AI Factory Austria AI:AT

Beyond Generative AI

The **History** and **Hype Cycles** of **Artificial Intelligence**

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Expert AI Knowledge Transfer @ AI Factory Austria AI:AT

05.03.2026

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AI in **manufacturing** (through digital twins)

- IT Consultant and Trainer
- Business Informatics Researcher (441 citations) [1]

AI for **general public**

- University lectures AI for law/business administration
- VHS courses AI for general public [2]
- Certified AI Manager trainings [3]

[1] https://scholar.google.com/citations?user=TGGaQ_0AAAAJ

[2] https://vhskurs.linz.at/index.php?kathaupt=18&suchesetzen=false&kfs_dozentid=139372

[3] https://tecnovy.com/de/tecnovy/certified-ai-manager

Artificial Intelligence (AI)

Computers as “intelligent beings”

- Reproducing the human brain
- Representation of knowledge, associative storage
- Capturing and interpreting signals from the environment
- Learning and drawing conclusions
- Applying learned knowledge

Goal: better understanding of how the brain works

Areas of AI

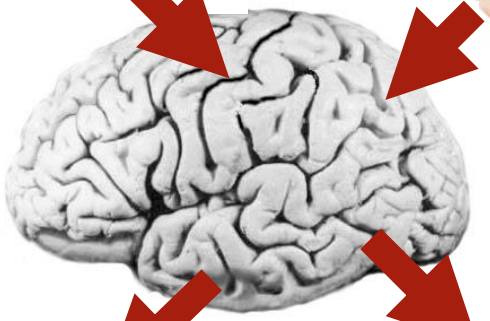
Seeing

Computer vision

Hearing

Voice recognition

Thinking



Logical reasoning, planning of tasks, learning

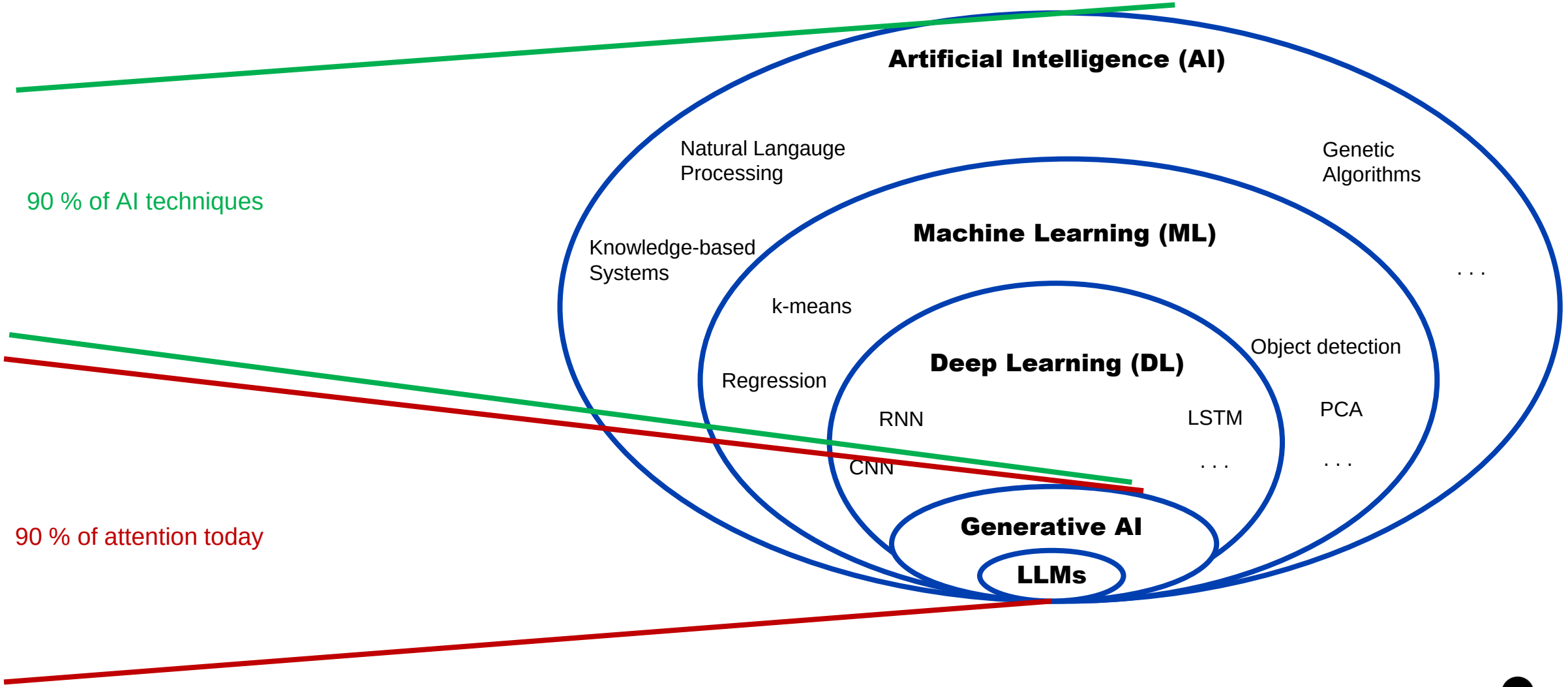
Feeling/moving

robotics

Talking

Voice synthesis

„AI Tunnel View“



