

Agent Programming Languages and Logics in Agent-Based Simulation

Abstract. Research in multi-agent systems has resulted in agent programming languages and logics that are used as a foundation for engineering multi-agent systems. Research includes reusable agent programming platforms for engineering agent systems with environments, agent behavior, communication protocols and social behavior, and work on verification. Agent-based simulation is an approach for simulation that also uses the notion of agents. Although agent programming languages and logics are much less used in agent-based simulation, there are successful examples with agents designed according to the BDI paradigm, and work that combines agent-based simulation platforms with agent programming platforms. This paper analyzes and evaluates benefits of using agent programming languages and logics for agent-based simulation. In particular, the paper considers the use of agent programming languages and logics in a case study of simulating emergency care units.

Descriptive agents

- Rich and complex behavior models.
- Useful for gaining insight into decision making.

Evaluation criteria

1. How the framework supports descriptive agents.
2. How reusable the framework or meta-model is.
3. How useful the framework or meta-model is for analysis.

AOP, Logic, ABS and MAOP

Agent Oriented Programming (AOP) - Programming paradigm for implementing agent behavior.

Logic - Offers formal frameworks for specification and verification of multi-agent systems.

Agent-Based Simulation (ABS) - Analysis method based on simulating a system of autonomous agents.

Multi-Agent Oriented Programming - Programming paradigm for implementing multi-agent systems.

MAOP frameworks and meta-models

Framework/meta-model	Main characteristic
CARTAgO	Virtual environments with Agents & Artifacts meta-model.
EIS	Interface between AOP platform and environment.
OperA	Agent organization meta-model.
Moise ⁺	Agent organization meta-model.
AORTA	Meta-model for enabling reasoning with OperA in agents.

Use Case: Emergency Care Units

Complex system with many different actors: doctors, nurses, patients, IT-systems, hospital departments, etc.

Employees follow guidelines but not strictly - a secretary can help out with nurse tasks but is not expected to do so.

Evaluation of AORTA in use case

1. Descriptive agents that have a mechanism to include organizational reasoning in their decision making. They are descriptive in the sense that they implement complex social behavior and support explainable behavior. An agent can use AORTA to reason about what other agents expect of the agent, and what it can expect of the other agents.
2. A reusable meta-model that can be integrated in any agent programming platform.
3. Formal syntax and semantics in logic that can be used for specification and verification of the organizational agent model. Logic reasoning can provide insight into social relations which are otherwise hard to identify or reason about.