

Die ZWEITE Welle der KI

- wo ist sie? -

- Prof. Dr. Ulf Lorenz
- Lehrstuhl für Technologiemanagement
- Vorstandssprecher des Siegener Mittelstandsinstituts SMI

Starter

Haben Sie schon einmal
über folgende Fragen
nachgedacht?

Starter

- Warum gibt es
 - GPS, aber **kein Galileo**?
 - die google Suchmaschine in USA,
und
nichts vergleichbares in Europa?
 - Siri, aber **keinen Siggi**
 - ...

Starter

- Warum

- haben google und Uber selbstfahrende Autos, aber sonst niemand?
- verkündet google einen Siegeszug nach dem anderen in Computerspielen wie Go, StarCraft, League of Legends etc., aber niemand in Europa?

Weil hier keiner weiss,
wie das geht.

Inhalt

I. Der neue Boost in der KI

1. Der sichtbare Teil

- Autonome Fahrzeuge, Intelligente, RoboterKommunikationsfreudige Geräte, Computerspiele

2. Technologische Ebene

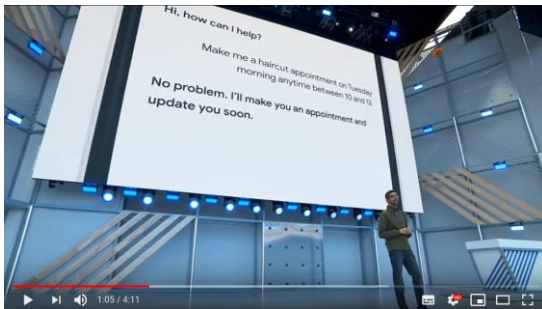
- Neuronale Netze
- Intelligenz + Lernen = Baumsuche + Neuronale Netze
- Autonome Fahrzeuge

II. KI - oder doch nur KI-light? Was können wir tun, was nicht?

Der neue Boost in der KI - sichtbarer Teil -

Googles: ganz weit vorne

2014 -
2017,
1,5
mio
km



<https://kotaku.com/googles-deepmind-ai-just-beat-two-pros-at-starcraft-ii-1832034863>

<https://deepmind.com/blog/deepmind-and-blizzard-open-starcraft-ii-ai-research-environment/>

<https://deepmind.com/blog/alphastar-mastering-real-time-strategy-game-starcraft-ii/>

<https://news.blizzard.com/de-de/starcraft2/21509421/gesprach-mit-dem-deepmind-starcraft-ii-team>

<https://www.heise.de/download/product/starcraft-ii-93620?hg=1&hgi=2&hgf=false>

<https://www.youtube.com/watch?v=D5VN56jQMWM>

<https://www.bgr.in/news/google-deepmind-alphago-vs-lee-sedol-googles-ai-claims-victory-over-go-world-champion/>

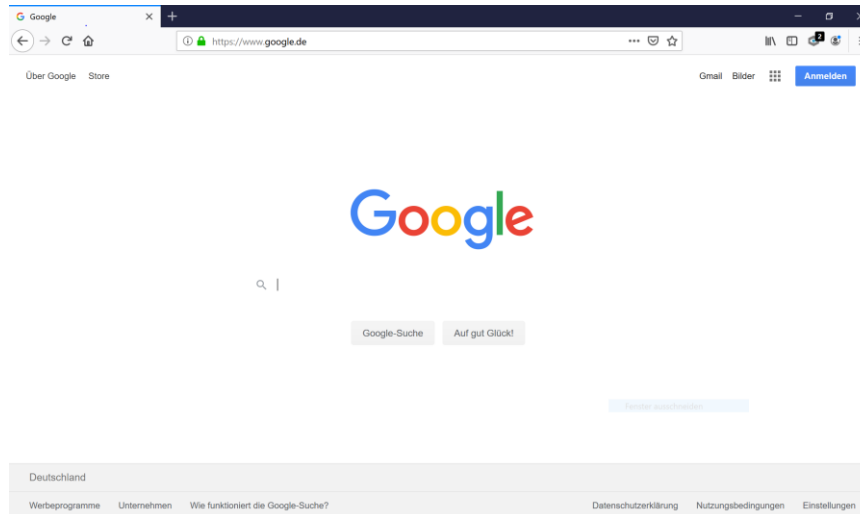
<https://www.youtube.com/watch?v=rVlhMGQgDkY>

