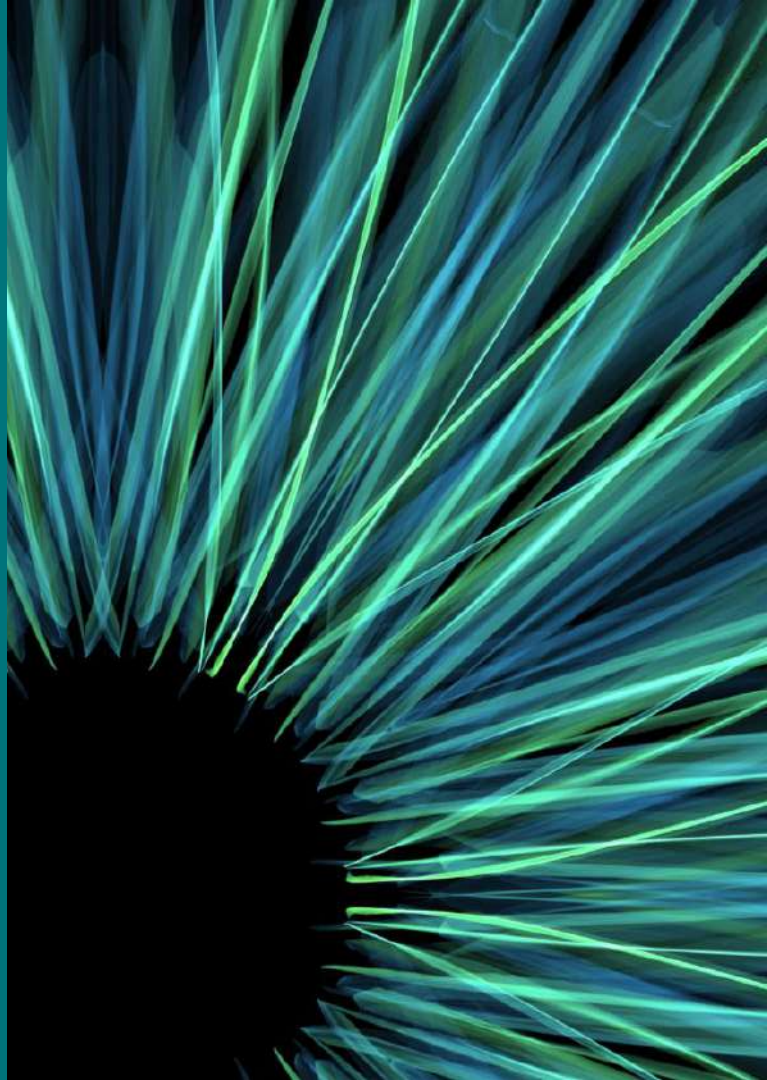
INITIATIVE FOR APPLIED ARTIFICIAL INTELLIGENCE

Künstliche Intelligenz
Potenziale für die Energiewirtschaft

Webinar
30. September 2020



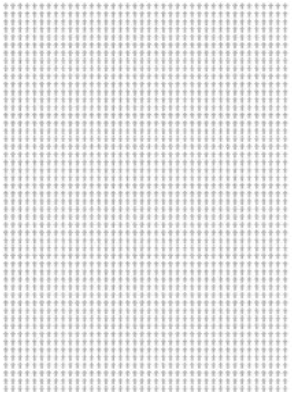
BY UNTERNEHMER TUM

#

UnternehmerTUM is the cradle of 10% of Germany's scalable Tech-Startups

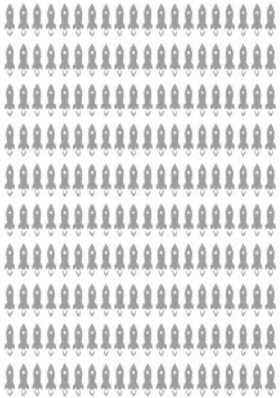
- **Largest European entrepreneurship center**: fully integrated support from first idea to IPO
- Integral **part of Technische Universität München** (TUM), Germany's best technical university
- **Biggest open B2B startup platform** with more than 100 corporate partners like Allianz, Bosch, BMW, Daimler, Facebook, Google, Intel, SAP, Siemens
- High performance **VC fund with over 100 Mio. Euro** under management, cooperation with leading global VCs like Accel, atomico, GA, Lakestar and NEA
- Owned by **industrial entrepreneur Susanne Klatten**, founded in 2002, average annual **growth rate >25%**

Entrepreneurship and Tech Education



>5,000 talents / year
>20,000 alumni

(Pre-)Incubation of Startup Projects



>300 startup and tech projects / year

Startup Development and Acceleration

>50 scalable startups / year
>1,000 new jobs / year

Attraction of Corporate Partners and Consulting

>100 corporate / industry partners

Venture Capital and Startup financing

>1 billion Euro funding / year

The appliedAI Initiative is a remarkable network of partners that has been operating since 2018

