The Quantified Argument Calculus: Recent Developments

Organizer: Hanoch Ben-Yami (Central European University, Budapest)
Participants: Norbert Gratzl (MCMP), Ran Lanzet (Tel Aviv University), Edi Pavlović (Central European University)

Abstract:

The Quantified Argument Calculus (Quarc) is a recently developed powerful formal system, closer in syntax and semantics to Natural Language than is the Predicate Calculus. Investigations into its formal properties and its application to the study of Natural Language and various metaphysical and other philosophical questions have been published or are being conducted. The symposium presents these investigations. It will contain a concise introduction of Quarc and its basic applications; application to modal logic and invalidity of Barcan formulas; development of a Quarc sequent calculus; development of a three-valued version with defining clauses; soundness and completeness results; further directions.

Titles and Abstracts of the talks

1.
Hanoch Ben-Yami: The Quantified Argument Calculus: Introduction and Application to Modality
I first introduce the Quantified Argument Calculus (Quarc). Its basic departure from standard first-order Predicate Calculus is in its treatment of quantification: quantifiers join one-place predicates and together they form a quantified noun phrase. E.g., Some Students are Polite is formalised P(S). (However, in Quarc arguments are written to the left of the predicate, (S)P.) I then introduce other features of Quarc, e.g. negation, distinguishing between sentential and predication negation, ¬((S)P) versus (S)¬P. The basics of a natural deduction proof system are next introduced. I conclude by extending Quarc to modal formulas and showing the invalidity of the Barcan formulas.

2.
Norbert Gratzl, Edi Pavlović: Proof-Theoretic Analysis of the Quantified Argument Calculus
We investigate the proof theory of Quarc as developed in (Ben-Yami 2014). Ben-Yami used natural deduction; we, however, use a sequent calculus presentation, which allows for proofs of many meta-theoretic results with minor modifications to Gentzen's original LK framework. We divide Quarc into several subsystems, containing progressively larger parts of full Quarc, and investigate their properties, before combining them into the system LK-Quarc, which is shown to be deductively equivalent to Quarc. LK-Quarc, and therefore Quarc, are shown to enjoy cut elimination and its corollaries (including subformula property and thus consistency). We discuss some further uses and applications of LK-Quarc.

3.
Ran Lanzet: A Three-Valued Quarc

I present 3-Quarc, a three-valued version of Quarc capable of straightforwardly representing defining clauses. 3-Quarc has a model-theoretic semantics and a sound and complete proof system. A nonstandard notion of interpretation is employed: 3-Quarc interpretations are not equipped with universes. This reflects the analysis of Natural Language quantification on which Quarc is based. PC results from 3-Quarc on certain semantic and syntactic restrictions, akin to simplifying assumptions. The way in which quantification is achieved in PC emerges not as a necessary feature of logic or of model-theory, but as a by-product of those restrictions.