

Lecture

## Foundations of Artificial Intelligence

**Part 1 – Introduction**

Dr. Mohsen Mesgar

Universität Duisburg-Essen

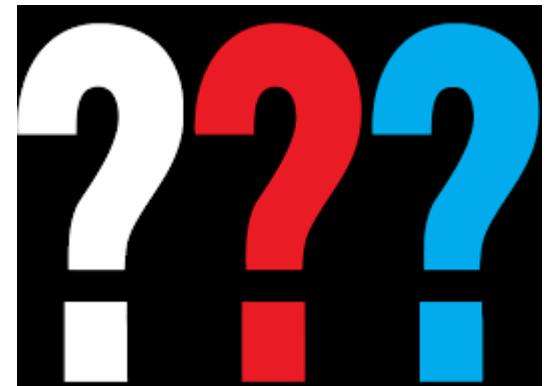
# Warm up

Hands up

- Computer Science (Informatik)?
- Other disciplines?

Expectations?

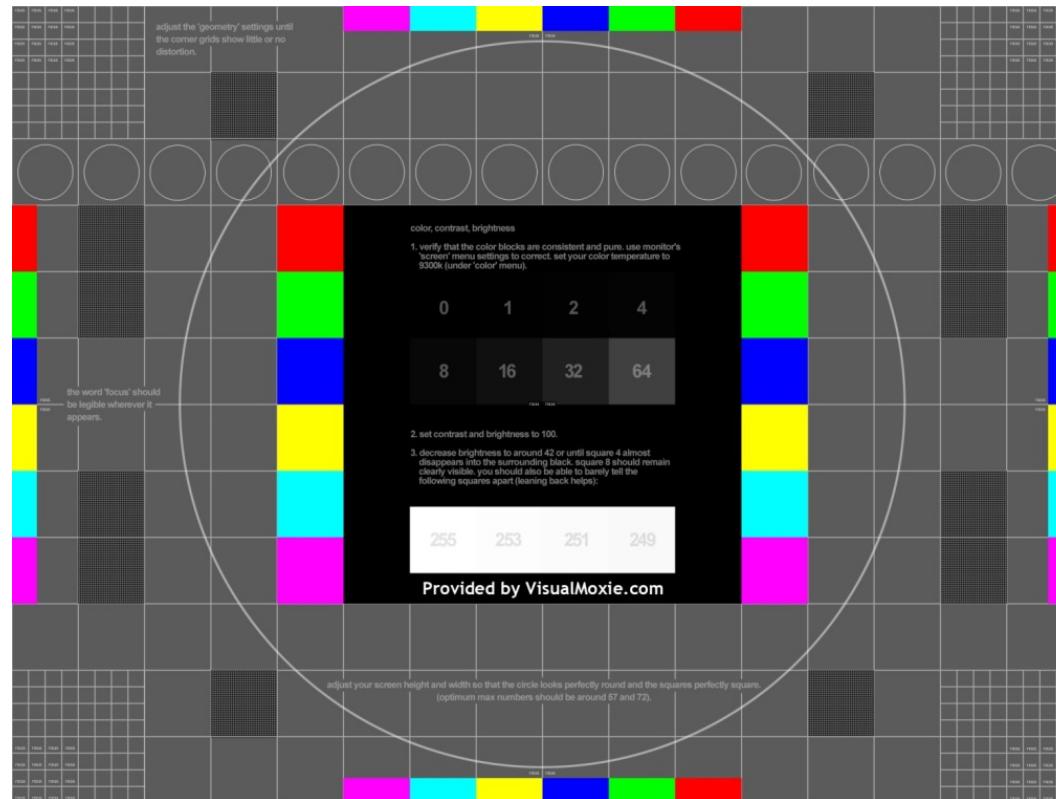
- ...



# Previous Knowledge

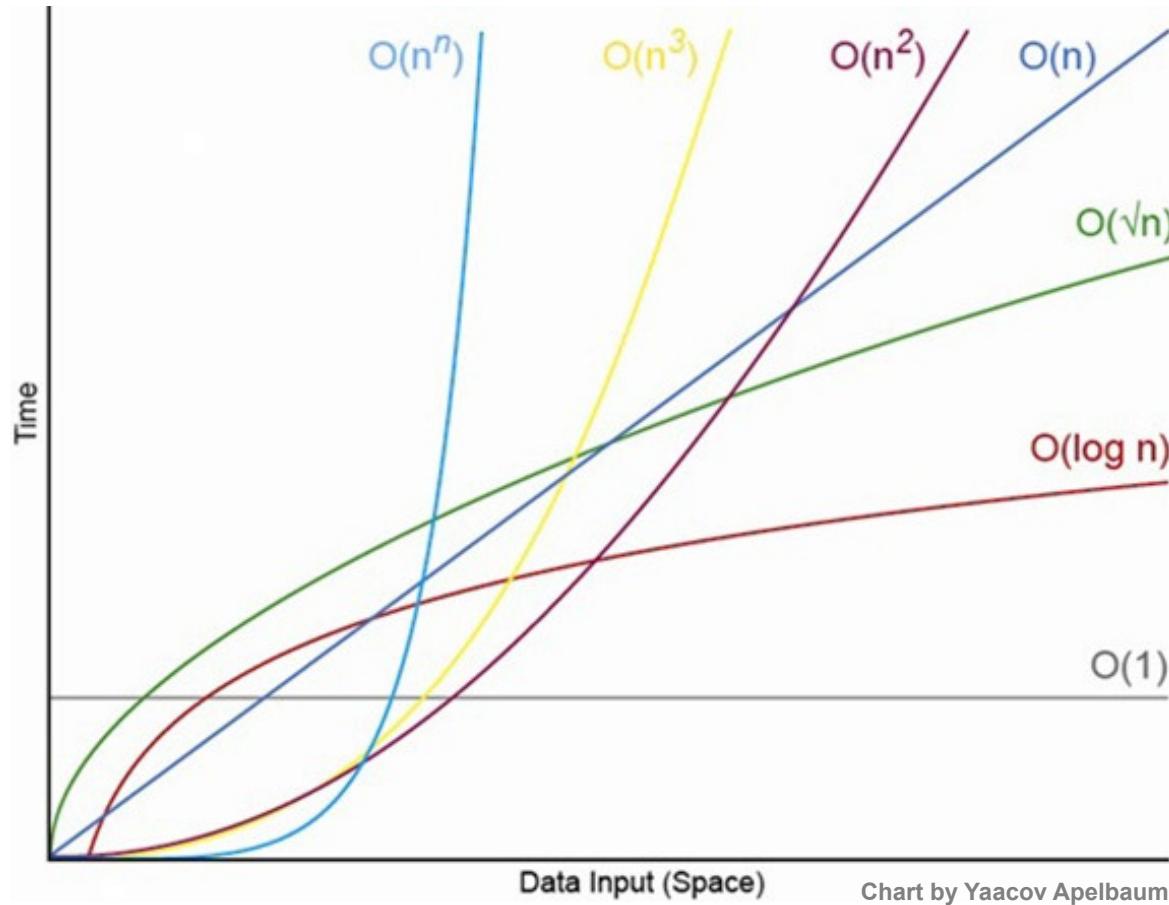
Previous knowledge on the topic?

- Calibrating ...



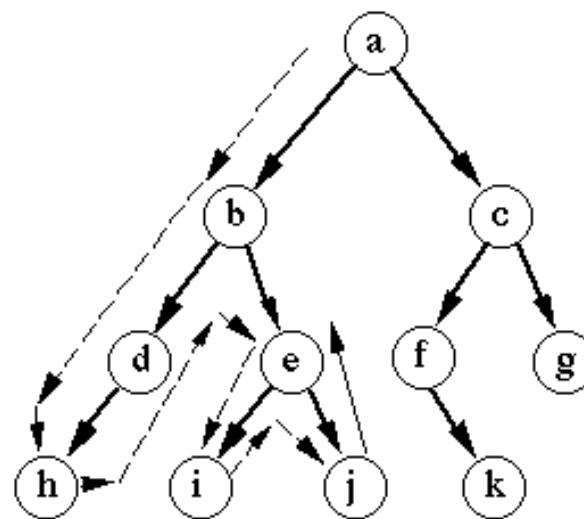
# Do You Already Know ...?

Hands up if you already know the O() – Notation.

