

Chomsky: a Content Language Translation Agent (Extended Abstract)

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Abstract. This paper describes Chomsky, a content language translation agent. This agent provides a service, which first translates the content expression from its original language into an abstract logic language (ALL). Then, the resulting ALL expression is translated to the desired target language. ALL has been designed as a superset of most known content languages to avoid losing expressiveness during translation. For more than three supported languages, using an intermediate language approach involves fewer translators than a pair wise approach. Currently, Chomsky supports FIPA-SL, KIF, and Prolog Content Language. In one mode of operation, Chomsky returns the result of the translation request to the client agent. In the other mode, Chomsky receives a message from the intended sender whose content is expressed in language L1, it translates the content to the content language used by the intended receiver (L2), and it sends the message with the L2 content to the intended receiver.

1 Introduction

In open agent societies of heterogeneous agents it is likely to have agents using different languages to express the contents of their messages. Even if agents comply with current standardization specs [1], it is not mandatory to use a particular content language.

We have implemented Chomsky, an agent that translates content expressions from their original language into other desired content languages, enabling interoperability between heterogeneous agents. Currently, Chomsky does not require agent-level autonomy or intelligence. However, Chomsky was built as an agent (it communicates in FIPA-ACL) to facilitate its use by other agents and to facilitate its future sophistication to handle problems requiring more autonomy and intelligence.

This is a short version of the paper “Chomsky: a Content Language Translation Agent” which can be found in <http://www.we-b-mind.org/publications/alopes-chomsky-ceemas05-final.pdf>. More detailed explanations, examples, an overview of the literature and complete references are given in the larger version of the paper.

Section 2 presents the content language translation process and it describes Chomsky, the content language translation agent. In section 3, we conclude and present guidelines for future work.

2 Content Language Translation

This section describes the proposed content language translation process, it describes Chomsky, the agent providing the translation service, and it presents an example of an interaction with Chomsky. Chomsky is a working agent publicly available. For more information on the content language translation service as well as information on the agent can be found at <http://clts.we-b-mind.org/>

2.1 Translation process and Supported Languages

The approach used in the development of the translation service was to create an internal content language to which all the object languages could be translated, and from which all the target languages could be generated. In our approach, any supported language can be object or target language.

In order to be possible to translate between any of the supported languages, it was decided that the internal content language should be a superset of the supported content languages. Notice that it is only necessary to have the adequate expressiveness. Inference mechanisms are not necessary since the internal content language is used only as an internal representation format. Certainly, this approach does not solve problems that are impossible to solve. The translation of expressions of a more expressive language into expressions of a less expressive language is not always possible. An alternative approach would be to create translators for each pair of object/target content languages. However, our approach requires only $2 \times N$ translators, in which N is the number of supported languages. The mentioned alternative requires $N!$ translators. Therefore, our approach is better when the number of supported languages is greater than 3.

Currently, the supported content languages are FIPA-SL [1], KIF [2] and PCL [3] (Prolog Content Language), each of which can be either an object or a target language. The internal content language is called ALL (Abstract Logic Language) [4]. FIPA-SL has been defined and used by FIPA to express the semantics of FIPA ACL. FIPA SL is a general-purpose representation formalism suitable for a number of different domains. SL is a quantified multi-modal logic with several referential (iota, any, all) and action (feasible, done) operators. Also, SL contains modal operators for beliefs, uncertain beliefs, persistent goals, and intentions.

The KIF parser used in the service is based on an extension of the KIF draft proposed to the American National Standards. However, not all of its features were covered by our current parser.

The PCL parser is based on the PCL draft definition proposed by the “*We, the Body and the Mind*” Research Group of ADETTI.

ALL is an abstract content language defined as a superset of the content languages FIPA-SL, KIF, and PCL. This way we ensure that it is possible to translate any content expression from any of these languages to ALL. Since FIPA-SL includes all the features of the two other languages, ALL closely mirrors SL. The addition of new languages may raise the need to further extend the expressive power of ALL. However, this would not interfere with the currently developed translators, since the added

constructs would not be involved in the current translation process. ALL complete specification, including its abstract grammar, its class model, and a concrete S-Expression syntax is described in the longer paper.

2.2 Chomsky, the Agent

The initial idea was the development of a content language translation library that each agent in the network could integrate in its own program as a new component or package. However, not all the agents in an open agent society are built using the same implementation technology, therefore the library would have to be built for all implementation technologies used to create agents. Hence, the creation of a content language translation service deployed by an agent became the best solution.

Chomsky uses the translation process explained in section 2.1 and its interaction is governed by the FIPA request protocol, which is initiated by the reception of a FIPA-Request message. Chomsky can use any of the supported content languages. Chomsky provides two language translation services, corresponding to two operation modes: translator mode, and interpreter mode. In the translator mode, Chomsky translates received content expressions and sends them back to its client agents. In the interpreter mode, Chomsky acts as a gateway between two clients, translating the contents of messages from one of its clients and sending the resulting message to the other client.

The action that performs the translation, in the translation mode, is “*translate*”. Its arguments are the object content language, the target content language, and the content expression to be translated. An example of this interaction is described in section 2.3. The action that performs the translation and forwards the result, in the interpreter mode, is “*forward_with_translated_content*”. Its arguments are the *object content language*, the *target content language*, the *message to be translated and sent* and the *intended receiver* of the message.

Chomsky was implemented in JAVA, using the JADE agent platform, and some agent tools previously created by our research group. The parsers used in the translation process were implemented using JAVA Cup and JAVA Lex.

2.3 Example of use

In this section we present the conversation in which the client agent (Dummy) requests Chomsky to translate a specific message from FIPA-SL to KIF (see Fig.1). According to the FIPA-Request interaction protocol [1], Chomsky sends a FIPA-agree message indicating that it agrees to perform the translation or a FIPA-refuse message indicating the reason for refusing to perform the translation.

```
(REQUEST
:sender (agent-identifier :name dummy@somewhere)
:receiver (set (agent-identifier
:name chomsky@elsewhere))
:content "((action (agent-identifier
:name chomsky@elsewhere)
(translate FIPA-SL KIF
\"((all ?x (instance ?x Car)))\")))"
:language FIPA-SL)
```

Fig. 1. Message requesting Chomsky to translate a message's content from FIPA-SL to KIF.

In the case that Chomsky agrees to perform the translation, it sends a FIPA-Inform message containing the result of the translation to the Dummy agent.

3 Conclusions and Future Work

We presented Chomsky, a content language translation agent, performing a simple syntactic translation between any of the content languages FIPA-SL, KIF and PCL.

The next steps for future work will be to overcome some limitations of current parsers, to add support for additional content languages (e.g., FIPA-RDF), and to consider a more intensive use of semantics in the translation process, by considering the use of language ontologies.

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