Technology partners

Industry partners

International partners

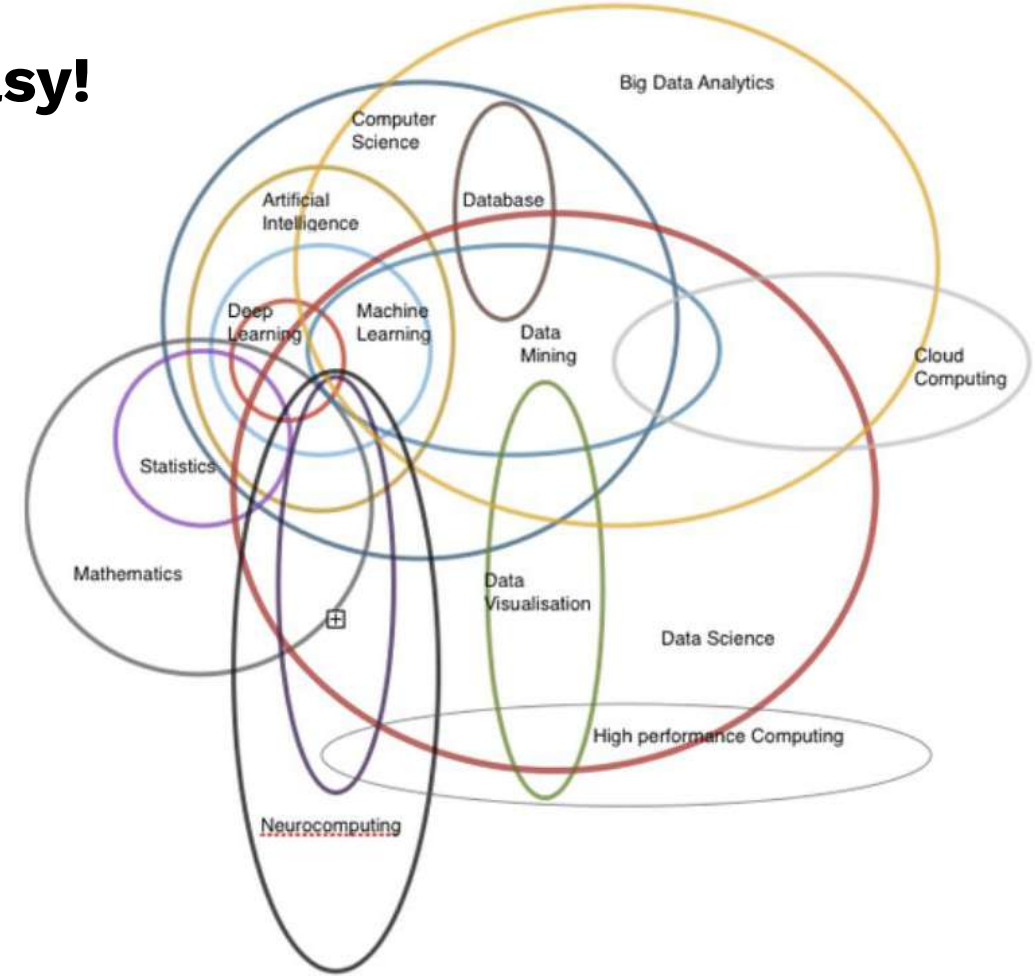
Academic partners

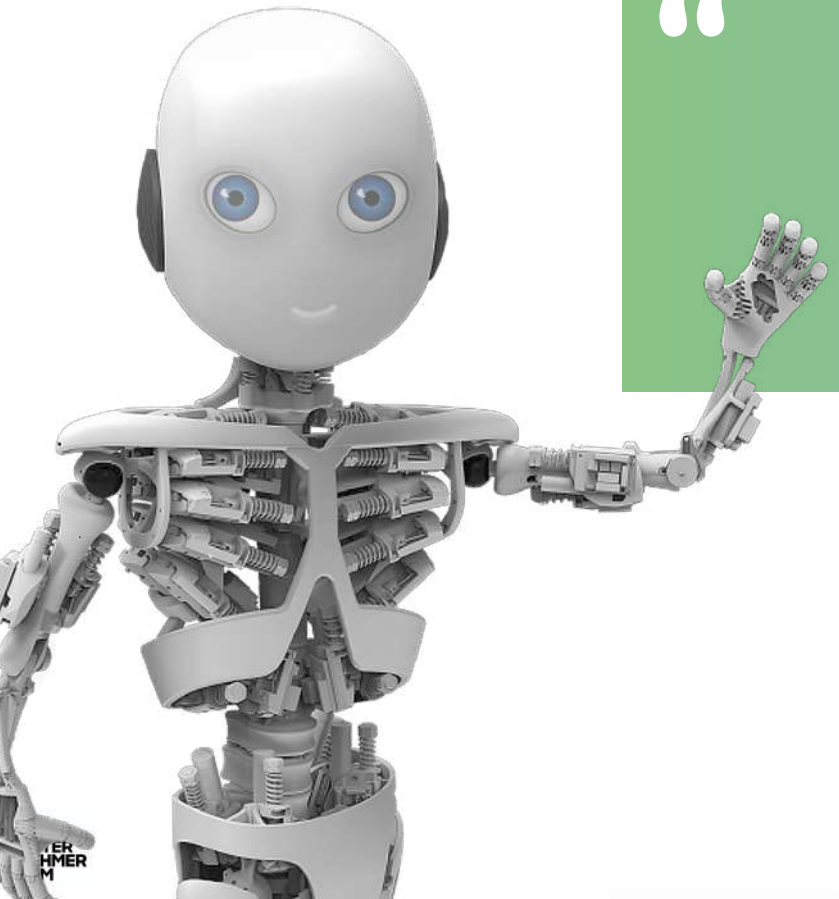
Ecosystem partners

Agenda

1	Wer oder was ist “Künstliche Intelligenz”?
2	Anwendungen von KI in der Energiewirtschaft
3	Strategische Handlungsempfehlungen

It’s that easy!





> Artificial intelligence (...) is a field of computer science researching the automation of intelligent behaviour.
>
> It is not possible to clearly define the term due to a missing definition of intelligence.

(Wikipedia/DE, 2017)

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Artificial Intelligence

Goals
Reasoning, problem solving
Knowledge representation
Planning
Learning
Natural language processing
Perception
Motion and manipulation
Social intelligence
Creativity
General intelligence

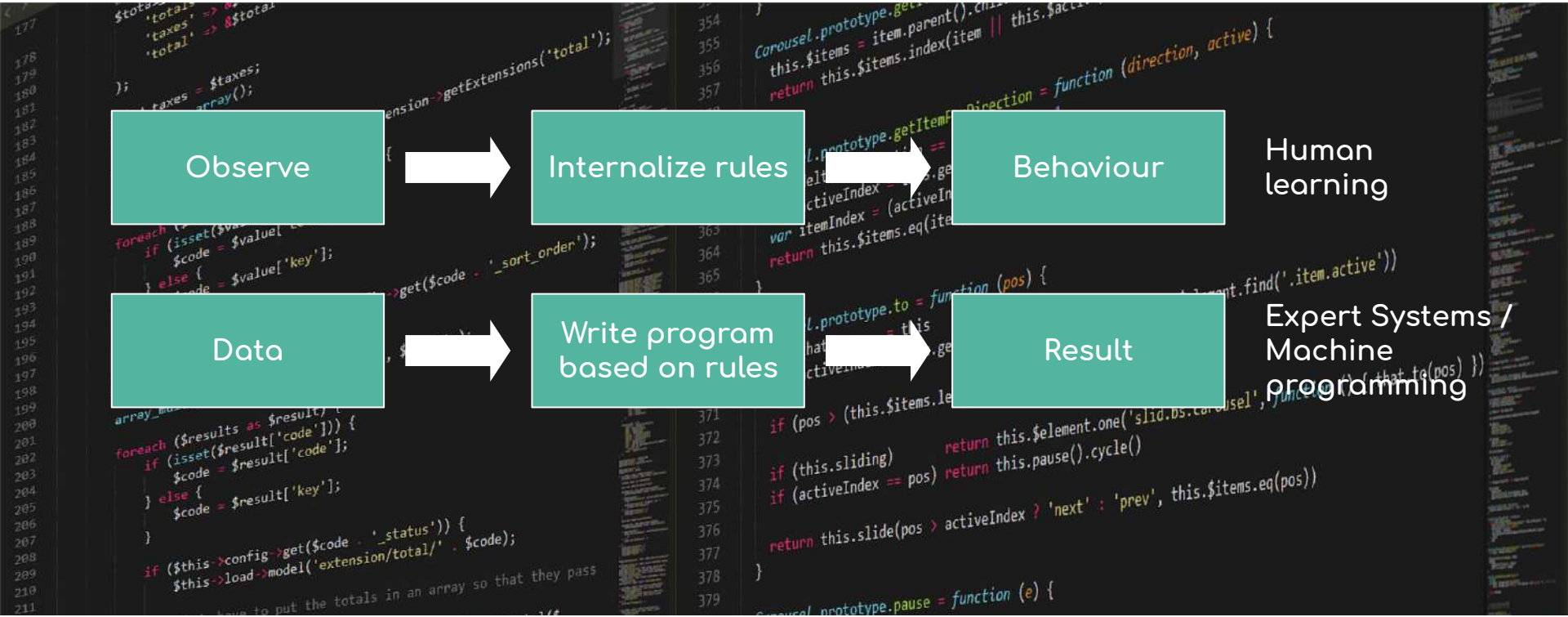
Approaches
Cybernetics and brain simulation
Symbolic
Sub-symbolic

IoT
Industry 4.0
...

