



Hauptseminar: “Advanced Topics in Collaborative AI”

Description

This seminar explores cutting-edge research at the intersection of multimodal machine learning, computational cognitive modelling, computer vision, and human-machine interaction to advance **collaborative artificial intelligence (CAI)**. Realizing this vision requires systems that can perceive, model, and reason about human behaviour, including subtle non-verbal cues, and use this understanding to make informed, context-sensitive decisions during interaction.

CAI research builds on and contributes to multiple areas of AI, including multimodal machine learning, human behaviour modelling, and social reasoning. In "Advanced Topics in Collaborative AI," students will gain a deeper understanding of how computational models of human perception, attention, and Theory of Mind (ToM) can be used to enable better human-AI collaboration.

Focus Area for WS 25/26

This year's seminar will focus on **modelling human social interactions** (using deep learning, computer vision) with a particular emphasis on **non-verbal behaviour** such as **gaze, gestures, posture, facial expressions**, and **Theory of Mind**. These behavioural signals are central to coordination, shared understanding, and joint action, and thus form a critical foundation for building collaborative AI systems that interact effectively with people. We will investigate how these signals are sensed, represented, and interpreted computationally, and how they can be integrated into the design of socially intelligent agents.

Learning Goals

Students in this seminar will:

- Learn about computational methods for analysing and modelling human behaviour from visual and multimodal data.



- Understand key machine learning and computer vision techniques for social signal processing, such as gaze estimation, body pose analysis, and gesture recognition.
- Explore models of social reasoning such as Theory of Mind and how they can be implemented in AI systems.
- Develop a project proposal that applies theoretical knowledge to a real-world collaborative AI problem.

Additionally, you will:

- Develop skills in critically analysing and discussing scientific literature.
- Practice formulating and proposing a research-level project.
- Learn scientific writing and oral presentation skills.

Format

To encourage active participation and a deeper learning experience, the seminar follows a case study format. Each week, all students read the same core research paper, but will be assigned a specific role to prepare it from a unique viewpoint. These rotating roles include:

- **The Theorist:** Situates the paper within broader theoretical frameworks of social intelligence and cognitive modelling.
How does this paper connect to broader theories of social interaction and intelligence? What are the underlying assumptions the authors are making?
- **The Innovator:** Proposes a follow-up project or application inspired by the paper.
How could you extend the method, apply it to a new problem in collaborative AI, or overcome its limitations?
- **The Critic:** Identifies key limitations or open questions.
What are the key weaknesses or limitations of the study? Did the authors miss anything important? What questions would you ask the authors in a Q&A session?
- **The Communicator:** After the discussion, write a short, accessible blog post or article explaining the paper's core ideas and significance to a non-expert audience.

All students are also expected to bring weekly discussion points, including alternative paper titles and critiques of the study's design, assumptions, or evaluation.

Requirements

This research seminar is intended for Master's students in Computer Science, Visual Computing, Artificial Intelligence and Data Science, Simulation Technology, and Computational Linguistics.



- Students should have a **good understanding of computer vision, machine learning, and/or human-computer interaction. Prior attendance of lectures in these areas is required.**
- Attendance in the weekly meetings is mandatory. The final grade will be composed of individual grades for the respective task each week as well as active participation in the discussions.

Logistics

- **Day & Time:** ?
- **Location:** ?
- **Available Spaces:** 6–14 students
- **Language:** English
- **Term:** WS 2025/26
- **Contact:** Prof. Dr. Andreas Bulling (andreas.bulling@vis.uni-stuttgart.de)