

Was ist, kann und darf Deep Learning?

Dr. Beat Tödtli

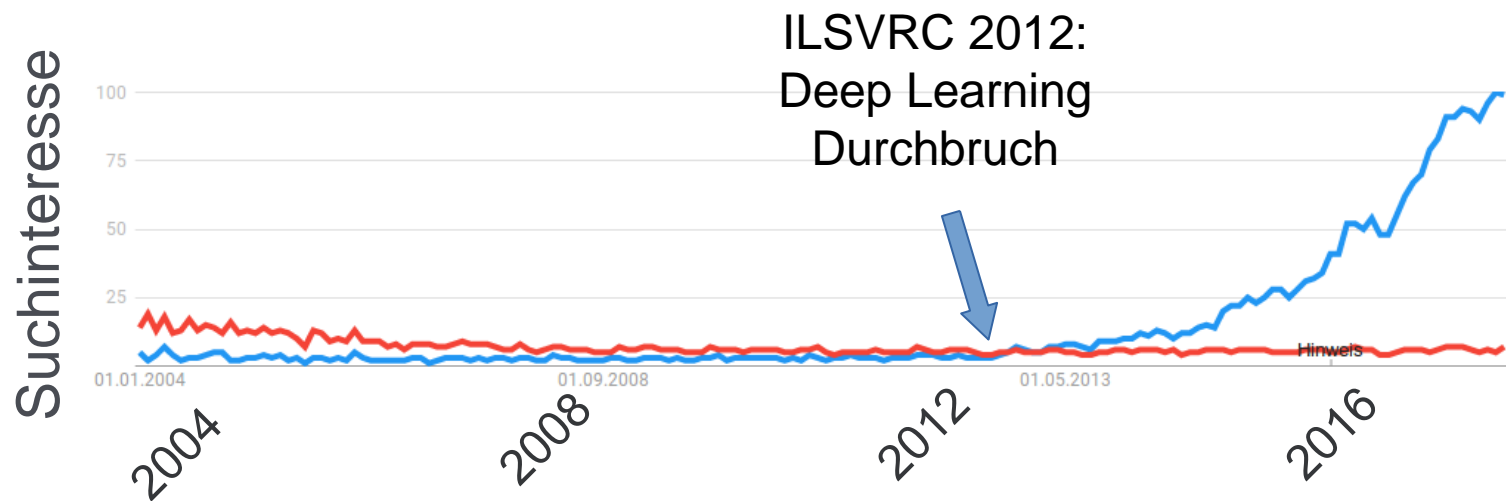
Laboratory for Web Science

15.12.2017

Google Trends für „Deep Learning“



● Deep Learning ● Support Vector Machine





Machine Learning

- Statistisches Lernen ↔ Didaktik
- Erstelle komplexes Steuerungsprogramm ohne explizites Programmieren
- Zeige Beispiele: Steuerungsprogramm wird berechnet
- Lernen: Mathematische Optimierungsaufgabe
- Zentrales Problem: **Verallgemeinerung**





Es gibt nicht nur Deep Learning

Decision Trees Random Forests Support Vector Machines

Ensemble Methods Principal Components Analysis

Expectation Maximisation Matrix Factorisation

Naive Bayes **etc.** Generalized Linear Models

Nearest Neighbour Classification Linear Discriminant Analysis

Networks Adaboost Ridge Regression

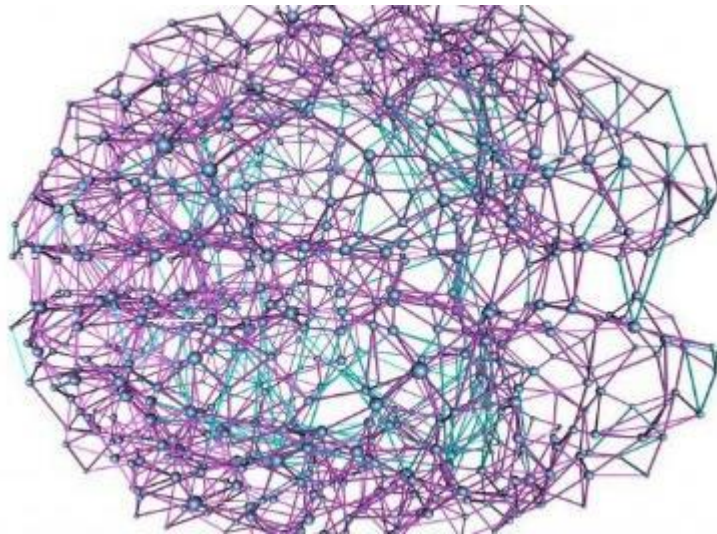
Hidden Markov Models Clustering Data Preprocessing,
Feature Selection