Source: https://www.linkedin.com/posts/jaylatta_llm-tunnel-vision-weve-fallen-into-the-activity-7386990451360387072-y6KI

History of Artificial Intelligence

[0] https://www.historyofinformation.com/detail.php?entryid=782

[1] https://courses.cs.umbc.edu/471/papers/turing.pdf

[2] https://home.dartmouth.edu/about/artificial-intelligence-ai-coined-dartmouth

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1940—50: Beginnings of AI

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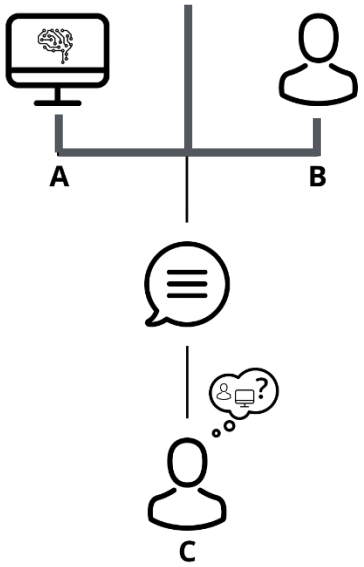
Computers as „intelligent beings“

Turing Test (1950)

- Human beings are intelligent
- To be called intelligent, a machine must produce responses that are indistinguishable from those of a human



Alan Turing

Computers as „intelligent beings“

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Where are we today?

https://www.youtube.com/watch?v=MZ2X-fSIPSU

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Salvador Dali
Died 1988
Video from 2011

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Let‘s Try! https://runwayml.com/research/theturingreel

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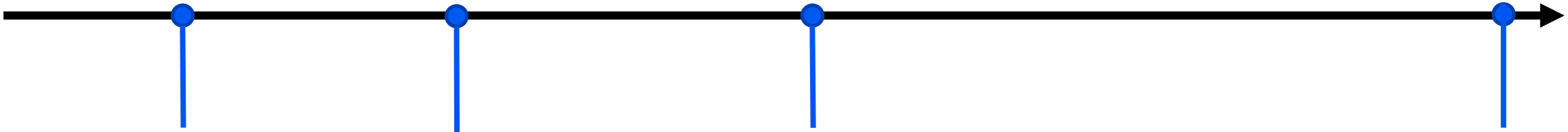

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1970—90: Knowledge-based Systems

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A first approach: Expert Systems

