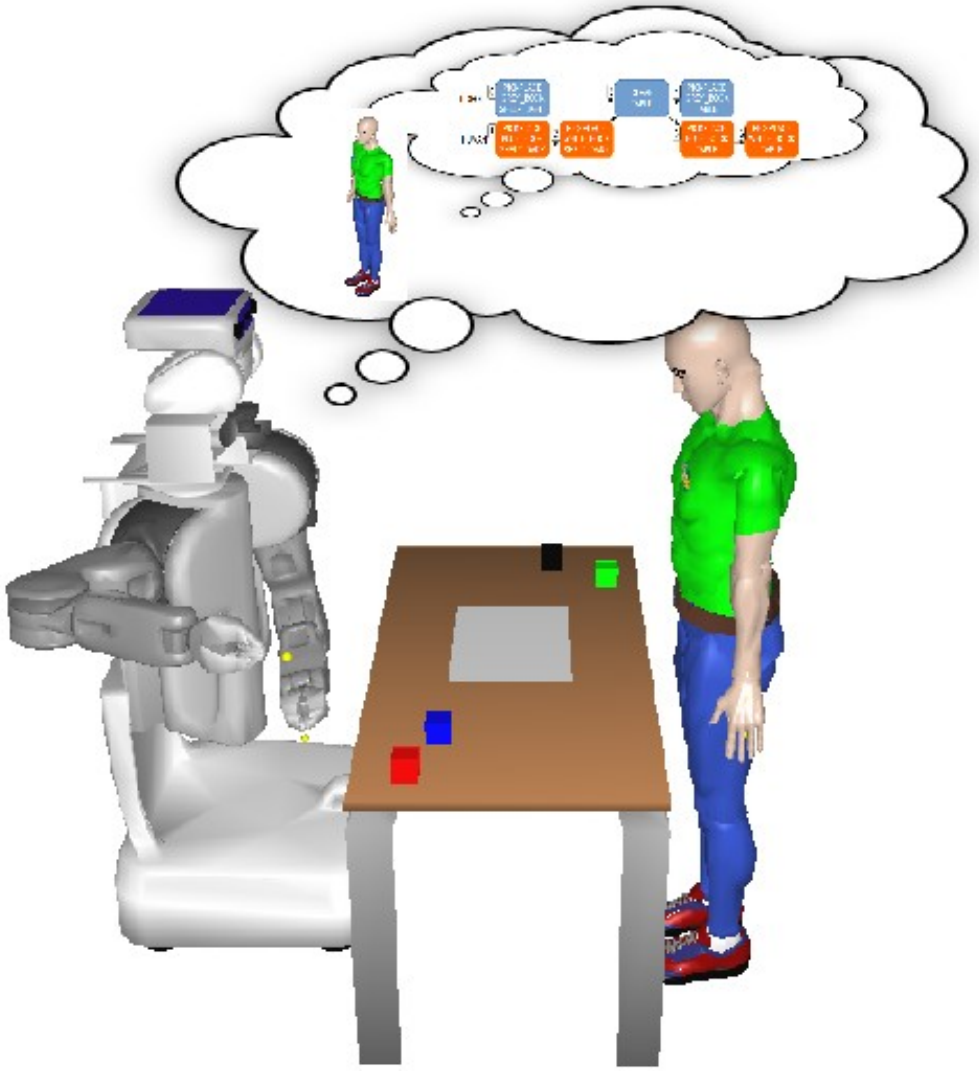
Theory of Mind to Improve Human-Robot Shared Plans Execution