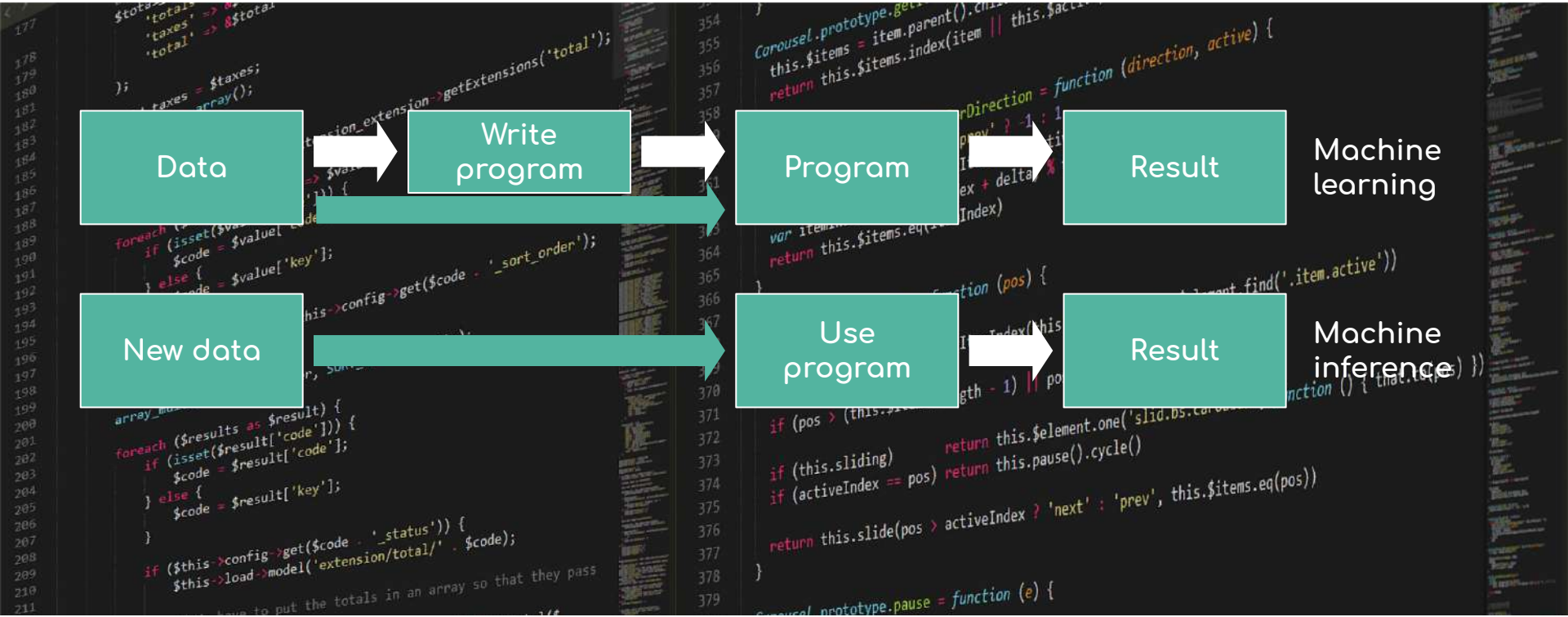
Robotics

Neuroscience
...

Normal “programming” vs. …



… machine learning



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Machine Learning

Algorithms
Decision tree learning
Association rule learning
Artificial Neural Networks
Inductive logic programming
Support vector machines
Clustering
Bayesian networks
Reinforcement learning
Representation learning
Similarity and metric learning
Sparse dictionary learning
Genetic algorithms
Rule-based machine learning
...

IoT
Industry 4.0
...

Robotics

Neuroscience
...

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Sometimes things become too complex for us to “learn”


Woof


Hui


Woof


Woof


Hui


Hui

id	Label	Red001	Green001	Blue001	Red002	Green002	Blue002	...
001	0	157	135	122	142	118	102	...
002	1	63	106	20	95	143	51	...
003	0	101	151	208	100	152	207	...
004	0	64	52	48	63	55	54	...
005	1	110	100	90	113	104	94	...

These are our **independent variables!**
We want to use these to predict the correct label

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...

Deep Learning

Use-Cases
Automatic speech recognition
Image recognition
Natural language processing
Drug discovery and toxicology
Customer relationship management
Recommendation systems
Bioinformatics
Gesture Recognition
...

IoT
Industry 4.0
...

Robotics

Neuroscience
...

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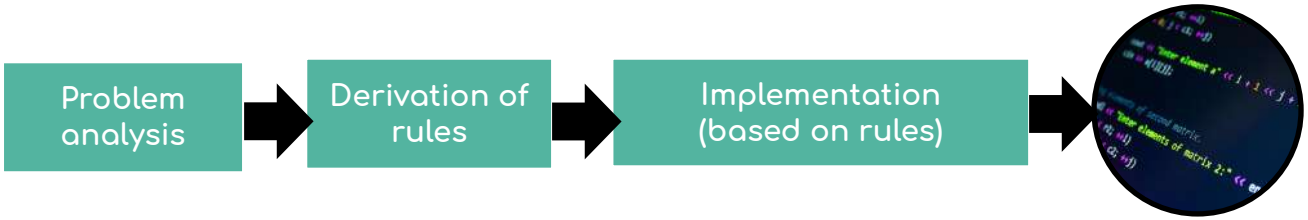
ML and Neural Networks - a new paradigm of software development

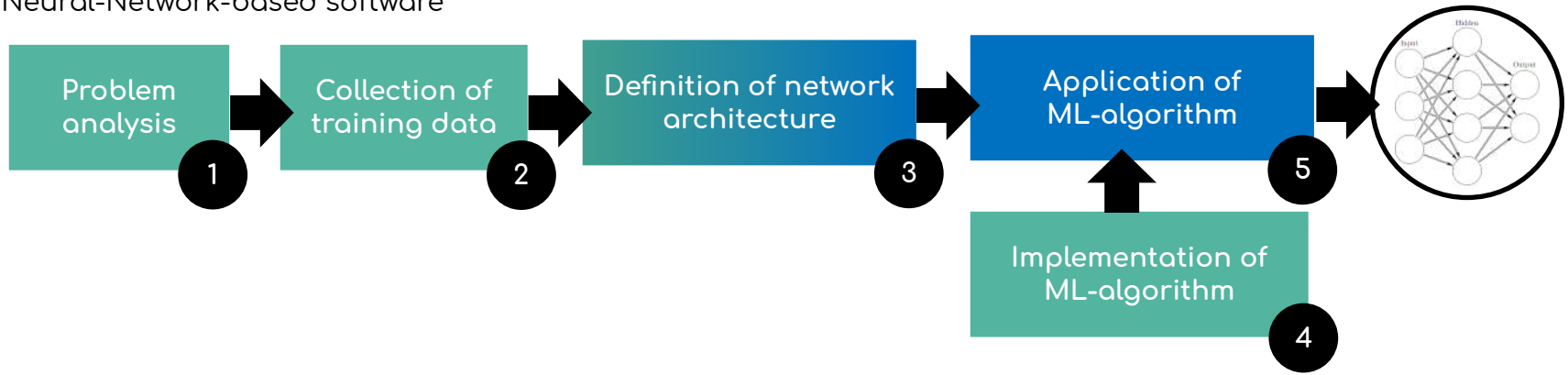
Human domain

Machine domain

"Traditional" Software



Neural-Network-based software



1 Problem analysis

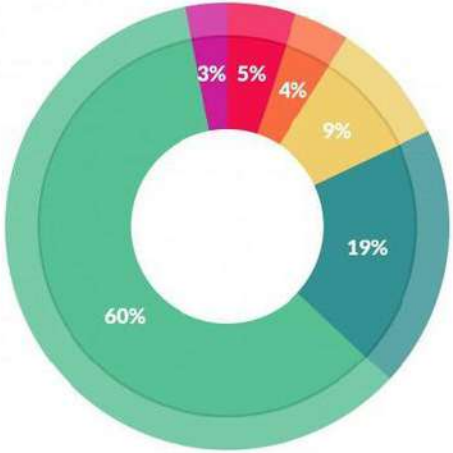
> "AI work requires **carefully choosing A and B** and providing the necessary data to help the AI figure out the A→B relationship. Choosing A and B creatively has already revolutionized many industries. It is poised to revolutionize many more."

