Schedule – Dutch Logic PhD Day 2023

10:00 - 10:30 RECEPTION/COFFEE

10:30 - 11:15 Keynote Speaker - **Herman Geuvers**: *Truth Table Natural Deduction*

11:15 - 12:30 Talks

***Søren Brinck Knudstorp****: Logics of Truthmaker Semantics: Comparison, Compactness and Decidability (long)*

***Josephine Dik****: Disambiguating permissions: A contribution from Mimamsa (short)*

***J.D. Top****: Towards an epistemic logic with Theory of Mind limitations (long)*

12:30 - 13:30 LUNCH

13:30 - 14:30 Talks

***Ruben Mud****: Betweenness in Enriched Categories (long)*

***Andrea De Domenico****: How to translate from display to labelled calculi (short)*

***Anton Chernev****: A dual adjunction between Ω-automata and Wilke algebras (short)*

14:30 - 15:00 COFFEE BREAK

15:00 - 16:15 Talks

***Flavia Naehrlich****: Homogeneity effects in natural language semantics (long)*

***Aleksi Anttila****: Further remarks on the "non-semantic" nature of the dual negation (short)*

***Rodrigo Nicolau Almeida****: Structural Completeness in (Bi)Intuitionistic Rule Systems (short)*

***Celestine P. Lawrence****: The nature of Boolean logic in a system of absolute value equations (short)*

16:15 - 16:45 COFFEE BREAK

16:45 - 17:30 Keynote Speaker - **Natasha Alechina:** *Reasoning about responsibility*

17:30 – 18:30 DRINKS

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KEYNOTE SPEAKERS

**Herman Geuvers**: Truth Table Natural Deduction

*(This is based on joint work with Tonny Hurkens.)*

*In classical logic, the propositional connectives can be explained in terms of truth tables, that fix the semantics of a connective. The deduction rules, that formalize the rules for reasoning with a connective, are derived from that and can be shown to be sound and complete with respect to the truth table interpretation. In intuitionistic logic, the propositional connectives are explained directly by saying what a proof of a formula involving such a connective looks like.*

*Proof theory studies the system of deduction rules itself, and it goes back to Gentzen and Prawitz. Among other things, it studies operations on deductions, like "detour elimination" and "permutation conversion" to obtain deductions that satisfy the so-called "subformula property".*

*In the talk we will present a generic approach to propositional connectives (both classical and intuitionistic) by showing how one can derive classical and intuitionistic natural deduction rules for a*

*connective from its ruth table definition. Some of the advantages of this approach are:*

*\* generic rules for classical connectives and for intuitionistic propositional connectives.*

*\* generic soundness and completeness results with respect to truth table semantics (classical) and Kripke semantics (intuitionistic)*

*\* gives also rules for "new" connectives, like "most", "if-then-else", "nand".*

*\* self-contained rules for the connectives (so, e.g. the classical implication is not explained in terms of negation, but has its own classical rules)*

*\* general proof theory (for all connectives at once) studying "detour elimination" and "permutation conversion" and proof normalization.*

*To study these notions, we have given a "proof-term" interpretation of natural deductions, where a derivation is interpreted as a term and detour elimination and permutation conversion become term reductions. We will indicate how this works. We will also discuss the extension to predicate logic, which is work in progressd.*

**Natasha Alechina**: Reasoning about responsibility

*How can we formalise the notion of "this group of agents is responsible for X"? I will talk about approaches using causal models, strategy logics, and logics containing probability operators. In the latter case, X may be a statement about the probability of some outcome (e.g. being responsible for the unacceptably high risk of some outcome). This is joint work with Maksim Gladyshev and other colleagues in Utrecht and elsewhere.*

