Competent Agents and Customising Protocols

Ulle Endriss\textsuperscript{1}, Wenjin Lu\textsuperscript{2}, Nicolas Maudet\textsuperscript{3}, and Kostas Stathis\textsuperscript{2}

\textsuperscript{1} Department of Computing
Imperial College London
180 Queen’s Gate, London SW7 2AZ, UK
ue@doc.ic.ac.uk
\textsuperscript{2} Department of Computing, School of Informatics
City University
Northampton Square, London EC1V OHB, UK
\{lu,stathis\}@soi.city.ac.uk
\textsuperscript{3} LAMSADE
Université Paris-Dauphine
75775 Paris Cedex 16, France
maudet@lamsade.dauphine.fr

Abstract. In open agent societies, communication protocols and strategies cannot be assumed to always match perfectly, because they are typically specified by different designers. These potential discrepancies raise a number of interesting issues, most notably the problem of checking that the behaviour of an agent is (or will be) conformant to the rules described by a protocol. In this paper, we argue that the ability to merely conform to a protocol is not sufficient for an agent to be a \textit{competent} user of that protocol. We approach the intuitive idea of protocol competence by introducing a notion that considers, broadly speaking, an agent's ability to reach a particular state of the interaction and we provide preliminary results that allow us to automatically check competence in the context of a specific class of logic-based agents. Finally, we illustrate how these results can facilitate the customisation of protocols used by agents that are not fully competent.

1 Introduction

Communication is one of the key feature of societies of artificial agents \cite{1}, and standards are required to regulate the distributed decision-making involved in interactions such as, for instance, negotiation or persuasion. A \textit{protocol} specifies the “rules of encounter” governing a dialogue between two or more communicating agents \cite{2}. It specifies which agent is allowed to say what in any given situation. It will usually allow for several alternative utterances in every situation and the agent in question has to choose one according to its \textit{strategy}. The protocol is \textit{public}, while each agent’s strategy is \textit{private}. In open societies, protocols and strategies cannot be assumed to match perfectly. Protocols are typically specified by the designer of the application, whereas strategies are implemented by the designer of the agent. The potential discrepancies caused by these different points of view raise a number of interesting issues, most notably the problem
of checking that the behaviour of an agent is (or will be) conformant to the rules described by a protocol [3]. In this paper, we argue that the ability to merely conform to a protocol, however, is not sufficient for an agent to be a competent user of that protocol.

Intuitively, we understand competence with respect to a protocol as the capacity of the agent “to deal adequately” with a protocol. Surely this may involve different notions. To start with, it is clear that the agent must have the ability to understand the meaning of the messages —to put it another way, the agent must share the ontology used in the interaction. This means that the agent must interpret the meaning of communicative acts (the performatives and their content) properly. Another requirement is that the agent should be able to give meaningful answers within the time window specified by the protocol. Note that the problem is not whether the agent can actually give a response (a point that we shall discuss later on), but whether the answer (if given) is fully satisfactory to the agent. On top of that, the agent should be available until the protocol terminates and not leave the interaction before. In this paper, we will take for granted that agents (i) share the same ontology, (ii) have sufficient reasoning capabilities to deal with the different types of message exchanged, (iii) are available until the end of interaction. We are now in a position to give a first hint of the notion we will investigate in this paper: competence amounts to evaluating whether the agent can explore (i.e. reach the different states) of a given protocol.

The remainder of this paper is structured as follows: the next section describes the logic-based representation for protocols that we shall use throughout this paper. Section 3 discusses what we regard as a first requirement for an agent to be considered competent, namely that this agent should be able to give at least one legal response to any message expected as part of the protocol (exhaustive conformance). However, as we shall see, this is not a fully satisfactory notion of competence. In Section 4 we go one step further and introduce the competence of an agent as, generally speaking, its ability to reach a particular state of the interaction. We provide preliminary results that allow us to automatically check competence in the context of our logic-based agents. Section 5 introduces a notion of practical importance: the customisation of protocols in order to adapt them to agents that are not fully competent. We illustrate this idea by means of a protocol inspired by electronic transactions. Section 6 concludes.

2 Protocols for Logic-Based Agents

In this paper, we shall only consider protocols that can be represented by means of a deterministic finite automaton (DFA). This is a widely used class of agent interaction protocols (see [4] and others), but we should also point out that certain types of interaction require more expressive formalisms (for instance, where concurrent communication is required). We recall here that a DFA consists of (i) a set of states (including an initial state, and a set of final states), (ii) a set of events, and (iii) a transition function \( \delta \) which maps pairs of states and events to states. Given a DFA with transition function \( \delta \), a dialogue move \( P \) is a legal