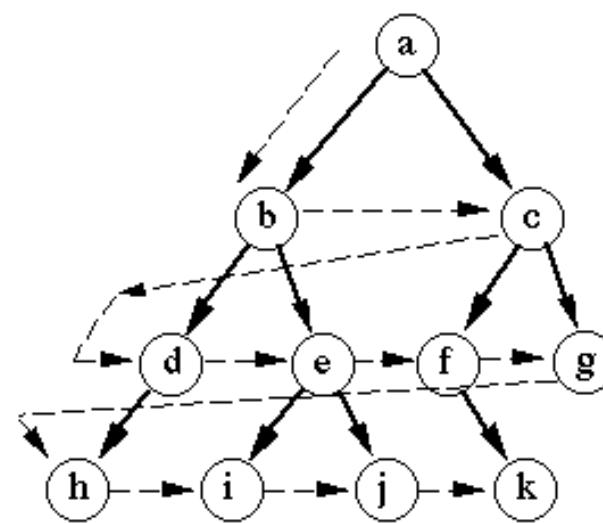


# Do You Already Know ...?

Hands up if you already know Basic Search Algorithms.



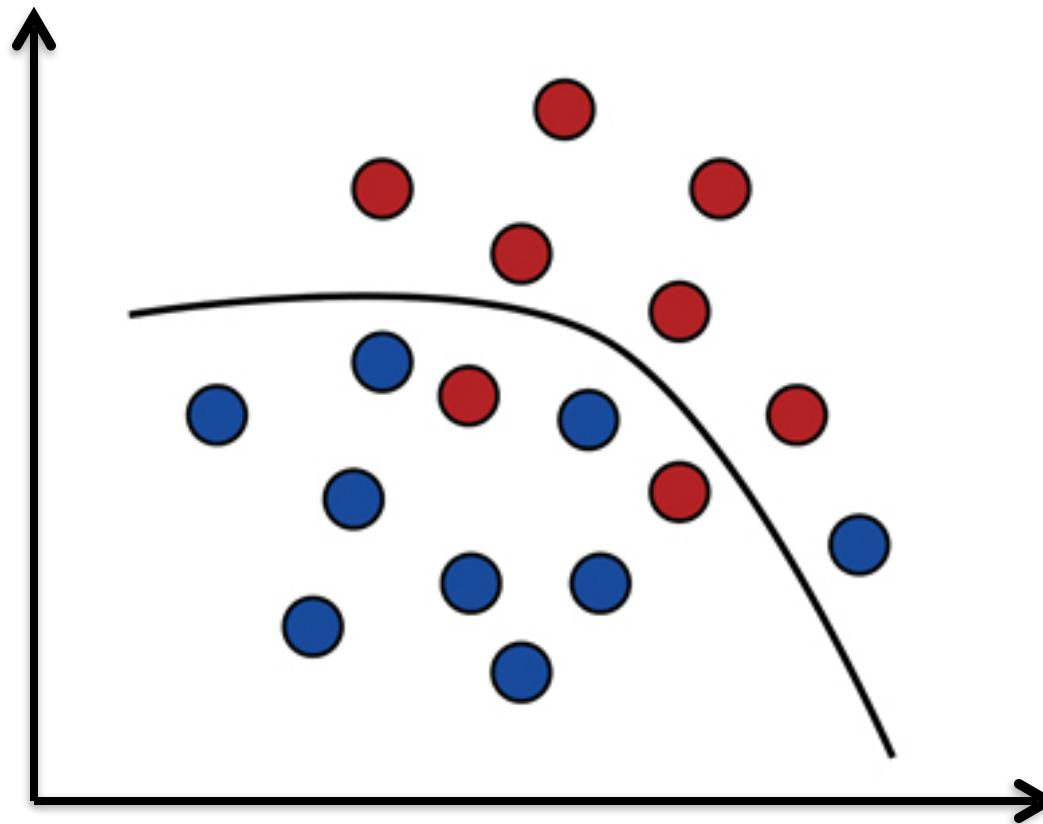
Depth-first search



Breadth-first search

# Do You Already Know ...?

Hands up if you already know Machine Learning.



# Who am I?



<https://mohsen-mesgar.io>

- ◊ Research: Intersection of AI/ML and Natural Language Processing (NLP)
- ◊ Conversational AI, few-shot learning, and text processing

# At The End of This Lecture ...

- You learn some introductions to AI
- You learn about the administrative organization of the course

**Artificial Intelligence**  
**A (hopefully) motivating Introduction**

**Administrative Course Issues**

# What is AI?

# Introduction to AI

A. M. Turing (1950) Computing Machinery and Intelligence. *Mind* 49: 433-460.

## COMPUTING MACHINERY AND INTELLIGENCE

By A. M. Turing

### 1. The Imitation Game

I propose to consider the question, "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think." The definitions might be



# Introduction to AI



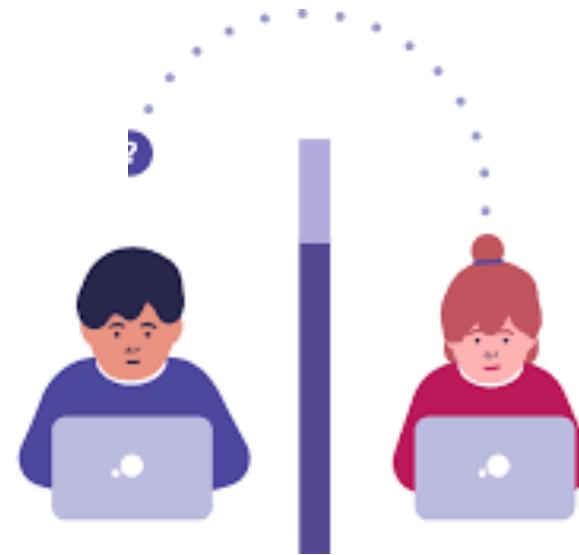
*A computer would deserve to be called intelligent if it could deceive a human into believing that it was human.*