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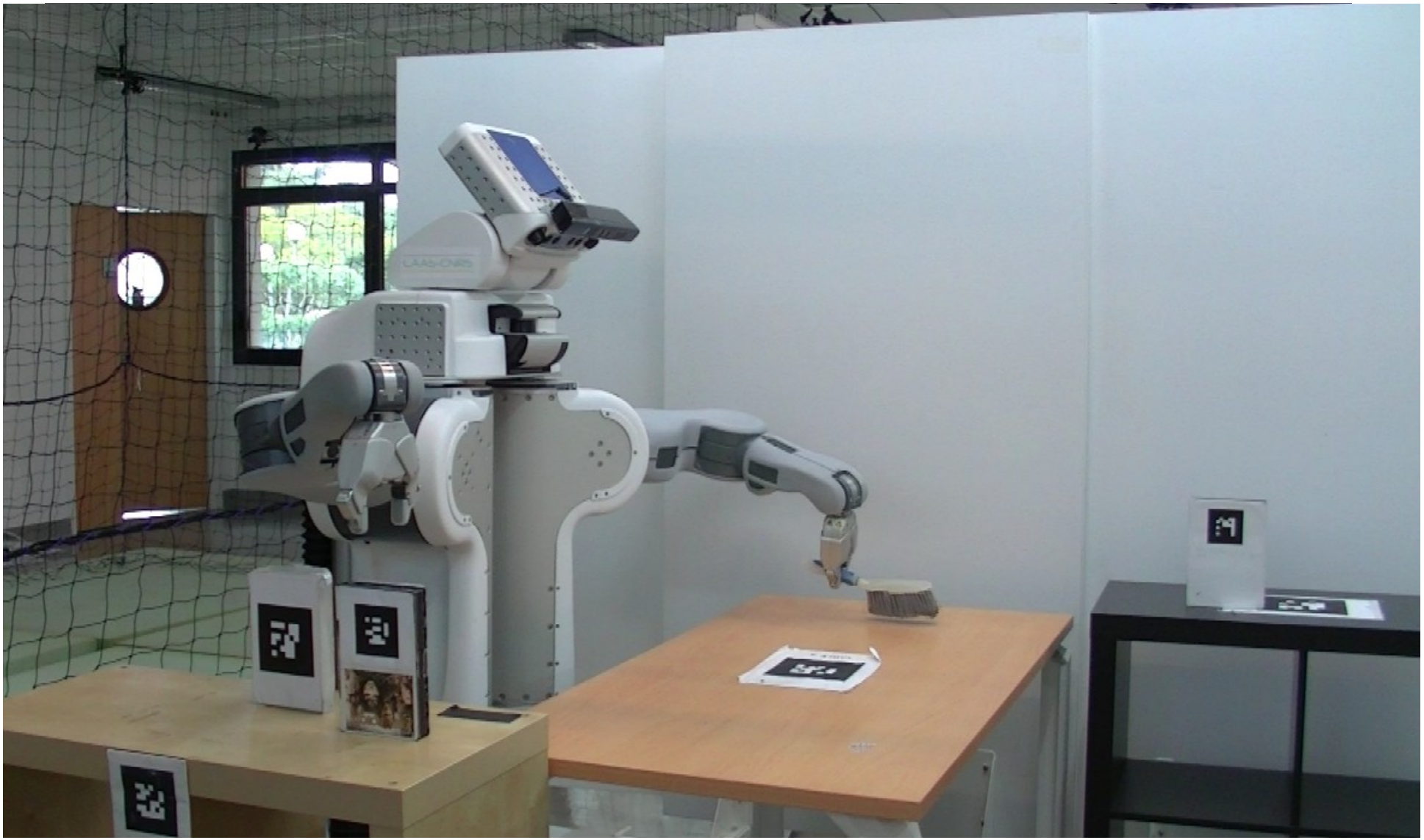

