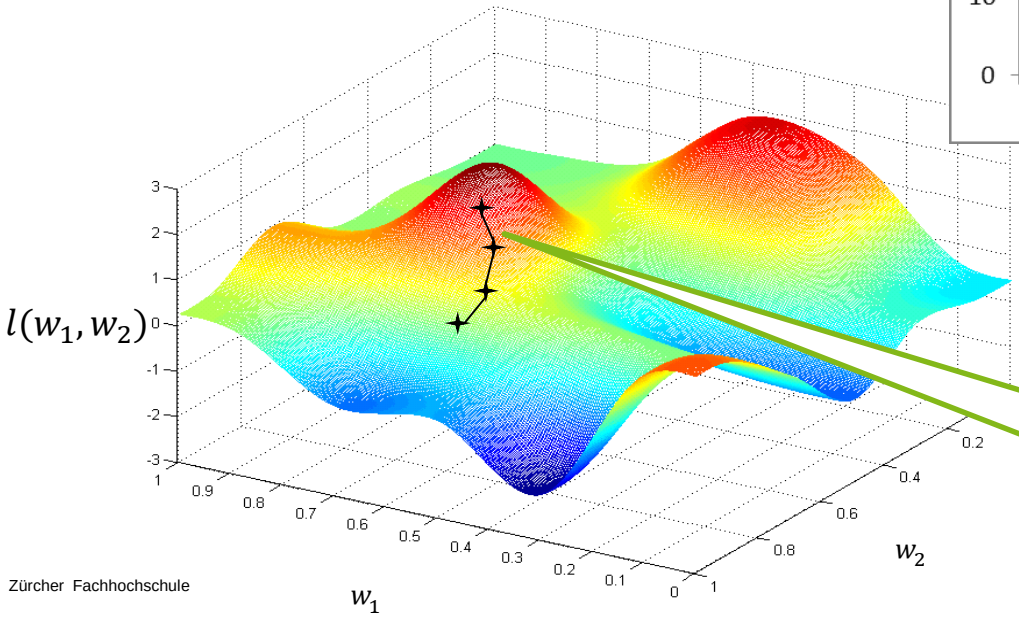

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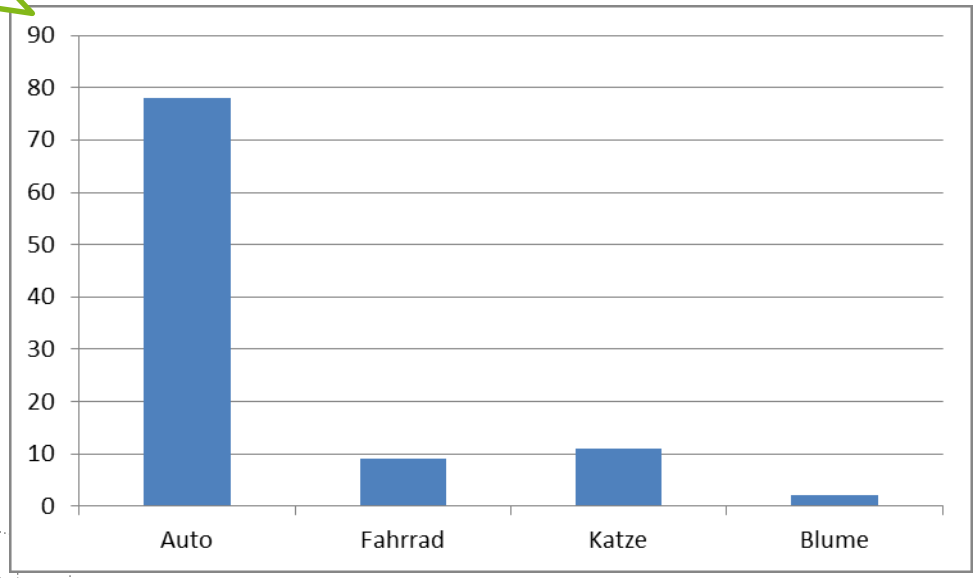

