



Technische Hochschule  
Ingolstadt

# Principles of Autonomy and Decision Making

(AI\_PrincAutonomy\_2808)

Week 1: Introduction

Team:

- Prof. Dr. rer. nat. Lenz Belzner
- Chidvilas Karpenahalli Ramakrishna, M.Eng.
- Adithya Mohan, M.Eng.
- Zahra Zeinaly, Ph.D.

## Week 1: Introduction

# Team Belzner



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- Chidvilas Karpenahalli Ramakrishna, M.Eng. (Lecturer, Practicals Guide)
  - Room: K208
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- Adithya Mohan, M.Eng. (Guest Lecturer, Practicals Guide)
  - Room: K208
  - E-Mail: [Adithya.Mohan@thi.de](mailto:Adithya.Mohan@thi.de)
- Zahra Zeinaly, Ph.D. (Guest Lecturer)
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  - E-Mail: [Zahra.Zeinaly@thi.de](mailto:Zahra.Zeinaly@thi.de)

# Our Research @ Almotion Bavaria



- Deep Reinforcement Learning (DRL) for Autonomous Driving
  - Fundamental research in machine learning and deep learning
  - AI Safety:
    - Robustness
    - Interpretability
    - Uncertainty quantification (deep ensembles and Conformal Prediction (CP))
    - Verification and validation
  - AI Security:
    - Adversarial attacks
  - DRL:
    - Criticality
    - Hierarchical Reinforcement Learning (HRL)



## Week 1: Introduction

# Organisation



- Moodle page:
  - Course: Principles of Autonomy and Decision Making
  - Passkey: [AI\\_PADM#SoSe24](#)
  - Weekly updates
- Communication:
  - Moodle
  - E-Mail ([Chidvilas.Karpenahalli@thi.de](mailto:Chidvilas.Karpenahalli@thi.de))
  - Personal Appointments via E-Mail (K208)
- Additional tools:
  - Pingo ([pingo.coactum.de](https://pingo.coactum.de))

## Week 1: Introduction

# Prerequisites

- Academic integrity
- University mindset 🧠🧠
- Growth mindset
  - *Mindset: Changing the way you think to fulfil your potential* (by Dr. Carol S. Dweck) – **NOT SPONSORED!**
- English
  - Good to Shakespearean!
- Mathematics (Linear Algebra, Probability and Statistics, Calculus)
- Programming (Python and NumPy, Pandas, Matplotlib and Pytorch)
  - **Not a programming class!**



“

The mediocre teacher tells.  
The good teacher explains.  
The superior teacher  
demonstrates. The great  
teacher inspires.



William Arthur Ward  
Writer

# Work and Grading



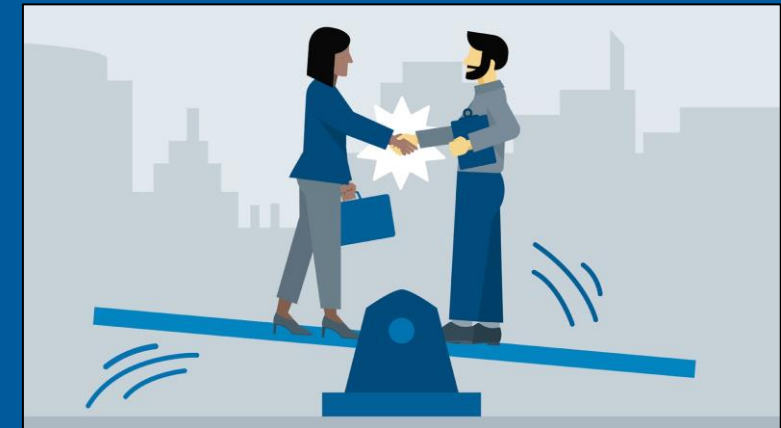
- Class will be divided into 2-3 groups for practicals
- Practical Exam (*Exact format will soon be finalized*)
  - Mathematical Assignments
  - Programming Assignments
  - Final report
  - Final presentation
- Deadlines and submission conditions
  - CEST 23:59 on the day of deadline
  - Compulsory/voluntary
  - 2 days free pass per student per semester 😊 (only for assignments & excluding assignment-0)
  - Unused free passes will help in margins

## Week 1: Introduction

# Points and grades



Total Points	Grades
95-100	1.0
90-94	1.3
85-89	1.7
80-84	2.0
75-79	2.3
70-74	2.7
65-69	3.0
60-64	3.3
55-59	3.7
50-54	4.0
<50	Fail

