Dynamics of Declarative Goals in Agent Programming

M. Birna van Riemsdijk Mehdi Dastani Frank Dignum
John-Jules Ch. Meyer

Institute of Information and Computing Sciences
Utrecht University, The Netherlands
birna , mehdi , dignum , jj @cs.uu.nl

1 Abstract

The full version of this paper appeared in the proceedings of the Second International Workshop on Declarative Agent Languages and Technologies (DALT'04).

An important concept in agent theory, agent logics and agent programming is the concept of a *goal*. In agent theory, goals are introduced to explain and specify an agent's (proactive) behavior. In this view, agents are assumed to have their own objectives, for the achievement of which they initiate behavior [10, 6, 2, 3]. Various logics have been introduced to formalize the concept of goals and reasoning about goals [7, 1]. In these logics, a goal is formalized as a set of states. What is important in these logics, is which conclusions can be drawn from the existence of a certain goal set, i.e. which other goals can and cannot be inferred, etc.

Many agent programming languages have been proposed to *implement* (represent and process) an agent's goals [4, 3]. The way in which goals are dealt with varies from language to language. For example, different languages propose programming constructs that capture different aspects of the concept of a goal. Also, in some programming languages goals are interpreted in a procedural way as processes that need to be performed while in other programming languages goals are interpreted in a declarative way as states to be reached. In this paper, we are interested in this *declarative* interpretation of goals. Declarative goals have a number of advantages in agent programming. They for example provide for the possibility to decouple plan execution and goal achievement [9]. If a plan fails, the goal that was to be achieved by the plan remains in the goal base of the agent. The agent can then for example select a different plan or wait for the circumstances to change for the better. Furthermore, agents can be implemented such that they can communicate about their goals [5]. Also, a representation of goals in agents enables reasoning about goal interaction [8].

During the execution of an agent, a goal can be adopted and might disappear again when there is for example no feasible plan to reach it. This paper aims to analyze these dynamics of declarative goals in the context of agent programming. We will do this by distinguishing and formalizing various notions of goal dropping

and goal adoption. Also possible motivations for an agent to drop or adopt goals are identified. Based on these motivations, we define specific mechanisms for capturing dropping and adoption in agent programming languages. Furthermore, we show how these mechanisms are related to the general definitions of dropping and adoption.

References

[1] C. Boutilier. Toward a logic for qualitative decision theory. In *Proceedings of the KR'94*, pages 75–86, 1994.

[2] J. Broersen, M. Dastani, J. Hulstijn, and L. van der Torre. Goal generation in the BOID architecture. *Cognitive Science Quarterly*, 2(3-4):428–447, 2002.

[3] M. Dastani and L. van der Torre. Programming BOID-Plan agents: deliberating about conflicts among defeasible mental attitudes and plans. In *Proceedings of the Third Conference on Autonomous Agents and Multi-agent Systems (AAMAS'04)*, pages 706–713, New York, USA, 2004.

[4] M. Dastani, M. B. van Riemsdijk, F. Dignum, and J.-J. Ch. Meyer. A programming language for cognitive agents: goal directed 3APL. In *Programming multiagent systems, first international workshop (ProMAS'03)*, volume 3067 of *LNAI*, pages 111–130. Springer, Berlin, 2004.

[5] A. F. Moreira, R. Vieira, and R. H. Bordini. Extending the operational semantics of a BDI agent-oriented programming language for introducing speech-act based communication. In *First International Workshop on Declarative Agent Languages and Technologies (DALT03)*, pages 129–145, 2003.

[6] A. Newell. The knowledge level. *Artificial Intelligence*, 18(1):87–127, 1982.

[7] A. S. Rao and M. P. Georgeff. Modeling rational agents within a BDI-architecture. In J. Allen, R. Fikes, and E. Sandewall, editors, *Proceedings of the Second International Conference on Principles of Knowledge Representation and Reasoning (KR'91)*, pages 473–484. Morgan Kaufmann, 1991.

[8] J. Thangarajah, L. Padgham, and M. Winikoff. Detecting and exploiting positive goal interaction in intelligent agents. In *Proceedings of the second international joint conference on autonomous agents and multiagent systems (AAMAS'03)*, pages 401–408, Melbourne, 2003.

[9] M. Winikoff, L. Padgham, J. Harland, and J. Thangarajah. Declarative and procedural goals in intelligent agent systems. In *Proceedings of the eighth international conference on principles of knowledge respresentation and reasoning (KR2002)*, Toulouse, 2002.

[10] M. Wooldridge. *An introduction to multiagent systems*. John Wiley and Sons, LTD, West Sussex, 2002.