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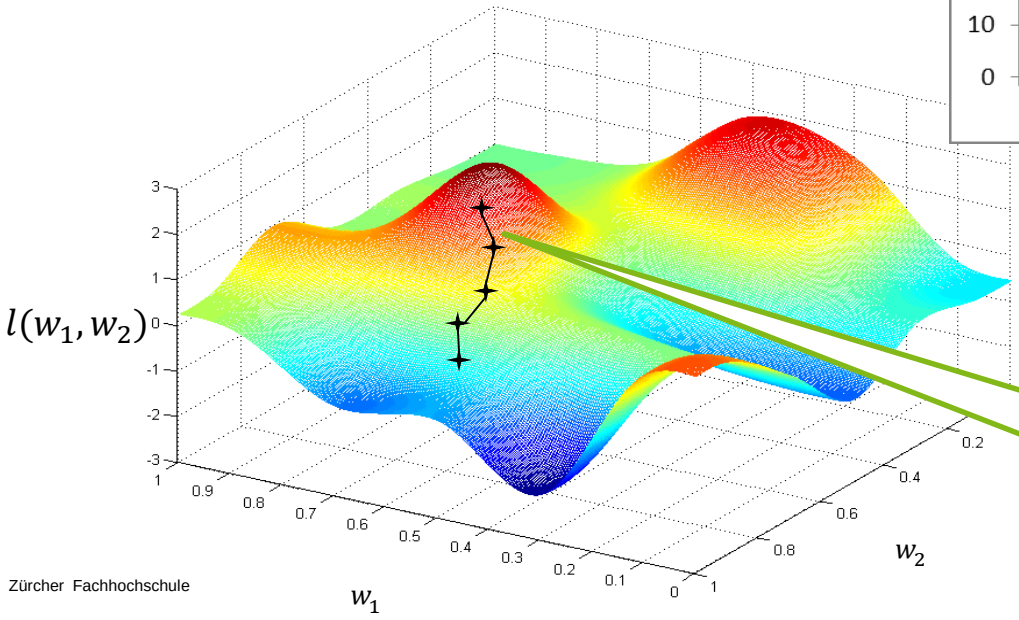

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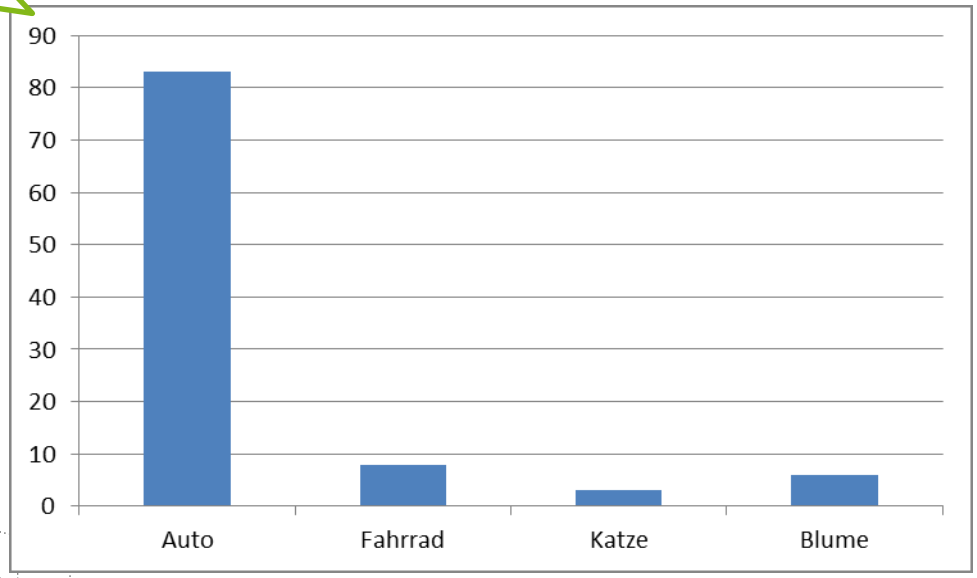

