IAA-00-IAA.9.2.08

LARGE-SIZE MESSAGE CONSTRUCTION FOR ETI: TYPING LOGIC CONTENTS

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A language for cosmic intercourse (LCI) can be 'pure' in the sense that the possible sentences of the language are strictly defined syntactically by means of grammatical rules. In previous papers by the first author, the idea was introduced of formulating a message for ETI in a (terrestrial) natural language in juxtaposition with a set of pictures (coded as bitmaps) illustrating the 'story' told – allowing interaction between text and pictures. The second author has explicit views on the contents of messages and arrangements of the pictorial part. An additional idea, also proposed by the first author, is that messages might be augmented with descriptions of the semantics of certain parts of it in another formalism at a higher level. The selected parts can be sections, in some cases also individual declarative sentences, but the expressions at the higher level are supposed to describe relations 'living' in the text (in general a kind of story) transmitted. The resulting two-level approach to message construction has been called a LCI^+ language. There are several formalisms from mathematics and logic available for use at the meta level.

In the present contribution we discuss the use of constructive type theory restricted to predicate logic for the purpose of partly clarifying messages for ETI. There are several reasons for using abstract type theory. Evidently a powerful system is needed, while the expressions at the second level should rely on a limited set of primitives only. Further preference is given to systems for which computer implementations are available, and finally extensions to higher order logic are feasible. We adopt here the Calculus of Constructions, more in particular the French Coq proof assistant which has the important advantage that each expression can be checked for correctness using available computer implementations.

Since type theory belongs to the realm of formal logic, we *systematically* review the underlying proposition and predicate calculus, including proof theory, expressing and verifying all examples immediately in the proof assistant Coq. The way constructions are formulated and the role of constructors is explained and examples illustrate some ways of using these concepts in explication of message content. In the present contribution we restrict ourselves to the description of logic relations by means of type definitions, and provable lemmas.

An advantage of this approach is that text augmented with formal descriptions is easily understandable for humans. For those ETs who have attained a level of technological and intellectual sophistication comparable or beyond ours, the underlying logic may well be familiar, even though the notation employed is not. The two levels (text – explanations in logic) in conjunction with one another should be self-explanatory.