Knowledge-based Systems

Store **Facts and Relations**

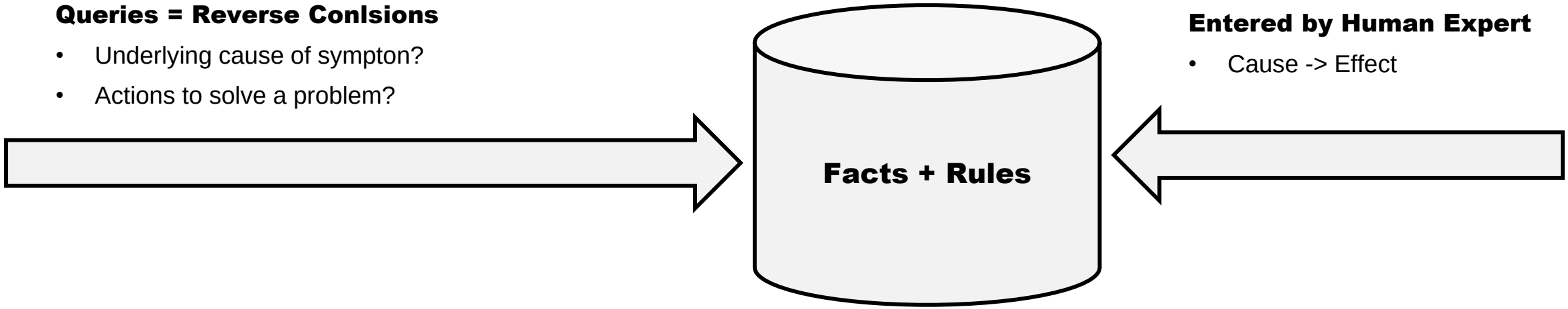
Basic idea

- **Human expert** stores known facts (e.g., cause -> effect)
- System draws reverse conclusions
  - What could be the underlying cause of a symptom?
  - What actions can be taken to solve the problem?
- The **system** takes over the **role of the expert**

A first approach: Expert Systems

Queries = Reverse Conlsions

- Underlying cause of sympton?
- Actions to solve a problem?



Entered by Human Expert

- Cause -> Effect

A first approach: Expert Systems

Queries = Reverse Conlsions

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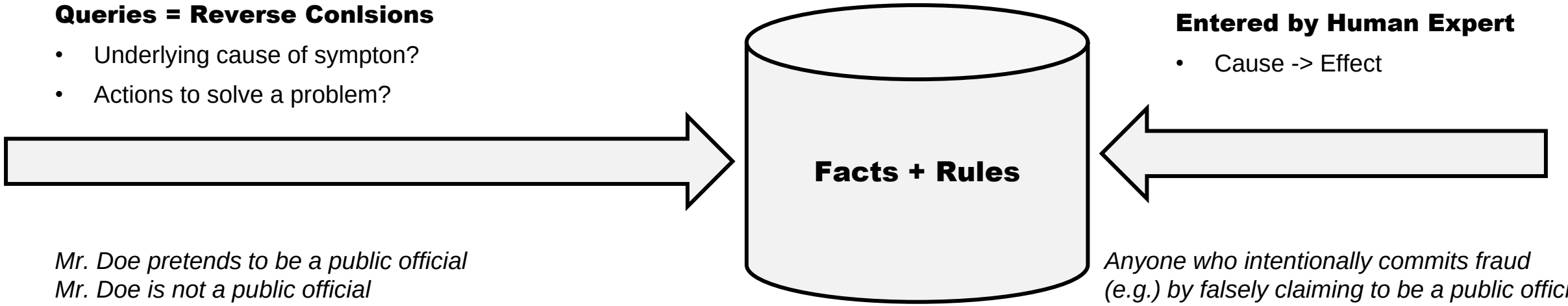


Entered by Human Expert

- Cause -> Effect

Mr. Doe pretends to be a public official
Mr. Doe is not a public official

It follows that Mr. Doe is committing fraud.
It further follows that Mr. Doe is to be punished with imprisonment of up to three years.

Anyone who intentionally commits fraud (e.g.) by falsely claiming to be a public official

shall be punished with imprisonment of up to three years.

„Modern“ Expert Systems

Automation of security-critical tasks (e.g., autopilot on planes)