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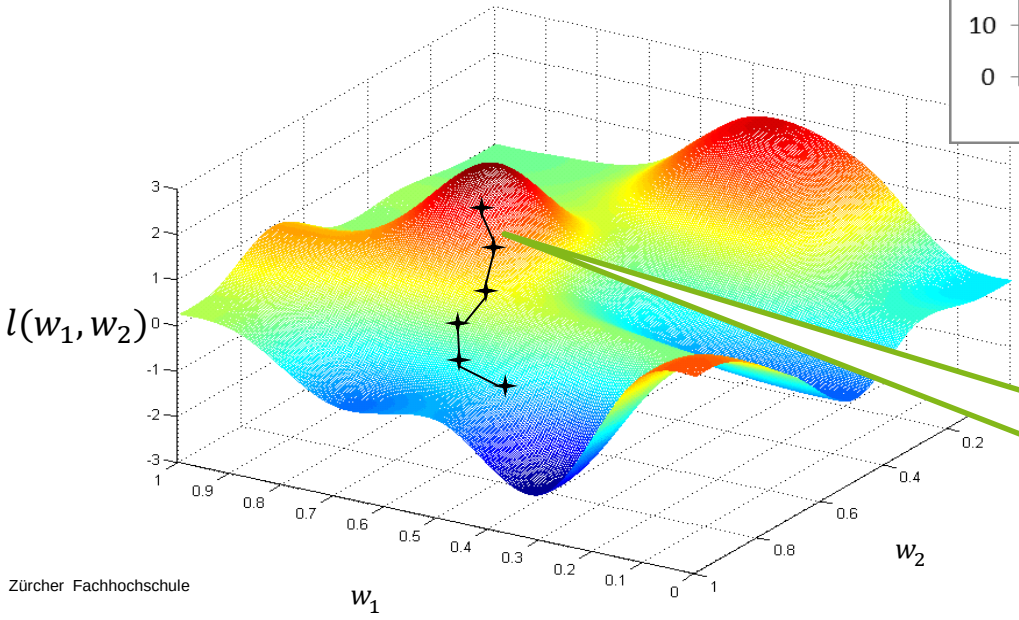

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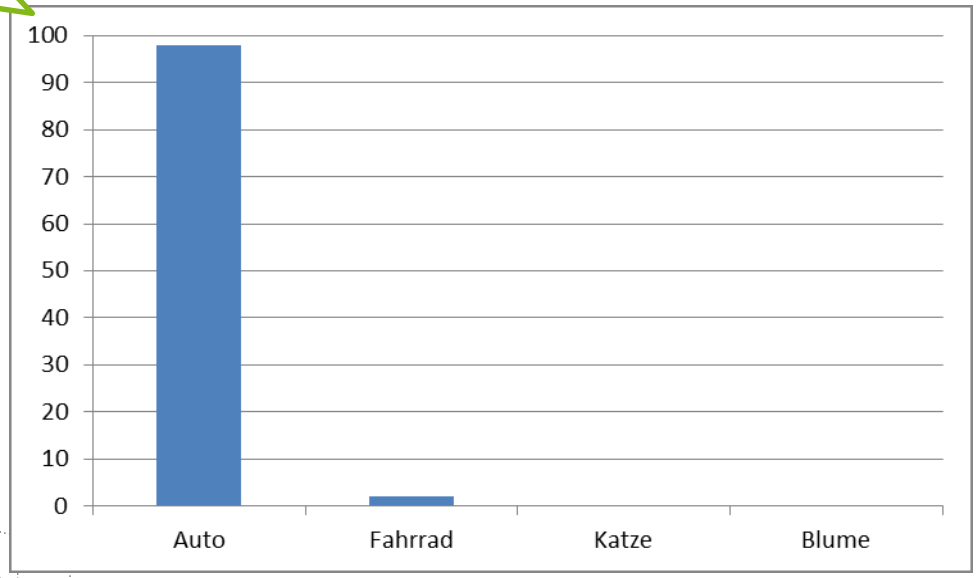