Gaussian Mixtures KMeans Gaussian Processes



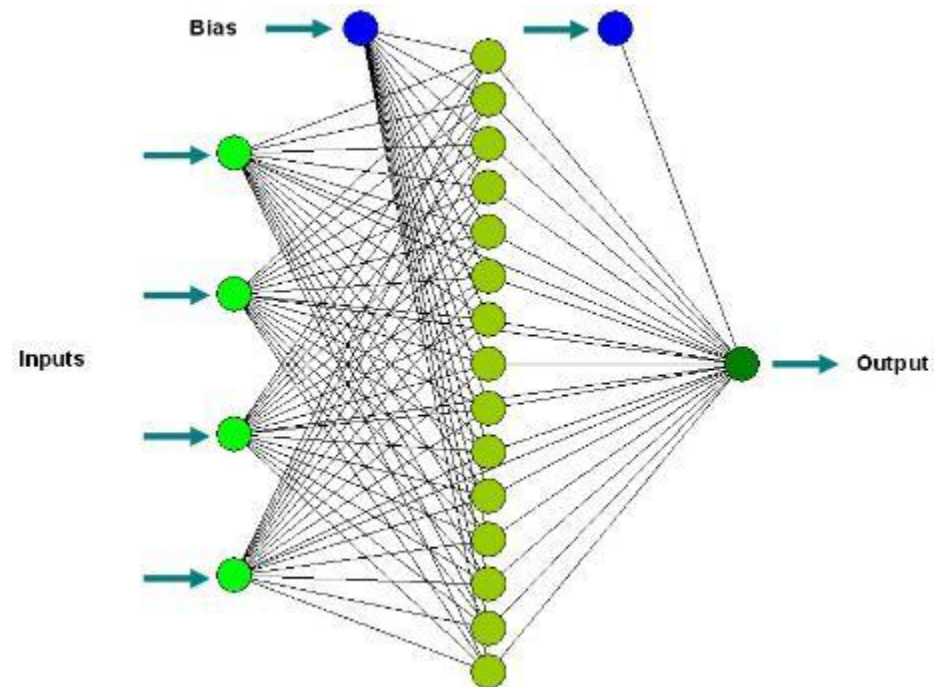
Was sind neuronale Netze?

Neuronales Netz (Gehirn)



~ 100 Milliarden Neuronen

Künstliches neuronales Netz



Neural network topology. Topology of multilayer full feedforward neural network for the estimation of lipase-catalyzed synthesis of palm-based wax ester. Basri et al. BMC Biotechnology 2007 7:53 doi:10.1186/1472-6750-7-53

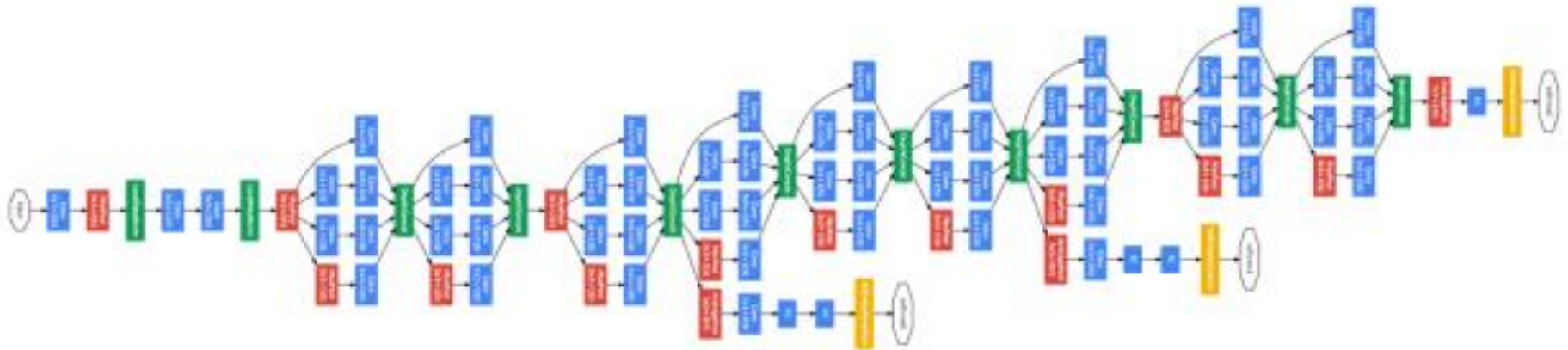
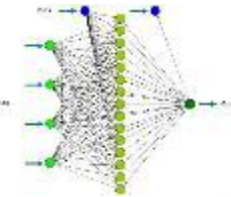


Was ist Deep Learning?