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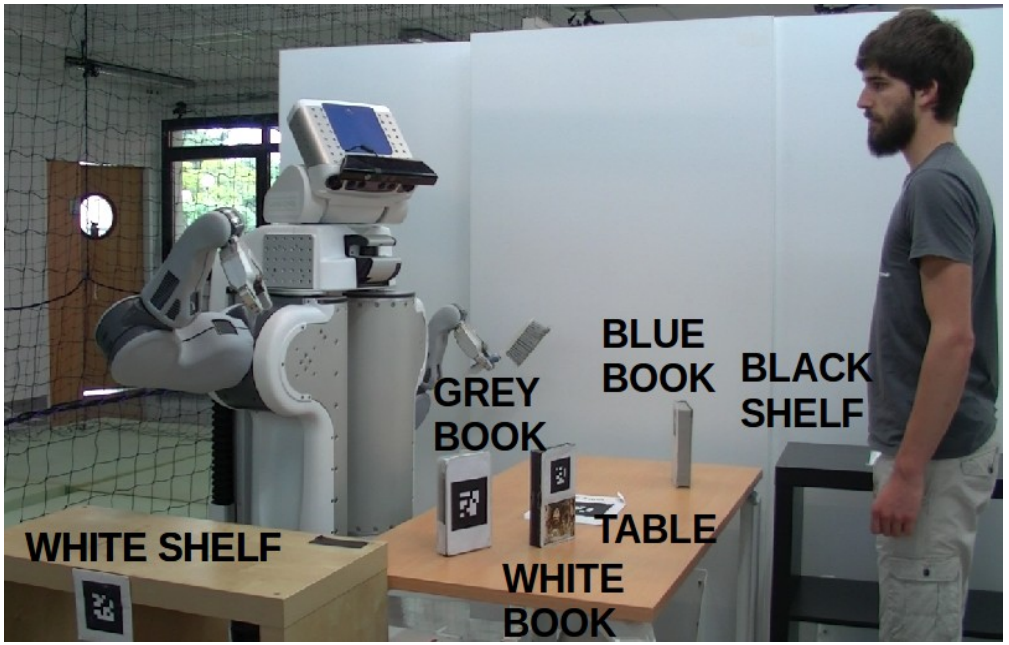
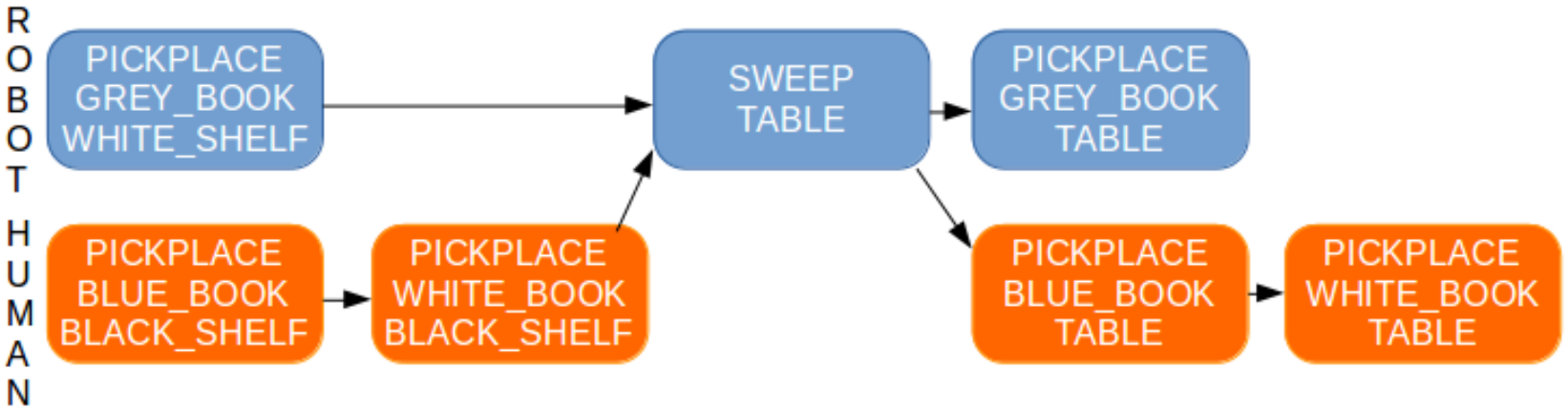
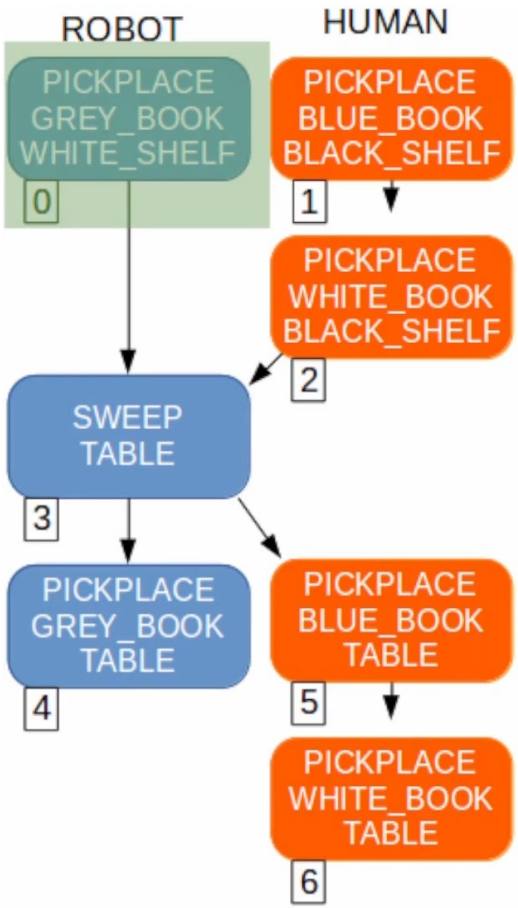
- Already established shared plan







The robot starts to pick and place the GREY_BOOK

What should the robot do?