Deterministic Result

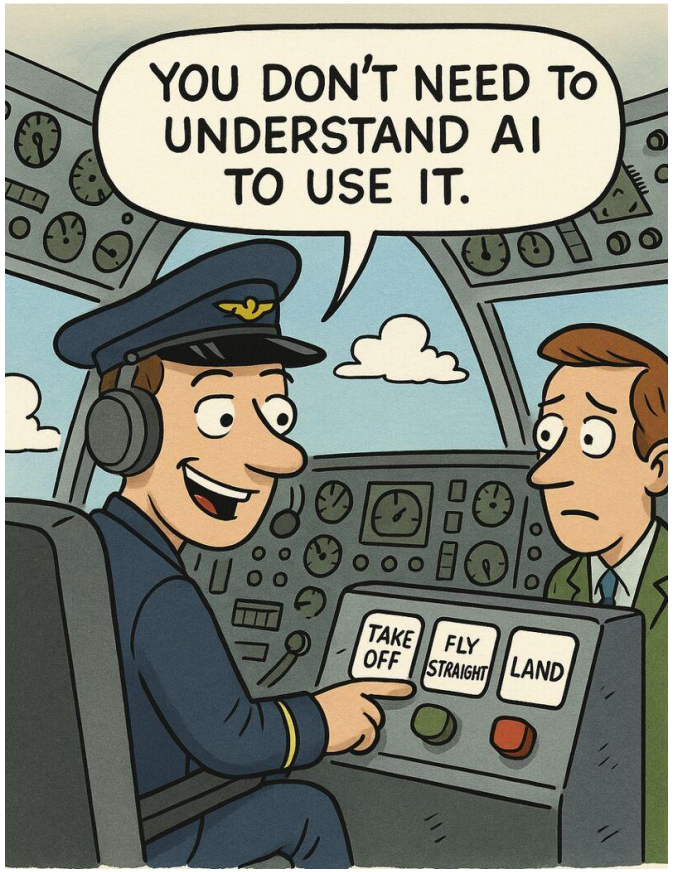
- I know in advance what will happen
- Reproducability of decisions

No Hallucinations

- Only works with what‘s there

What happens in unknown situations?

- Pilot takes over
- Also applicable to legal texts?



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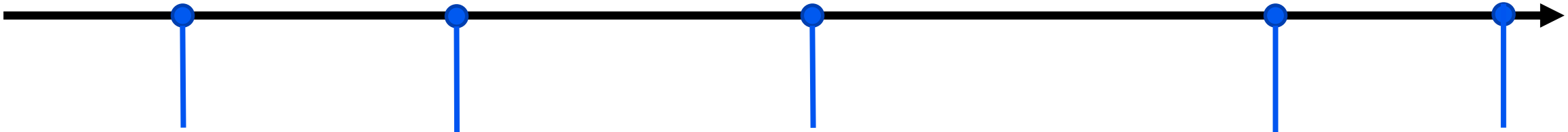

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1990—: statistical approaches

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The computer as model of the human brain

Quick calculations and executing predetermined processes are **not enough**!

“Intelligence” also means

- Learning new things
- Making connections with existing knowledge
- Drawing conclusions; generalizing
- Applying experience to completely unfamiliar tasks
- Creative activity, self-reflection, self-awareness

Learning-based Approaches
Artificial Neural Networks

What are Artificial Neural Networks?

Simulation of the brains‘ working mode

Allows **„biological“** processing of informaiton

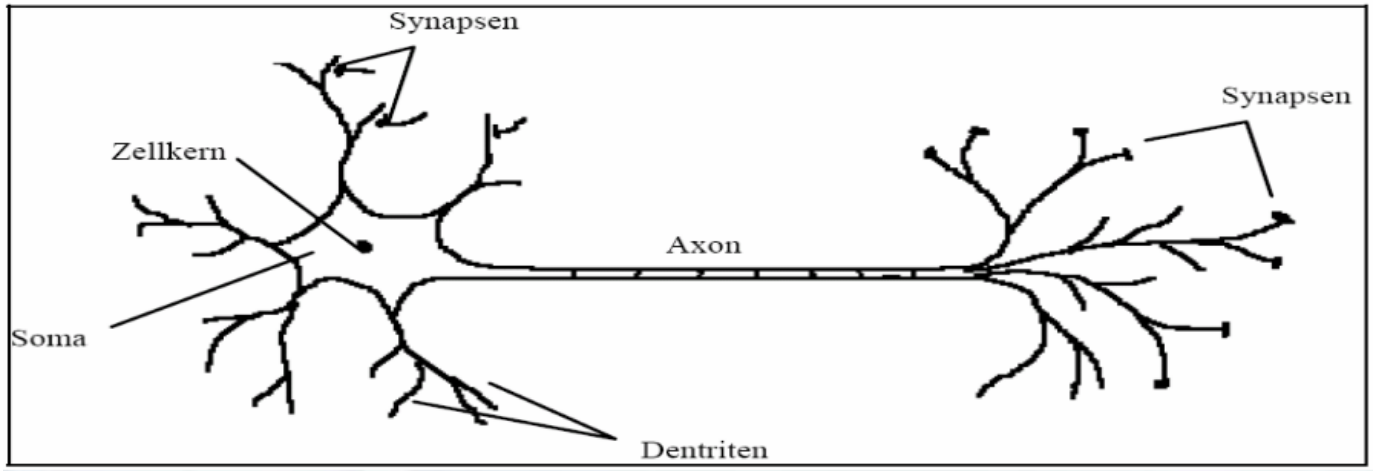
Also a **technical concept for problem solving**