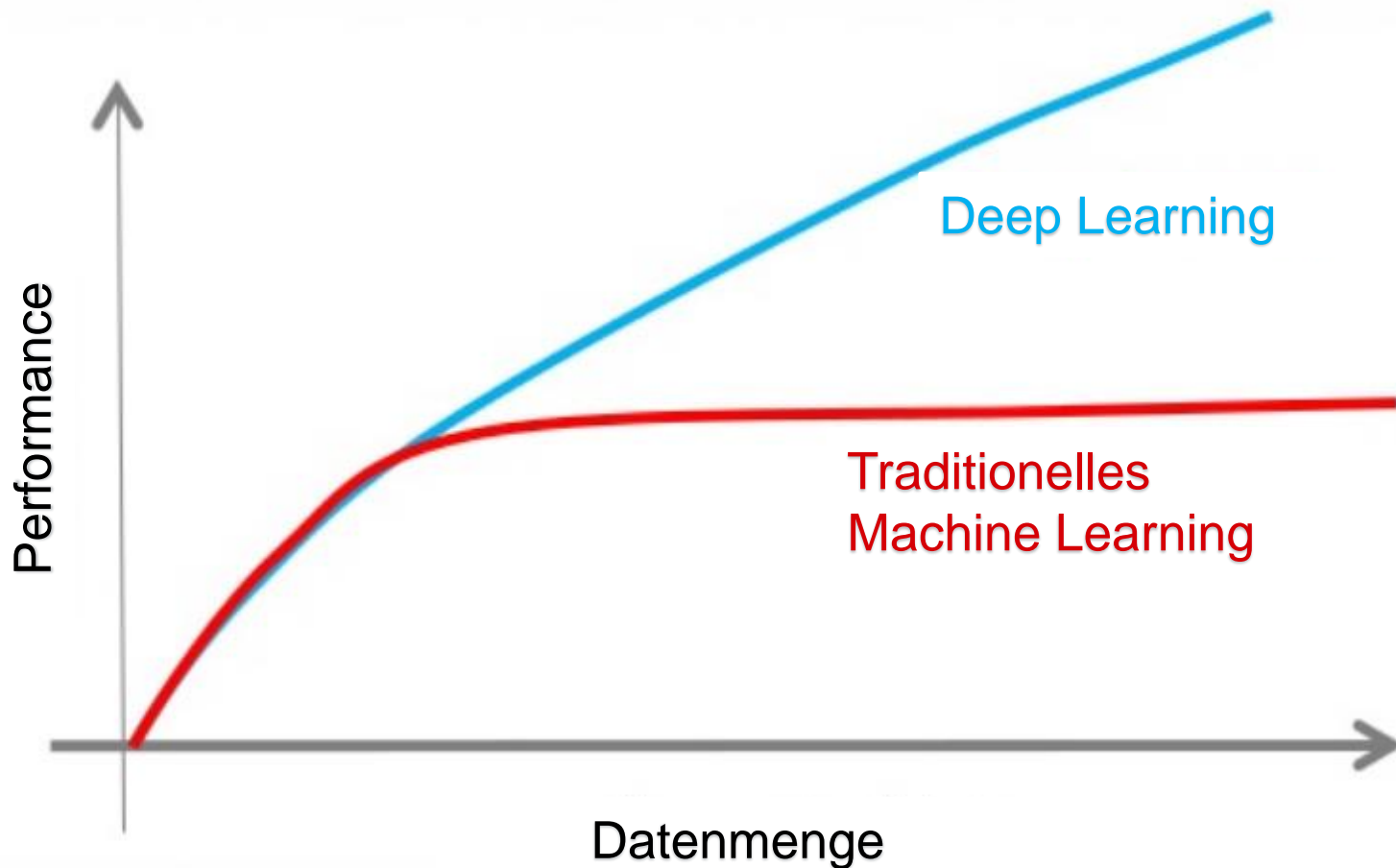
Deep Learning $\stackrel{?}{=}$ tiefe neuronale Netze + Big Data +
effizientere Algorithmen