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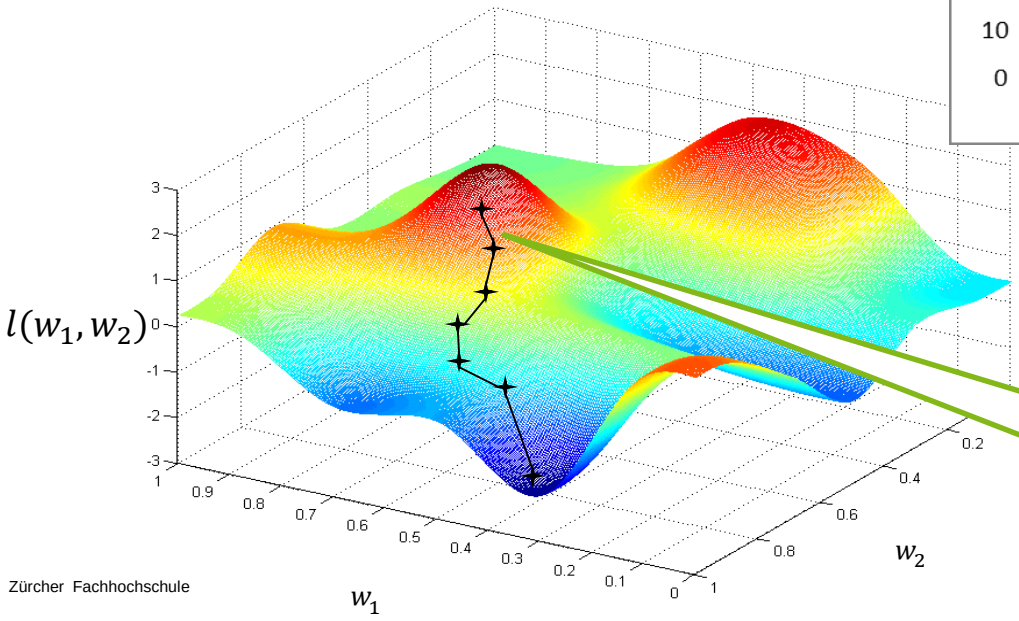

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Methode: Anpassung der Gewichte von f in Richtung der steilsten Steigung (abwärts) von J

Schlussfolgerungen

- Deep Learning hat zu Paradigmenwechsel in *Mustererkennungsaufgaben* geführt
- Die Zeit vom Grundlagenresultat zur praktischer Anwendung beträgt wenige Monate
- Es gibt Methoden zum Hineinschauen in neuronale Black Boxes (siehe Anhang)
- «~~Denkende~~ rechnende» Maschinen sind trotzdem nur *insel(-hoch-)begabt*
  ➔ *Herausforderungen bestehen im Bereich Robustheit, Interpretierbarkeit, rechtl. Stellung*