Andrew Ng

- Understanding of **logic between input and output** data less relevant
- Focus moving from understanding the relation between input and output towards **defining the relevant inputs**

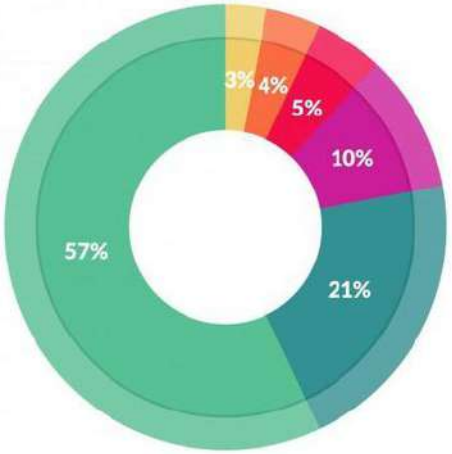
Andrew Ng, What Artificial Intelligence Can and Can't Do Right Now
https://hbr.org/2016/11/what-artificial-intelligence-can-and-cant-do-right-now

2 Collection of training data



What data scientists spend the most time doing

- Building training sets: 3%
- Cleaning and organizing data: 60%
- Collecting data sets; 19%
- Mining data for patterns: 9%
- Refining alg
- Other: 5%



What's the least enjoyable part of data science?

- Building training sets: 10%
- Cleaning and organizing data: 57%
- Collecting data sets: 21%
- Mining data for patterns: 3%
- Refining algorithms: 4%
- Other: 5%

Source: CrowdFlower Data Science Report 2016
URL: http://visit.crowdflower.com/rs/416-ZBE-142/images/CrowdFlower_DataScienceReport_2016.pdf

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2 Collection of training data

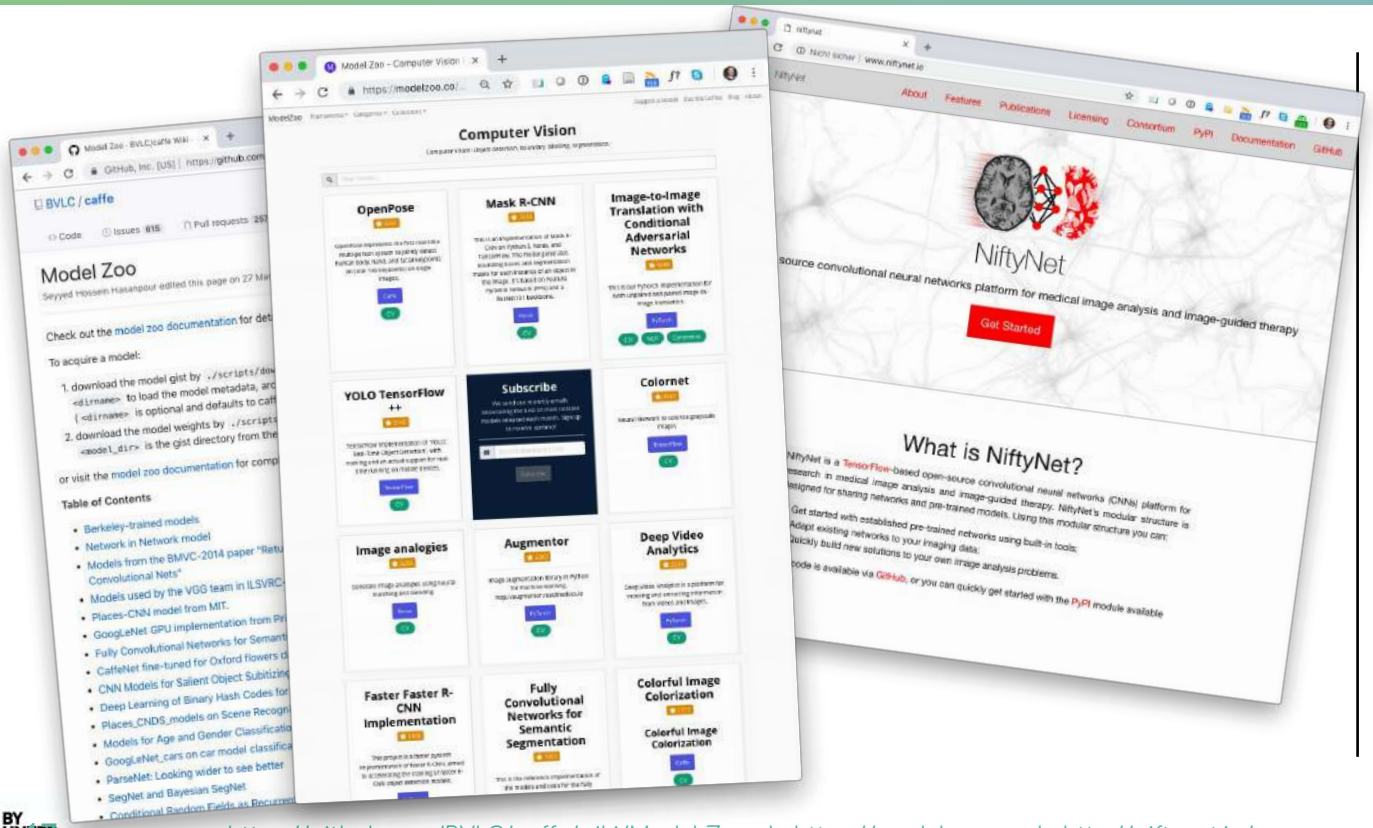
> "Among leading AI teams, many can likely replicate others' software in, at most, 1–2 years. But it is exceedingly difficult to get access to someone else's data. Thus data, **rather than software, is the defensible barrier for many businesses.**"

Andrew Ng

- Increasing **value of data**
- **Digitalization prerequisite** for large-scale AI
- Having a clear **data governance concept** is strongly advised!