z.B. Inception, 2014: 22 Schichten
ResNet, 2015: 152 Schichten

1 Schicht:

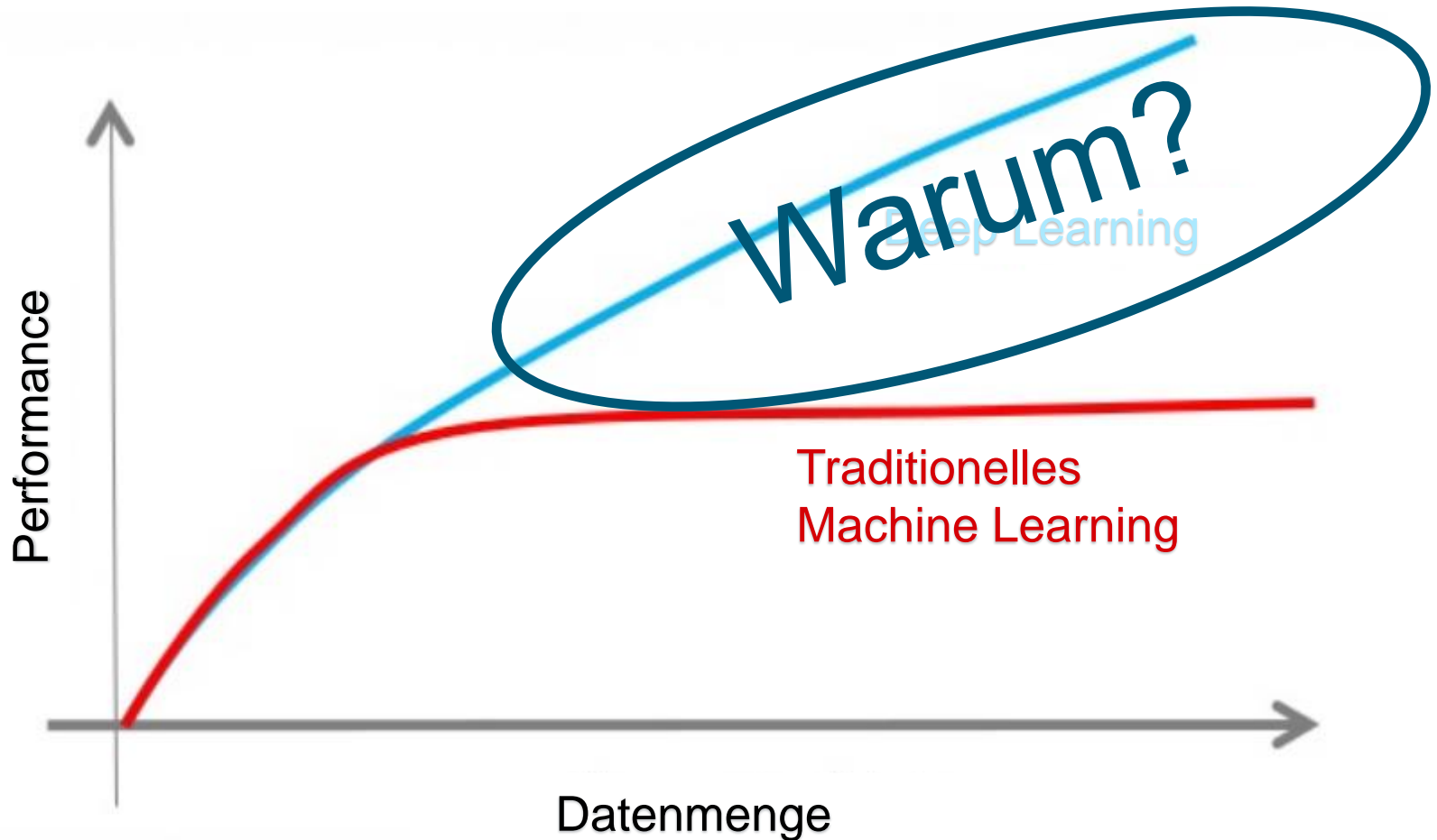


Warum Deep Learning?

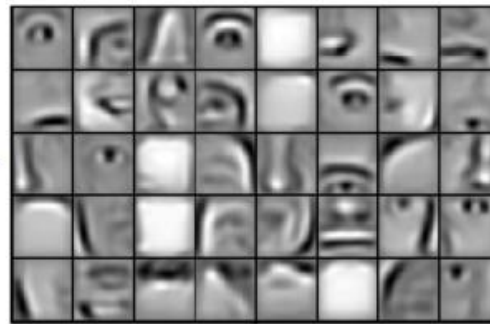
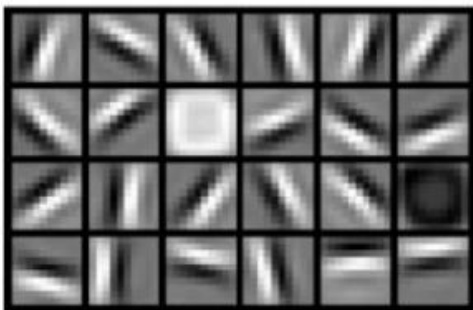


Urheber: Andrew Ng

Warum gewinnt Deep Learning?



Abstrakte Darstellungen von Rohdaten: Bilder





Abstrakter Begriff: „Lächeln“

- NN verstehen die Struktur des Bildraums
- Addieren den „Lächeln-Vektor“ zu bestehendem Bild