datalab
www.zhaw.ch/datalab

swiss group for artificial intelligence and cognitive science
SGAICO

data service
Swiss Alliance for Data-Intensive Services

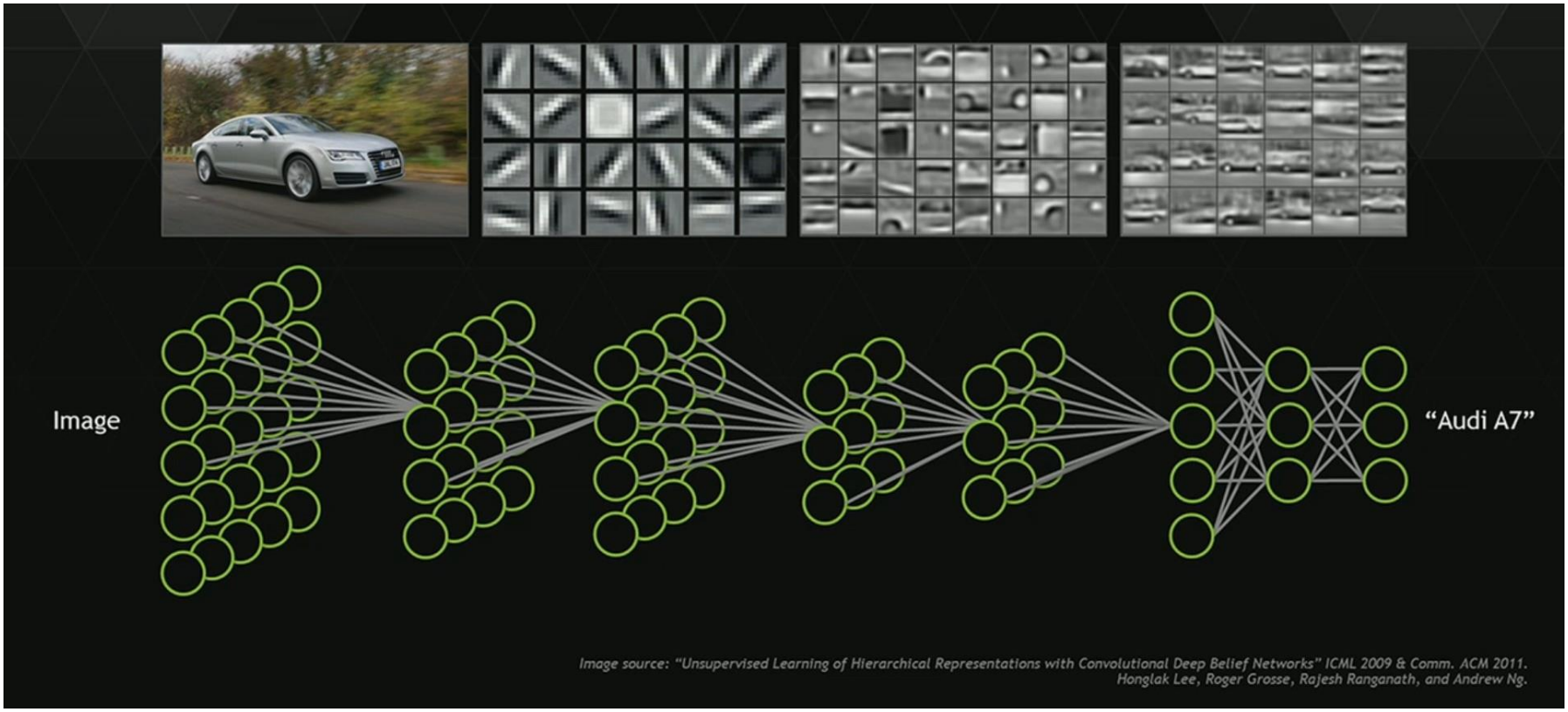
Zu mir:
- Leiter ZHAW Datalab, Vice President SGAICO, Board Data+Service
- thilo.stadelmann@zhaw.ch
- 058 934 72 08
- https://stdm.github.io/

Mehr zum Thema:
- KI: https://sgaico.swissinformatics.org/
- Data+Service Alliance: www.data-service-alliance.ch
- Gemeinsame Projekte: datalab@zhaw.ch

➔ Fragen Sie gerne nach.

ANHANG

Was «sieht» das Neuronale Netz?
Hierarchien komplexer werdender Merkmale



Quellen: https://www.pinterest.com/explore/artificial-neural-network/
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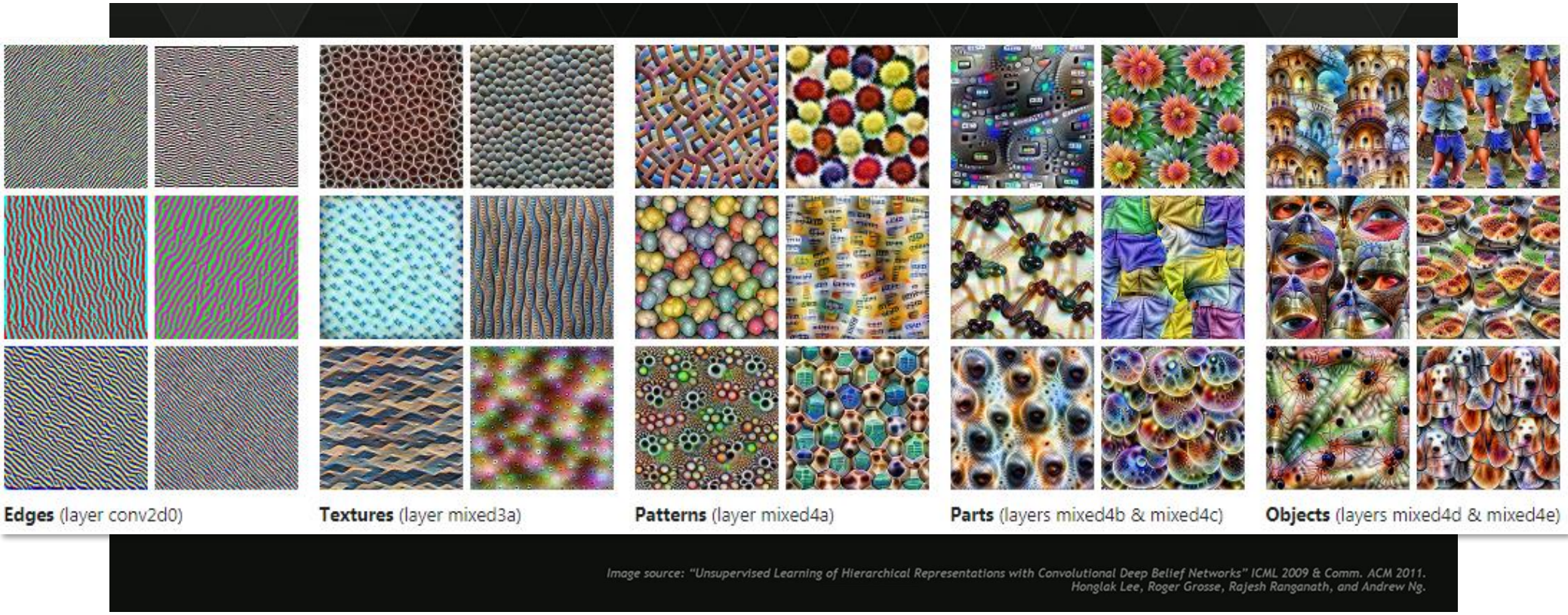

