Interdisciplinary Research in Logic

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Litteraturhuset

Abstracts

Proofs, paths and multisets

Håkon Robbestad Gylterud, Informatics

In dependent type theory, propositions are represented by types instead of formulas. Proofs of a proposition is simply a term of the corresponding type. There might be many terms of a given types, in the same way there might be many of a given proposition. For example, an existentially quantified proposition, saying there exists an object with a certain property, will have (at least) one proof for each object there is with that property.

For the logical connectives and quantifiers, it is natural to imagine different proofs. But what does it mean to have many different proofs of an equality? Or what about different proofs of elementhood in a set?

Homotopy type theory (HoTT) gives a robust answer to the first question, namely that types are spaces with paths in the space as equality proofs. HoTT, is an extension of Martin-Löf's intutionistic type theory – initiatied by Veovodsky's model of type theory into Kan-simplial sets and based on his Univalence Axiom.

By using models in HoTT, I have investigated how material set theory can be extended to answer the second question. A first approximation might be stated that with proof-relevent membership, sets become multisets. The axioms I found go beyond first order logic by using proof relevant equivalence as a logical connective.

The Logic and Artificial Intelligence research group

Thomas Ågotnes, Information Science and Media Studies

The Logic and AI (LAI) research group works in pure and applied formal logic, motivated by fundamental problems in Artificial Intelligence (AI). The LAI group currently consists of six permanent staff, one postdoc and four PhD students. Our research overlaps with both philosophical, mathematical and computational logic. We are particularly interested in logics of agency and multi-agent interaction. In addition to logics of notions related to agency such as action, ability, intentions, goals and preferences, knowledge and belief, obligations and permissions, we are very interested in the intersection between logic and models of interaction from the social sciences such as game theory, social choice and social network analysis. Key areas we work in include modal logic in general; dynamic logic; temporal logic; epistemic logic; logics of agency; deontic logic; normative and ethical reasoning; action logic; game logic; formal argumentation; judgment aggregation and belief merging. In the talk I will present the LAI group, with some recent examples of my own work in some of these areas.

Logic of sentential predicates

Michal Walicki, Informatics

Paradoxes involve almost invariably a form of self-reference, which arises also in attempts to define some fundamental notions like truth. Self-reference appears in the same form in semantic, intensional or modal paradoxes, and our formalization, based on directed graphs, provides a common perspective on such appearances, treated traditionally by distinct means. Classical semantics arises as a special case, for which, in case of FOL, complete reasoning is obtained by adding (cut) to the system complete for the paraconsistent logic.

The Philosophy of Logical Practice

Ben Martin, Philosophy

While we now have an increasingly detailed understanding of the varied goals and methods which constitute the sciences and mathematics, our understanding of logic as a research area lags behind. A significant reason for this deficiency is that, unlike in the philosophy of science and mathematics, philosophers of logic have yet to embrace a *practice-based approach* to their field, re-orientating their attention towards logic as it is actually practiced by logicians. In this talk I'll outline how contemporary philosophy of logic is making many of the same mistakes that both the philosophy of science and mathematics have in the past, and make the case for a new area of research, the *Philosophy of Logical Practice*, to sit alongside traditional philosophy of logic.

Diagrammatic Specifications and Logics

Uwe Egbert Wolter, Informatics

Reflecting the experiences of our efforts concerning a theoretical foundation of Model Driven Software Engineering I present the idea of Diagrammatic Specifications and outline how to define arbitrary first-order statements to be used in those specifications.

I sketch Category Theory as an example of a Diagrammatic Specification Technique and discuss objectives and challenges for the development of diagrammatic deduction calculi.

Detecting Bots with Modal Logic

Mina Young Pedersen, Information Science and Media Studies

Logics for social networks is an emerging field in the intersection of formal logic and social network analysis. Work in this field often involves formalizing social relationships in terms of relations on a modal logic Kripke frame and using tools from various logics to reason about agents' knowledge, characteristics and access to information. This talk aims to give a high-level understanding of logics for social networks for logic-interested researchers across disciplines. As an example of relevant work, I will present an ongoing project on using a temporal logic to detect bots on social media platforms.

Boolean operations and context specifications in formal grammars

Mikhail Barash, Informatics

Context-free grammars have been a model for defining syntax of various kinds of languages since the early days of computer science and they found their foremost application in specifying programming languages. However, their expressive power turned out to be insufficient to express many useful constructs, such as cross-reference, which reduces their applicability. I will be presenting my work which attempts to implement N. Chomsky's idea (1959) of a phrase-structure rule applicable in a context and introduces an extension of context-free grammars equipped with operators for referring to left and right contexts of the substring being defined. In this model, a rule, for example, $A \to a \& \lhd B \& \rhd C$ defines a symbol a, as long as it is preceded by a string defined by B and followed by a string defined by C.The conjunction operator in this example is taken from conjunctive grammars (A. Okhotin, Conjunctive grammars, J. Autom., Lang. Comb., 2001), which are an extension of ordinary context-free grammars that maintains most of their practical properties, including many parsing algorithms.

The work I will present gives a definition of grammars with contexts by logical deduction (à la W.C. Rounds's "LFP - A Logic for Linguistic Descriptions and an Analysis of its Complexity", Comput. Linguistics, 1988), and establishes some basic properties of the model, including a cubic-time general parsing algorithm. A variety of examples of grammars with contexts is constructed, including grammars for defining anaphoric constructions in natural languages and reflexive possessive pronouns in Swedish. The most extensive example specifies completely the syntax and static semantics of a simple typed programming language.

MaGIC and Relevance

Tore Fjetland Øgaard, Philosophy

Although a quite old program – the last major update dates back to 1995 – MaGIC (short for Matrix Generator for Implication Connectives) is still a superb tool for investigating non-classical logics. In my talk I will give a hands-on introduction to MaGIC. The first part will focus on MaGIC itself, whereas the second part will show forth some problems that I've worked on for which MaGIC has proven to be an invaluable instrument.