3rd HBP Curriculum Workshop

MODERN TRENDS IN COGNITIVE ARCHITECTURES AND SYSTEMS: FROM THEORY TO IMPLEMENTATION IN NATURAL AND ARTIFICIAL AGENTS

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Speaker Abstract Collection

Alphabetical order according to presenting author

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List of Abstracts

A neurocognitive perspective on human-robot interaction

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Understanding the mechanisms and consequences of attributing socialness to artificial agents has important implications for how we can use technology to lead more productive and fulfilling lives. In this talk, I will integrate recent findings on the factors that shape behavioural and brain mechanisms that support social interactions between humans and artificial agents. First, I will argue that the cognitive reconstruction within the human observer is likely to be far more crucial in shaping our interactions with artificial agents than previously thought, while the artificial agent's visual features are possibly of lesser importance. Next, I will discuss recent neuroimaging studies that me and my collaborators have completed to test how long-term socialisation with artificial agents shape social cognitive processes and ultimately our relationships with these machines. Together, these findings will help to understand the flexibility of human social cognition during real interactions with artificial agents, while at the same time inform the development of these sophisticated technologies.

Designing social signals for artificial agents using psychological science

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Artificial agents are now increasingly part of human society, destined for schools, hospitals, and homes to perform a variety of tasks. To engage their human users, artificial agents must be equipped with essential social skills such as generating different facial expressions. However, even state-of-the-art artificial agents remain limited in this ability because no formal model of social face signalling exists to equip them with. Here, we address this challenge by building a generative model of social face signalling using a novel face generation platform combined with data-driven methods, subjective cultural perception and mathematical psychology. Transference of this generative model of face signals to a popular artificial agent substantially increased in their social signalling capabilities including recognition accuracy, judgments of human-likeness, and cultural diversity. Analysis of the face signaling models also reveals a specific latent syntactical signaling structure that can further inform the design of generative face signaling models for both culture-specific and universal social face signalling. Together, our results demonstrate the utility of an interdisciplinary approach that applies data-driven, psychology-based methods to inform the social signalling generation capabilities of artificial agents. We anticipate that these methods will broaden the usability and global marketability of artificial agents and highlight the key role that psychology must continue to play in the design of artificial agents of the future.

Simulating psychological theories of emotion and its impact on behaviour

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A large body of research has documented the functional, often adaptive role of emotions in human behavior. This led to a significant growth in research on computational models of human emotional processes, fueled both by their basic research potential as well as the promise that modeling the function of emotion in human behavior is critical for a range of applications. Findings on the role that emotions play in human behavior have motivated artificial intelligence and robotics research to explore whether modeling the function of emotion can lead to more intelligent, flexible and capable systems. As research has revealed the deep role that emotion plays in human social interaction, researchers have proposed that more effective human computer interaction can be realized if the interaction is mediated both by a model of the user's emotional state as well as by the expression of emotions. Large scale multi-agent simulations that seek to model a community's response to a natural disaster are incorporating emotion models into the simulation. This presentation will discuss the computational modeling of emotion and the use of these models in such applications.

Encoding and decoding models of brain activity

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In neuroscience and artificial intelligence have long benefited from strong mutual interactions. Neuroscience has provided initial models of neural architectures to solve cognitive problems, such as vision, sound or language processing. Conversely, the spectacular development of artificial architectures in the last decade has brought candidates model to analyze the functional architecture of several brain systems. Importantly, leveraging brain imaging data requires the analysis of large amounts of brain images or signals, making it a canonical example of large-scale structured signal analysis. In this course, we will review the interactions between functional brain imaging and AI, then discuss current challenges regarding the interactions of these fields.

Modelling the emergence of social behaviour

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Humans are mammals, and mammals are endotherms, thus a major challenge for our brains is to help maintain a constant high body temperature. The energy costs of using thermal physiology to maintain a high body temperature can be offset by social thermoregulation, e.g., by huddling together with conspecifics. Patterns of huddling observed in litters of rodents can be recreated using agent-based models, which reveal how complex group behaviours can emerge from simple rules of interaction between individuals. I have been using this approach to ask how agents might learn to predict the thermal consequences of their actions, and to ask how physiological and social thermoregulation are supported by the mammalian brain architecture. In this talk I will show in simulation how `physiological huddling', driven by energetics, can give rise to `filial huddling', driven by social cues, via mechanisms of associative learning. I will also suggest how thermoregulation can be used to investigate the interplay between cortical and subcortical structures in the context of mammalian social behaviour.