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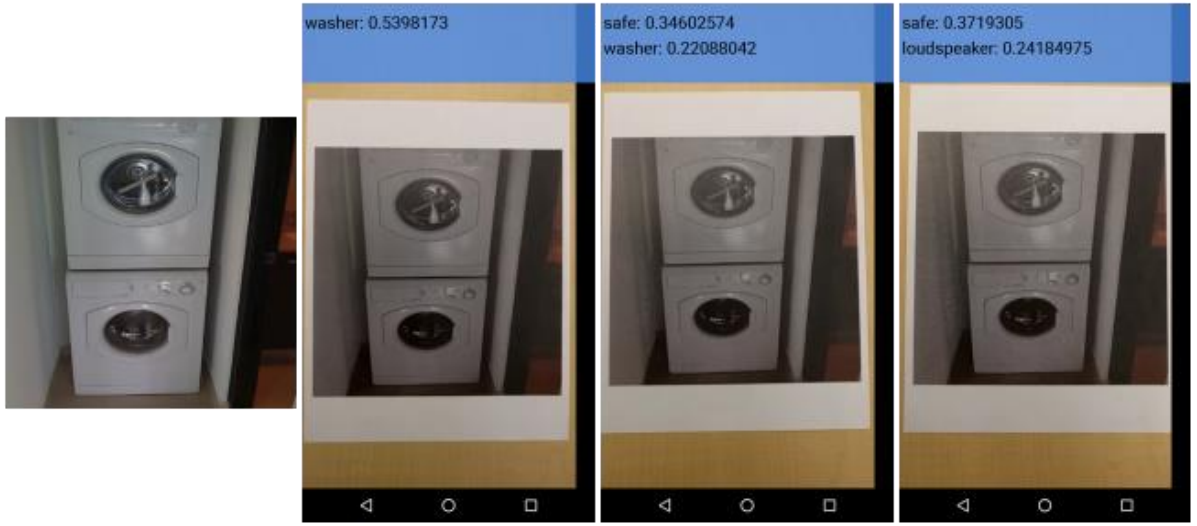
Wie schlussfolgert die Maschine?

«Debugging» für Einblicke in die vermeintliche «Black Box»

Verdeutlichen ein Problem:

- Adversarial Examples



(a) Image from dataset (b) Clean image (c) Adv. image, $\epsilon = 4$ (d) Adv. image, $\epsilon = 8$