Andrew Ng, What Artificial Intelligence Can and Can't Do Right Now
https://hbr.org/2016/11/what-artificial-intelligence-can-and-cant-do-right-now

3 Definition of network architecture



- New network architectures are largely **subject of research**
- AI developers are better advised to **build on existing models** (possibly even pre-trained)
- Check **license terms** when using open source!

https://github.com/BVLC/caffe/wiki/Model-Zoo | https://modelzoo.co | http://niftynet.io/

4 Implementation of ML-algorithm

TensorFlow™

mxnet

theano

Microsoft CNTK

PyTorch

Keras

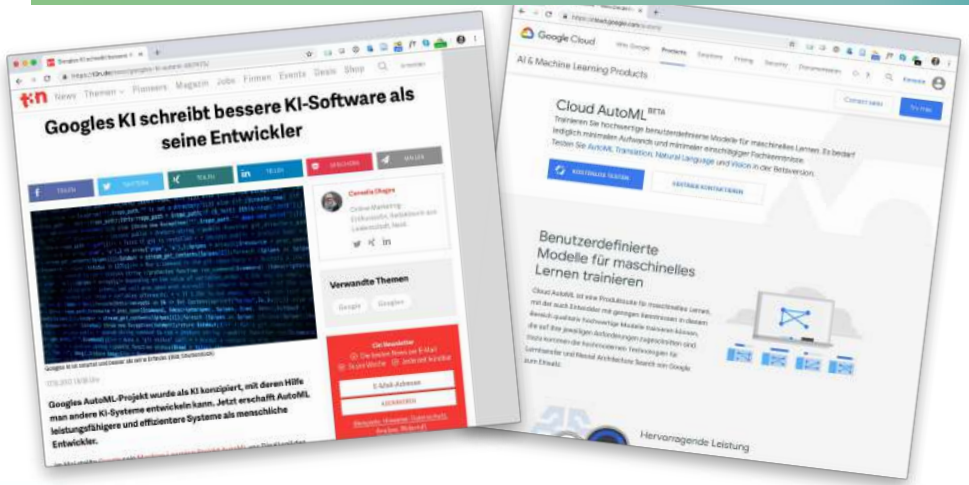
NVIDIA CUDA

- Do **not reinvent the wheel** here!
- Various highly optimized **open source frameworks** available
- Various **communities and online-resources** exist around frameworks

5 Application of ML-algorithm

> "Simply downloading and "applying" open-source software to your data won't work. AI needs to be customized to your business context and data. This is why there is currently a war for the scarce AI talent that can do this work."

Andrew Ng



- Influence of ML-Engineer: So-called **"hyper-parameter tuning"**
- First approaches to **automate** even this task exist (AutoML)

Andrew Ng, What Artificial Intelligence Can and Can't Do Right Now
https://hbr.org/2016/11/what-artificial-intelligence-can-and-cant-do-right-now
https://t3n.de/news/googles-ki-automl-867473/ | https://cloud.google.com/automl/

Wann sollte ich den Einsatz von KI-Technologien in Betracht ziehen?

Eher **kein KI-Anwendungsfall**, wenn

- Logik zur Problemlösung auf technischer Ebene beschreibbar
- Nachvollziehbare Entscheidungen sind notwendig
- Nur geringe Datenmenge verfügbar*
- Möglicher Bias/Verzerrung in den Trainingsdaten*

Möglicherweise ein **sinnvolles KI-Szenario**, wenn

- Viele messbare Datenpunkte, ggf. ohne strukturelle Kriterien
- Optimierung von bereits heute (teil)automatisierten Entscheidungen und Abläufen
- Intuitive Aufgaben – “alles, was ein Mensch in weniger als einer Sekunde entscheiden kann”
- Ein System soll sich während der Anwendung selbstständig weiter optimieren oder anpassen

* KI kann trotzdem einen Mehrwert bieten, erfordert aber zunächst Aufbau passender Datengrundlagen

Agenda

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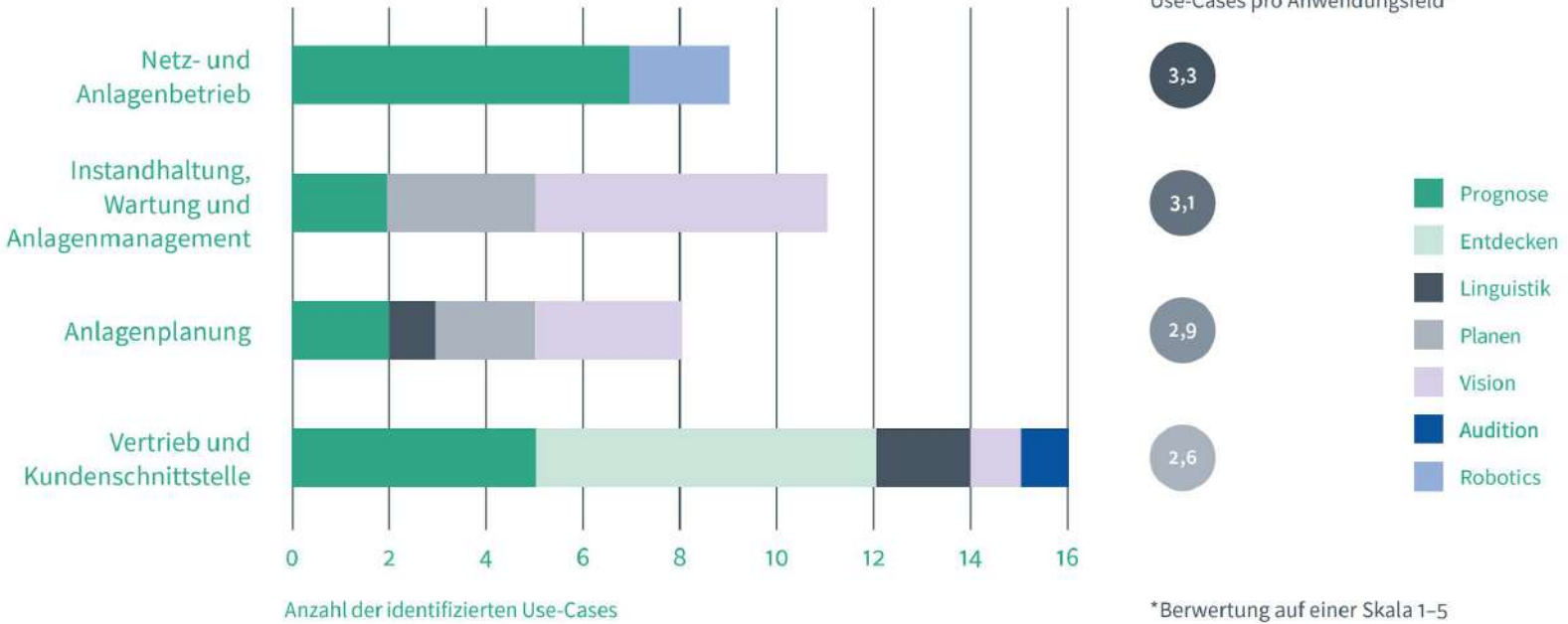
2	Anwendungen von KI in der Energiewirtschaft
3	Strategische Handlungsempfehlungen

Insgesamt wurden mehr als 40 KI-Anwendungsfälle in der Energiewirtschaft identifiziert



Effiziente Vermarktung von PK-Anlagen durch Erkennung geeigneter Flächen

Project Sunroof

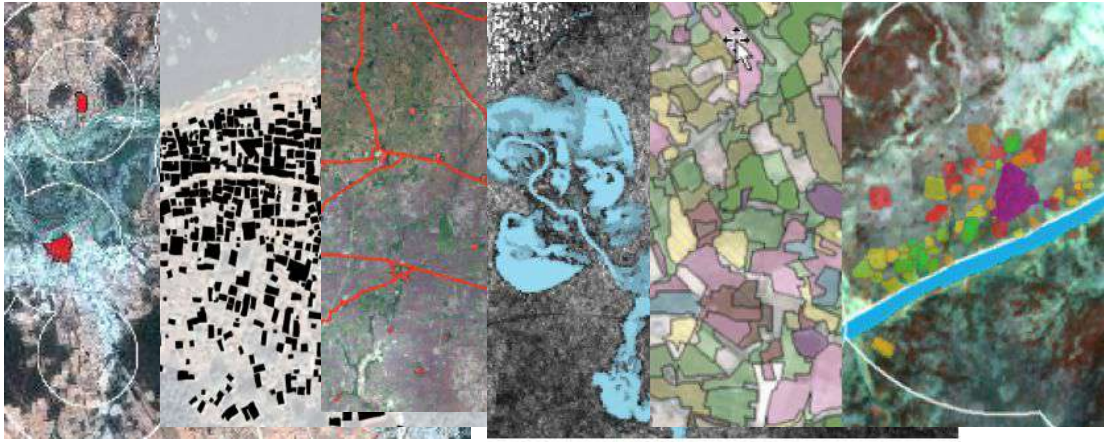
Auf Basis von **Luftbildaufnahmen**:

- Identifikation von Dachflächen
- 3D Modellierung von Dächern
- Erkennung potenzieller Schattenwürfe von nahestehenden Objekten

Unterstützung der Netzausbauplanung durch Analyse von Luftbildern

VIDA - Village Data Analytics

Automatic identification of remote villages and determination of their suitability for rural electrification.