<https://www.googlewatchblog.de/2017/06/rip-weiterentwicklung-waymo-google/>

- nicht sichtbarer Teil -

Ein Blick in die
Schlüsseltechnologien

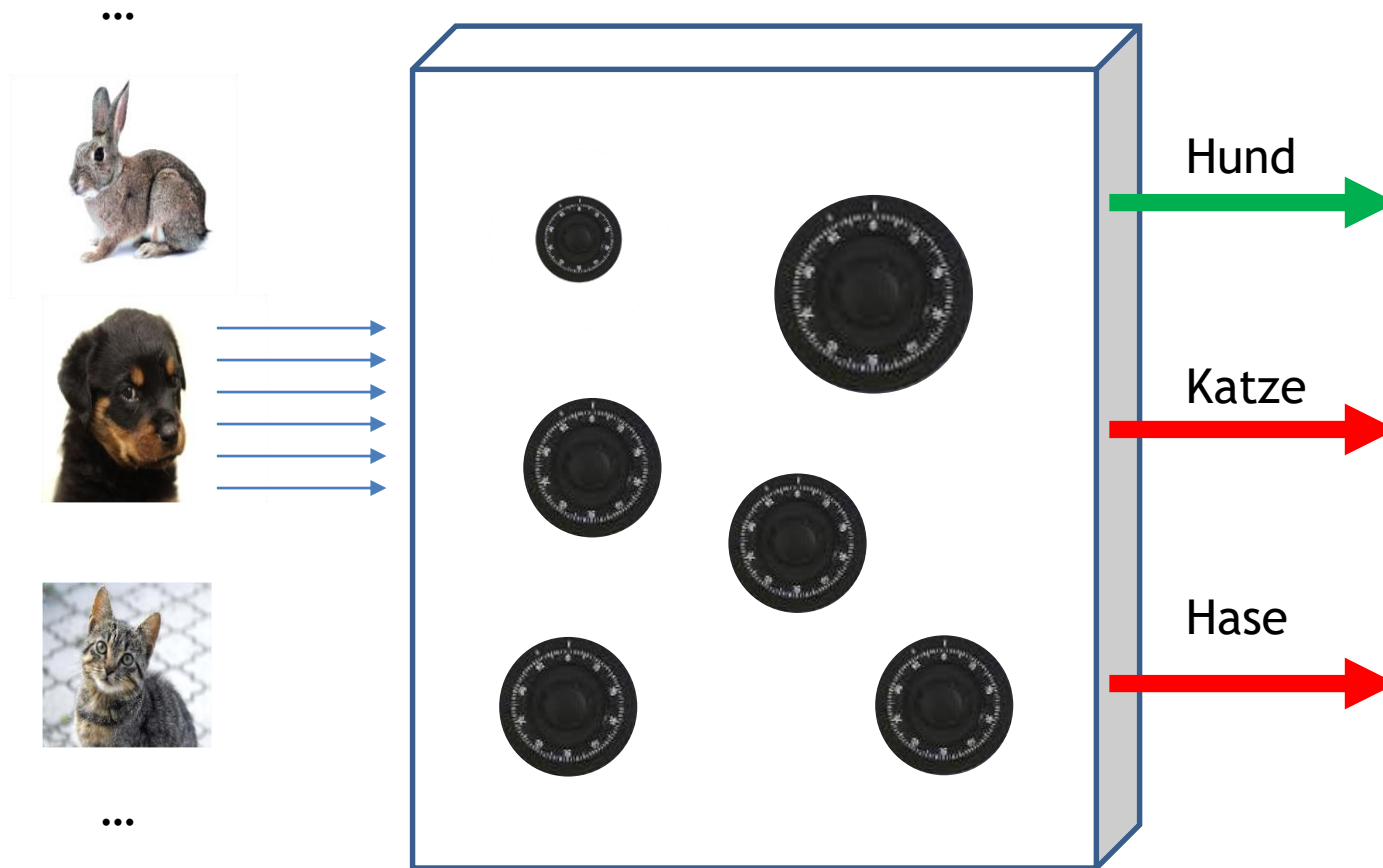
Googles Suchschlitz



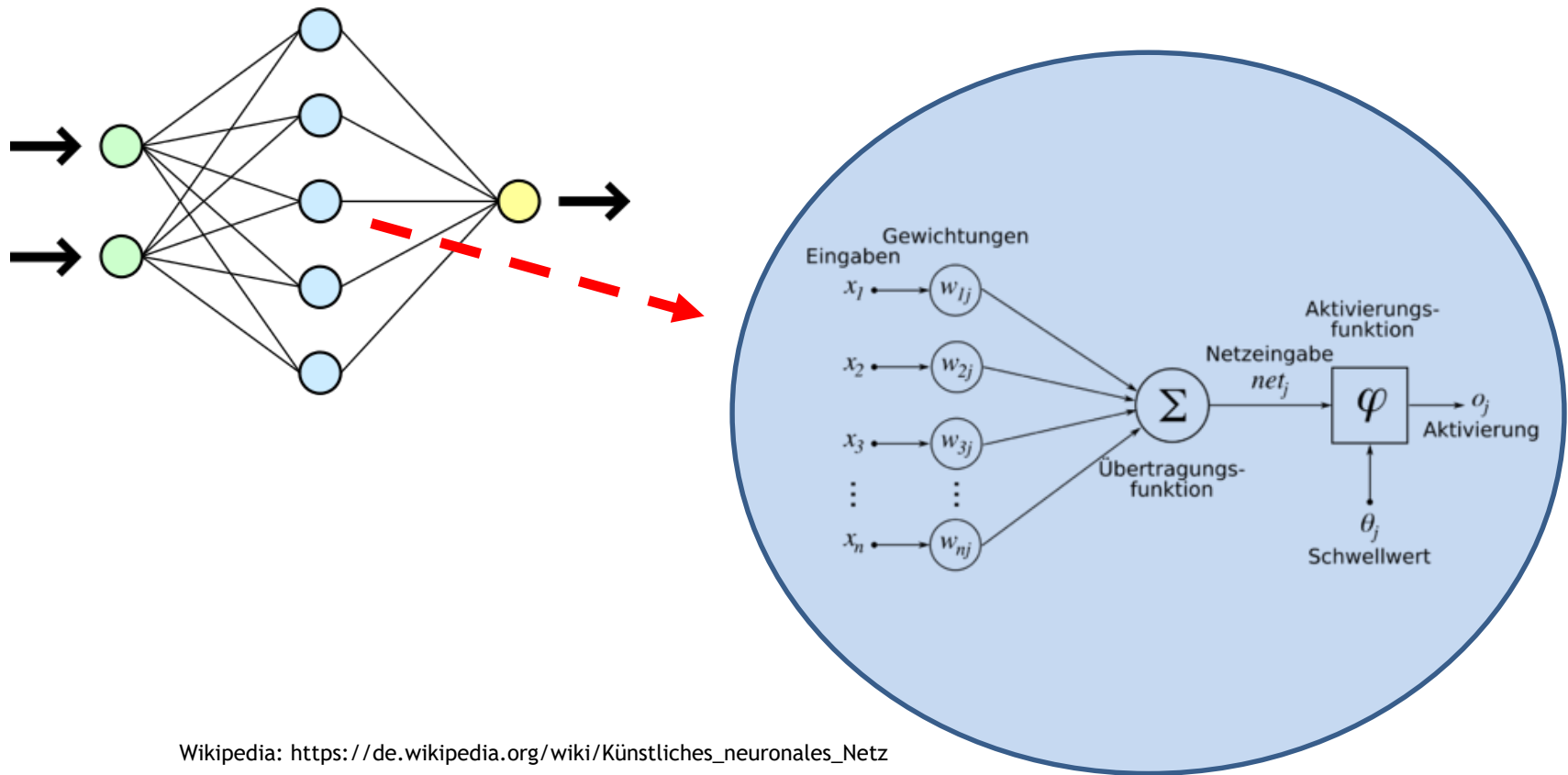
„... Um die Vertrauenswürdigkeit und Kompetenz für ein bestimmtes Thema zu ermitteln, suchen wir nach Websites, die andere Nutzer bei ähnlichen Fragen bevorzugen. Wenn **andere bekannte Websites zu diesem Thema auf eine Seite verlinken, ist das ein gutes Zeichen dafür**, dass die Informationen dort gut passen....“