Alan Turing

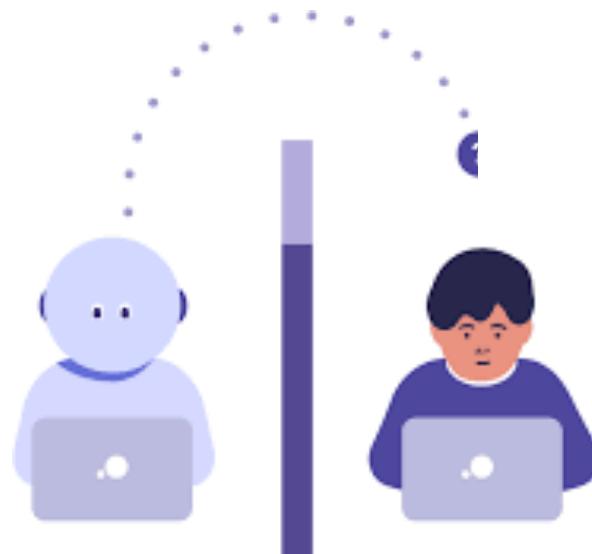
# Turing Test



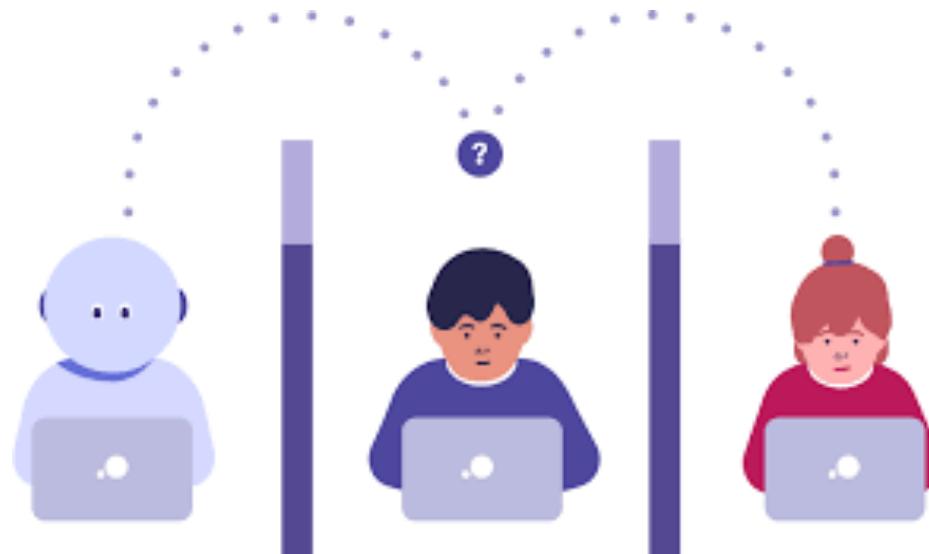
# Turing Test



# Turing test



# Turing Test



# Introduction to AI

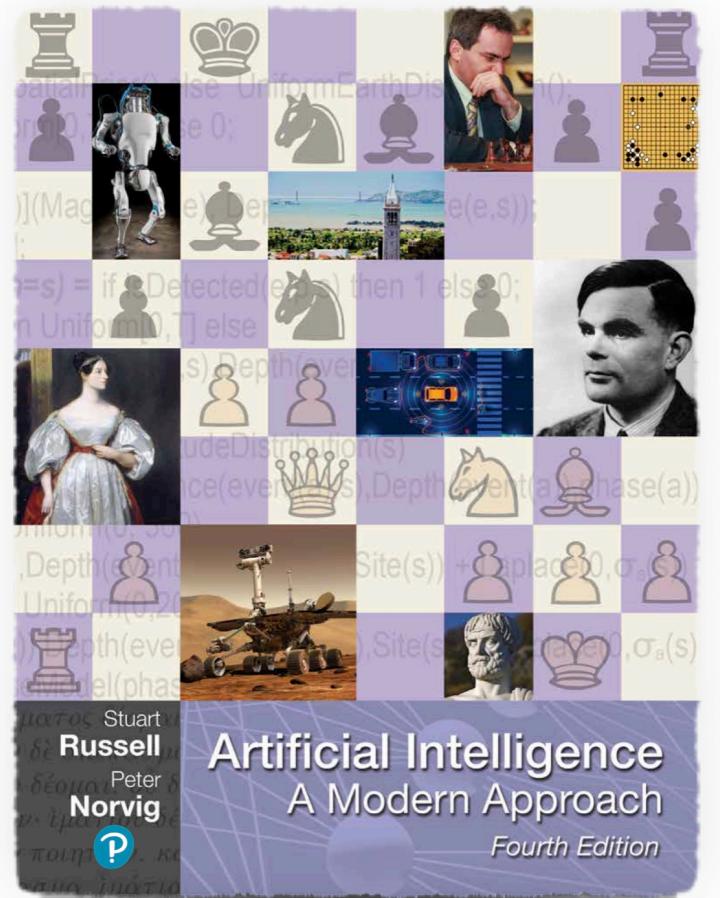
- Russell and Norvig delve into four potential definitions of AI:

## Human approach:

- Systems that **think like humans**
  - Systems that **act like humans**

## Ideal approach:

- Systems that **think rationally**
  - Systems that **act rationally**



# Introduction to AI

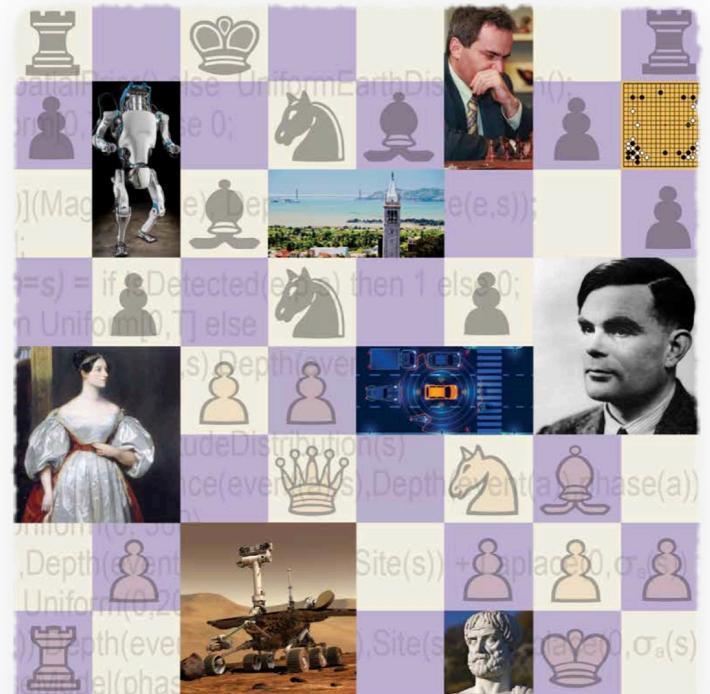
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Ideal approach:

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Artificial Intelligence  
A Modern Approach

Fourth Edition

# Look at Your Cellphone

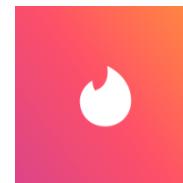
- Which apps are intelligent?



amazon



You Tube



Google  
Translate



XTRADE  
ONLINE CFD TRADING

- <https://rb.gy/mui9md>
- If the above link does not work use the following:
  - <https://jamboard.google.com/d/1KPTv9WWt4bX83W-vupSiUiKxFOxm3N66gV9GZptj7sg/edit?usp=sharing>

# AI in daily life (on your phone)

- Automatic translation
- Chess computer (Game AI in general)
- Face recognition
- Handwriting recognition
- Recommender systems (Amazon)
- Spam-filter
- Speech recognition (Alexa, Cortana, Siri)
- Stock trading
- Weather forecast
- Web search

# Chess



- 1997: Deep Blue wins against chess world champion Garry Kasparov

*It was an impressive achievement, of course, and a human achievement by the members of the IBM team, but Deep Blue was only intelligent the way your programmable alarm clock is intelligent. Not that losing to a \$10 million alarm clock made me feel any better.*

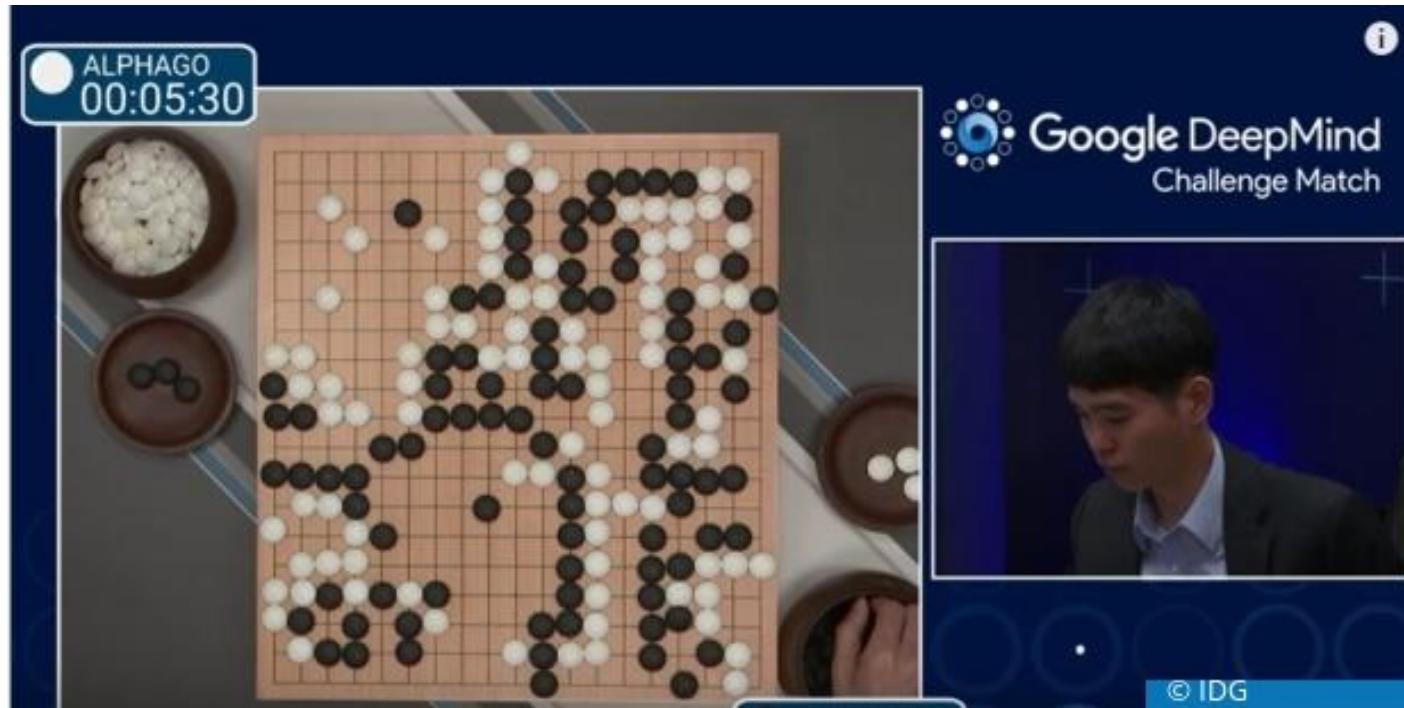
Garry Kasparov





# AlphaGo

- 2016: AlphaGo wins against Lee Sedol



<https://www.alphagomovie.com/>

# Poker

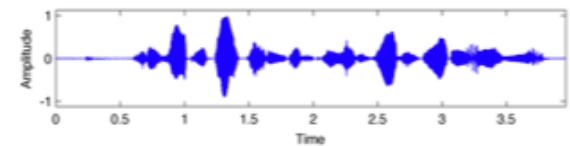
- 2017: Libratus and Deepstack win against professional poker players.