https://blog.openai.com/adversarial-example-research/

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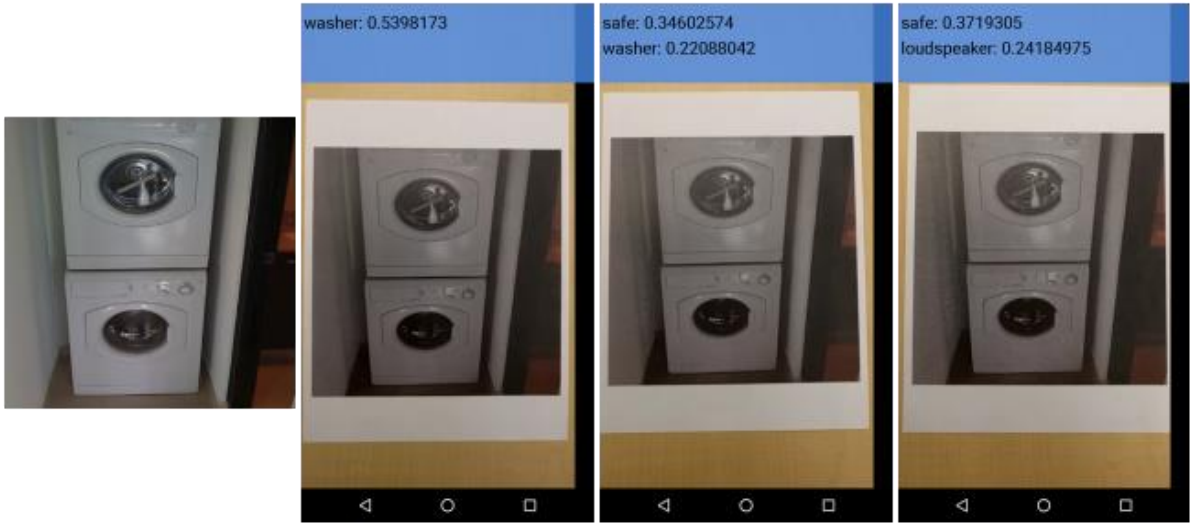

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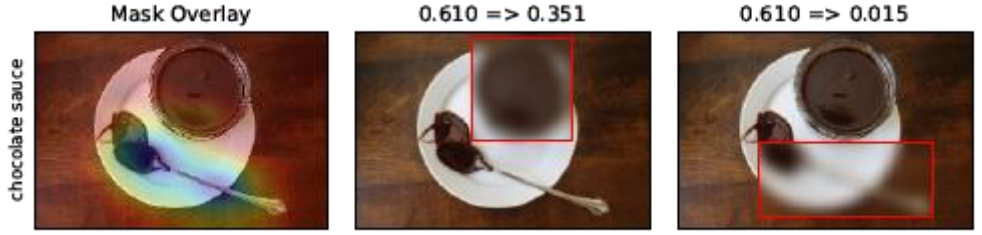
Bieten eine Lösung:

- Saliency Maps

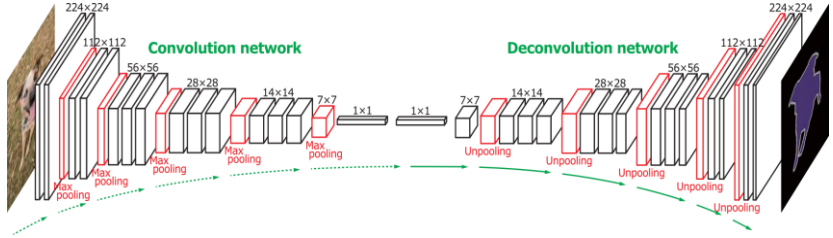


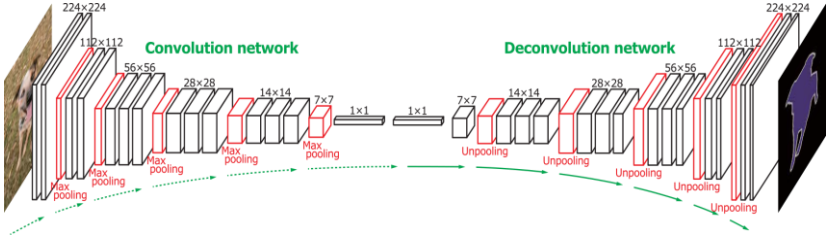
Ruth C. Fong & Andrea Vedaldi, «Interpretable Explanations of Black Boxes by Meaningful Perturbation», 2017

