Agents

- Agents act in some environment.
- Agents have beliefs and goals.
- Agents act in some environment in order to achieve goals.
- Agent program determines what to do, given beliefs, in order to achieve goals.
Agent programming languages and logic

- how to verify agent programs (one way is to design a logic of goals)

things which are believed to be true, cannot be chosen as goals

Agent architectures formalised in logic (e.g. a logical axiom: things which are believed to be true, cannot be chosen as goals)

how to design a programming language which implements an agent architecture

- how to design a programming language which implements an agent architecture

Some of the research questions:

• Prolog-like

Programming languages usually declarative, often rule-based or

(Cooper/Rao, 2APL, people in Utrecht...)

Specialised agent programming languages: SimAgent, AgentSpeak

Agent programming languages and logic
Our work in this area

- How to ascribe beliefs to agents
- Various logics for bounded memory reasoners (joint work with Mark Jago’s PhD)
- Various logics to reason about rule-based agents (Mark Jago’s PhD)
- Various rule application strategies in logic
- Logics to reason about 2APL agents (in progress, joint with Mehdi Dastani and John-Jules Meyer from Utrecht)
- Various logics for bounded memory reasoners (joint work with people from Trento) - including rule-based agents, but also arbitrary reasoners

Arbitrary reasoners
Resource limitations and any trade-offs between time, memory and communication.

We are especially interested in verifying properties like:

- How much time will it take the agents to achieve the goal?
- How many messages do the agents need to exchange to achieve the goal?
- Can an agent with memory of size \( m \) achieve the goal?
- How much time will it take the agents to achieve the goal?

Resource limitations
If agents reason in logic, resource limitations above relate to questions in proof complexity.

Proof complexity: a logic is given by a set of inference rules (e.g., resolution).

- **Time complexity**: if a formula is derivable from a finite set of premises \( \Gamma \), how long can the proof get (as a function of the size of \( \Gamma \) and \( \phi \))? Resolution.

- **Space complexity**: if all the agent can to do is read premises into memory, apply inference rules to formulas in memory, and erase some formulas from memory, how large a memory does it need to derive \( \phi \) from \( \Gamma \) (as a function of the size of \( \Gamma \) and \( \phi \))?

- **Proof complexity**: if a logic is given by a set of inference rules (e.g., resolution).
Benthem and Fenrong Liu

with Thomas Ågotnes, recently started working with Johan van Benthem and Thomas Ågotnes, recently started working with Johan van Benthem and Fenrong Liu

Efficient belief revision for resource-bounded reasoners (on our own, also

Epistemic logics for resource-bounded reasoners (on our own, also

Modal logic, in particular modal logic to reason about path

Constraints, intuitionalistic modal logic (Dima Shkatov's PhD)

Implementation in AgentSpeak (with Rafael Bordini)

Efficient belief revision for rule-based agents (with Mark Jago),