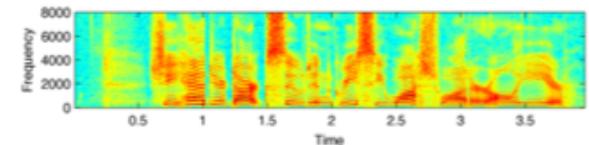
# Speech Recognition



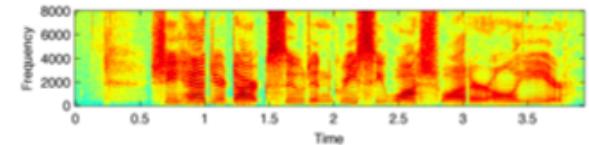
**Time Domain  
Waveform**



**Spectrogram**



**MFCC  
Spectrogram**



# Machine Translation

German ▾

Künstliche Intelligenz ist ein spannendes Thema, bei dem man immer wieder überrascht ist, wie gut bestimmte Anwendungen funktionieren, während andere vollkommen versagen.



170 / 5000

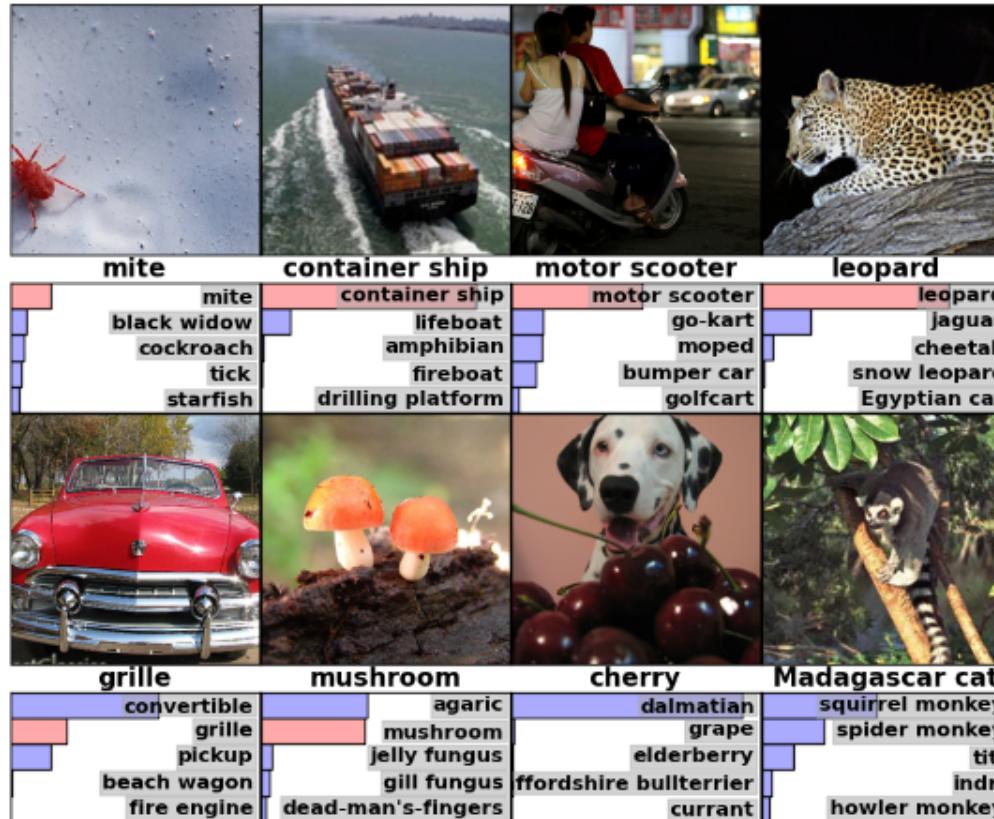


English (US) ▾

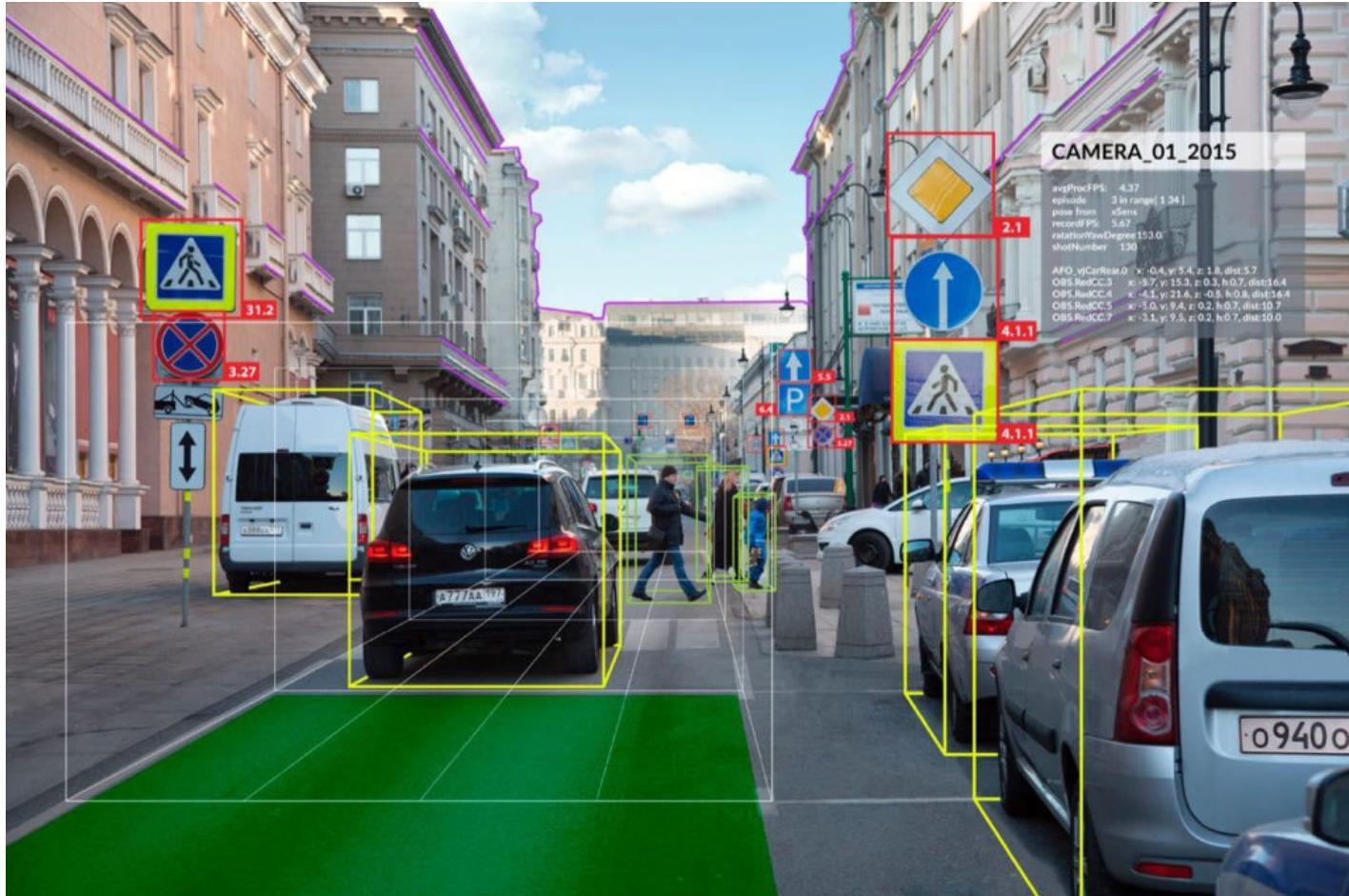
Artificial intelligence is an exciting topic, where one is always surprised at how well certain applications work while others fail completely.