<https://www.google.com/search/howsearchworks/crawling-indexing/>

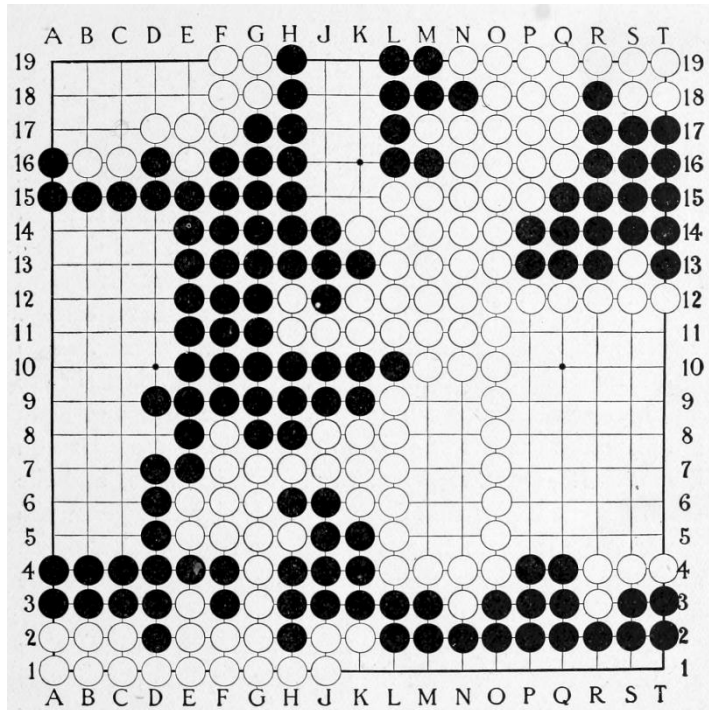
Neuronale Netze: Analogien und bildliche Vorstellungen



Neuronale Netze: Analogien und bildliche Vorstellungen



Wikipedia: https://de.wikipedia.org/wiki/Künstliches_neuronales_Netz



- Bewertung lernen galt als unmöglich
- AlphaGo hat sie erlernt
- Deep Convolutionary Network mit vielen Schichten
- Lernaufwand enorm, parallelisiert auf 5000 TPUs zum lernen