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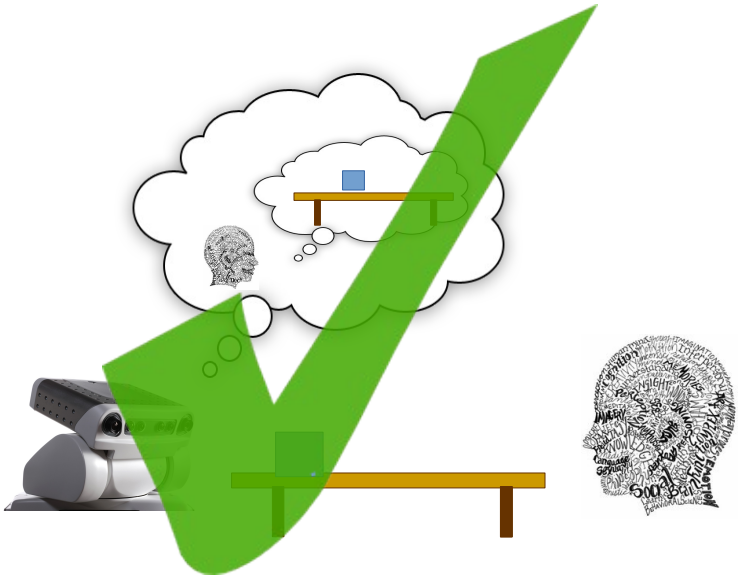
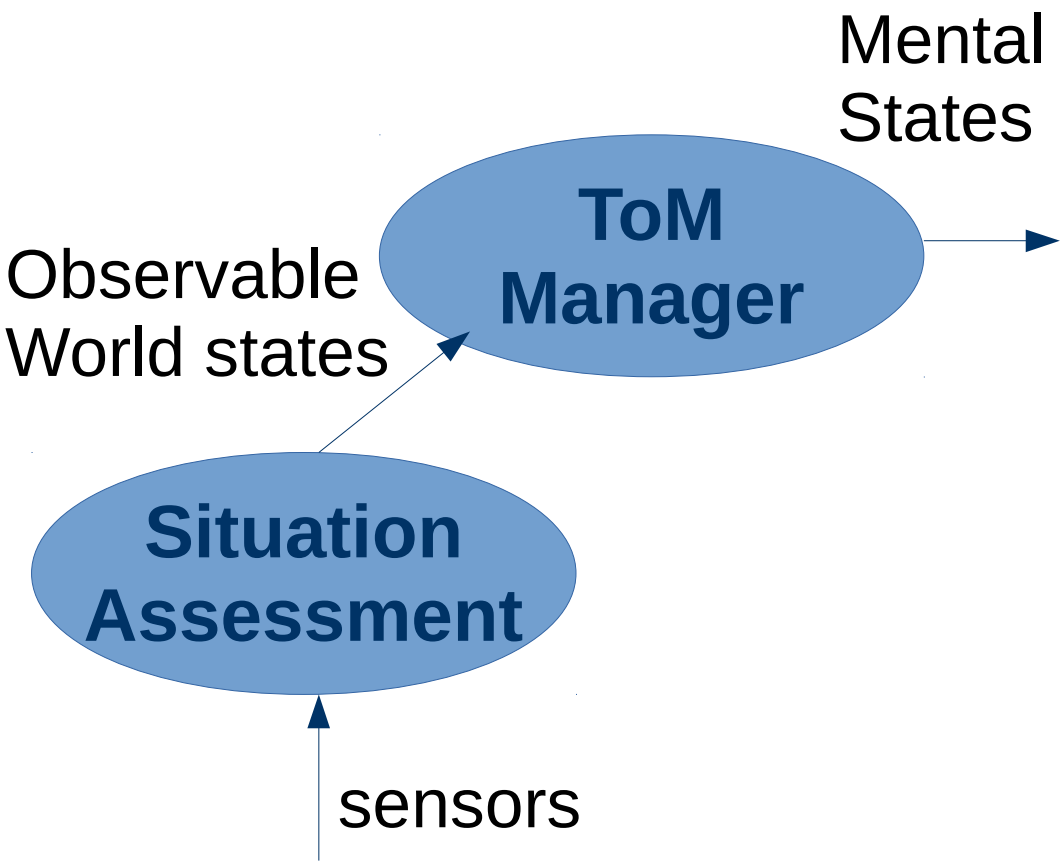
Previous works

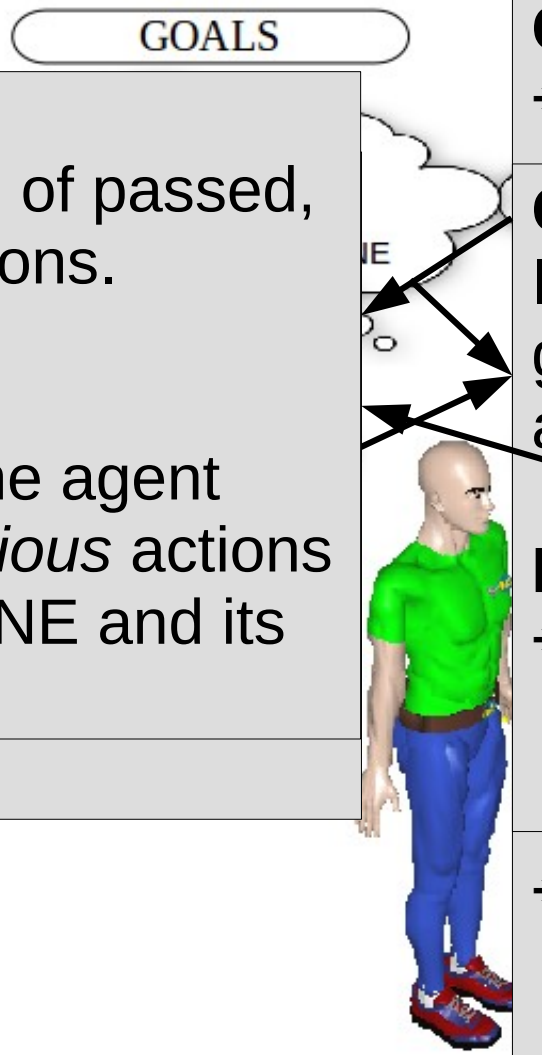
Perspective taking



Shared plan execution

→ Taking into account the human point of view concerning not only the environment but also goals, plans and actions.