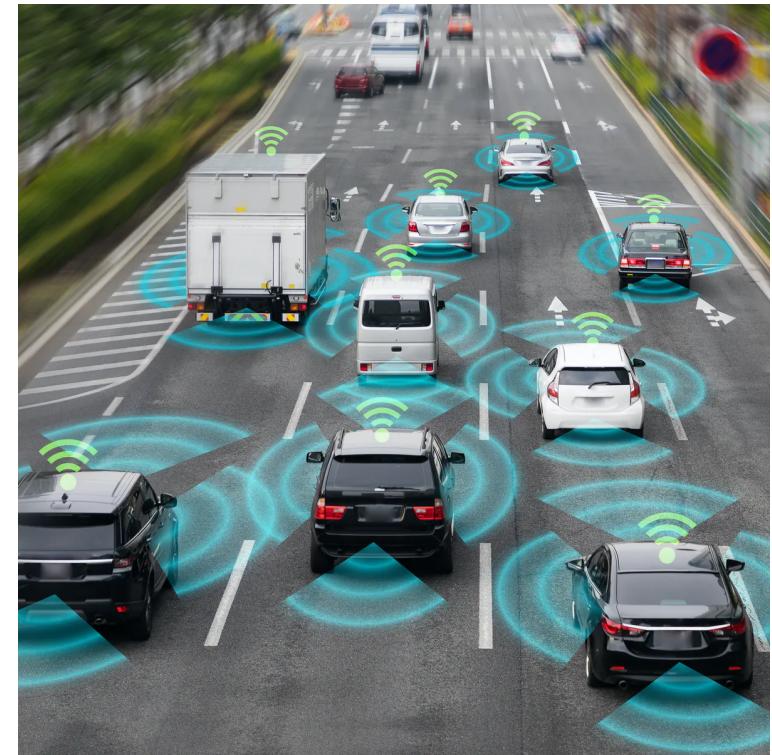
# Object Recognition



# Object Recognition



# Autonomous Vehicles

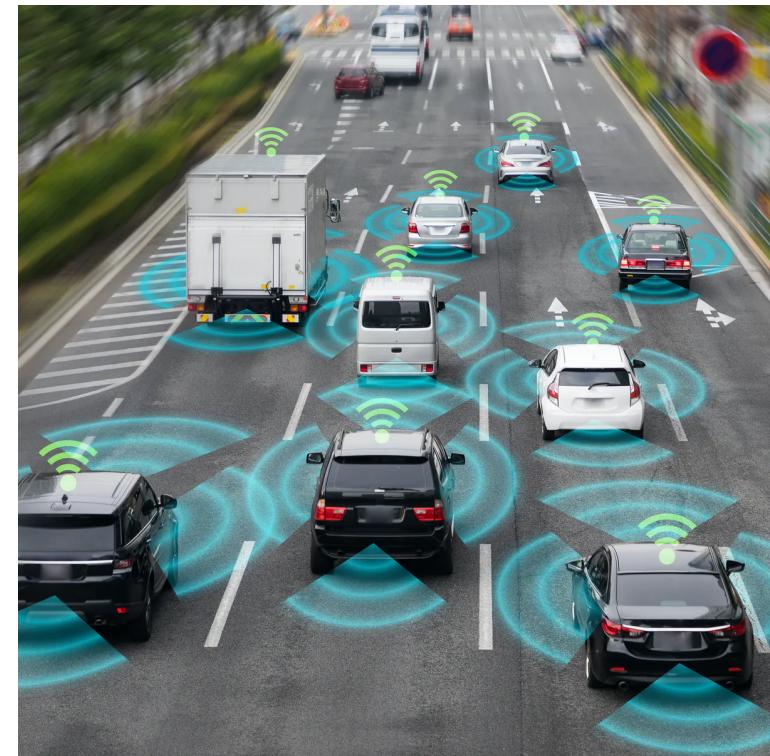


- Put your suggestions in a category of AI applications
  - Image processing
  - Video processing
  - Text processing
  - Signal processing
  - Planning
- <https://rb.gy/mui9md>
- If the above link does not work use the following:
  - <https://jamboard.google.com/d/1KPTv9WWt4bX83W-vupSiUiKxFOxm3N66gV9GZptj7sg/edit?usp=sharing>
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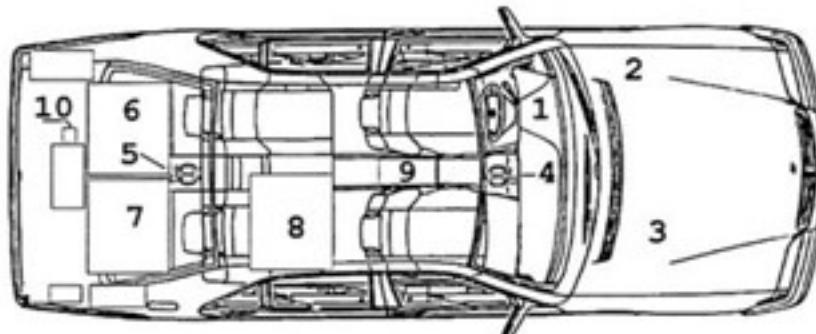
# AI Applications

- Put your suggestions in a category of AI applications
  - Image processing
  - Video processing
  - Text processing
  - Signal processing
  - Planning
- These applications have a long history

# Autonomous Vehicles



# Autonomous Vehicles

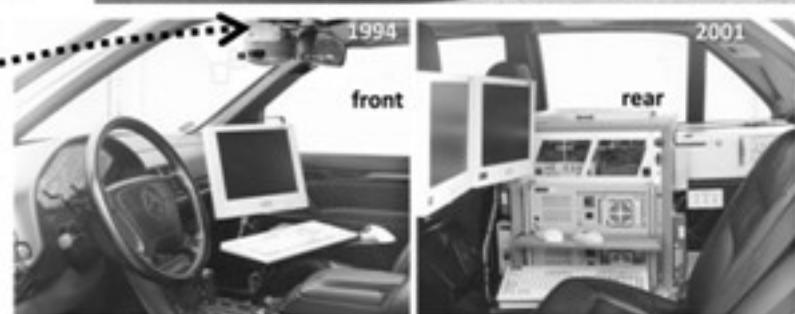


- 1 electrical steering motor  
2 electrical brake control  
3 electronic throttle  
4 front pointing platform for CCD-cameras  
5 rear pointing platform

- 6 Transputer Image Processing system  
7 platform and vehicle controllers  
8 electronics rack, human interface  
9 accelerometers (3orthogonal)  
10 inertial rate sensors



At distance  $L_s \sim 20 \text{ m} (\sim 60 \text{ m})$ ,  
the resolution is 5 cm/pixel



Developed in the 1980ies

1995: a nearly 2000-km drive at up to 130 km/h, almost completely autonomously

# Machine Translation

German ▾

Künstliche Intelligenz ist ein spannendes Thema, bei dem man immer wieder überrascht ist, wie gut bestimmte Anwendungen funktionieren, während andere vollkommen versagen.



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English (US) ▾

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# Machine Translation

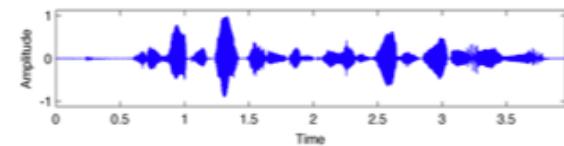


1950ies

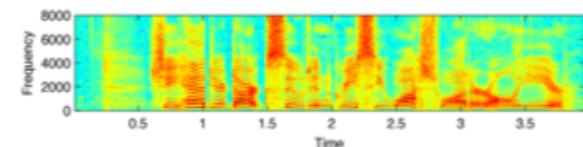
# Speech Recognition



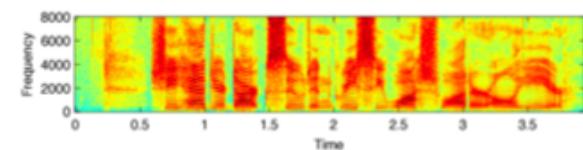
**Time Domain  
Waveform**



**Spectrogram**



**MFCC  
Spectrogram**



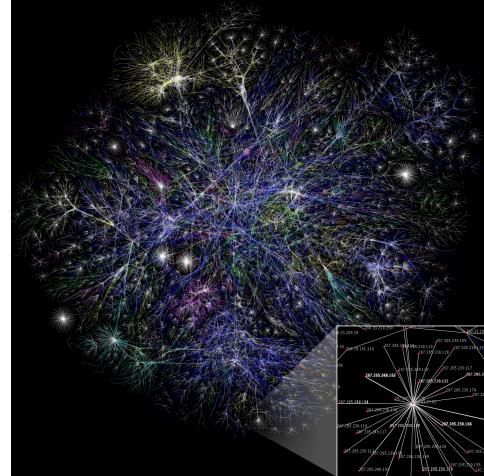
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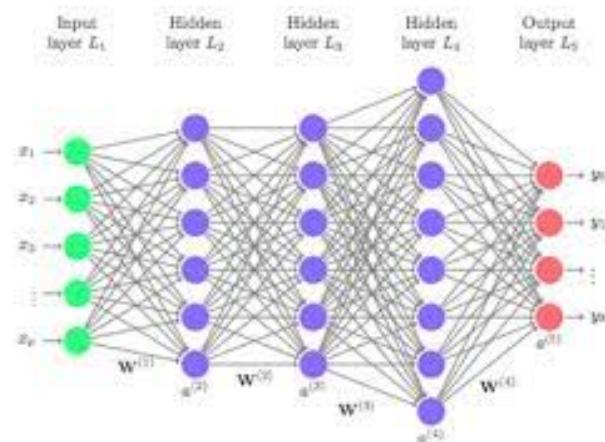
1960ies