TFE Energy

esa

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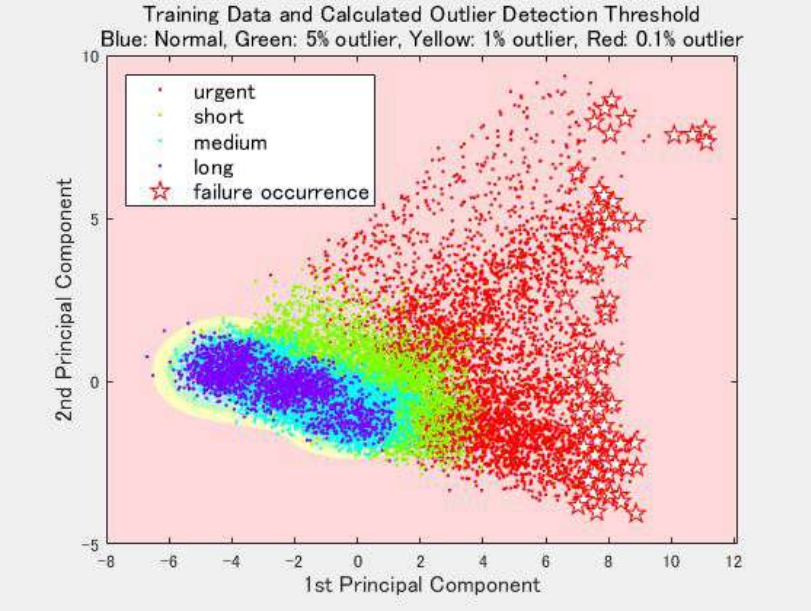
Effizientere Anlagenwartung durch Früh-erkennung von Ausfällen

a.k.a. “Predictive Maintenance”

Problem:
Ausfälle und kurzfristige Wartungseinsätze durch spontane Ausfälle und Fehlfunktionen

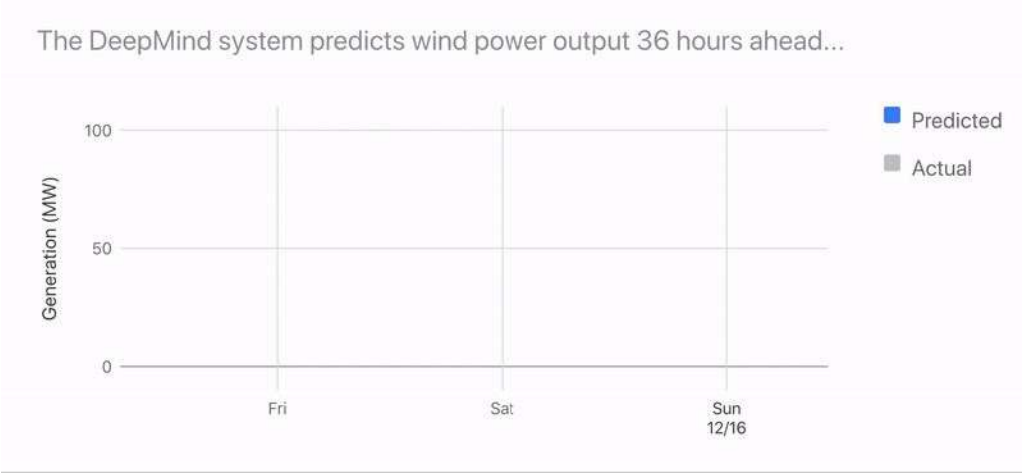
Ansatz:
Erfassen von Maschinendaten und kontinuierliche Prüfung dieser auf “Besonderheiten”, d.h. Abweichungen vom Zustand im Normalbetrieb



Optimiertes Einspeisemanagement durch vorhersage der Energieerzeugung

DeepMind

"Using a neural network **trained on widely available weather forecasts and historical turbine data**, we configured the DeepMind system to predict **wind power output 36 hours ahead** of actual generation. Based on these predictions, our model recommends how to make **optimal hourly delivery commitments** to the power grid a full day in advance."



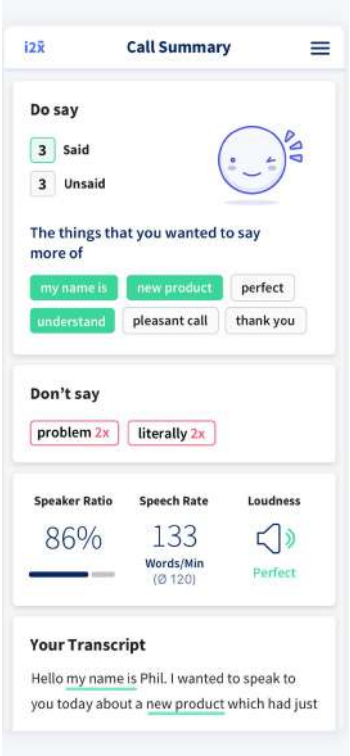
https://deepmind.com/blog/article/machine-learning-can-boost-value-wind-energy

Verbesserung des Kundenservices durch Analyse der Kundenkommunikation

Vertrieb & Kundenschnittstelle 4

Problem
Beobachtbarkeit und damit Messbarkeit von Kundengesprächen ist gering. Ermittlung von Erfolgs- und Qualitätsfaktoren damit schwierig.

