

On the Computational Character of Semantic Structures

Prakash Mondal, Indian Institute of Technology Delhi, New Delhi, India

ABSTRACT

Logical form in logic and logical form (LF) in the Minimalist architecture of language are two different forms of representational models of semantic facts. They are distinct in their form and in how they represent some natural language phenomena. This paper aims to argue that the differences between logical form and LF have profound implications for the question about the nature of semantic interpretation. First, this can tell us whether semantic interpretation is computational and if so, in what sense. Second, this can also shed light on the ontology of semantic interpretation in the sense that the forms (that is, logical form and LF) in which semantic facts are expressed may also uncover where in the world semantic interpretation as such can be located. This can have surprising repercussions for reasoning in natural language as well.

Keywords: Logical form (LF), Minimalist Architecture, Semantic Facts, Semantic Interpretation, Reasoning

INTRODUCTION

The exact nature of semantic interpretation as a property rather than as a psychologically grounded process is still barely understood or grasped despite the fact that we use language everyday and understand an enormous number of linguistic expressions with no *a priori* bound. This paper aims to make sense of the nature and form of semantic interpretation by tracking the differences between logical form, which is used in logic and Logical Form (LF), which is a part of the *Minimalist* architecture of language within Generative Grammar. Throughout the entire paper, the phrase 'logical form' will be used to signify the logical representation and LF will denote the syntactic component in Generative Grammar. Both logical form and LF represent aspects of semantic structures of natural language. But what is it about semantic

structures that they can be represented as such by logical form or LF? Note that logical form is a metalanguage that can be employed to express properties of semantic interpretation, while LF is a syntactic component within the architecture of the language faculty. When we say that LF represents aspects of meaning, we mean that LF is a syntactic system which is interpreted semantically. Within Generative Grammar, the model that interprets LF objects is a mental organization called 'Conceptual-Intentional (C-I) system', which interfaces with LF, while the model for logic is an abstract model in which interpretations of logical forms are couched. On another view, LF represents what may be called structured meanings in the sense of Cresswell (1985). Structured meanings derive from the meanings of the component expressions *and* from the meaning of the whole structure the component expressions are components of.

DOI: 10.4018/ijcssa.2014010104

Suffice it to say, these formal representations express properties of natural language meaning, and so they can uncover, one may believe, much about the form of semantic representation. There are well-known differences between logical form and LF many of which have already been noted (Bach, 1989; Heim & Kratzer, 2002). The significant question for us is whether semantics or meaning in language can be computational in its character, given that syntax is generally believed to be computational in Generative Grammar, and that descriptive generalizations about semantic facts can be made with reference to both logical form and LF. The important proviso to be made is that the aim is certainly not to merely zoom in on differences between logical and LF. Rather, the aim is to understand how and in what ways logical and LF can tell us something about the ontological status of semantic interpretation. Given this goal, much of what will follow in essence derives from Mondal (2013).

With this in mind, first an introductory sketch of what logical form and LF are will be drawn up. Then a range of pertinent but unexplored differences between logical form and LF that may have serious consequences for the ontology of semantic interpretation will be highlighted.

SEMANTIC REPRESENTATION AND SEMANTIC COMPUTATIONALITY

In the absence of a fuller grasp of what meaning is, it is certainly difficult, if not outright impossible, to understand the notion of semantic computability. This is more so because computation per se is also one of the most confounded and unclear notions used in cognitive science (Piccinini & Scarantino, 2011; Fresco, 2011). Questions on whether semantics is or can be computational rest on whether or not the right concept of computation for semantic representations is employed in order to have it applied to the phenomenon which we are concerned about. There is reason to believe that the notion of semantic computability may

be used in the classical sense of computation within which inputs are mapped to outputs according to some well-defined rules by means of symbolic manipulation of digital vehicles in the form of linguistic strings, insofar as the symbols in semantic representations can be modeled on the inputs and outputs subject to symbolic manipulations. We may note that this question can be best understood if and only if the minimal sense of semantic computability in terms of the specification of computable functions on semantic structures is figured out. The notion of computable functions can be approached in the following sense. When we talk about computation, we require (i) a function that is computed, (ii) a system which computes the function, and also (iii) an effective procedure (also called an *algorithm*). This comes out clearly from the *Church-Turing Thesis*, which states that anything that can be computed with an effective procedure in the physical world can be computed in Turing machines. So let's now have an overview of logical form in logic and LF.

ON LOGICAL FORM

Logical form of natural language sentences determines their logical properties and logical relations. Logical form of natural language sentences is constructed relative to a theory of logical form in the language of a theory of logic (say, first order logic) (Menzel, 1998). In fact, this idea can be traced to the Davidsonian system of logical forms. Plus Quine (1970) has always insisted on a pluralism of different logical forms. Logical form in logic can be schematized in the following way:

$$T = \{T_1 \dots T_n\}, \mathcal{L} = \{\mathcal{L}_1 \dots \mathcal{L}_m\}, L = \{\mathcal{L}_1 \dots \mathcal{L}_k\}$$

$$A = \{A_1 \dots A_j\}, B = \{B_1 \dots B_i\}$$

The formulation in (1) specifies a few things: T is the set of theories of logical form; \mathcal{L} is the set of all possible logical forms; L is the set of theories of logic. $L \mathcal{L}_k^{T_m}$ in (2) below

9 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the product's webpage:

www.igi-global.com/article/on-the-computational-character-of-semantic-structures/120234?camid=4v1

This title is available in InfoSci-Journals, InfoSci-Journal Disciplines Computer Science, Security, and Information Technology, InfoSci-Artificial Intelligence and Smart Computing eJournal Collection, InfoSci-Journal Disciplines Engineering, Natural, and Physical Science, InfoSci-Select.

Recommend this product to your librarian:

www.igi-global.com/e-resources/library-recommendation/?id=2

Related Content

Simplicity, Consistency, Universality, Flexibility and Familiarity: The SCUFF Principles for Developing User Interfaces for Ambient Computer Systems

Rich Picking, Vic Grout, John McGinn, Jodi Crisp and Helen Grout (2010).

International Journal of Ambient Computing and Intelligence (pp. 40-49).

www.igi-global.com/article/simplicity-consistency-universality-flexibility-familiarity/46022?camid=4v1a

Application of Bayesian Modeling to Management Information Systems: A Latent Scores Approach

Sumeet Gupta and Hee-Wong Kim (2007). *Bayesian Network Technologies:*

Applications and Graphical Models (pp. 103-126).

www.igi-global.com/chapter/application-bayesian-modeling-management-information/5498?camid=4v1a

Fuzzy Labeled Transition Refinement Tree: Application to Stepwise Designing Multi Agent Systems

Sofia Kouah and Djamel-Eddine Saidouni (2017). *Fuzzy Systems: Concepts, Methodologies, Tools, and Applications* (pp. 873-905).

www.igi-global.com/chapter/fuzzy-labeled-transition-refinement-tree/178426?camid=4v1a

The Concept of [Robot] in Children and Teens: Some Guidelines to the Design of Social Robots

João Sequeira and Isabel Ferreira (2014). *International Journal of Signs and Semiotic Systems* (pp. 43-57).

www.igi-global.com/article/the-concept-of-robot-in-children-and-teens/127094?camid=4v1a