Ontological Feedback in Multiagent Systems[1]

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When agents transfer information, they need a conceptualisation of the domain of interest and a shared vocabulary to communicate facts with respect to this domain. The conceptualisation can be expressed in a so-called *ontology*, which is often defined in a formal language, such as a programming language or a formal logic. An ontology abstracts the essence of the domain of interest and helps to catalogue and distinguish various types of objects in the domain, their properties and relationships (see, e.g. [3, 4]).

In successful communication and in collaborative performance of tasks, agreement between different agents with respect to the ontology is crucial or, at least, the agents should be aware of existing discrepancies. In case of discrepancies, various troublesome situations may arise. One of the agents, for instance, by mistake may assume that a particular concept is shared, while the other has no knowledge about it. Or worse, both dialogue partners have different conceptualisations, while the relevant discrepancy remains unnoticed. Ontological discrepancies may cause serious communication flaws and the generation of adequate feedback in order to repair these flaws is an essential part of modelling a proper communication process.

In principle, there is a range of approaches to achieve ontological agreement. In this paper, we aim at the design of a mechanism that solves ontological discrepancies during the communication process. In particular, it will be shown how ontological discrepancies can be detected during a communicative situation and how a dialogue participant can react to these observed discrepancies. Agents may detect discrepancies by, for instance, type conflicts, ontological gaps and particular inconsistencies that emerge during the conversational process. Depending on the kind of discrepancy, the agent generates a particular feedback message in order to establish alignment of its private ontology with the ontology of the sender. For that, we will adopt an approach in which agents have a dynamic mental state that contains ontological information about the domain of interest in terms of simple type theoretical contexts.

The decision criteria for discrepancies will be expressed in terms of type theory where the addition of particular information to ontologies yields so called legal or illegal contexts. A *legal context* is a context where the addition of new information

[1] This abstract summarises the main findings of [2].

was adhered to the rules of the type system. For instance, the introduction of new predicates is only possible if the type of its arguments is already included in the ontology; otherwise, the context is illegal. If we would like to add, for instance, the assumption that 'whales are heavy', we must at least have a notion of 'heaviness' and 'whale' in our current state.

In the detection stage of the interpretation process of an incoming message, particular information – so called *presuppositions* – is extracted from the message. In cases where the addition of presuppositions to the ontology of the receiver yields an illegal context, the receiving agent has to generate particular feedback. In other words, possible ontological discrepancies are detected by comparing the presuppositions from an incoming message with with the existing ontology of the receiver. In case the presuppositions follow from the ontology; there is no discrepancy; in all other cases, for instance, if the presuppositions are in conflict with the receiver's ontology, feedback has to be generated.

Essential to our approach, is the starting point that ontological discrepancies are treated at the level of agents themselves, without the aid of an external observer. The framework accounts for the detection and handling of ontological discrepancies by the agents themselves, on the basis of their own subjective view on the world. This means that there is no reference to any (implicit) third ontology. It also means that the framework abstracts from a notion of truth which is inherent to model-theoretic approaches. Agents work towards agreement on the basis of their belief states and communicative acts. We believe that this approach is both theoretically and practically important for multiagent systems.

Future work will include the extension of the basic framework to richer ontologies and more complex type theoretical constructs. Important research questions are (in line with [1]): How does the initial feedback change the belief state of the agents and and how can subsequent dialogue contributions be modelled? To answer these questions we must consider a variety of additional constructs such as agent roles and various types of beliefs and speech acts. Furthermore, we believe that our approach is applicable to important other aspects of communication in multiagent systems, such as argumentation and negotiation. We also expect the approach to be fruitful with regard to ontology alignment and merging.

References

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