Mental States
ToM Manager
Observable World states
Situation Assessment
sensors



Action state:
If the agent is aware of passed, current of future actions.

Example:
- Action READY if the agent considers the *previous* actions in the plan are DONE and its preconditions true.

actions in it.

Contain:
- Relations between objects

Goal state:
If the agent still consider the goal feasible or already achieved.

Example:
- Goal DONE if the agent considers the *objective* of the goal reached.

- Non-observable facts: Coming from actions effects

[1] Milliez, Warnier, Clodic & Alami. A framework for endowing an interactive robot with reasoning capabilities about perspective-taking and belief management.

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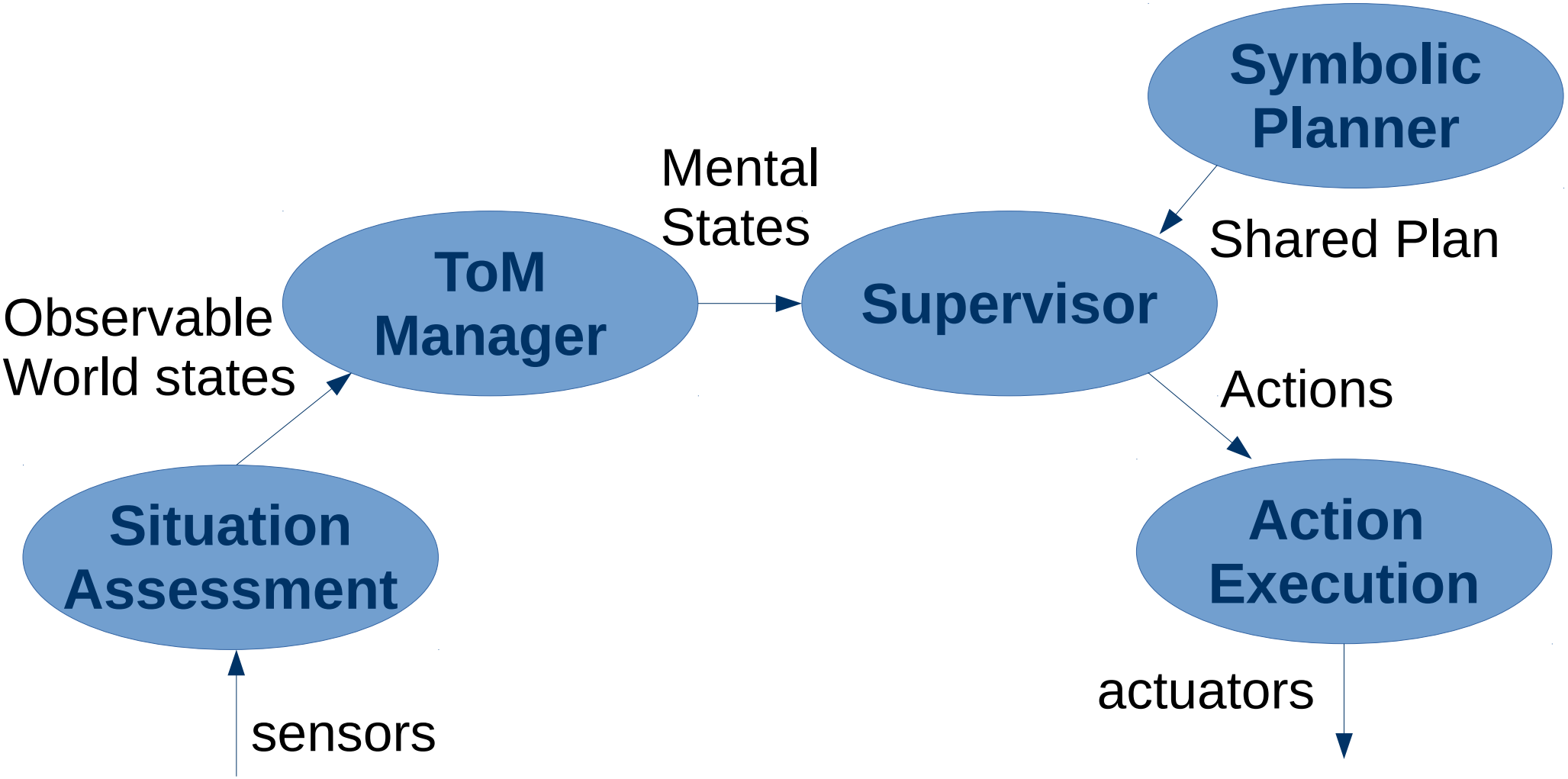
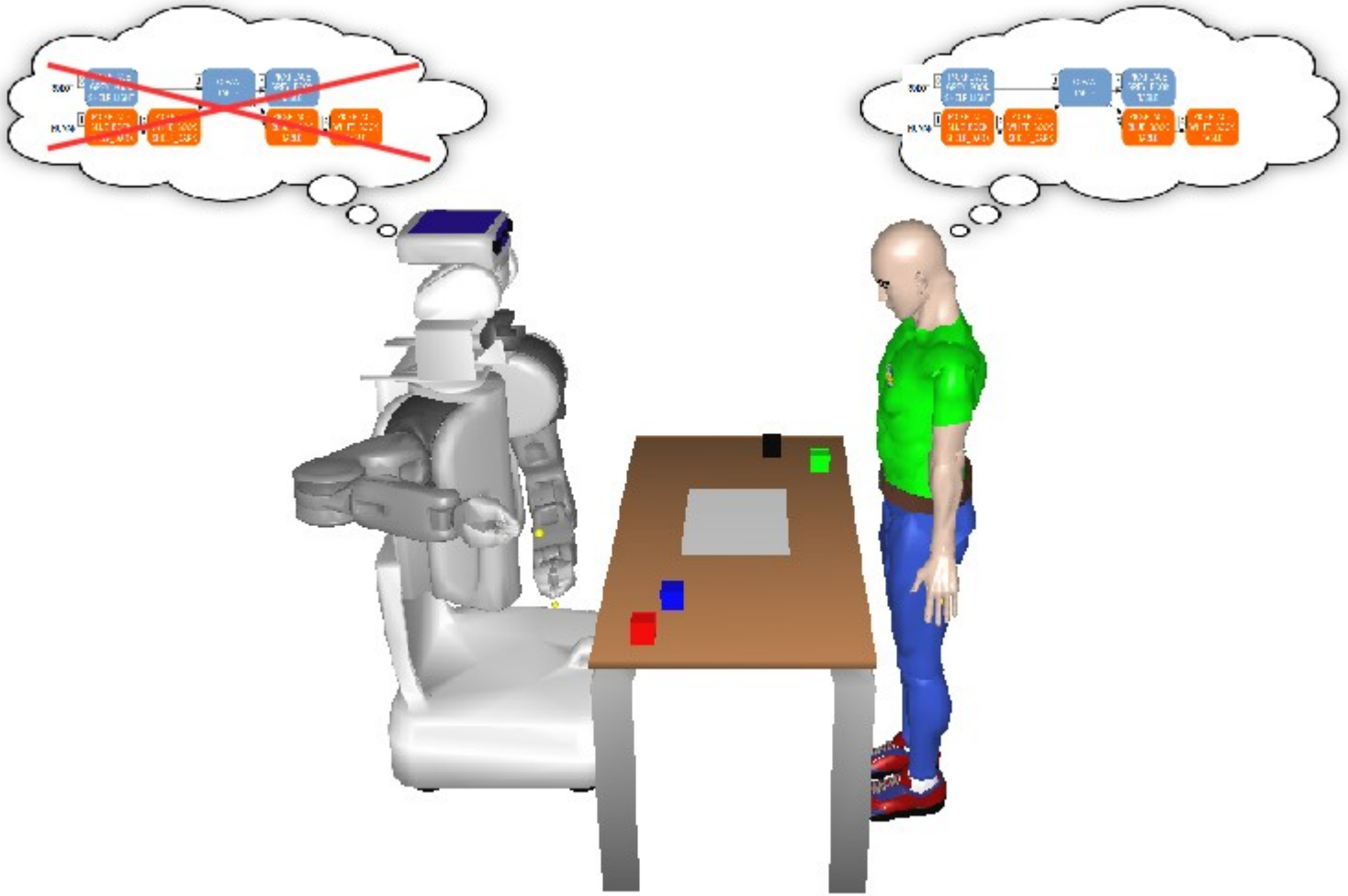

Symbolic Planner
Mental States
Shared Plan
ToM Manager
Supervisor
Observable World states
Actions
Situation Assessment
Action Execution
actuators
sensors

