

A Gentle Introduction to Artificial Intelligence and Its Potential for (Language) Teaching

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<https://www.goethe.de/ins/cn/de/spr/unt/ver/konferenz/dkf.html>

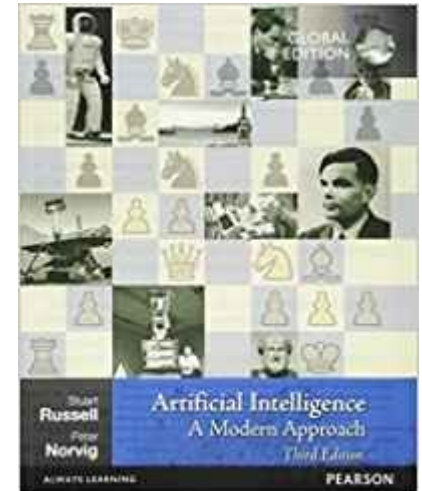
Artificial Intelligence

... is a long established area of research: 1956 term coined by computer scientist John McCarthy

AI is the study of how to make computers do things at which, at the moment, people are better. (Elaine Rich, 1963)

AI research is concerned with computer problems yet unsolved. (Marvin Minsky)

Topics of AI: Knowledge representation, reasoning, planning, language understanding, object recognition, machine learning

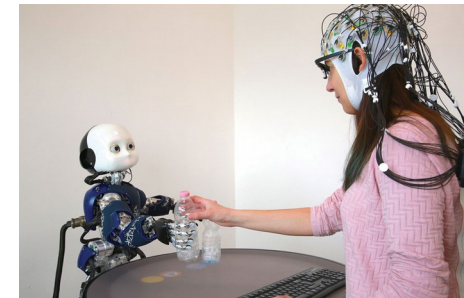


Weak and Strong AI

- Goal: develop specific AI solutions for complex domains (solutions are restricted, e.g. to recognizing traffic signs, translating from German to Chinese, playing Go)
= **weak AI**
- Goal: reconstruct human intelligence on a computer (and thereby gain a better understanding of human intelligence)
= **strong AI**

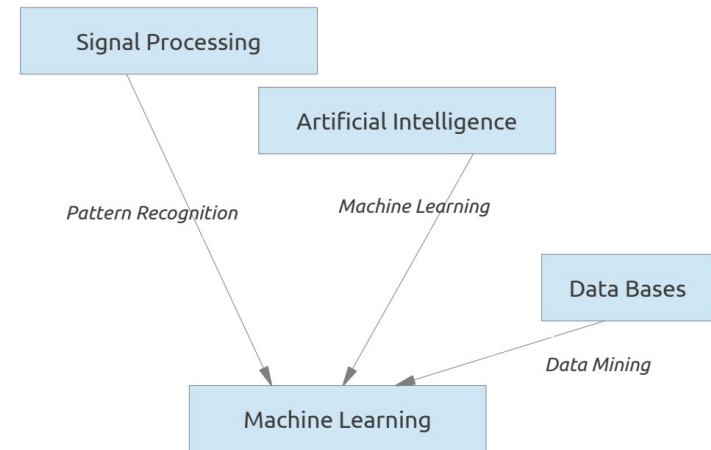


Can an AI system have intentions, self-consciousness?



Machine Learning as part of AI

- Current focus: Machine learning, especially deep learning
- Specific variant of pattern recognition approaches in very large data sets
- Modern ML is a blend of AI, signal processing, and statistics
- Early ML research was driven by the goal to simulate human learning
 - Pioneers: Arthur Samuel (Checkers, 1952),
 - Donald Michie (Tic-tac-toe, 1963)



The Power of Human Learning

Learning from very few examples



✓ Learning from few data

✓ Greedy generalization

(e.g. language learning – seed, womans)

✓ Dark side: stereotypes and prejudice

(men cannot listen, women cannot park a car)

Changes and Risks of AI

- **Fears:** humans will be replaced by machines
 - Unemployment of humans (are unskilled workers or academics more at risk?)
 - losing competences
 - autonomous AI systems will start to rule over humans
- **Hopes:** deep learning allows to make sense of very complex data and can be applied to automate or support many aspects of live *industrial manufacturing, medical diagnosis, credit assessment, marketing, health care, teaching*
 - relieve of hard or routine work, efficiency gain

AI for Teaching (Languages)

- Learning Analytics

- Data driven prediction of learning success
- Similar methods as for credit worthiness prediction
- Mainly behavioristic, easily observable data (e.g., turning in of home work, time on a website, points in a multiple choice test) and attention tracking (EEG, eyetracking)



- Intelligent Tutor Systems (ITS)

- Model of knowledge domain
- (more or less) unrestricted types of tasks, typically in easily formalisable domains (STEM)
- Individual diagnosis of misconceptions
- Generating helpful feedback
- Mainly cognitive, also constructive



Example: ITS for Subtraction

CogSys Cognitive Companion * M

G@SYS Mein Mathe Tutor

Löse folgende Aufgabe:

$$\begin{array}{r} 3 \quad \square \quad \square \\ 4 \quad 3 \quad 7 \\ - 3 \quad 7 \quad 4 \\ \hline \square \quad 4 \quad 3 \end{array}$$

Weiter

Deine Antwort ist noch nicht ganz richtig. Ich zeige dir nochmal ein Beispiel.