<https://github.com/dribnet/plat>

Frau + 0.3 * Lächeln → lächelnde Frau

Frau
↕
Mann

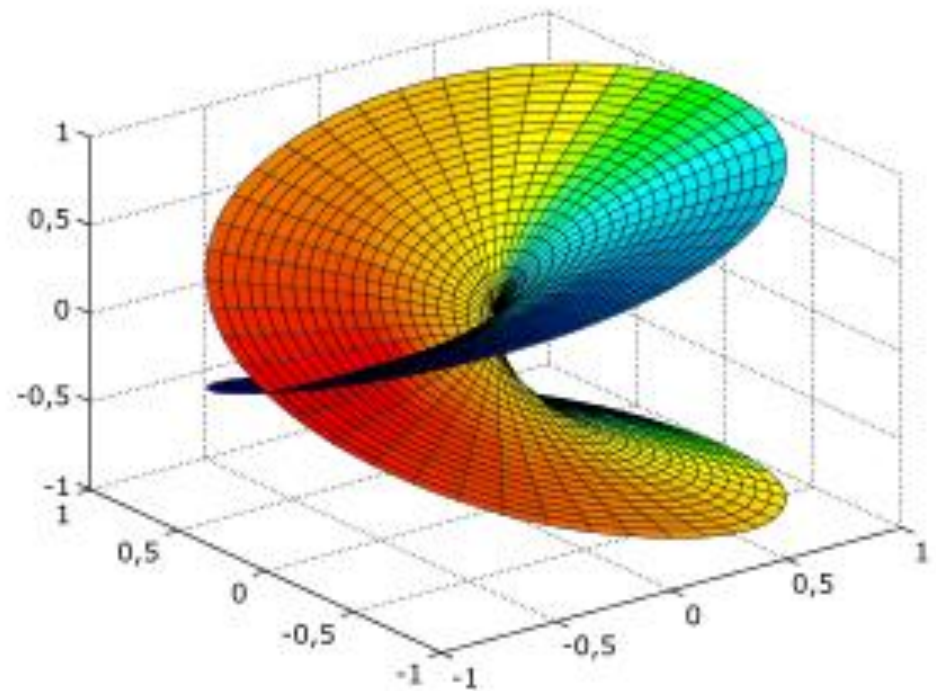


blond ↔ dunkel

Hyperfläche der sinnvollen Bilder

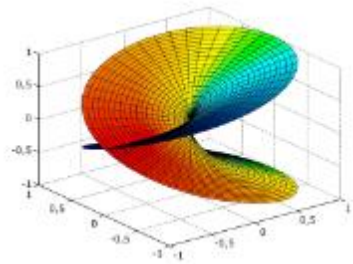


blond \longleftrightarrow dunkel

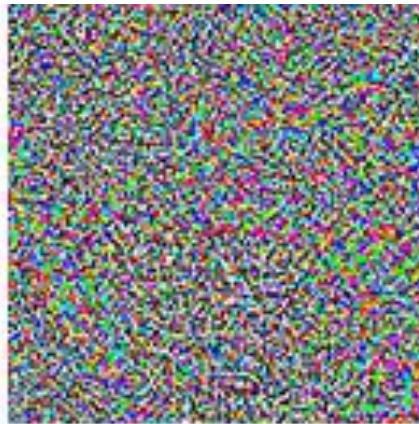


By Leonid 2 (Own work) [<https://creativecommons.org/licenses/by-sa/3.0/>] CC BY-SA 3.0 or <http://www.gnu.org/copyleft/fdl.html> GFDL, https://commons.wikimedia.org/wiki/File%3ARiemann_sqrt.svg via Wikimedia Commons

Adversarial examples



+ ϵ



=



"panda"

57.7% confidence

"gibbon"

99.3% confidence

Goodfellow, Shlens, Szegedy 2014, arxiv.org/pdf/1412.6572.pdf

Style transfer



A



C



Nehme Kunststil von hier (V. Van Gogh)...

...und übertrage ihn auf das Foto!

Style transfer



(V. Van Gogh)



(E. Munch)

Loving Vincent (2017)

- 125 Maler
- 65'000 Bilder



Abstrakte Darstellungen von Rohdaten: Text



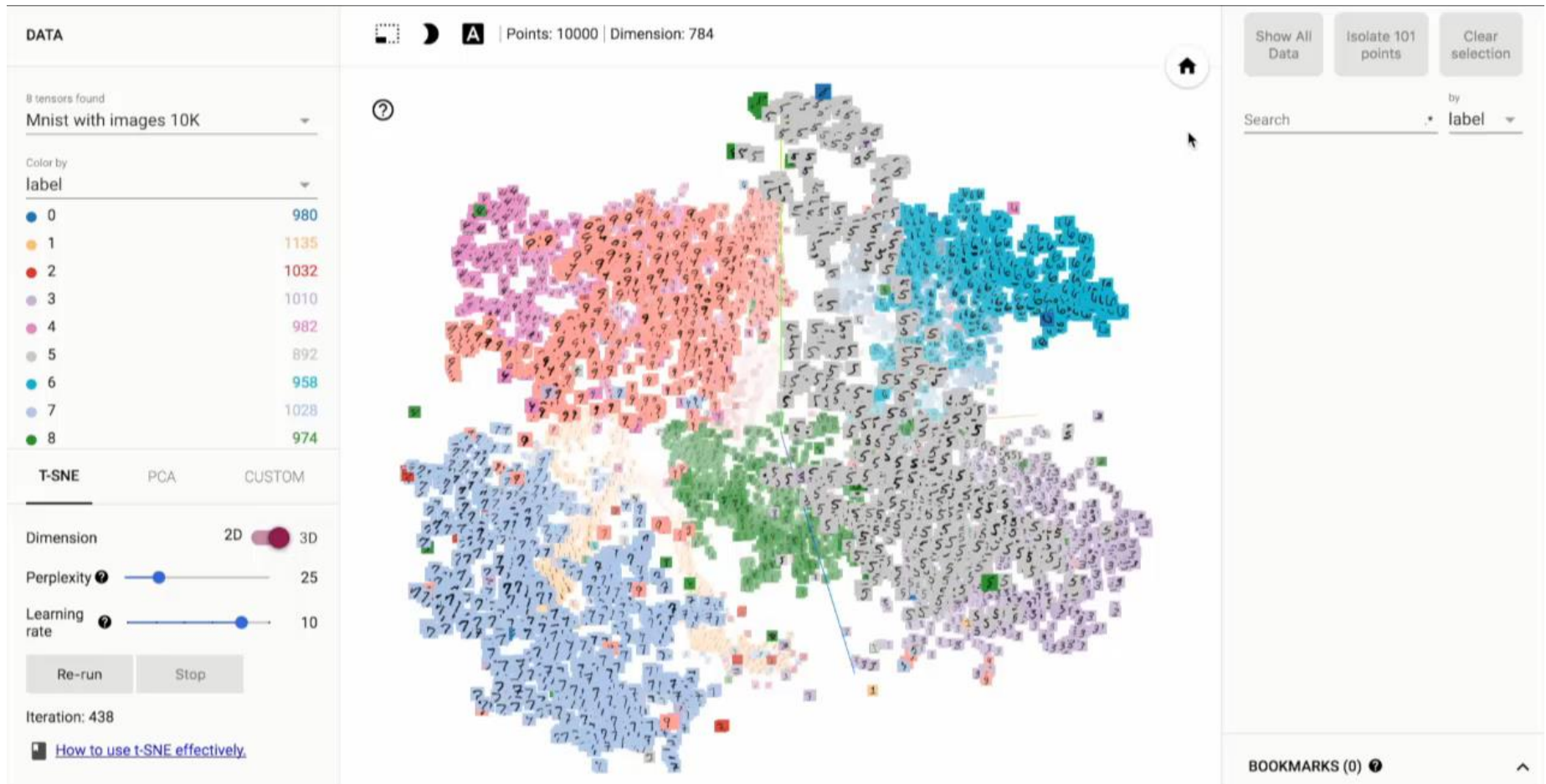
- Bsp. Word2Vec:

Rom – Italien + Frankreich → Paris

$$\begin{pmatrix} 1 \\ 1 \\ 1 \\ 0 \end{pmatrix} - \begin{pmatrix} 0 \\ 1 \\ 1 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 0 \\ 0 \\ 1 \end{pmatrix} \rightarrow \begin{pmatrix} 1 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$



Visualisierung von Embeddings





Fashwell



Reinforcement Learning in AlphaGo: allgemeine Lernfähigkeit



- Erstes System, das **allgemein** lernt?
- **Kreativität von Maschinen**





Eine neue Informatik?

- Computer lernen, abstrakte Begriffe zu verstehen

Formale Sprache



informelle Sprache

```
using namespace sf;

class Player {
public:
    Player();
    Player(int i);
    RectangleShape* getShape();
    float points = 1;
    const Joystick* joystick;
private:
    RectangleShape shape;
};

14 Player::Player(int i, *Joystick j){
15     shape = RectangleShape(Vector2<float>(50,50));
16     shape.setFill(Color(100+(i*150), 250-(150*
17     joystick = j;
18
19 }
```



robot-ears.eu

<https://www.flickr.com/photos/qubodup/16708290022>

„Informelle Informatik“



Steuerung,
Programmierung



Training, „Dressur“
Erziehung

~~Nachvollziehbarkeit~~



Haftung?

Neue Aufgaben für Informatiker?



Bisher

- Dokumentation
- Tests, Validierung
- Mehrwert schaffen

Neu

- Nachvollziehbarkeit?
- Soziale Akzeptanz
- Ethik – Dialog:
Was soll und darf KI?



Herausforderungen, technisch

- **25'000 Bilder für so was Triviales?!**
- Kleine Datensätze
- Spracherkennung, Chatbots
- Lernen von Verhalten
- ...



politische und soziale Herausforderungen

- **Fake Video-Anrufe!**
(Deklarationspflicht?)
- **Technologievorherrschaft?**
- **Wertevorgaben an KI-Systeme:**
 - Z.B. Rassismus-Problematik



Würde?



Silizium vs. Kohlenstoff?

Komplexe Maschine → Moralisches
Subjekt?

Komplexität

Lernfähigkeit



Dankeschön!

Backup Slides

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Weitere Anwendungen

- Lippensynchronisation, Videogeneration von Obama-Audio
- Sprachsynthese aus Text
- WaveNet: Sprachsynthese aus Text -> Fake Radio News ?
- Chopin-Musikgeneration

Noch mehr Transfer abstrakter Eigenschaften



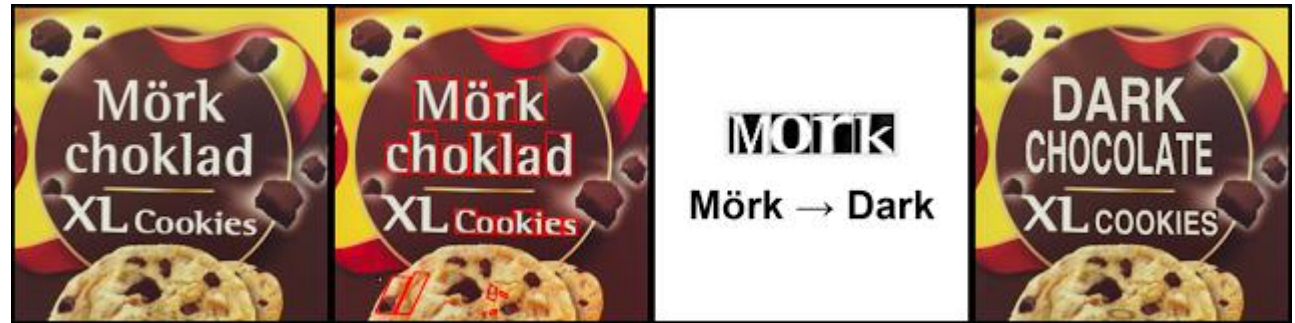
- <https://youtu.be/XOxxPcy5Gr4?t=1m47s>
- Ergibt sinnvolle neue Beispiele



