Taking Interaction Ontologically Prior to Meaning

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1 The Semantic Web Vision

The Semantic Web was envisioned, at the turn of the century, as a way of "bringing the World Wide Web to its full potential" [5], as an extension of the Web "in which information is given well-defined meaning, better enabling computers and people to work in cooperation" [3]. One of the basic components destined to play a crucial role in this effort were what computer scientists called ontologies: documents or files that formally define vocabularies of terms and the relations among these terms. According to this vision, the activity of the World Wide Web Consortium (W3C) centred around the specification of recommendations for structuring the data on the web using logic-based representation formalisms that would provide a well-defined model-theoretic semantics for carrying out inferences and drawing conclusions about these data. The proponents of Semantic Web made clear that "the computer does not truly 'understand' any of this information," but that it will be able to "manipulate the terms much more effectively in ways that are useful and meaningful to the human user." [3] This view of cooperation on the Web takes "well-defined meaning" by means of ontologies as a prerequisite for successful interaction. By adopting this stance, meaningful communication between, for instance, separately engineered software agents in a multi-agent system, relies on an a priori commitment to a shared conceptualisation of the application domain [?], which explicitly specifies what the communicated terms shall "mean." Ontologies may indeed be useful for stable domains and closed communities of agents, but it is often impossible to reach global semantic agreements because soon the cost of being precise abaout semantics and guaranteeing it at a global level increases very quickly when the number of participants grows. As a result, current state-of-theart approaches tackling semantic heterogeneity no more seek to agree on shared global ontologies, but instead attempt to establish correspondences between varying terminologies through ontology matching [6, 4].

2 Meaning and Interaction

We argue, however, that by computing semantic correspondences of separate terminologies focusing on ontologies and ontology matching, the problem is only partially addressed. Modern hermeneutics, as initiated by Heidegger and Gadamer, has shown that language is listened to in a background, and that interpretation is not independent of the interpreter. Meaning, thus, is always re-created in the context of the purposes, expectations, and commitments the interpreter attaches to its usage or utterance. Meaning is ultimately interaction-dependent and relative to an implicit background, which cannot be fully de-contextualised. Despite that, current state-of-the-art ontology matching systems, compute semantic alignments generally prior to interaction. Moreover, most current ontology matching techniques follow a classical functional approach, taking two or more ontologies as input and producing a semantic alignmentof ontological entities as output [4]. This yields several drawbacks. On the one hand, it limits the dynamism and openness of the interaction, as only agents with previously matched ontologies may participate in an interaction. On the other hand, it keeps matching out of the context of the interaction. Semantic correspondences are established in an interaction-independent fashion, e.g., by means of external sources such as WordNet, where semantic relations such as synonymy, among others, were determined prior to interaction and independently from it. Although recent approaches apply ontology matching at interaction-time and only among those fragments of ontologies that are deemed relevant to the interaction at hand -allowing for increased openness and dynamism- such dynamic ontology matching techniques still follow a functional approach: when a mismatch occurs, semantic heterogeneity is solved applying current state-ofthe-art ontology matching techniques, albeit only for a fragment.

Furthermore, although done at interaction-time, matching is still done separately from the interaction. But, as mentioned earlier, the meaning of certain terms is often very interaction-specific. For example, the semantic similarity that exists, in the context of an auction, between the Spanish term "remate" and the English expression "winning bid" is difficult to establish if we are left to rely solely on syntactic-based or structural matching techniques, or even on external sources such as dictionaries and thesauri. The Spanish term "remate" may have many different senses, and none of them may hint at its meaning as "winning bid." Its meaning arises when uttered at a particular moment of the interaction happening during an auction.

3 Semantic Alignment as a Wittgensteinian Language Game

We investigate how software agents may establish the semantic relationships between their respective terminologies on the grounds of their communication within a specific interaction by taking interaction ontologically prior to meaning. As with Wittgenstein's language games [9], the meaning of those terms uttered by each agent arises by how the agents actually make use of them in the interaction, which, in some respect, can be seen as a simple language game. We assume agents follow certain interaction models, or protocols (the game rules), according to which they are allowed to make certain utterances at certain interaction states. These utterances are in the form of illocutionary speech acts whose content are the words of the game language (such as "remate" or "winning bid"). When an agent listens to an utterance whose content it does not understand, it does so in the beackground of a particular interaction state. It will have to guess among the possible alternatives regarding its own view of the interaction, assuming that all agents are in the same or compatible interaction state. The "meaning" an agent attaches to a term, then, is the interaction state transition it thinks is the result from the term's utterance in a speech act, according to the agent's view of the interaction and of the current interaction state. As with a language game, the guesses of what the meanings of the words are may be wrong, which will eventually lead to a breakdown of the communication: the interaction has not progressed in the direction foreseen by the interaction models of each agent. Agents can be aware of such a breakdown if they are capable of communicating about the interactions themselves. In our model, which builts upon [1], agents follow both their own interaction protocol and also an alignment protocol in parallel. This alignment protocol is seen as a meta-protocol through which the actual communication is carried out: any communication act regarding the lower level becomes ineffective and has an effective counterpart according to the meta-level. In addition, agents are endowed with an alignment mechanism used to perform the actual matching. Matching elements are reinforced as many interactions are completed and this reinforcement is based on statistical reasoning. Eventually, terms are deemed semantically related if they trigger compatible interaction state transitions, where compatibility here means that the interaction progresses in the same direction for each agent -albeit their interaction views (that is, their own interaction models) may be more constrained than the interaction that is actually happening. From a theoretical point of view, we have based our model on the mathematical theory of information flow proposed by Barwise and Seligman [2], because it models the flow of information occurring in distributed systems due to the connections of particular situations -or tokens- that carry information. Similarly, the semantic alignment that will allow information to flow ultimately will be carried by the particular interaction state transitions agents are apprehending during their interaction. But this theoretical model is not left by itself, and we have carried out an implementation of the model, proving empirically its effectiveness in establishing the semantic alignment that arises in the context of an interaction.

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