ABSTRACTS OF TALKS

**Søren Brinck Knudstorp**: Logics of Truthmaker Semantics: Comparison, Compactness and Decidability

*In recent years, there has been a growing interest in truthmaker semantics as a framework for understanding a range of phenomena in philosophy and linguistics. Despite this interest, there has been limited study of the various logics that arise from the semantics. In this talk, I aim to address this gap by exploring numerous ‘truthmaker logics’ and proving their compactness and decidability. This is in continuation with the inquiry of Fine and Jago (2019), who proved compactness and decidability for a particular kind of truthmaker logic.*

*The key results going into this are (1) ‘standard translations’ into first-order logic; (2) a truthmaker analogue of the finite model property; and (3) a proof showing that truthmaker consequence on semilattices coincides with truthmaker consequence on complete lattices.*

*Finally, the connection with modal logic is examined. Specifically, it is illustrated how endowing truthmaker semantics with classical negation results in modal information logics.*

**Josephine Dik**: Disambiguating permissions: A contribution from Mimamsa

*The notion of permission has received less attention than obligation from the deontic logic community, that has often taken for granted the interdefinability of deontic operators (obligations, prohibitions and permissions). Yet, permission has proven to be a complex topic with various nuances that require careful treatment, and can lead to unwanted consequences if the interdefinability is kept. By contrast, the Sanskrit philosophical school of Mimamsa refuted such interdefinability and defined deontic concepts independently of each other. In this article, we present the notion of permission in Mimamsa and its formalization (Hilbert axioms and semantics). We also compare the Mimamsa approach to contemporary deontic logic discussions, and show that the central paradoxes of permission do not arise in the Mimamsa paradigm.*

**J.D. Top**: Towards an epistemic logic with Theory of Mind limitations

*Epistemic logic is the logic of knowledge, and is used to reason about statements such as ‘I know that you know that I know’. In this logic, and its extensions, it is commonly assumed that agents can reason about epistemic statements of arbitrary nesting depth. In contrast, empirical findings on Theory of Mind, the ability to (recursively) reason about mental states of others, show that human recursive reasoning capability has an upper bound.*

*Our research is a work-in-progress where we try to resolve this disparity by proposing some elements of a logic of bounded Theory of Mind, built on Public Announcement Logic. We propose a method for determining which formulas an agent can understand given her Theory of Mind level, and how such agents update their knowledge in response to announcements that go beyond their Theory of Mind capability.*

*In previous research, we have used this logic to model the decisions of participants playing an epistemic game called ‘Aces and Eights’ in a prior experiment. We found that some participant decisions can be explained using our logic.*

**Ruben Mud**: Betweenness in Enriched Categories

*The idea that a point can be between two other points is prevalent throughout mathematics. Commonly this is modelled with a ternary relation called a betweenness relation. There are many examples of betweenness relations in geometry, metric spaces and topology. By making a minor adjustment in the axiomatization, we can define a betweenness relation in an arbitrary enriched category whose underlying category satisfies the Cantor-Bernstein-Schröder theorem. Conversely, it turns out that any set with a betweenness relation yields an enriched category. We conjecture that the category of betweenness spaces is a reflexive subcategory of the category of enriched categories equipped with a suitable notion of morphism.*

**Andrea De Domenico**: How to translate from display to labelled calculi

*I introduce a labelled sequent calculus for a wide class of non-distributive logics known as LE-logics, where the labels are atomic formulas of a first-order language which is interpreted on the canonical extensions of the algebras in their corresponding varieties. More interestingly, I will show how to translate between this calculus and an already-existing display calculus for the same class of logics (and vice versa). Hopefully, this endeavour will shed some light on the similarities between the two proof-theoretic frameworks.*

**Anton Chernev**: A dual adjunction between Ω-automata and Wilke algebras

*The notion of ω-regular language captures the idea of a regular language that consists of infinite words. The most standard type of automata for ω-regular languages are called Büchi automata. Runs in a Büchi automaton are infinite since the words are infinite.*

