Generic-to-Specific Reasoning and Learning for Ad Hoc Teamwork

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Collaboration without Prior Coordination

Example-FA   Example-HFO   Example-VH

- Ad hoc Teamwork: collaborate with other agents "on the fly".

- Limited prior knowledge of other agents/robots; fully/partially observable state but no (limited) communication.

- Need to reason with, learn, and understand behavior of other agents.

Existing Work and Our Approach

- Encoded protocols/plays, probabilistic sampling-based methods.

- **State of the art**: sequential decision making with data-driven component.
  - Deep network-based models; behavior of other agents or agent "types".
  - Optimize choices using long experience history.
  - Resource-hungry, opaque, domain knowledge not leveraged.

- Cognitive systems-inspired approach; joint reasoning, learning, control; different abstractions and processes. How to effectively leverage reasoning (domain-specific knowledge), interactive learning (behavior models), and LLM (generic prediction)?

Hasra Dodampegama and Mohan Sridharan. **Reasoning and Explanation Generation in Ad hoc Collaboration between Humans and Embodied AI**. In International Conference on Logic Programming and Nonmonotonic Reasoning (LPNMR), October 2024.

Hasra Dodampegama and Mohan Sridharan. **Back to the Future: Toward a Hybrid Framework for Ad hoc Teamwork**. In the AAAI International Conference on AI (AAAI), February 2023.

Reuth Mirsky, Ignacio Carlucho, Arrasy Rahman, Elliot Fosong, William Macke, Mohan Sridharan, Peter Stone, Stefano V Albrecht. **A Survey of Ad Hoc Teamwork: Definitions, Methods, and Open Problems**. European Conference on Multiagent Systems (EUMAS), 2022.

Architecture Overview
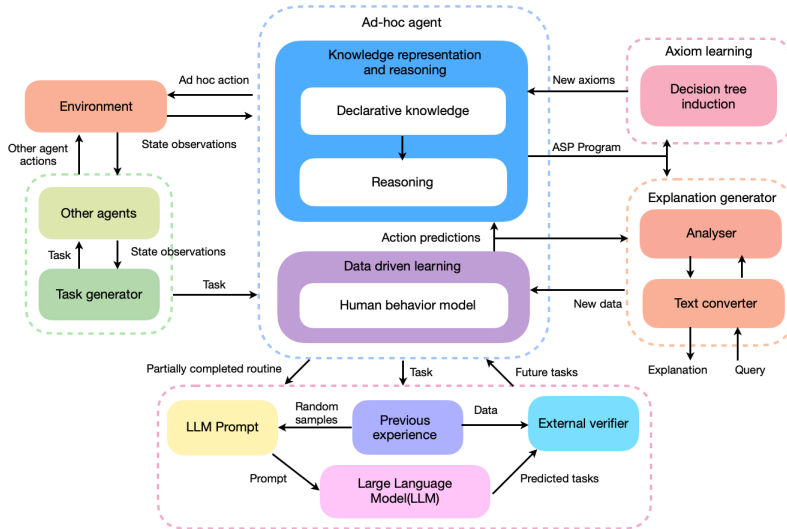
Contributions

- Non-monotonic logical reasoning, probabilistic reasoning, interactive learning, and foundation models inform and guide each other.

- Better performance than methods considered state of the art, using orders of magnitude fewer resources.

- Step-wise refinement: simplifies design; confidence and scalability.

- Ecological rationality for reliable and efficient reasoning and learning.

- Relational descriptions as on-demand explanation of decisions.

- Separation of concerns: common methodology, automation.

Execution Example: Reasoning + Learning

human   agent1

agent3   agent4

That's all folks!

SMPT talk : 1615 February 27 (Rm. 125).

PhD, Postdoctoral research positions available.

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