Description English: The Game of Go, Plate 11

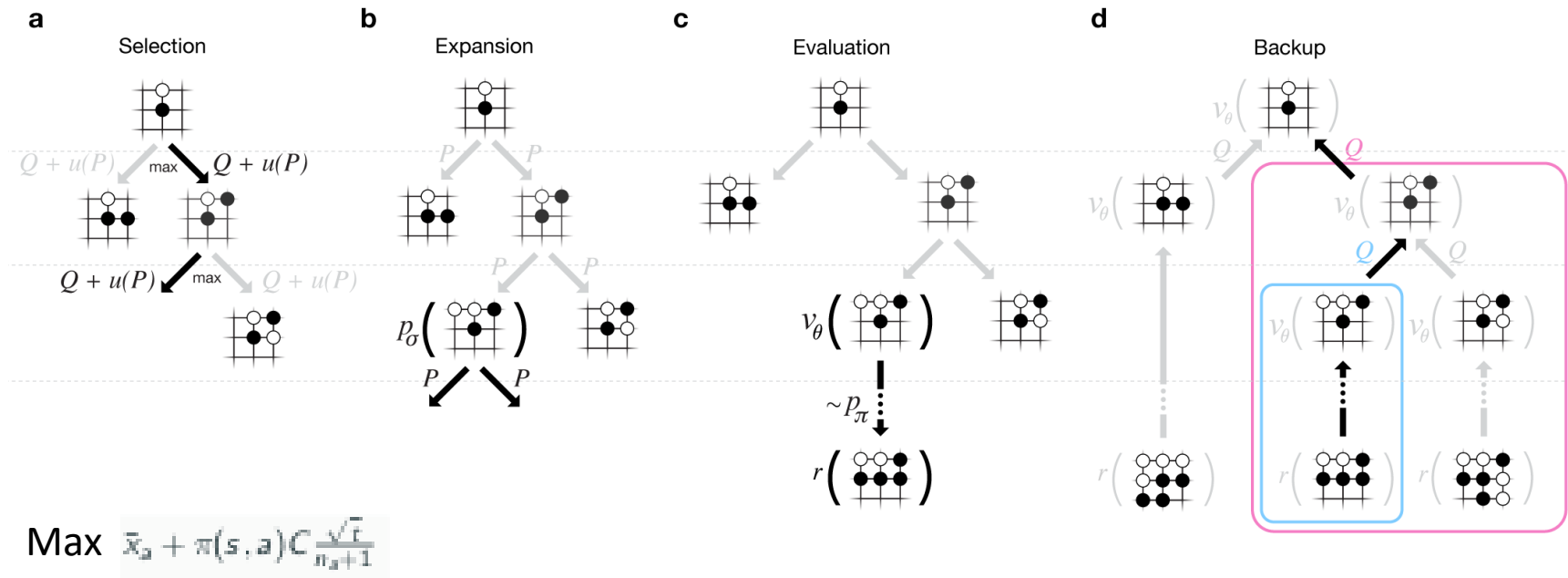
Date 1908

Source Original: The Game of Go (1908) Scan <https://archive.org/details/gameofgonational00smitrich>

Author Arthur Smith (1870-1929)

[https://commons.wikimedia.org/wiki/File:Smith_\(1908\)_The_Game_of_Go_Plate_11.png](https://commons.wikimedia.org/wiki/File:Smith_(1908)_The_Game_of_Go_Plate_11.png)

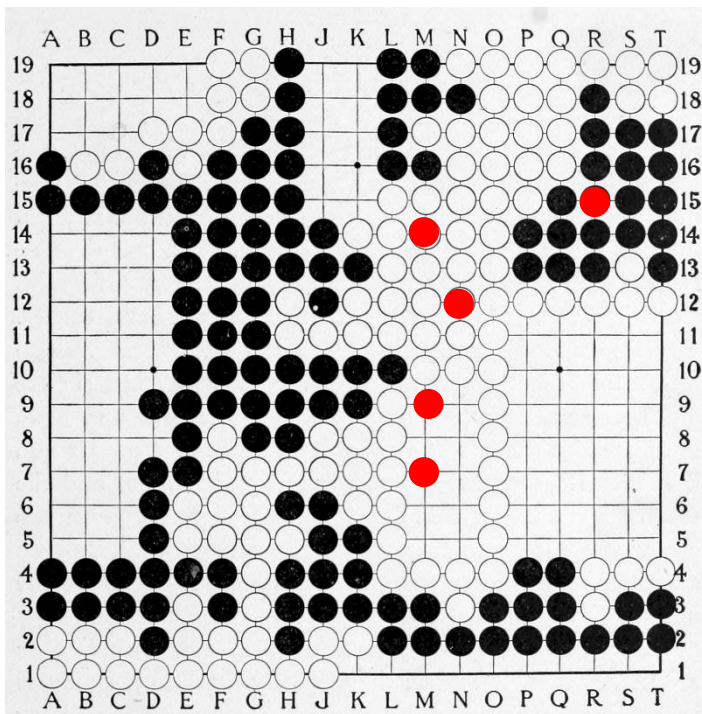
Intelligence + Experience = Search + Neural Networks



P. Auer. Using upper confidence bounds for online learning. In FOCS, pages 270-279, 2000
<https://gogameguru.com/i/2016/03/deepmind-mastering-go.pdf>

Weitere Stärke:

Ein DNN modelliert (zu einem gewissen Grad) die Umwelt ausschnittshaft.



