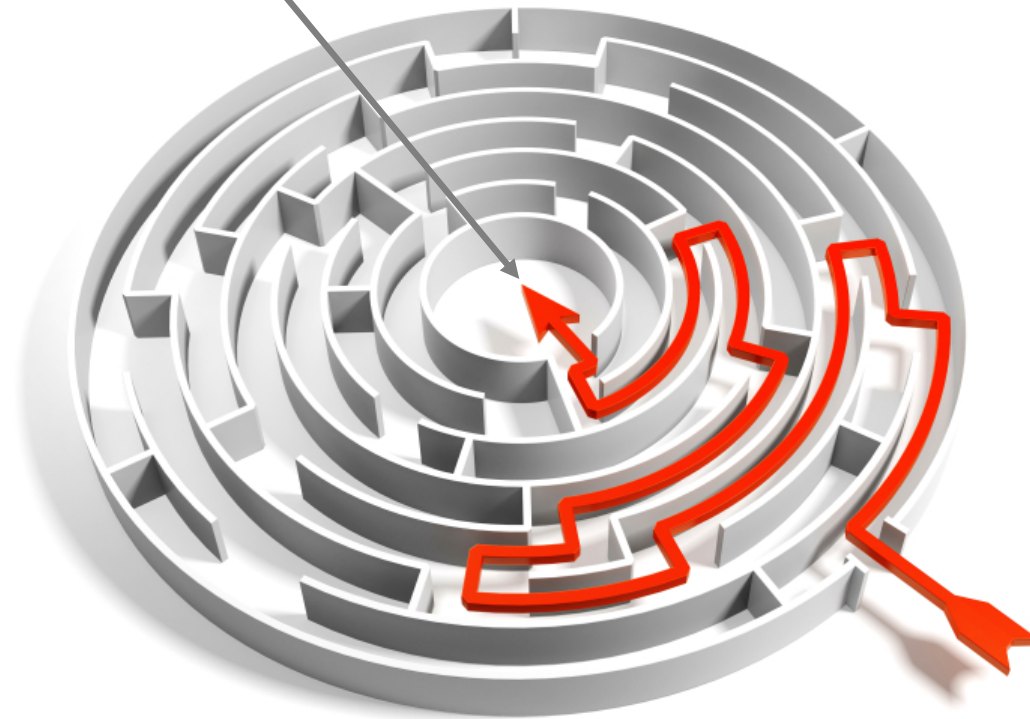


Artificial Cognitive Systems

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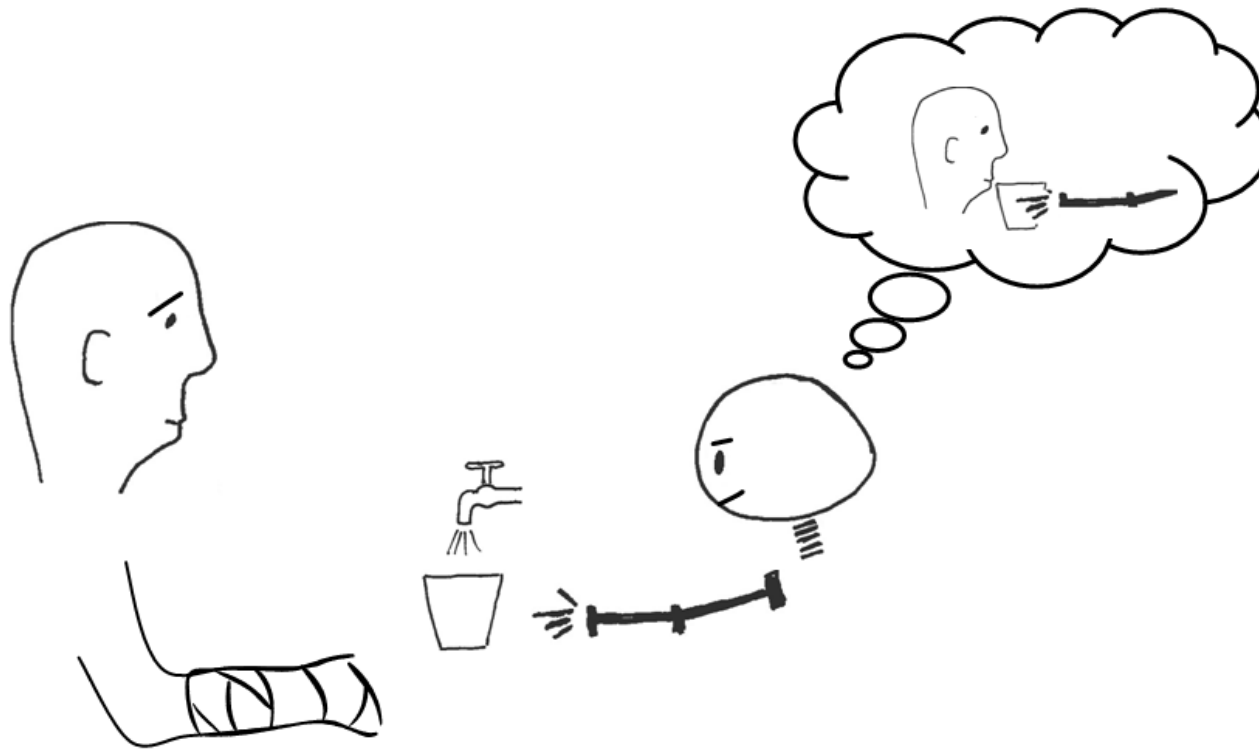
Social
Cognition II