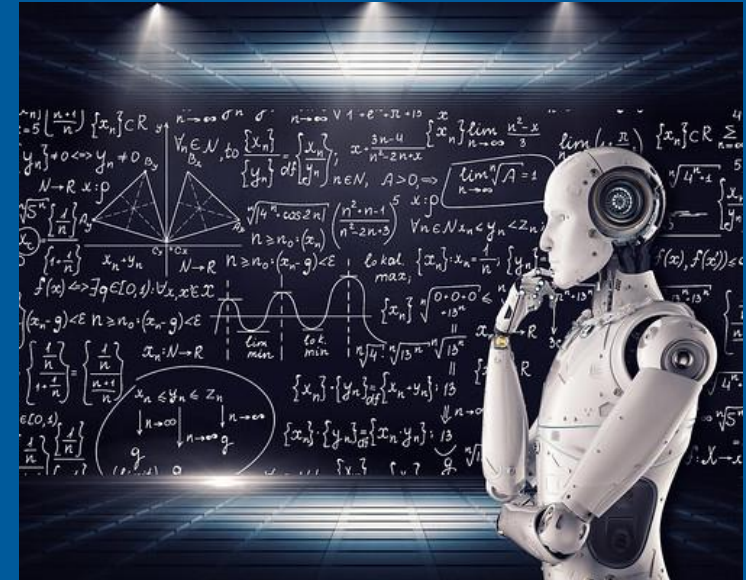




# Artificial Intelligence (AI)



- What is AI? 😞
- What is this course about? 😞



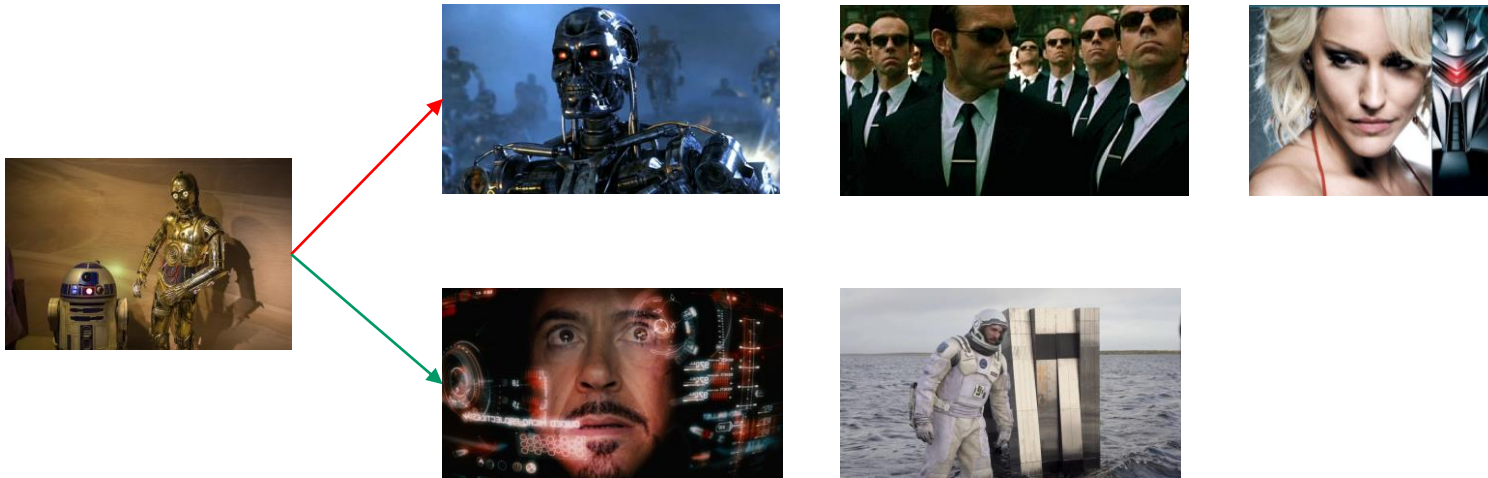


## Week 1: Introduction

# Artificial Intelligence (AI)



- Sci-fi examples

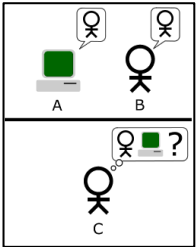


## Week 1: Introduction

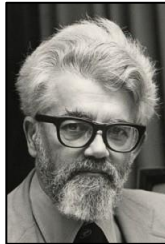
# Artificial Intelligence (AI)



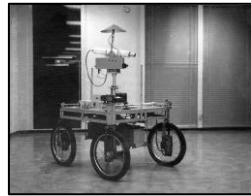
- Real-world



Turing test  
(1950)



John McCarthy termed AI  
(1955)



Stanford Cart  
(1979)



ALVINN  
(1989)



Stanley wins  
DARPA grand challenge  
(2005)



Siri  
(2011)



Google's AI AlphaGo defeats Lee Sedol  
(2016)



OpenAI ChatGPT3  
(2020)



What are some cutting-edge AI that  
you know?

