The Knowledge Engineering Review, Vol. 30:5, 564–606.
doi:10.1017/S0269888915000065

Computational logics and verification techniques of multi-agent commitments: survey

MOHAMED EL MENSHAWY[1,2], JAMAL BENTAHAR[1], WARDA EL KHOLY[1], PINAR YOLUM[3] and RACHIDA DSSOULI[1]

[1]*Faculty of Engineering and Computer Science, Concordia University, Montreal, Canada;*
e-mail: m_elme@encs.concordia.ca, bentahar@ciise.concordia.ca, moh_marzok75@yahoo.com, w_elkh@encs.concordia.ca, rachida.dssouli@concordia.ca;
[2]*Faculty of Computers and Information, Menofia University, Shebin El Kom, Egypt;*
e-mail: m_elme@encs.concordia.ca;
[3]*Department of Computer Engineering, Bogazici University, Istanbul, Turkey;*
e-mail: pinar.yolum@boun.edu.tr

Abstract

Agent communication languages (ACLs) are fundamental mechanisms that enable agents in multi-agent systems to *talk*, communicate with each other in order to satisfy their individual and social goals in a cooperative and competitive manner. Social approaches are advocated to overcome the shortcomings of ACL semantics delineated by using mental approaches in the figure of agents' mental notions. Over the last two decades, *social* commitments have been the subject of considerable research in some of those social approaches as they provide a powerful representation for modeling and reasoning upon multi-agent interactions in the form of mutual contractual obligations. They particularly provide a declarative, flexible, verifiable, and social semantics for ACL messages while respecting agents' autonomy, heterogeneity, and openness.

In this manuscript, we go through prominent and predominate proposals in the literature to explore the state of the art on how temporal logics can be devoted to define a formal semantics for ACL messages in terms of social commitments and associated actions. We explain each proposal and point out if and how it meets *seven* crucial criteria, four of them introduced by Munindar P. Singh to have a well-defined semantics for ACL messages. Far from deciding the best proposal, our aim is to present the advantages (strengths) and limitations of those proposals to designers and developers using a concrete running example and to compare between them, so that they can make the best choice with regard to their needs. We explore and evaluate current specification languages and different verification techniques that have been discussed within those proposals to, respectively, specify and verify commitment-based protocols. We also investigate logical languages of actions advocated to specify, model, and execute commitment-based protocols in other contributed proposals. Finally, we suggest some solutions that can contribute to address the identified limitations.

1 Introduction

Communication among autonomous and heterogeneous agents is a fundamental aspect for building open and *effective* multi-agent systems (MASs). The autonomy property means that agents are free to communicate as they are delighting, but behave with respect to the rationale of their state of affairs, plans, and goals. The heterogeneity property means that agents are designed and implemented in different ways (i.e. agents are following different and probably opposite goals, desires, and intentions). In contrary, homogeneous agents have the same capabilities, as they are designed in an identical way. The reason that makes communication significant is not only because agents have the property of social ability and