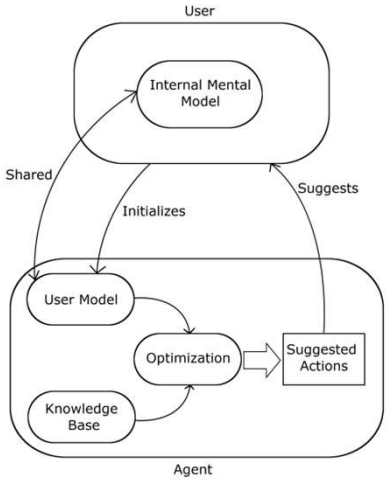
Using non-monotonic reasoning techniques for understandable user modelling

Johanna Wolff[1], Victor de Boer[2], Dirk Heylen[1], Birna van Riemsdijk[1]
[1]University of Twente, [2]Vrije Universiteit Amsterdam

Introduction

For behavior change support agents to be effective the agent and the user need to work as a team. They require a **shared mental model** [1] of the user's goals and motivations. This user model needs to be **accurate, flexible and understandable**. However, it is also usually **based on incomplete information.** We explore the use of non-monotonic reasoning and specifically autoepistemic logic for this purpose.



Non-Monotonic Reasoning

These methods were specifically designed to mirror human reasoning. In particular, non-monotonic reasoning makes it possible to reason with assumptions but also discard them when they are disproven. This lets us draw conclusions based on incomplete information but update it when necessary. We can use this to formalize notions such as:

- I don't know this
- I believe this
- Normally, this is true
- If this were true, I would know about it

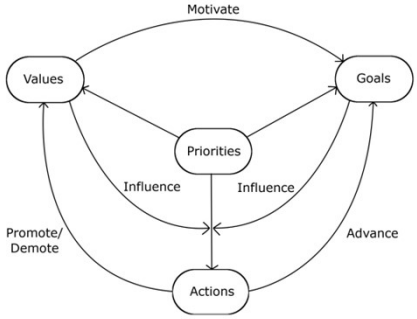
By making the reasoning of the agent explicit in this way, we create opportunities for the user to understand and actively shape the user model.

Example Application

A behavior support agent that helps the user create an exercise schedule. We want to model the user's goals, motivations, possible actions and the priorities/ preferences regarding these.

Potential Structure

We base the structure of our user model on the work with value-based motivations [2]. We assume that the preferences between different actions are influenced by the priorities between the values and goals that are connected to the action



Autoepistemic Logic

We can differentiate between objective sentences, knowledge and beliefs [3]. This allows us enrich the incomplete user model with the agent's beliefs while still making it very clear that these are not facts.

Objective fact:

$\forall x, y: x \leq_V y \rightarrow Value(x) \wedge Value(y)$

Knowledge statement: input from the user

$K\ (Comfort \leq_V Social \wedge Social \leq_V Health)$

Belief statement: assumptions by the agent

$B\ (\forall x, y, z : (x \leq_V y \wedge y \leq_V z) \rightarrow x \leq_V z)$

Conclusions:

$B\ (Comfort \leq_V Health)$

This statement is usually true in user models but not exclusively derived from certain information.

Future Directions

- Evaluate whether non-monotonic user models are more understandable than other techniques
- Include additional concepts such as context, requirements or cost of an action
- Make this system dynamic and reasoning explicitly about possible updates

References

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Contact:
j.d.wolff@utwente.nl

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