Ansatz:
- Transkription von Gesprächstexten
- Sprechererkennung
- Analyse von Transkripten hinsichtlich Gesprächserfolg und Ableitung von “do’s” und “don’ts”



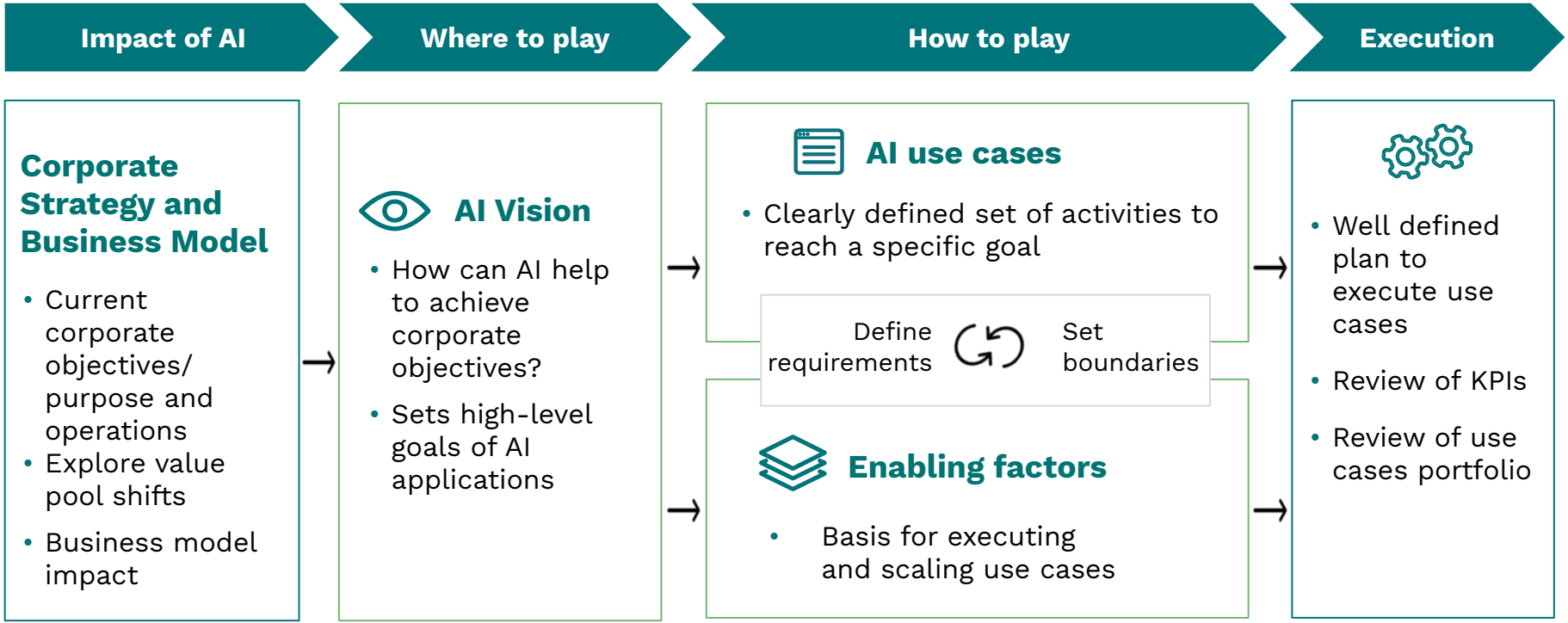
https://i2x.ai/de/

Agenda

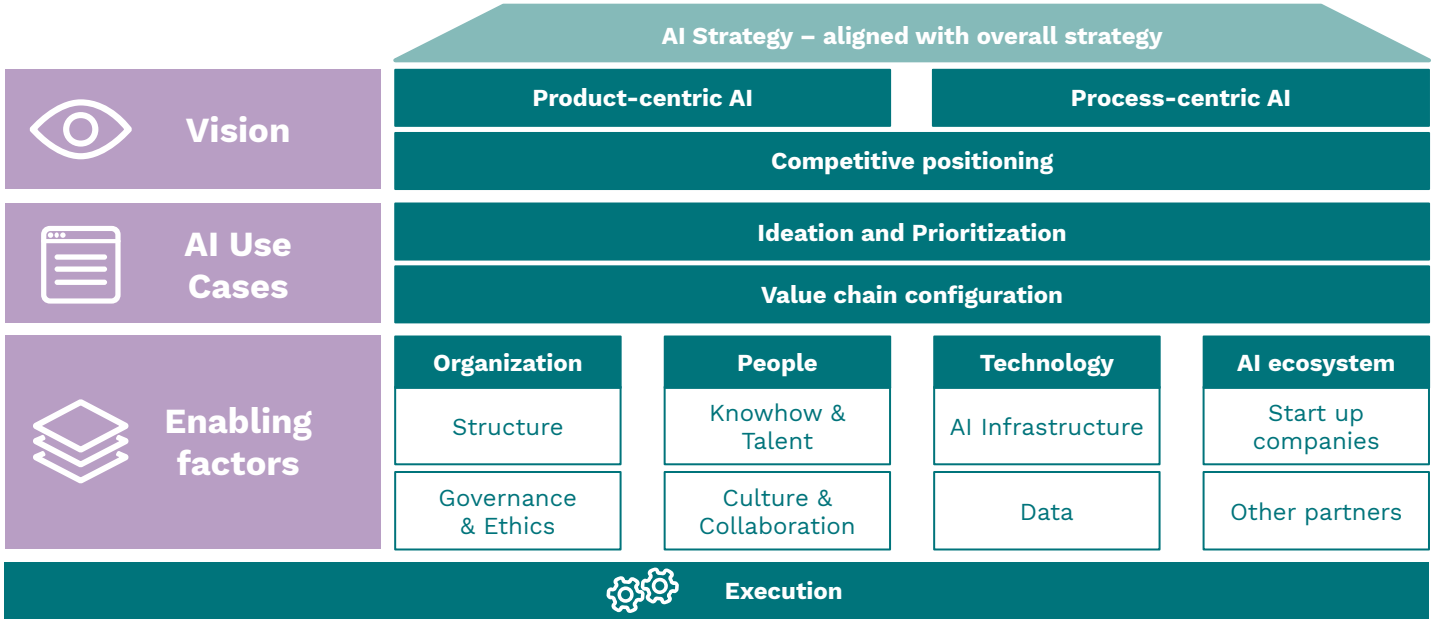
Typical hurdles on they way to AI adoption

POC		AI Product
CoE	Structure	Business Unit
-	Governance	Liability, Real-time
Data Scientist	Skillset	(AI) Software Engineer
Initial need	Culture	Acceptance
"Lab" setup	Infrastructure	Software Architecture
"Clean", Synthetic	Data	"Dirty", Real

Applying AI requires a holistic approach encompassing Strategy, Use Cases, Enabling Factors and Execution



A strategic approach:
“Divide and conquer” the battleground



From “The elements of a comprehensive AI strategy”, appliedAI (Waldmann, Liebl, Hartmann, Brakemeier)
https://www.appliedai.de/hub/elements-of-a-comprehensive-ai-strategy

Companies typically follow certain phases towards AI adoption

Level	Not Started	Experimenter	Practitioner	Professional	Shaper
Description	*AI is not on the company's agenda*	*Impulse to start with AI is established, first prototypes are built*	*AI vision is known and systematic implementation has started*	*AI is in production / in use and broadly embedded in the organization*	*Organizational DNA is transformed*
Companies in this level	~85%	5-10%	1-5%	<1%	<1%
Status	Risk of losing competitiveness	Stuck at PoC level	First value but not sustainable and cost-efficient	Sustainable value creation	Reshaping whole markets

Across the AI Journey, companies go through different phases with specific challenges

Level

Not Started | Experimenter | Practitioner | Professional | Shaper

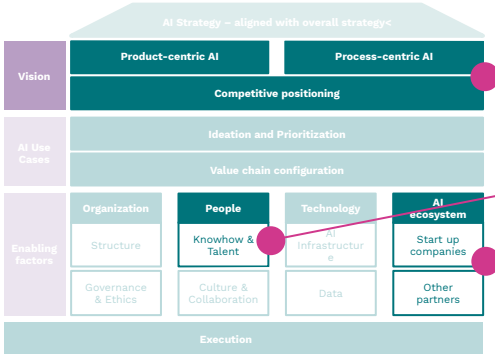
Company characteristics

AI is not on the company's agenda

Companies in this stage are either unaware of AI or have consciously decided not to invest in AI (yet).