[https://commons.wikimedia.org/wiki/File:Smith_\(1908\)_The_Game_of_Go_Plate_11.png](https://commons.wikimedia.org/wiki/File:Smith_(1908)_The_Game_of_Go_Plate_11.png)

Warum sind andere so weit
vorn?

- Forschung wird als strategischer Faktor gesehen, der Geld braucht und kreativen Output erzeugt. Gibt Schätzungen, dass das Go-Projekt Google ca. 25 mio USD gekostet hat.
- Zusammenhänge werden erkannt.
 - Schach -> Go -> Starcraft -> echte Welt
 - Suchmaschine -> Daten sammeln -> Gewinne -> Macht
- Diskrete Mathematik + Lineare Algebra statt Analysis als Technologietreiber.
- Man lässt den kreativen Köpfen ihre Freiheit, auch verrückt aussehende Pfade zu verfolgen.



Horizon



Towers & Pagodas



Trees



Buildings



Leaves



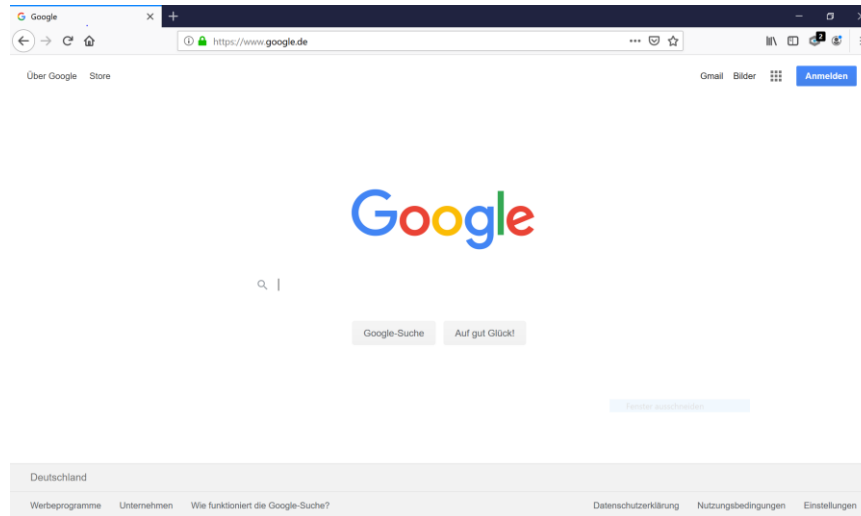
Birds & Insects

<http://googleresearch.blogspot.de/2015/06/inceptionism-going-deeper-into-neural.html>

KI - oder doch nur KI-light?

Was können wir tun, was nicht?

Googles Suchschlitz



„... Mit dem Knowledge Graph setzen wir unser Bestreben fort, nicht nur Keywords abzugleichen, sondern die Personen, Orte und Dinge besser zu verstehen, die dir wichtig sind. ...“

<https://www.google.com/search/howsearchworks/crawling-indexing/>

Stärke:

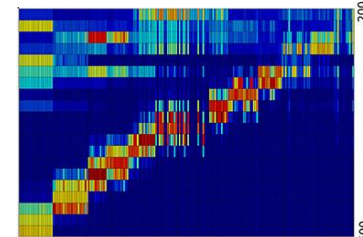
Neues Learning-Werkzeug extrem einfach anwendbar