# Why now?

- Internet
- Compute power
- Algorithms
- Data
- People



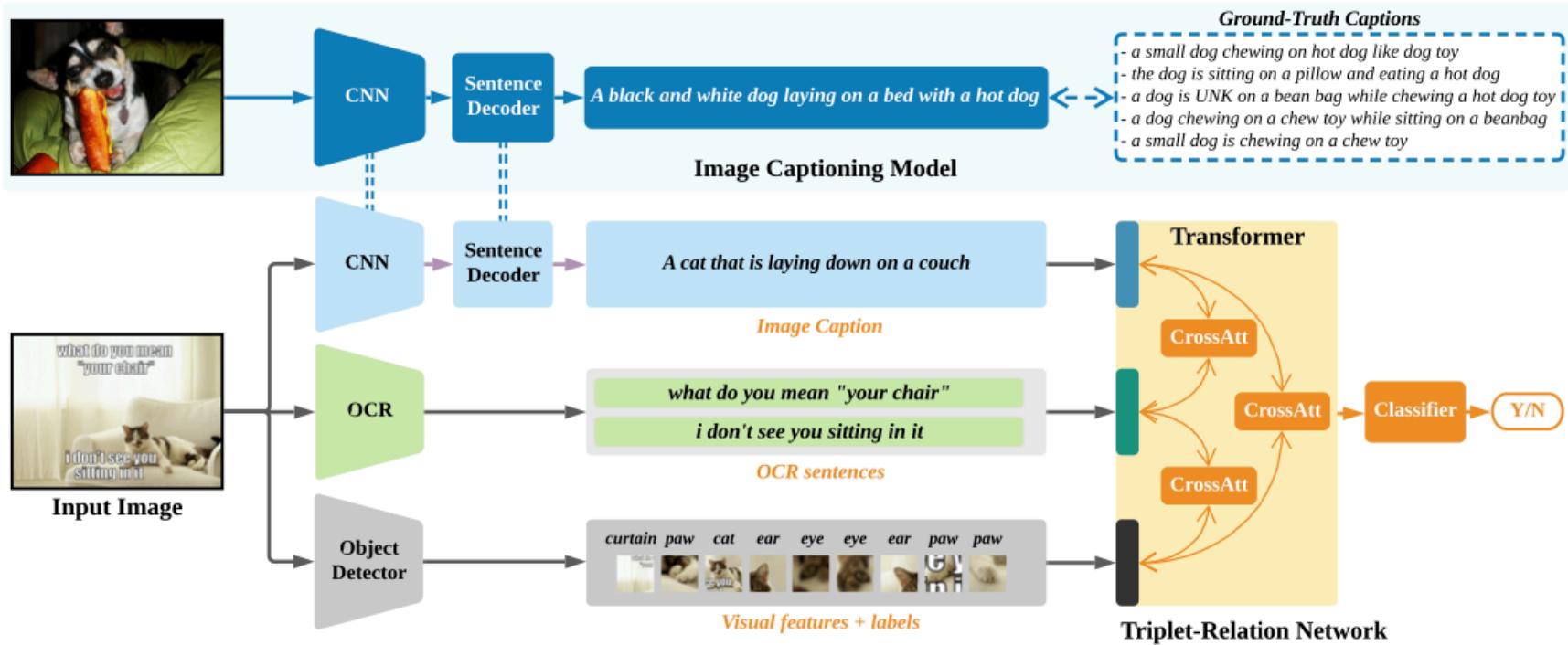
CPU vs TPU vs GPU



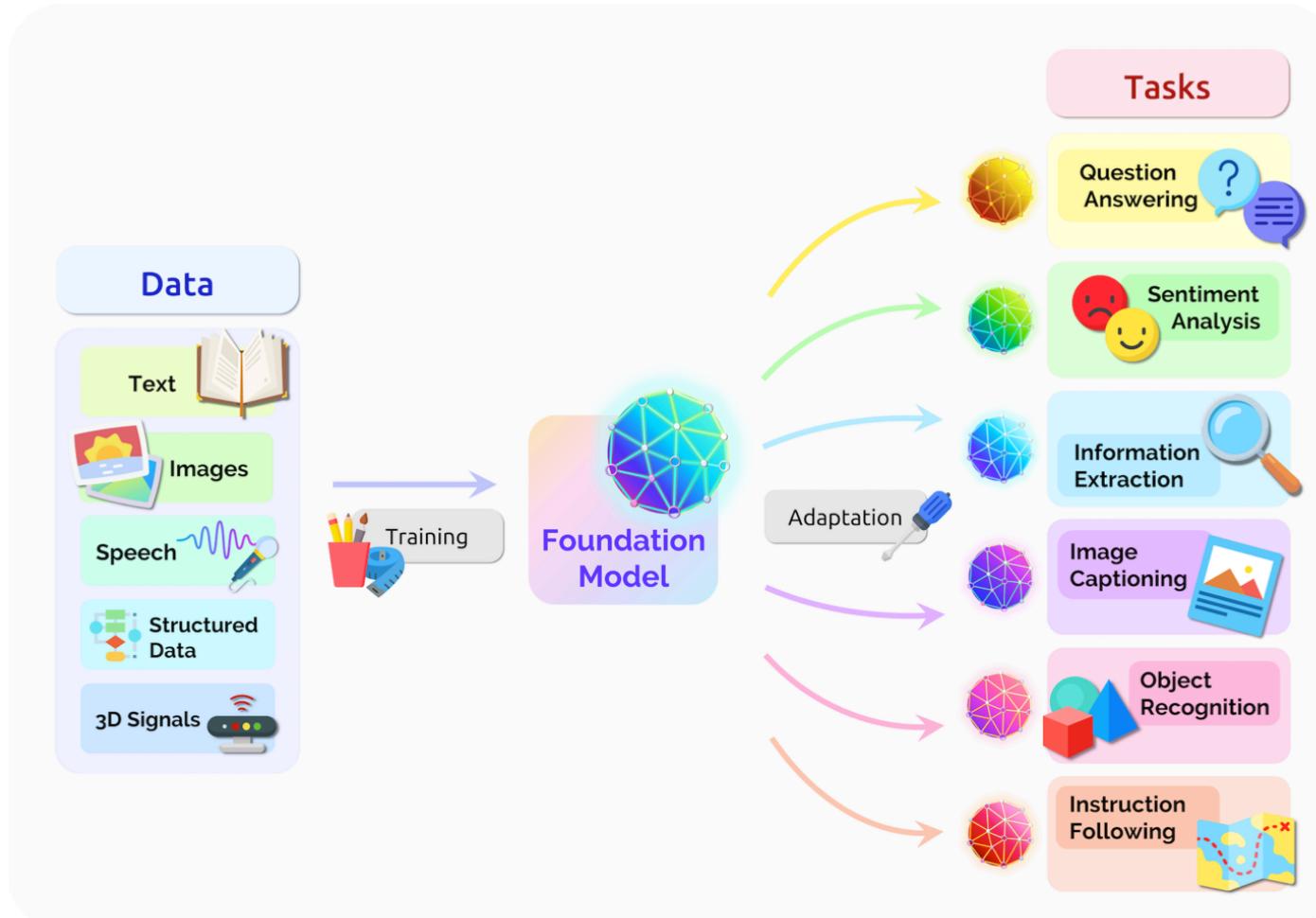