Topic Overview

- Interaction: action, goals, intention, and attention
- Social interaction
- Inferring intentions and **Theory of Mind**
- Instrumental helping
- Collaboration
- Development and interaction dynamics

Social Cognition



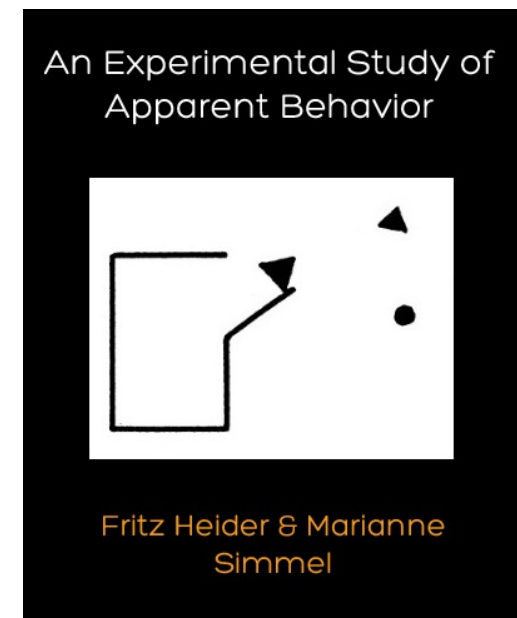
Inferring Intentions & Theory of Mind
Instrumental Helping
Collaboration

Inferring Intentions and Theory of Mind

- Prospection is the essence of cognition
- Social interaction is complex because ...
 - **A cognitive agent's act must anticipate the actions of an agent that itself is already anticipating what it is going to do**
- That is, an agent must anticipate the intentions of other agents
 - Predict what they will do
 - Possibly, why they want to do it

Inferring Intentions and Theory of Mind

- Theory of Mind:
 - To have the ability to infer what someone else is thinking and wants to do
- Young children differentiate between the behaviour of inanimate and animate objects
 - attributing mental states to the animate objects
- Attribute agency (animacy) to inanimate objects that exhibit biological motion
 - Intentions,
 - Emotions
 - Personality traits



Fritz Heider and Marianne Simmel, 1944

Inferring Intentions and Theory of Mind

Animation from:
Heider, F. & Simmel, M. (1944).
An experimental study of apparent behavior.
American Journal of Psychology, 57, 243-259.

Courtesy of:
Department of Psychology,
University of Kansas, Lawrence.

Inferring Intentions and Theory of Mind

Humans infer different types of intention

- Interpreting movements (lower level intentions) ... **what** is the desired state
- Interpreting actions (higher level) ... **why** is it desired (underlying motive)
- Grasp a cup *vs.* he is thirsty

Inferring Intentions and Theory of Mind

- How do human infer the intentions of others from their actions?
- **Internal simulation**
 - A mechanism that predicts the consequences of the agent's own actions based on its own intentions by internal simulation using forward models
 - Input: overt or covert motor commands
 - Output: the likely sensory consequences of carrying out those commands
 - When observing another agent's actions, the same mechanism can be used
 - Associate **observed** movements with likely, i.e. intended, sensory consequences

Inferring Intentions and Theory of Mind

Internal simulation

- Ideo-motor models
 - Focus on goals and intentions
 - Use a joint representation that embraces both perception and action
- When an agent just sees another agent's action
 - The agent's own actions activated
 - And so too are the consequences of those actions
 - Hence the intention of the actions can be inferred
- **With a suitably-sophisticated joint representation and internal simulation mechanism, both low-level movement intentions and high-level action intentions can be accommodated**

Inferring Intentions and Theory of Mind

Internal simulation

- HAMMER can be used to give robots the ability to read intentions
 - By internal simulation to form a theory of mind
 - Exploiting the multiple pairs of inverse and forward models as a correlate of the mirror neuron system and a realization of ideo-motor theory

Recommended Reading

Vernon, D. *Artificial Cognitive Systems – A Primer*, MIT Press, 2014;
Chapter 9.

D. Vernon, S. Thill, and T. Ziemke, "The Role of Intention in Cognitive Robotics", in *Toward Robotic Socially Believable Behaving Systems-Volume I*, A. Esposito and L. C. Jain (Eds.), Intelligent Systems Reference Library, Vol. 105, pp. 15-27, Springer.