Fourier-Transform



Chromagram

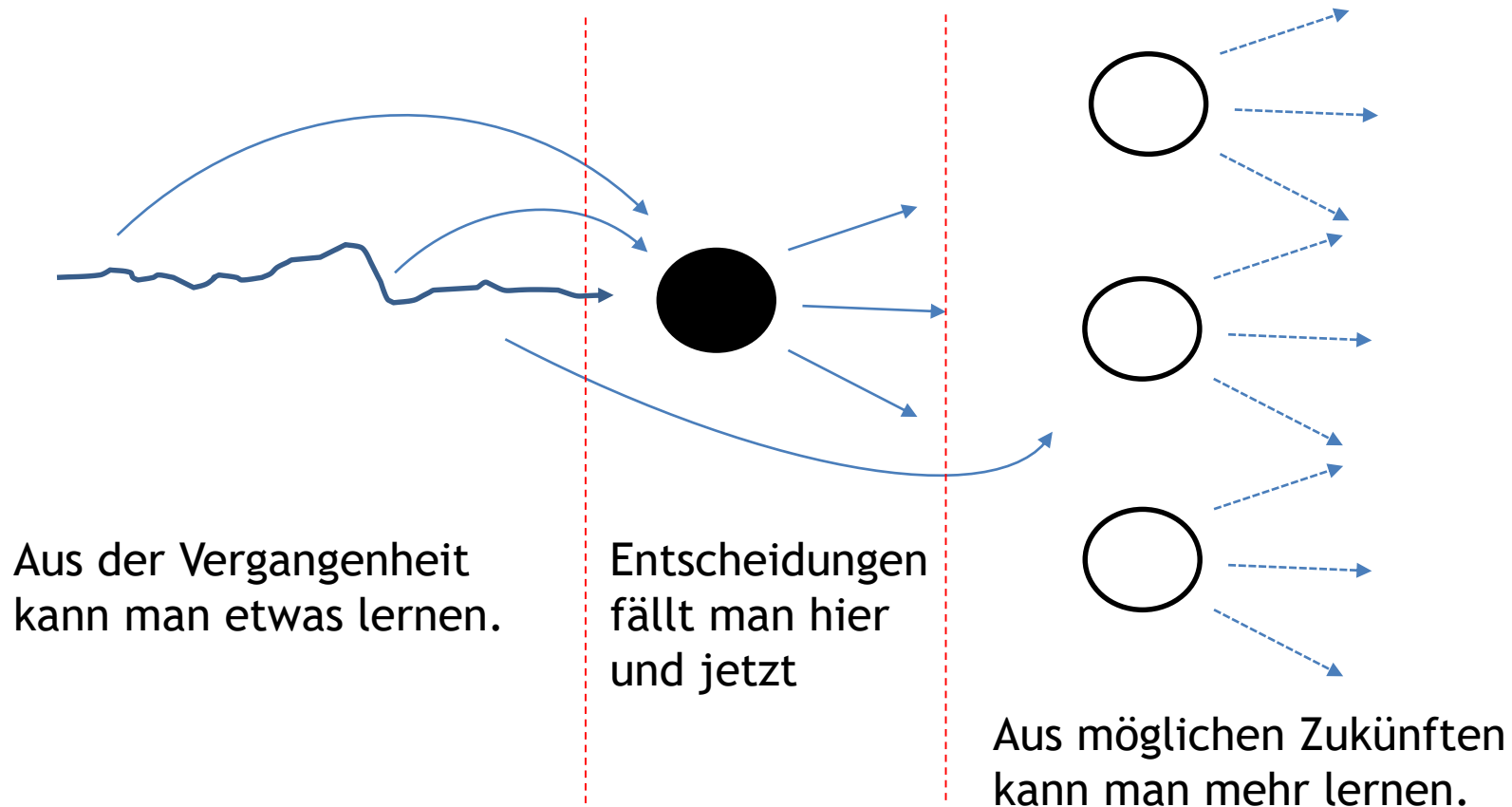


neural network training



Output

Intelligenz + Lernen = Baumsuche + Neuronale Netze



Maßnahmen

- Die einfachen Dinge kennenlernen, annehmen , verstehen
 - KI-Kurse, diverse Anbieter aus der Uni Siegen, auch SMI
- „Aufholforschung“: Es gibt zur Zeit kein Finanzierungsinstrument für Forschung, die streng genommen nicht neuartig ist du nicht direkt umsetzbar ist.
 - Angebot für regionale Aufholforschung
 - SMI / Lehrstuhl TM kann Aufholforschung durchführen
 - Benötigt Finanzierung
 - Region kann sich im Sinne von **Crowdfunding** beteiligen
 - Werden Sie Silbersponsor vom SMI
- Hoffen, dass ...
- **BEDENKE: Technologische Kapitulation ist keine Option!**

