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LARGE-SIZE MESSAGE CONSTRUCTION FOR ETI: ARISTOTELIAN SYLLOGISMS

Abstract

The art and science of message construction for interstellar communication presents significant challenges for designers. One important reason is that the interpretation of message content is a non-trivial task for recipients. It cannot be expected that the construction methodology and formalism employed is familiar and known to them. This indicates the necessity of including some sort of key for interpretation. Also the motivation for message transmission it might not be transparent for recipients. The present author has therefore often claimed that items for communication should be large-size and should not have a *uni* but a *multi* level structure so that interrelations between levels might serve as useful instruments for the task of interpretation. Thus any *Lingua Cosmica* (LINCOS) for message construction will have the character of a *system.* In the process of choosing material suitable for communication designers may use several different kinds of levels, *e.g.* textual and pictorial levels and perhaps an *audio* (music) level too. In addition there should be a separate level where *abstractions* of the information contained in messages are presented.

A LINCOS system specific for the purpose of explaining information contents of texts in an abstract setting has been advocated the last few years by the present author. Explanations are provided in the form of annotations at a separate level. The formalism itself is based on logic, in fact constructive logic with induction. Suppose that items for communication contain Aristotelian *syllogisms* in textual forms using natural language. In view of the fact that Aristotelian logic has held a prominent position in formal logic for more than 2000 years and even today is considered to be a cornerstone in the art of reasoning, the use of syllogisms in messages would be quite natural. In order to explain (*i.e.* annotate) assertions of this type it should be possible not only to formalise the underlying logic in LINCOS but also to describe Aristotelian reasoning in the same system. The paper explains how this is achieved.

In Aristotelian logic the four basic structures of assertions consisting of subjects *S* and predicates *P* are: *all S are P*; *no S is P*; *some S is P*; *not all S is P*. The four basic conversions are (hypotheses in the form of implications): *all S are P -¿ some P is S*; *no S is P -¿ no P is S*; *some S is P -¿ some P is S*; *not all S is P -¿ some S is not P*. The conversions are simple Aristotelian syllogisms. In LINCOS these basic structures are modelled by inductive *definitions* and the conversions by verifiable *facts*.

Using the logical connective *and*, Aristotelian *figures* (*i.e.* compound syllogisms) can be formed from the basic structures. For example: *all S1 are P and all S2 are S1 -¿ all S2 are P*. Here *S1* occurs as a subject but also as a predicate. Figures like these are represented in LINCOS also by verifiable facts. The paper also discusses more involved

examples of the kind: *no P1 is S1 and all S2 is S1 -¿ no P is S2.* In all cases the conclusions are verified by constructive methods.

In terms of classical set theory subjects as well as predicates are represented by (non-empty) sets. Using set theory the conversions and examples shown are trivially true. In LINCOS sets and relations over sets are not in the basic repertoire. However, the above mentioned basic assertion structures can formally be interpreted within LINCOS as concepts in set theory: inclusion, disjunction, non-empty intersection, complementarity. So we have a remarkable situation: *via* an embedding procedure Aristotelian logic from antiquity is useful for enriching in a natural way modern LINCOS with aspects of set theory.