A Special Issue on Statistical and Logical Models of Meaning

Glyn Morrill[1] *and Mehrnoosh Sadrzadeh*[2]
[1] Department of Computer Science,Universitat Politècnica de Catalunya
[2] School of Electronic Engineering and Computer Science,
Queen Mary University of London

In this special issue we collect five papers derived from the workshop on Statistical and Logical Models of Meaning (SaLMoM) celebrated 11th–15th July 2016 as part of the North American Summer School in Logic, Language and Information at Rutgers University. The workshop addressed fundamental problems of the interplay of syntax, traditional logical semantics, and contemporary distributional semantics. Speakers, in the order of presentation, were Mehrnoosh Sadrzadeh, Gemma Boleda, Laura Rimell, Glyn Morrill, Richard Moot, Jules Hedges, Mark Steedman, Gijs Wijnholds, Kyle Richardson, Dimitri Kartsaklis, Martha Lewis, Reinhard Muskens, and Nicholas Asher (`https://sites.google.com/site/statlogmeaning/workshop-program`).

Since the time of Richard Montague's semantic analysis of phenomena such as quantification around 1970, logical semantics based on lambda calculus and type theory has been a stable paradigm for the characterization of natural language truth conditions (via model theory) and, to a lesser extent, entailment (via proof theory), with the two in principle related by metalogical properties such as soundness and completeness. More recently, statistical semantics has used massive computational corpora to revindicate prior methods such as distributional semantics which models the semantics of a word by the words which locally cooccur with it. At the present time these distinct paradigms appear to represent approaches which are radically distinct, yet both valid. The central objective of this volume is to air options to contrast and possibly reconcile and bring together logical and statistical semantics such as distributional semantics.

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Standardly, linguistics identifies dictionary semantics for linguistic study. But in practice language is used for reasoning without a clear distinction between such linguistic knowledge and world knowledge. A classical problem in real reasoning is that of establishing and combining the relevant roles of encyclopedic or world knowledge and linguistic semantic knowledge. The article by Bankova et al. analyses entailment in distributional semantics in relation to this issue.

The article by Wijnholds addresses the classical covert movement phenomenon of quantification in logical syntactic calculi with statistical semantics building on a categorical compositional distributional approach that uses bialgebras to model generalised quantifiers.

The article by Moot proposes weighted logical syntactic proof rules integrating distributional and logical semantics and suggests ways to compare proofs by applying vector similarity measures induced from their weights; the latter are mined from proof banks.

Lambda calculus logical semantic representation is a lingua franca of logical semantics. The article by Muskens and Sadrzadeh presents possible ways for a systematic development of distributional semantics for lambda calculus models of natural language. For this purpose they adopt also lambda grammar syntax, but inessentially, and in this way they furnish proposals which are widely applicable. Their approach allows them to use dynamic logic to reason about admittance of sentences by corpora using concepts similar to those in Heim's context logic.

The squib by Morrill discusses details of logical grammar in relation to the covert movement of relativization and the overt movement of quantification.

The order of papers and a brief description of them are as follows:

1. Bankova et al: entailment in distributional semantics using density matrices,
2. Gijs Wijnholds: scope ambiguity in compositional distributional semantics,
3. Richard Moot: weighted proof rules for distributional + logical semantics,
4. Reinhard Muskens and Mehrnoosh Sadrzadeh: vector semantics for lambda calculus and its logic,
5. Glyn Morrill: a note on movement in logical grammar.