P Set of items

M Set of machines

I Set of tasks

T Number of periods (1...T)

M_i Machine needed by task i

P_i Item produced by task i

$I_i = \{j \in I : M_j = M_i, j \neq i\}$. Set of tasks that concur with task i for the same machine.

S_p Nonnegative holding costs for one unit of item p one period in inventory.

B_p Nonnegative cost for backloging one unit of item p for one period

O_p Stockout cost for not fulfilling the (external) demand of one unit of item p

$X_{i,j}$ Nonnegative setup costs for switching from task i to j (on machine $M_i = M_j$)

Q_i Production cost for one unit of item P_i with task i

$D_{p,t}$ External demand for item p in period t

$A_{p,q}$ Gozinto factor. Zero if item q is not immediate successor of item p. Otherwise: quantity of item p directly needed to produce one unit of item q.

$\Delta_{p,i}$ (Integral) number of periods for „transporting“ setup on machine M_i (for task i)

$C_{i,t}$ (Maximum) production quantity of item P_i with task i during period t

$T_{i,j}$ (Fractional) number of periods for switching from task i to j

$R_{i,j}$ = $T_{i,j}$. Number of periods exclusively used for switching from task i to j

$R_{i,j}^f$ = $T_{i,j} - R_{i,j}$. Fraction of the $(R_{i,j} + 1)$ th period after switching from task i to j

$x_{i,j,t}$ Binary variable which indicates whether a setup change from task i to j occurs in (at the beginning of) period t ($x_{i,j,t}=1$) or not ($x_{i,j,t}=0$)

$y_{i,t}$ Binary variable which indicates whether machine M_i is set up for task i at the beginning of (during) period t ($y_{i,t}=1$) or not ($y_{i,t}=0$)

$q_{i,t}$ Production quantity of item P_i by task i in period t

$s_{p,t}$ Inventory for item p at end of period t

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Thank you
For your
Attention!

$$\text{minimize } \sum_{t=1}^T (\sum_{p \in P} (S_p s_{p,t} + B_p b_{p,t} + O_p o_{p,t})) + \sum_{i \in I} \sum_{t=1}^T X_{i,j} x_{i,j,t} + \sum_{i \in I} \sum_{t=1}^T Q_i q_{i,t}$$

$$s_{p,t-1} + \sum_{i: P_i=p} q_{i,t} - D_{p,t} - \sum_{q \in P} A_{p,q} q_{q,t} + b_{p,t} + o_{p,t} - b_{p,t-1} = s_{p,t}, \forall p \in P, t = 1 \dots T$$

$$s_{p,t-1} + \sum_{i: P_i=p} q_{i,t} - D_{p,t} - \sum_{q \in P} A_{p,q} q_{q,t} + b_{p,t} + o_{p,t} - b_{p,t-1} \leq D_{p,t}, \forall p \in P, t = 1 \dots T$$

$$\sum_{i: M_i=m} y_{i,t} = 1, \forall m \in M, t = 1 \dots T$$

$$y_{i,t-1} + y_{j,t} - 1 \leq x_{i,j,t}, \forall i \in I, j \in I, t = 1 \dots T$$

$$C_{i,t} (y_{i,t} - \sum_{j \in I_i} x_{j,j,t} - \sum_{j \in I_i} R_{j,i}^f x_{j,j,t-R_{j,i}}) \geq q_{i,t}, \forall i \in I, t = 1 \dots T$$

$$q_{i,t} \geq 0; s_{p,t}, b_{p,t}, o_{p,t} \geq 0; x_{i,j,t}, y_{i,t} \in \{0,1\}; \forall i \in I, \forall p \in P, t = 1 \dots T$$