# Artificial Intelligence (AI)



- Evolution of „*What is AI?*“
  1. Machines that **think** rationally
  2. Machines that **think** like humans
  3. Machines that **act** like humans
  4. Machines that **act** rationally/optimally
- Action requires planning and decision-making
- *What is this course, „Principles of **Autonomy** and **Decision Making**“ about?*



AlphaGo (2016)  
*Acting like humans vs. acting optimally*

# Inspiration from the human brain



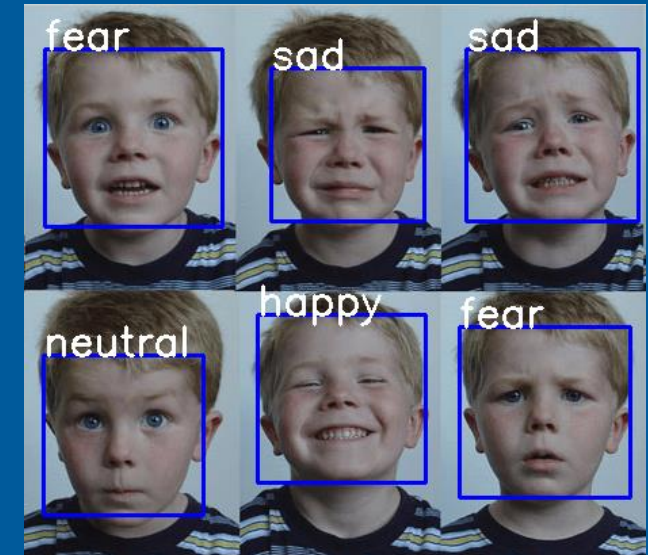
- Human brain:
  - Prefrontal cortex:
    - Planning, reasoning, judging and decision making
    - It considers the potential outcomes of our decisions and takes appropriate actions
    - Rational and calculated decisions
  - Limbic system:
    - Regulates emotions and memories
    - Decisions are highly influenced by emotions and past experiences
    - Impulsive decisions
- Decision-making is an interaction between the prefrontal cortex and the limbic system
- Neuroplasticity allows for adaptable decision-making from new experiences



# Unpacking „Autonomy and Decision Making“



- Autonomous systems are inspired by the human brain
- Requirements for an autonomous system:
  - Perception
  - Prediction, planning and decision making:
    - Through computation/simulation
    - Through data/memory
  - Action

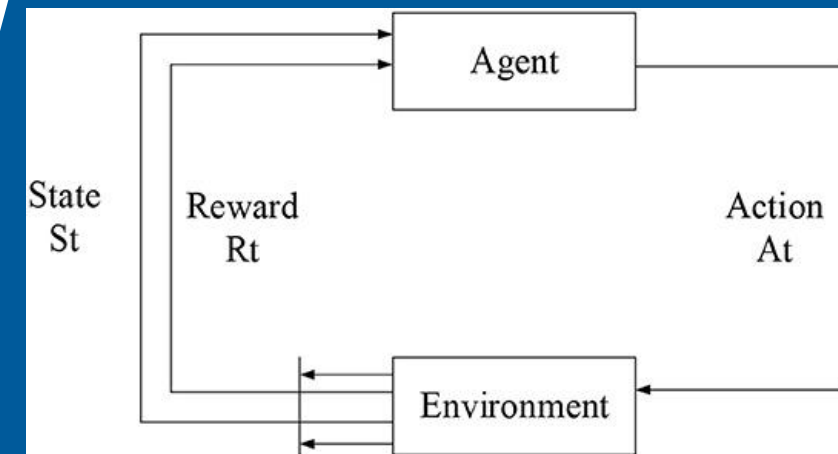


Perception

# What you will learn in this course?



- You will build an environment
  - You don't control the environment
  - The environment responds to your actions
- You will build an agent
  - An agent takes decisions and acts
  - You control the agent
  - Your agent should learn to act rationally in the environment



Depiction of agent environment interaction



## Week 1: Introduction

# Students vs. AI



- Challenge:
  - Students and AI play Breakout Atari game
  - Each student gets 1 attempt (5 lives)
  - If a student can beat the highest score of AI, they get boasting rights 🤔💪
- Leader board:

Player	Final score
Student 1	8
Student 2	5
Student 3	8
AI (PPO)	🤔 it was in 3 digits!



Breakout Atari game