Versuch's nochmal:

$$\begin{array}{r} \square \quad \square \quad \square \\ 4 \quad 3 \quad 7 \\ - 3 \quad 7 \quad 4 \\ \hline \square \quad \square \quad \square \end{array}$$

Weiter

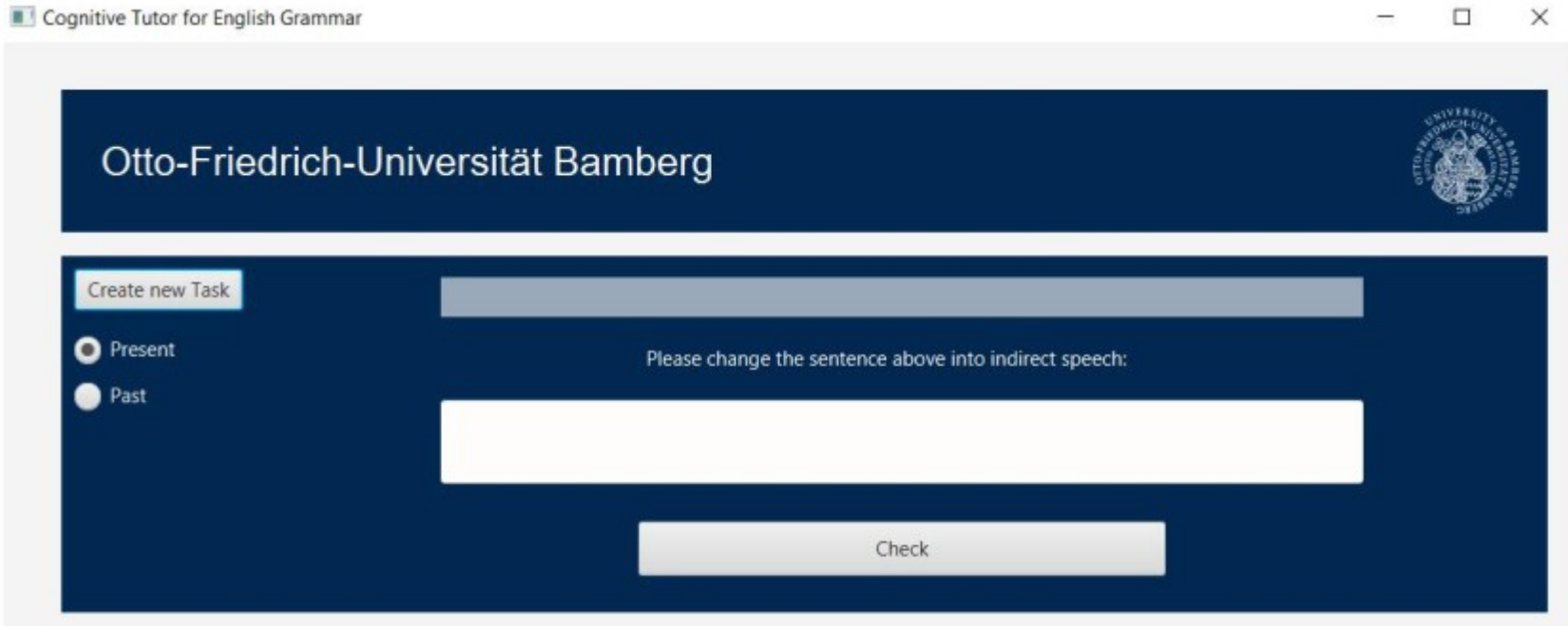
Beispiel:

$$\begin{array}{r} 3 \quad 11 \quad \square \\ 4 \quad 1 \quad 0 \\ - 1 \quad 8 \quad 0 \\ \hline 2 \quad 3 \quad 0 \end{array}$$

Weiter

- Expert model: the subtraction algorithm
→ All tasks can be solved by the ITS
- Error diagnosis: automated identification which part of the algorithm has been applied incorrectly
- Feedback: a structurally analogous task with solution
→ Learning by analogy instead of by being told (more efficient)

Example: ITS for English as Second Language



Example: ITS for English as Second Language

: Rules for the Time Shift from Direct to Reported Speech

Direct Speech	Reported Speech
Simple Present	Simple Past
Present continuous	Past continuous
Present perfect	Past perfect
Simple past	Past perfect
Past continuous	Past perfect continuous
Past perfect	Past perfect
is going to	was going to
will	would
can	could
may	might
shall	should

- Expert model: grammar rules for transforming direct into indirect speech
 - can be solved by the ITS (with some limitations)
- Error diagnosis: automated identification which part of the algorithm has been applied incorrectly
- Feedback: a structurally analogous task with solution
 - Learning by analogy instead of by being told (more efficient)

Take Away Messages

- AI research is concerned with computer algorithms to solve problems yet better solved by humans
- AI is more than machine learning
- Depending on how AI systems are designed, they can result in disempowerment or support humans in complex domains
- (Language) teaching can be supported by learning analytics but also by intelligent tutor systems



Image Sources and Credits

- Tufa: Josh Tenenbaum
- <https://www.denofgeek.com/uk/movies/terminator/46910/where-the-terminator-franchise-went-wrong-by-james-cameron>
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- Math Tutor: Christina Zeller, Ute Schmid: Automatic Generation of Analogous Problems to Help Resolving Misconceptions in an Intelligent Tutor System for Written Subtraction. ICCBR Workshops 2016: 108-117
- English Grammar Tutor: Kristina Prümer: A Cognitive Tutor Generating Error-Specific Feedback for English Grammar Learning (Master thesis, December 2019)