“Weak achievement” goal and plan



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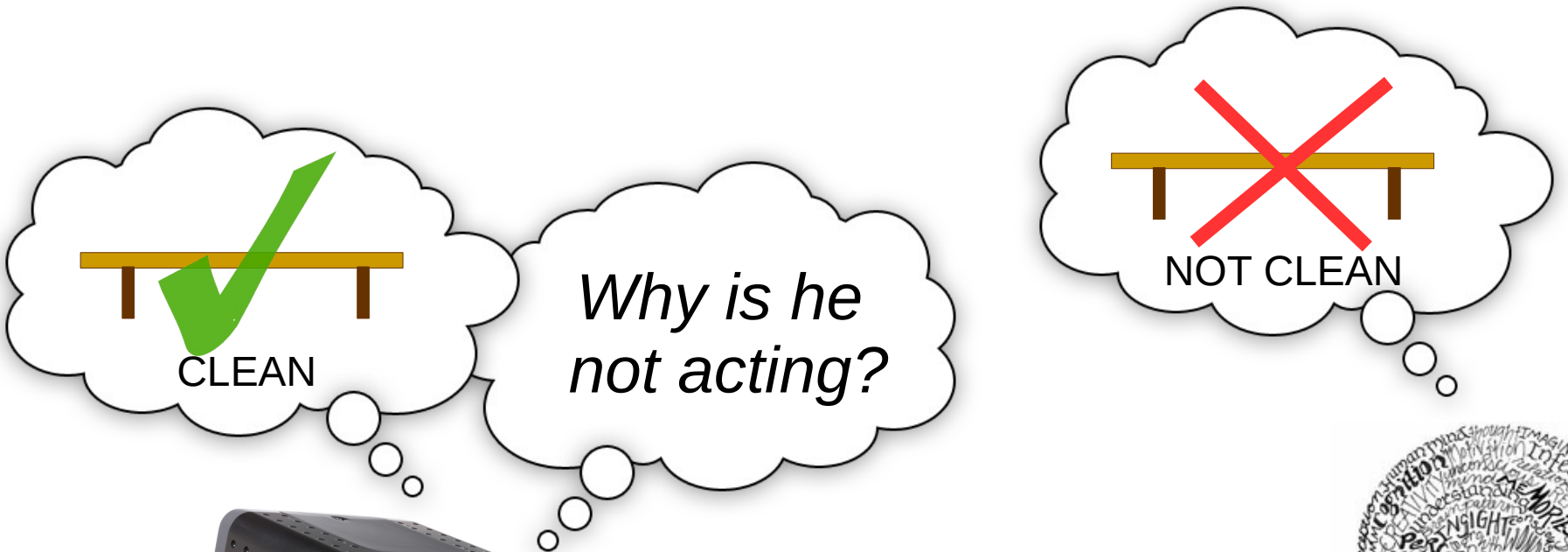
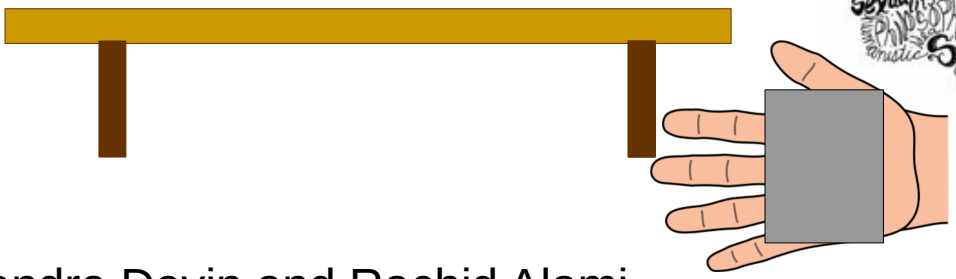
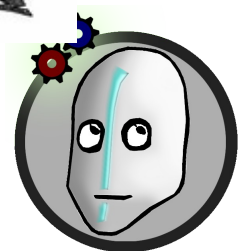
Before humans' actions







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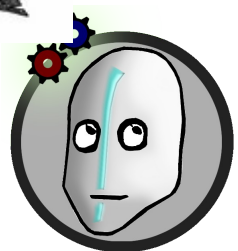
Preventing mistakes



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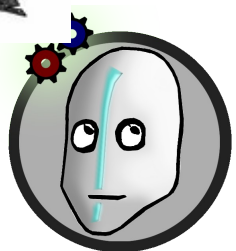
Inaction and uncertainty



