Artificial Recognition System

Development and Evaluation

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Artificial Recognition System (ARS) Project

- General-purpose model of human information processing for the usage in various artificial systems

- Humanoid agents in a virtual world
  
  **Body**  
  **Psyche**  
  **Decision unit (ARS model)**

- Human-Robot Interaction (Kismet)
- Evacuation Simulation (ESCAPES)
Key Features of the ARS Approach

- Functional model
  
  *Generative approach: describing functions not behavior* → *generic, flexible*

- Layered description model
  
  *Appropriate means of description for different aspects* (neurons, neurosymbolics, psyche)

- Holistic and unitary model
  
  *Consistent and coherent integration of basic aspects* (motivation, emotion, planning...)

- Top-down approach
  
  *Concretize abstract functions incrementally, starting with psychic layer*

- Bionic and interdisciplinary approach
  
  *Translate knowledge into technical models*
Basic question:

How to develop and evaluate such a model?
Challenges

- Restricted accessibility of mind’s functioning
- Interdisciplinary understanding and knowledge translation
- Complexity in description and explanation
Restricted Accessibility of the Mind

- Various ways to get information about the mind’s functioning
- Relevant knowledge for our objective? Right level (psyche)?
- Cannot be used directly
- Interpretation and knowledge translation required → Experts needed

http://de.wikipedia.org/wiki/Elektroenzephalografie
http://homepages.uni-tuebingen.de/karnath/Research.html
http://www.edgehill.ac.uk/psychology/research-participation/
Interdisciplinary Understanding

- Regular, intensive collaboration
- Different concepts, vocabulary....?
Complexity and Explanation

- Right level, relevant knowledge?
- Not only on neuronal level, also on psychic level
- Interplay of various factors determine behavior
Case-driven Agent-based Simulation

Combination of

• Casuistics for interdisciplinary collaboration
• UC-based requirement analysis for deterministic structuring
• Agent-based simulation as a evaluation framework
Step 1: Describe phenomena and assumptions

- Platform and tool for interdisciplinary collaboration
- Exemplify and discuss research question with a concrete *exemplary* case
e.g. How two hungry agents behave in front of a food source (eat, share...)
- Enables stating (and testing) concrete assumptions
  (e.g. the role of emotions, drives, and norms)
- Avoids drifting into abstract discussions
- Embodies and integrates theories from different disciplines to explain
  behavior
  State of the art, experts’ interpretation of real world conditions
- But: indeterministic, gaps in assumptions, inconsistent \(\rightarrow\) no direct usage
Step 2: Analysis and Structuring

- Clarify the exemplary case
  - Explication of assumptions
  - Consistent description

- Structure to deterministic description
  - Causal function description
  - Data determinants of behavior *(Memories, personality, environment, internal state)*

- Simulation-case (SC) enables
  - Requirements analysis
  - Computational model
  - Test plan for evaluation
Step 3: Data and Functional Model

- Previous steps enable
  - Requirements statement
  - Algorithmic description of functions
  - Modelling of knowledge representation

- Specify function modules, interfaces, data
  Adaption or extension?

- Implemented in MASON (Java) and Protégé (Ontology)
Step 4: Evaluation

- Simulation-case as test-template → parameterize simulation according to scenarios
- Does the functions generate and data determine behavior as expected?
- How is the behavior generated?
- Test our hypotheses’ predictability
  - Are the assumptions of exemplary case valid?
  - Does the interplay of specified factors (e.g. emotions, drives, norms) generate the expected behavior?
  - Does the specified data determine behavior (change)?
- Unexpected behavior or state → analysis on different levels → feedback cycles
Conclusion

- Feedback cycles
  - Possibility a, b: mistake in model translation
  - Possibility c: inconsistent in or between theories
- Bridge disciplines, test knowledge translation
- Concretize testable assumptions from other disciplines
- Structure interdisciplinary knowledge to a causal model and test plan
- SC scenarios $\rightarrow$ model calibration
- Stable model? $\rightarrow$ sensitivity analysis!
- Premises for model application in specific domains $\rightarrow$ Outlook
Thank you!