- Pattern recognition
- Prediction
- Planning
- …

Neurons in Biology

Basis of brain structure of humans and animals

Specific kind of neural cell that build brain structure



Each Neuron comprises of

- Cell body (Soma)
- Dendriten to receive signals of other neurons
- Axon for transmitting signals to dendrites of other neurons

Sum of weighted input **signals exceeds a threshold => Neuron becomes active** and sends signal via Axon and synapses

Neural Networks in Biology

Brain comprises ~10 Billion Neurons
Each Neuron is connected with 10.000 other Neurons

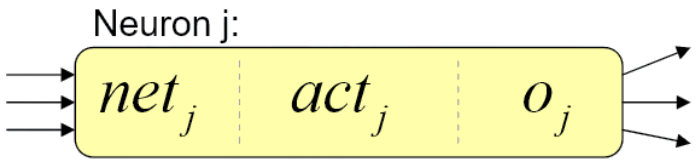
All inputs are processed in parallel by Neuron

Learning = change in connections between neurons (=Synapses)

Neurons in Informatics

Perceptron as „computer representation“ of a neuron

- Input: Set of numerical values
- Activation function to calculate output by applying weiths on inputs
- Output: Activation (0/1)

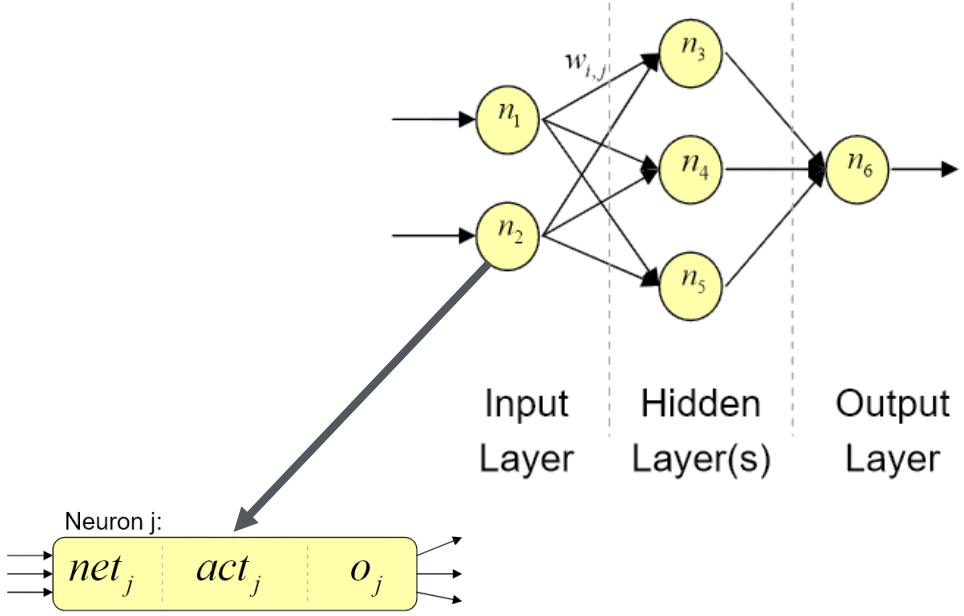


Input Activation function Output

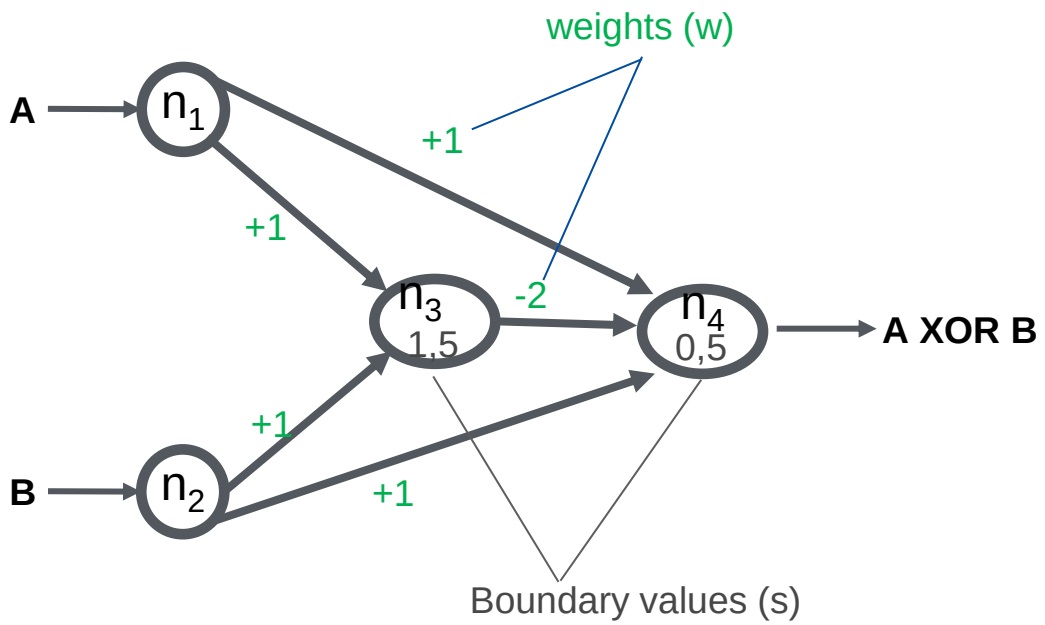
Artificial Neural Networks

Simple Neural Network

- Directed, weighed graph
- Layers of Perceptrons
- Each weighed edge connects two Perceptrons from different layers



Example Neural Network



Input Function (for each Neuron):
- Sum of output * weight for each incoming neuron

Activation Function (for each Neuron):
- 1, if Input ≥ threshold
- 0 else

Symbolic VS Non-Symbolic AI