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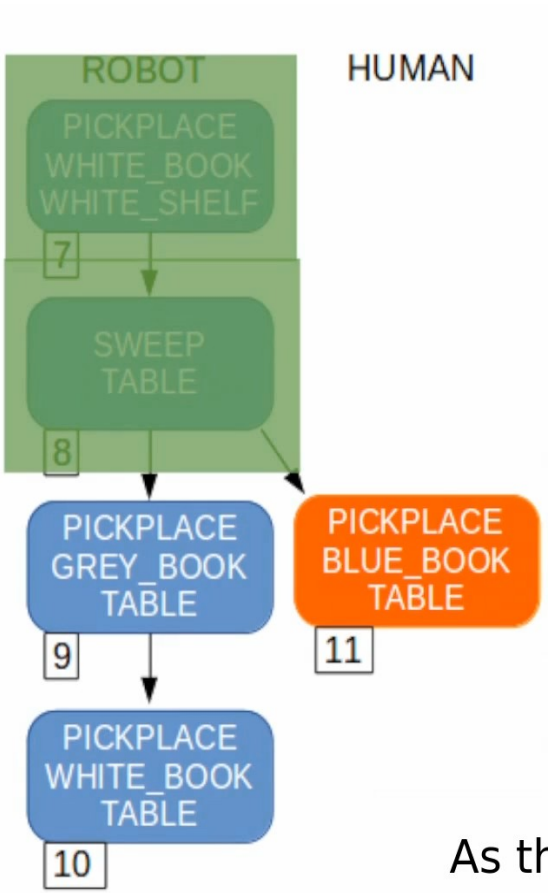
Example



As the human can see that the WHITE_BOOK has been moved by the robot, the robot infers that the human knows that the first plan has been abort.

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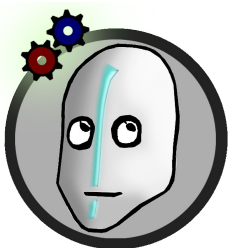
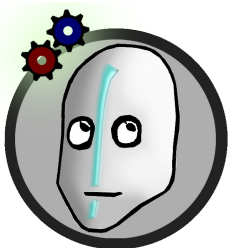
Contribution

- **Mental states** also on **goals, plans and actions**
- Taken into account when **executing shared plans**
- **Less intrusive** behavior by giving only **necessary information**
- Implemented in a **complete human-aware architecture**

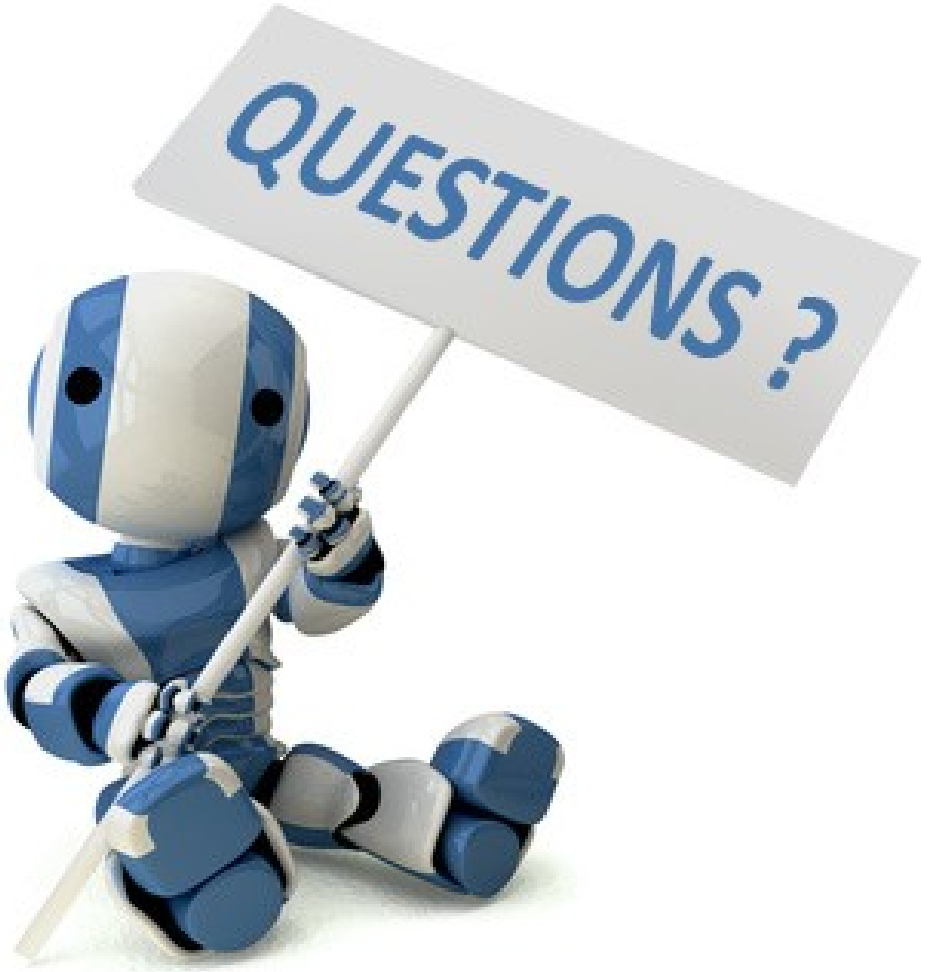


Future work

- Possibility of wrong or missing knowledge for the robot
- Use humans mental states to better understand humans unexpected behaviors



Thanks for your attention



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