However, often there are individuals inside the company that see the relevance of the topic and try to bring it to the attention of top management.

Main Focus Areas



Exemplary Challenges

Vision
- Deciding whether to start own AI activities vs. waiting for technology to mature further
- No sense of urgency across (top) management
- Lacking overview of what competitors are doing

Talent
- No single person in company knowledgeable about AI

Ecosystem
- No overview of contact points, information hubs and potential partners

Across the AI Journey, companies go through different phases with specific challenges

Level

Not Started | **Experimenter** | Practitioner | Professional | Shaper

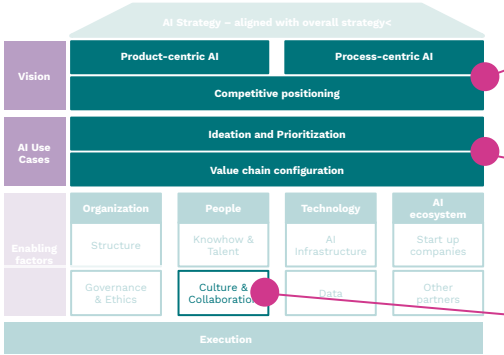
Company characteristics

Impulse to start with AI is established, first prototypes are built

First projects based on AI-technologies have started, often as “submarines” without a coherent estimation of business value or strategic relevance. If topic is driven top-down experts often react with rejection and skepticism.

Most projects are in a “proof-of-concept” stage without concrete plan of how to bring them into production.

Main Focus Areas



Exemplary Challenges

Vision
- No knowledge of what it takes to implement AI at scale
- Short-term thinking leads to chaos and incoherent AI-storyline

Use Cases
- AI team lacking oversight of potential use cases across organization
- Decision for first pilot use case difficult

Culture
- Experts stick to traditional methods and do not believe in "fancy AI stuff"
- Project structures do not allow for experimentation

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Across the AI Journey, companies go through different phases with specific challenges

Level

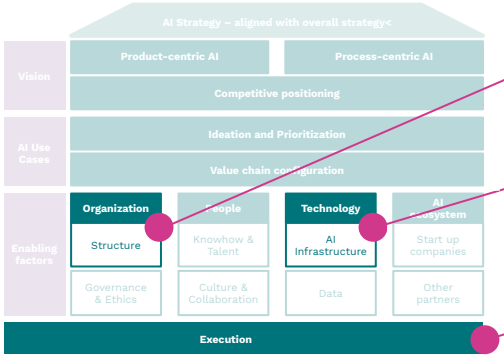
Not Started → Experimenter → **Practitioner** → Professional → Shaper

Company characteristics

AI vision is known and systematic, implementation has started

First proof-of-concepts have been developed successfully, but real world application is still the exception. While know-how on how to train models is available now, the main challenge shitfts towards bringing applications into production settings and managing them through their application lifecycle.

Main Focus Areas



Exemplary Challenges

Organization & Governance
- Different teams working on AI w/o alignment
- Distribution of responsibilities between core team and distributed teams unclear

Infrastructure
- No awareness of tools in the AI space
- Shadow IT exists to build first prototypes, but hinders scaling

Execution
- Difficult to move AI talent between projects due to different development processes
- Work done redundantly because teams cannot share work results conveniently

Across the AI Journey, companies go through different phases with specific challenges

Level

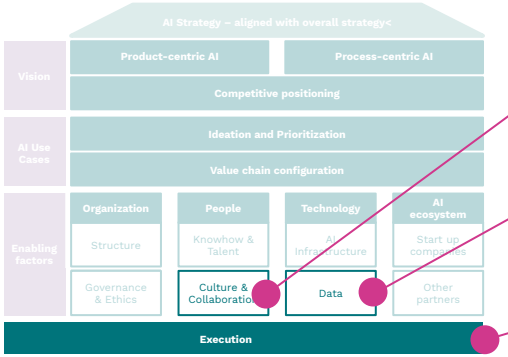
Not Started	Experimenter	Practitioner	**Professional**	Shaper

Company characteristics

AI is in use and broadly embedded in the organization

There are individual use cases in production in the organization and AI is generally accepted as a valuable tool. The goal is now to enable a large number of decentral teams to build and deploy AI applications in a standardized way. This is done by providing clear governance, data- and development-related self-service tools and CI/DI environments for AI.

Main Focus Areas



Exemplary Challenges

Culture
- Establish AI as normal part of every project
- Workforce not used to work with software that is probabilistic and may "make mistakes"

Data
- Visibility and accessibility of data as a self-service throughout the organization
- Tracing and managing of data dependencies

Execution
- AI algorithms need immense compute power due to scaled application
- How to handover responsibilitiees / AI products for operation

Across the AI Journey, companies go through different phases with specific challenges

Level

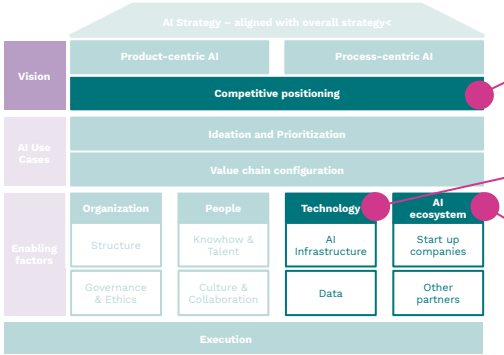
Not Started → Experimenter → Practitioner → Professional → **Shaper**

Company characteristics

The organizational DNA is transformed

AI is deeply embedded into the organization and is profoundly changing the core of the business model. Developing and deploying AI solutions has become “natural”. The challenges are shifting towards shaping the AI ecosystem. Organizations at this stage are heavily involved in fundamental AI research and actively shape discussions around standards, AI ethics and user experience for AI.

Main Focus Areas



Exemplary Challenges

Vision
- Use AI for vertical and horizontal integration
- Invest in market development by training other organizations and end-users

Technology
- Research and and development of high-performance hardware solutions
- Enable scalability of AI and data infrastructure

Ecosystem
- Actively drive the development of AI-related technical and ethical standards
- Integrate with AI research community and establish relations to world-leading AI experts

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Roles and whom to start with

1. AI Strategist to steer and align activities
2. ML Engineer if focus is on self-developing solutions
3. Data Engineer if focus is on building data assets or integration of external solution

AI Center of Excellence

Non-technical roles
- AI Strategist
(Business Analyst, AI Translator)
- AI trained Lawyer/ Compliance*

Technical roles
- AI Project Lead
- AI / ML Engineer
- Data Scientist
- Software Engineer
- UX / Design
- Data Engineer
- AI Product Manager
- DevOps / DeepOps
- Machine Learning Researcher/ Applied Machine Learning Scientist
- AI Trainer

Business Units

- AI Ambassador

IT

- IT Collaborator
- Infrastructure Engineer

Legal

- AI-trained Lawyer/ Compliance*

* Role can be positioned in different units

Mehr Details in der aktuellen Studie “Künstliche Intelligenz für die Energiewirtschaft” des BDEW

Verständliche Einführung in das Thema “Künstliche Intelligenz”

Übersicht über Anwendungspotenziale in der Energiewirtschaft

Tipps und Anregungen für strategische Handlungsfelder

Handlungsempfehlungen für die Politik

https://www.bdew.de/energie/kuenstliche-intelligenz-fuer-die-energiewirtschaft/

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