Zürcher Hochschule
für Angewandte Wissenschaften

Erkennung von Musiknotation

Grundlage für Digitalisierung in Orchestern und Musikschulen

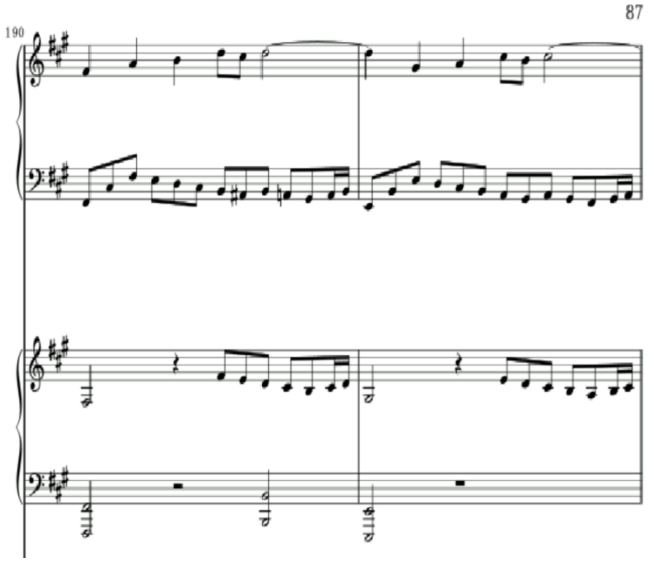




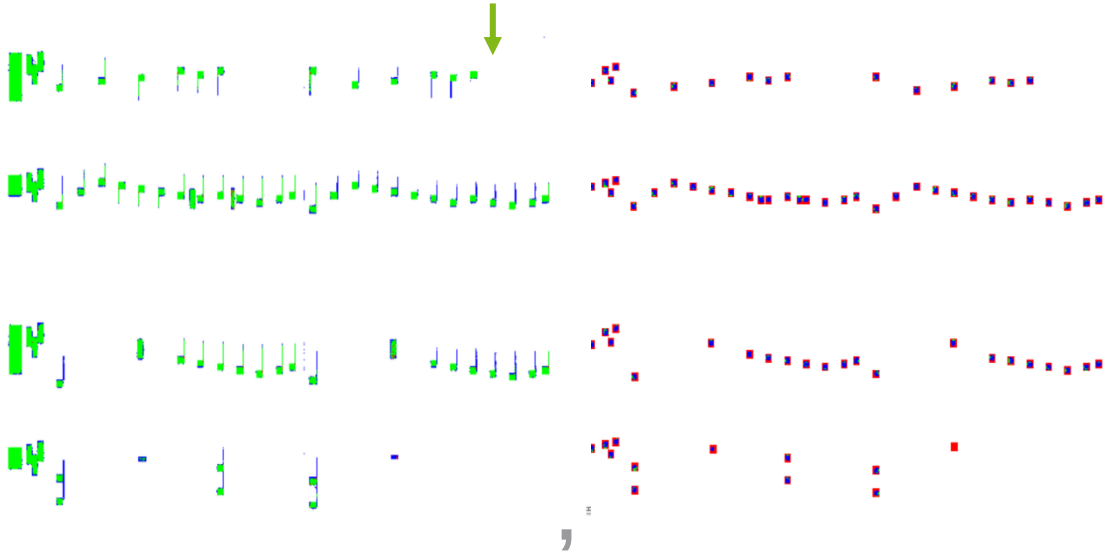
Bild

Label pro Pixel

Objekthaftigkeit



Benannte Symbole



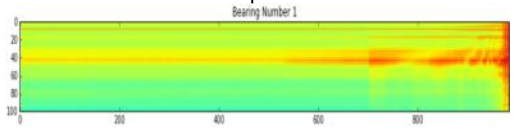
Zürcher Hochschule
für Angewandte Wissenschaften

Datengetriebenes Condition Monitoring

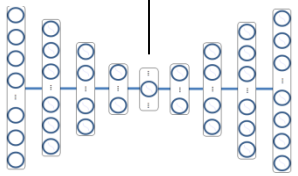
Predictive Maintenance von Rotationsmaschinen

Vibrations-Sensor

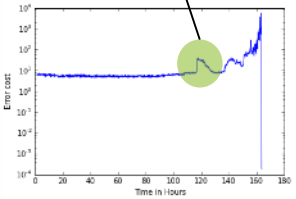
Merkmalsextraktion



z.B. neuronaler Autoencoder



Früherkennung von Fehlern



Segmentierung von Zeitungsartikeln

Semiautomatische Medienbeobachtung