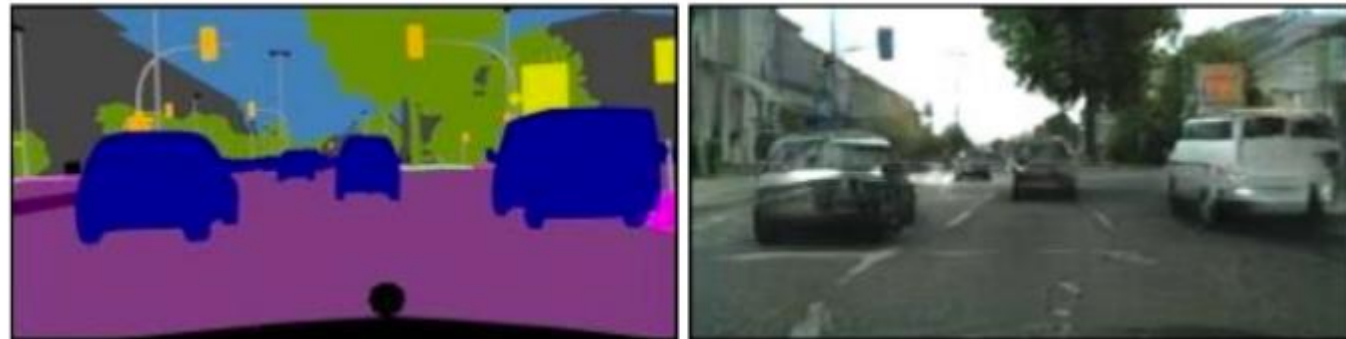


Weitere Anwendungen

- Übersetzung



- Segmentierung



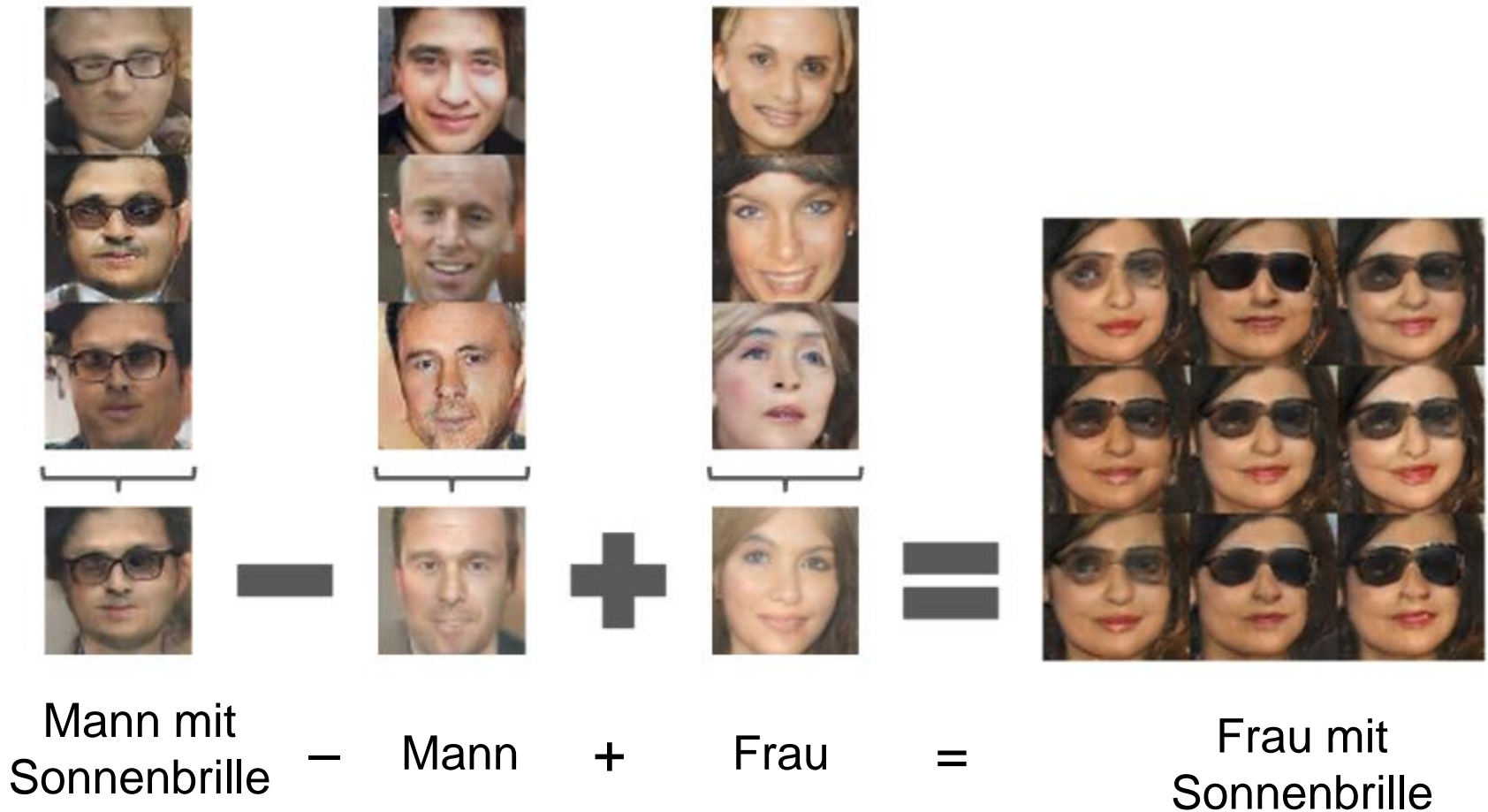
- Vervollständigung



input

output

Abstraktee Begriffe Mann, Frau und Brille





Anwendungen

■ Wikipedia-Artikelschreiben

```
Naturalism and decision for the majority of Arab countries' capitalide was grounded
by the Irish language by [[John Clair]], [[An Imperial Japanese Revolt]], associated
with Guangzham's sovereignty. His generals were the powerful ruler of the Portugal
in the [[Protestant Immineners]], which could be said to be directly in Cantonese
Communication, which followed a ceremony and set inspired prison, training. The
emperor travelled back to [[Antioch, Perth, October 25|21]] to note, the Kingdom
of Costa Rica, unsuccessful fashioned the [[Thrales]], [[Cynth's Dajoard]], known
in western [[Scotland]], near Italy to the conquest of India with the conflict.
Copyright was the succession of independence in the slop of Syrian influence that
was a famous German movement based on a more popular servicious, non-doctrinal
and sexual power post. Many governments recognize the military housing of the
[[Civil Liberalization and Infantry Resolution 265 National Party in Hungary]],
that is sympathetic to be to the [[Punjab Resolution]]
(PJS)[http://www.humah.yahoo.com/guardian.
cfm/7754800786d17551963s89.htm Official economics Adjoint for the Nazism, Montgomery
was swear to advance to the resources for those Socialism's rule,