# New directions



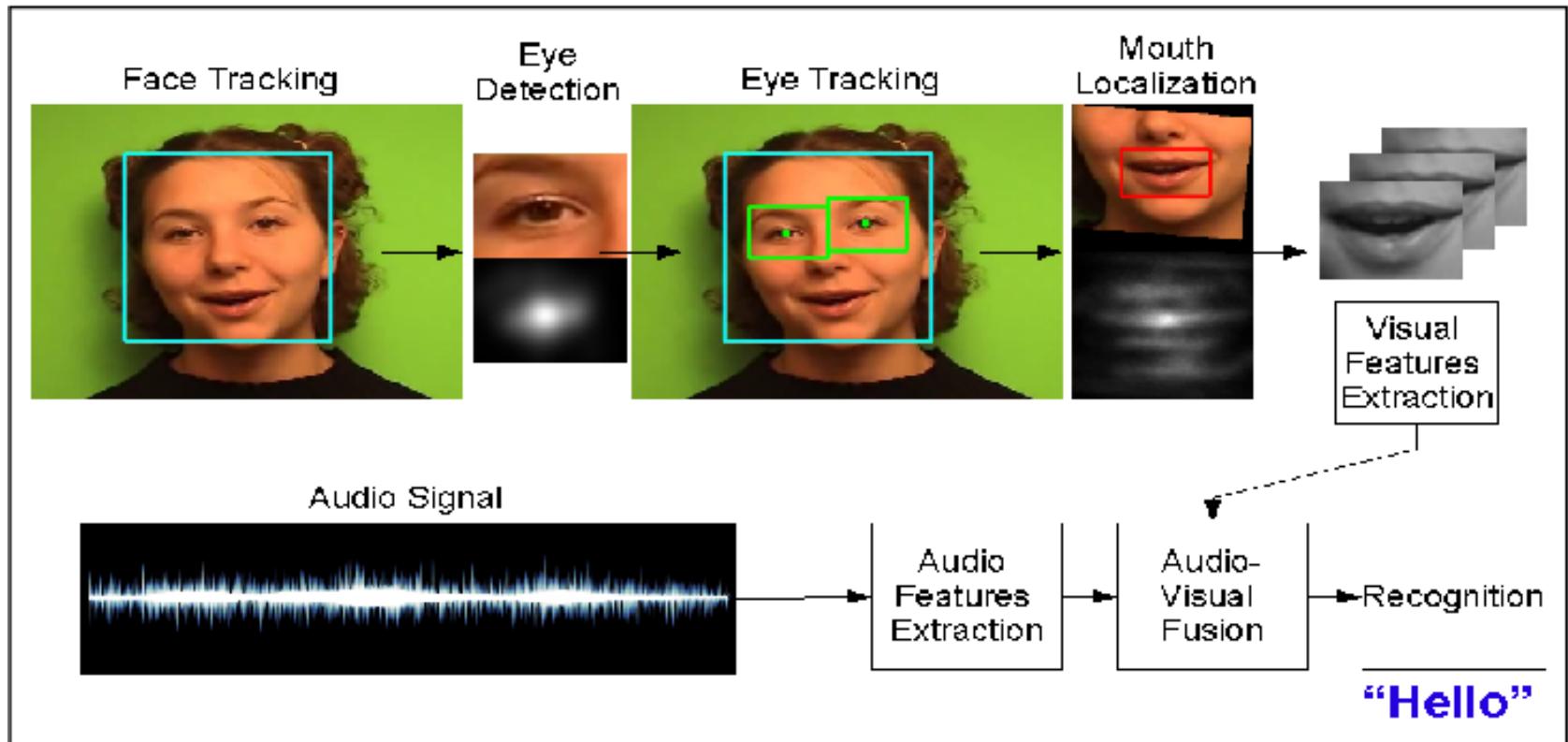
# Hateful Meme Detection



# Foundation Models



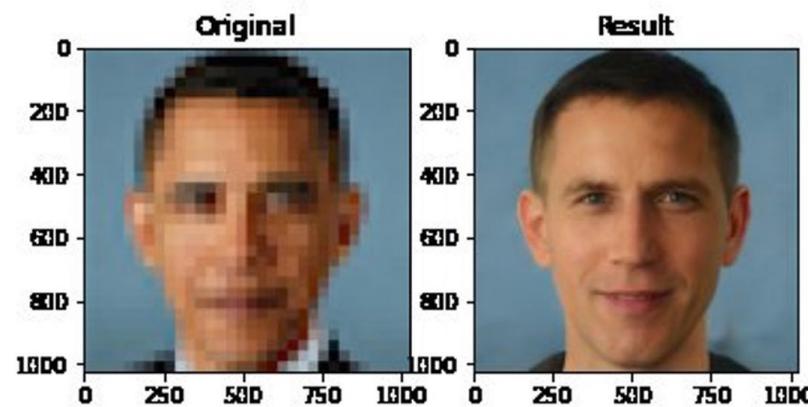
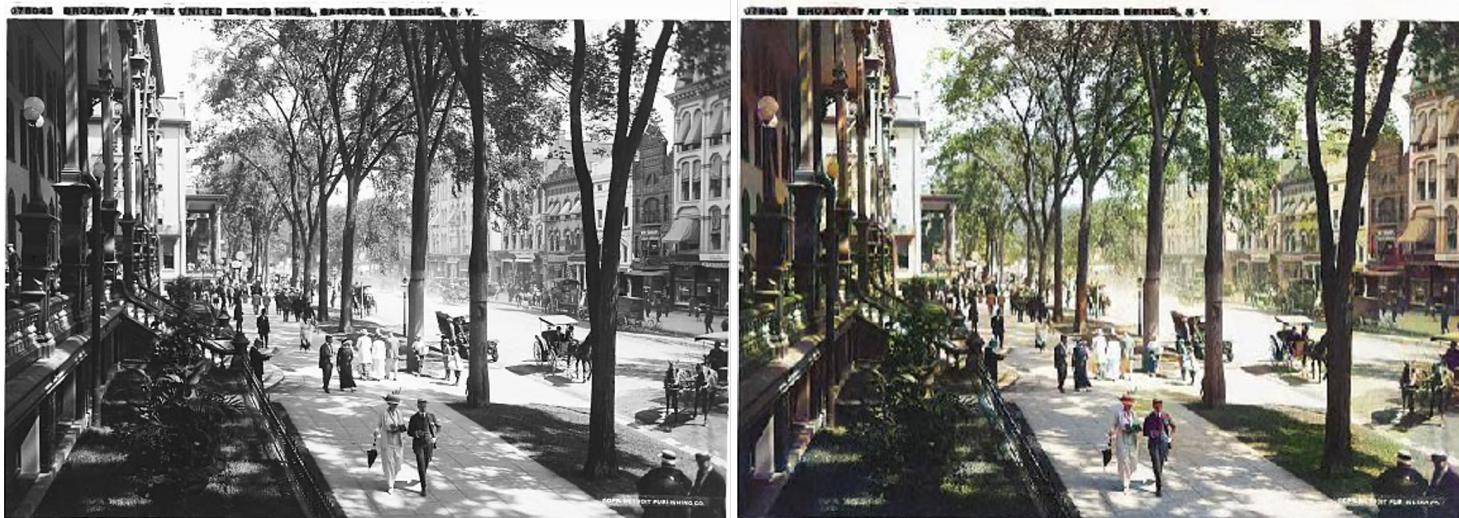
# Multi-modal