Expert Systems (Symbolic AI)	**Trait**	**Learning-based Systems (Non-Symbolic AI)**
Explicit (Provide rules)	**Learning Rules**	Implicit (Provide examples)
Reverse Cause->Effect Chains	**Prediction**	Apply rules to new data
Depends on quality + amount of provided rules	**Precision**	Depends on quality of provided examples

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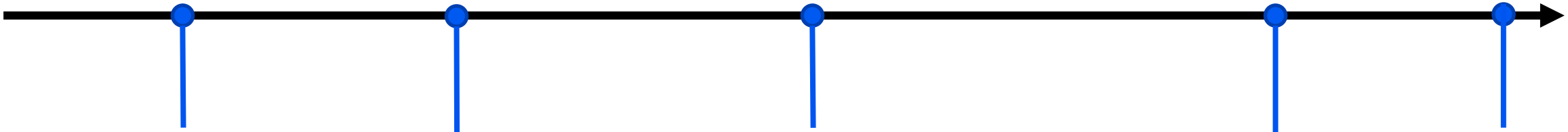

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1990—: statistical approaches
- “AI spring” through probabilities and uncertainty
- Improvement in academic and technical depth

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Summary

AI since 1943

- Increasing technical and scientific depth over decades
- Many theoretical ideas now proven relevant with respective computing power

Symbolic AI (Expert Systems) as first approach

- Deterministic, but limited value

Non-Symbolic AI (learning-based systems) for new applications

- Advanced applications, but undeterministic

Combination of Symbolic/Non-Symbolic AI: https://www.bilateral-ai.net/home

Contact

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Funded by

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AI Factory Austria AI:AT has received funding from the European High-Performance Computing Joint Undertaking (JU) under grant agreement No 101253078. The JU receives support from the Horizon Europe Programm of the European Union and Austria (BMIMI / FFG).