was starting to signing a major tripad of aid exile.]]
```

Generative Adversarial Networks



<https://www.flickr.com/photos/190673196>



Machine Learning

- Deep Learning ein Untergebiet des Machine Learning
- Man vergesse die nicht!
- Es gibt einfachere Machine Learning Techniken, welche
 - Mit 20% des Aufwands...
 - ...80% des Ertrags rausholen
- Deep Learning ist nur in Teilbereichen erfolgreich
- Deep Learning hat das Potenzial zur Killerapp: Selbstfahrende Autos, Digital Doctor
- Immer noch gilt: Zuerst einfachere Methoden ausprobieren!

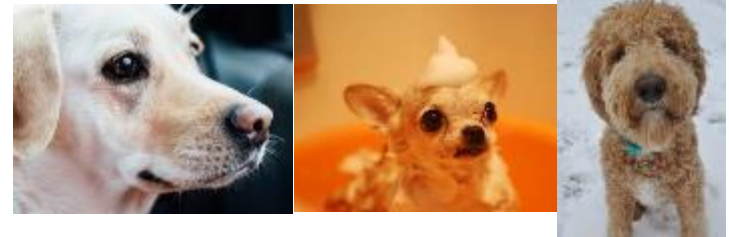


Machine Learning 101

- **Supervised Learning:** Unterscheide Katzen von Hunden



Vs.



- **Unsupervised Learning:** Finde nützliche Struktur in Daten

- **Reinforcement Learning:** Lerne ein Verhalten

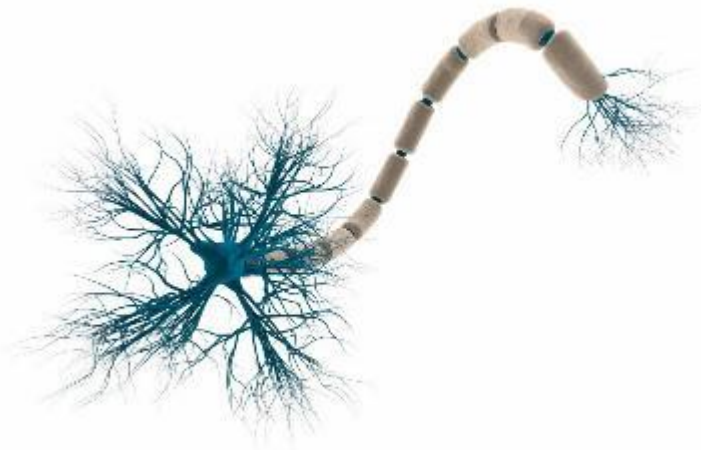
- Laufen,
- Computerspiele
- Autofahren



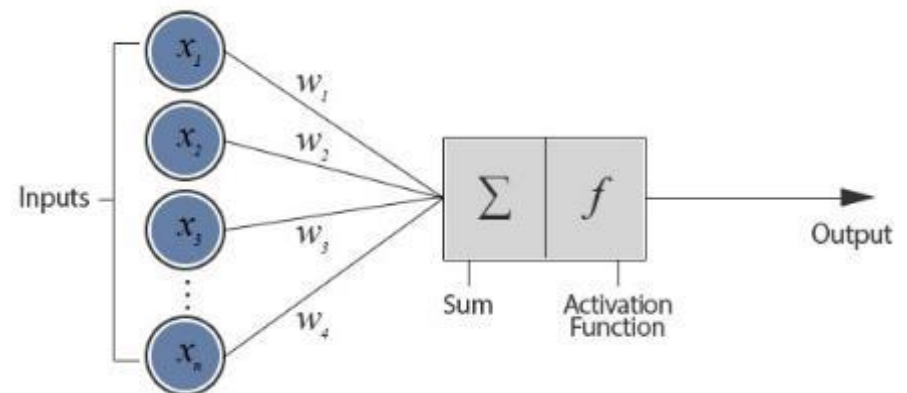
Was sind Neuronen?



Neuron (Gehirnzelle)



Neuron (Perzeptron)



<http://www.theprojectspot.com/tutorial-post/introduction-to-artificial-neural-networks-part-1/7>

<http://www.milad.no/2015/02/07/creating-a-3d-neuron-scene-in-blender/>

Northeastern University. "Organization of human brain is nearly ideal: New research reveals that structure of the human brain has an almost ideal network of connections." ScienceDaily. ScienceDaily, 7 July 2015. <www.sciencedaily.com/releases/2015/07/150707120101.htm>.