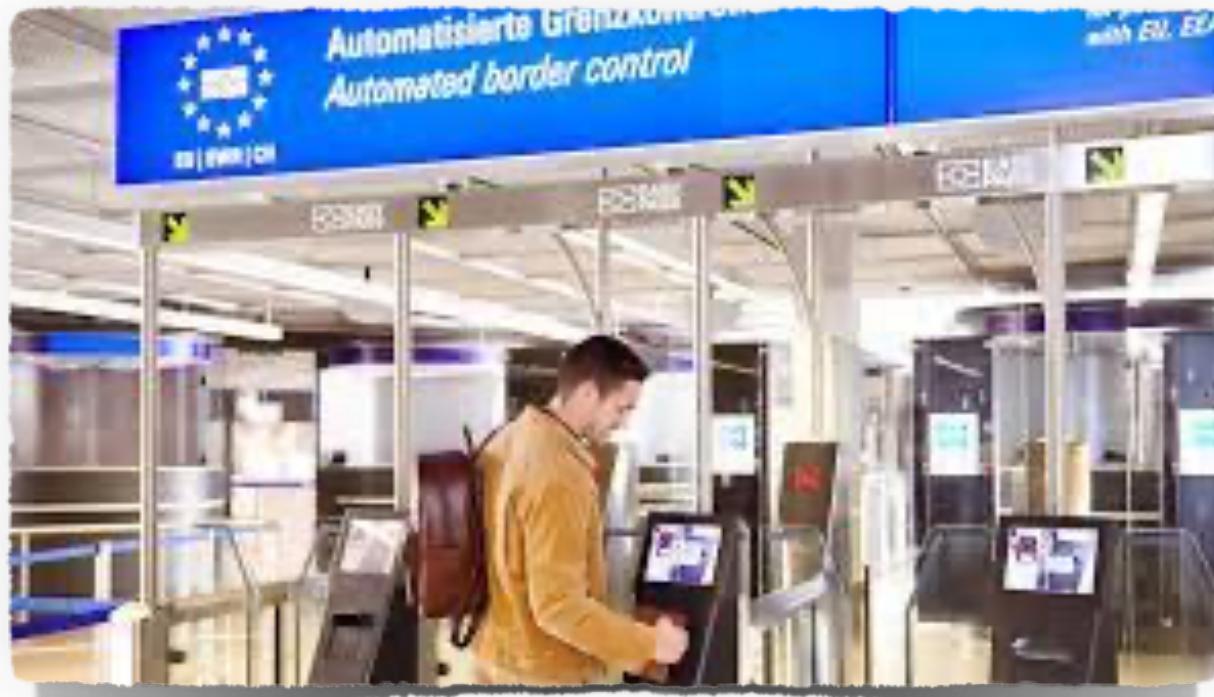
# Dual Use



# Dual Use – Image Enhancement



# Dual Use – Face Recognition



# Dual Use – Social Bots

(1). This model of psychotherapy is being modified because software programs that talk like people (i.e., conversational artificial intelligence, chatbots, digital assistants) are now beginning to provide mental health care (2). Conversational artificial intelligence (AI) is gathering diagnostic information (3, 4) and delivering evidence-based psychological interventions (5–7). Additionally, conversational AI is providing clinicians with feedback on their psychotherapy (8) and talking to young people about suicide, sex, and drug use (9, 10).



<https://www.frontiersin.org/articles/10.3389/fpsy.2019.00746/full#B4>

Write With Transformer distil-gpt2 ⓘ

🔀 Shuffle initial text ⓘ Trigger autocomplete or tab Select suggestion ↑ ↓ and enter Cancel suggestion esc

I think vaccination is dangerous because

the more I get the more I need it.

it may cause cancer or some other illness that makes it difficult to vac...

vaccines are not good for them," he said.

The screenshot shows a user interface for generating text using a transformer model. At the top, there's a header with a unicorn icon, the text "Write With Transformer", the model name "distil-gpt2", and various keyboard shortcut keys for interacting with the AI. Below this, a text input field contains the sentence "I think vaccination is dangerous because". A dropdown menu or suggestion box is open, displaying three lines of text: "the more I get the more I need it.", "it may cause cancer or some other illness that makes it difficult to vac...", and "vaccines are not good for them," he said. The interface has a clean, modern design with a light gray background and white text areas.

# Not even dual use

*DeepNude deep-nuked: AI photo app stripped clothes from women to render them naked. Now, it's stripped from web*

The creator of DeepNude, an app that used a machine learning algorithm to "undress" images of clothed women announced Thursday that he's killing the software, after viral backlash for the way it objectifies women.

# Long Road



# Next breakthrough?



**WE WANT YOU!**



Moral  
Problems

—SHIFT—



# Chat Bots

UNIVERSITÄT  
DUISBURG  
ESSEN

*Offen im Denken*



# What does such an agent need to do?

- Model world knowledge
- Search for the answer
- Cluster and classify results
- Have confidence about the answer (= deal with uncertainty)
- Learn from previous rounds

→ We will discuss all of these topics.

# Course Goals

Intelligent agents:

- intelligence, environments, performance and utility measures

Search in the problem space:

- search and planning algorithms

Dealing with uncertainty:

- probabilistic decision processes

Learning from examples:

- machine learning algorithms
  - e.g. clustering, classification, regression, and deep learning

## Artificial Intelligence A (hopefully) motivating Introduction

Administrative Course Issues

# Administrative Organization

**Moodle page:** you are here, so you know where it is ... :)

**Office hours:** send me a request in Moodle or email me

**Literature:**

- **Mandatory readings** are crucial for the exam
- **Optional readings** are relevant for your education

# Exam

- Written
- Bonus points will be added to exam results (about **10% of final results**)
- Extra bonus points can be used like normal bonus points
  - If maximum bonus points are already reached, up to 5 extra points can be added on top of that
- A single handwritten paper (double-sided) of notes will be allowed in the exam
- Date and room(s) – TBA

# Practice Class

- Montag 16-18 Uhr - Jenny - Online - German
- Mittwoch 8-10 Uhr - Clara- In Person - German
- Mittwoch 16-18 Uhr - Mohammed - In Person - English
- Donnerstag 14-16 Uhr - Mohammed - In Person - English
- Freitag 14-16 Uhr - Clara - In Person - German

**Start: April 11, 2022**



# Bonus System

- Each **lecture** contains **homework**, which will be **graded**.
- **Homework is not mandatory**, but you can improve your grade in the exam.
- **Maximum of 10 bonus points**.
  
- **You can work in groups up to a size of 4.**
- Pay attention to the submission guidelines! **Wrong format is rejected directly.**



# Bonus Points for Improvements

**Extra bonus points** are assigned to students who make substantial improvements to the course:

- Nice visualizations
- Python codes for the practice classes
- Additional practice tasks
- Etc
- **It is left to my sole discretion to decide what counts as substantial.**  
*“No, making all boxes green is not a substantial change.”*  
If in doubt, get in touch first.
- Bonus points will be added to exam results (about 10% of final result). Extra bonus points can be used like normal bonus points. If maximum bonus points are already reached, up to 5 extra points can be added on top of that.

# Bonus Points for Spotting Mistakes

Everyone makes mistakes. **Lecturers make a lot of them** 😅

**One extra bonus point per week is assigned to students who find the most mistakes in the lecture and/or practice class.**

- It is left to my sole discretion to decide what counts as a mistake and about the granularity of mistakes.

*“No, spotting two typos in one word is not counted as two mistakes.*  
“

- It is left to my sole discretion to award extra bonus points for mistakes that were especially hard to find.

# Your Role

Ask, wonder, doubt, correct, engage, contribute, discuss, argue!



# Your Role

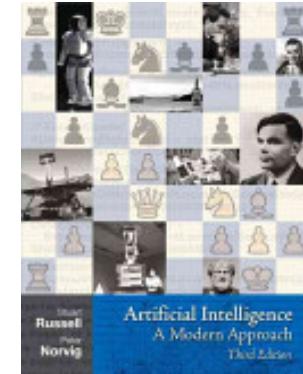
Ask, wonder, doubt, correct, engage, contribute, discuss, argue!



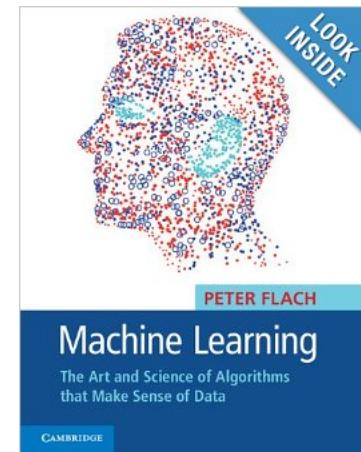
# Textbooks

- Stuart Jonathan Russell and Peter Norvig:  
*Artificial Intelligence: A Modern Approach*  
Third Edition, Prentice Hall, 2010  
<http://aima.cs.berkeley.edu/>

Deutsche Ausgabe: Künstliche Intelligenz: Ein Moderner Ansatz



- Peter Flach:  
*Machine Learning: The Art and Science of Algorithms that Make Sense of Data*  
First Edition. Cambridge University Press,  
2012



# Mandatory Reading

Mandatory:

1. Russell & Norvig
  - Section 1.3: *The history of artificial intelligence*, p.16-27
  - Section 1.4: *The state of the art*, p.27-28
2. Brenden M. Lake, Tomer D. Ullman, Joshua B. Tenenbaum, Samuel J. Gershman (2016): *Building Machines That Learn and Think Like People*.  
<https://arxiv.org/pdf/1604.00289.pdf>
  - Section 6: *Looking forward*, p. 38-44.

Optional:

- Russel & Norvig, Section 1.2: *The foundations of artificial intelligence*

# Questions

**Any questions, suggestions, ...?**

Post a message in the Moodle forum

Thank you.