*Ω-automata are another type of automata for ω-regular languages. Instead of infinite words, they read pairs of finite words, called lassos, that represent ultimately periodic words. Due to the fact that ω-regular languages are determined by their ultimately periodic fragments, Ω-automata can be associated with ω-regular languages. In terms of structure, they resemble pairs of DFAs, and as a result they can be modelled as coalgebras.*

*We study the categorical relationship between Ω-automata and Wilke algebras – the latter are algebraic structures recognising ω-regular languages. We present a chain of adjunctions starting from the category of Ω-automata without initial states and ending with the dual of the category of quotients of the free Wilke algebra. As key ingredients, we determine how the Ω-automata properties circularity and coherence change under transition reversal and we propose novel transformations between Ω-automata and Wilke algebras.*

*This is joint work with Helle Hvid Hansen (University of Groningen) and Clemens Kupke (University of Strathclyde).*

**Flavia Naehrlich**: Homogeneity effects in natural language semantics

*Compositional views of natural language semantics assume that the meaning of complex expressions is derived from the meaning of its parts. Combining the parts that constitute a sentence gives rise to its truth conditions that represent the meaning of a sentence. Standard compositional accounts are based on classical logic. As a consequence, they adopt the tertium non datur principle which states that a sentence can always be evaluated as either true or false.*

*Homogeneity is a pervasive feature of natural languages that challenges this traditional view. The phenomenon occurs in a multitude of constructions (e.g. generics, mereological complex objects, conjunctions) but was first discovered and has been repeatedly studied in sentences with plural definites descriptions such as (1) ""The books are written in Dutch."". (1) is true if all of the books are written in Dutch and false if none of them are but neiter true nor false in mixed contexts. However, sentences with plural definites can have non-maximal interpretations, e.g.(2) ""The townspeople are asleep."" is true even if `a few insomniacs are puttering around their houses'.*

*My talk will briefly present the most recent accounts on this phenomenon and highlight their pros and cons.*

**Aleksi Anttila**: Further remarks on the "non-semantic" nature of the dual negation

*The dual negation of dependence logic does not correspond to any well-defined semantic operation: the class of models of a sentence does not determine the class of models of its dual negation. It has further been shown that this lack of determination is extreme in the sense that for any pair of contradictory sentences A and B, there is a sentence which is equivalent to A, and whose dual negation is equivalent to B. So given only the class of models X of a sentence, all we know of the class of models Y of its negation is that Y is the class of models of some sentence of dependence logic, and that X and Y share no models. Dependence logic employs first-order team semantics: formulas are evaluated with respect to sets of first-order assignments called teams. It is also downward-closed: if a formula is true in team T, it is also true in all subteams of T. We show that an analogue of the negation result holds in various logics which employ propositional/modal team semantics and logics which are not downward closed if the notion of contradictoriness is adjusted in a suitable way.*

**Rodrigo Nicolau Almeida**: Structural Completeness in (Bi)Intuitionistic Rule Systems

*In this talk, I will discuss the overall algebraic, topological and model theoretic approach to rule systems, through a case study of structural completeness. For our purposes, a rule system is a consequence relation over the set of formulas of a given language, with the property that it is closed under substitution. A given rule \Gamma/\phi is said to be admissible over a rule system if whenever we can prove \Gamma we can also prove \phi; it is said to be derivable if \Gamma derives \phi. A rule system is said to be structurally complete if all of its admissible rules are also derivable.*

*The aim is to give an introduction to these kinds of problems, and invite collaboration from different fields of study. This is done by framing both classic results, relating structural completeness to a description of the so-called weakly projective algebras, and analysis focused on duality theory, which highlight the role of geometric intuition in the study of logic. I will also report on some ongoing work aimed at studying the interaction of such properties as structural completeness in different logical frameworks, such as modal intuitionistic, bi-intuitionistic and modal systems.*

**Celestine P. Lawrence**: The nature of Boolean logic in a system of absolute value equations

*A system of absolute value equations defines the equilibrium-point functionality of nonlinear dynamical systems, with a nonlinearity that is approximated by a piecewise linear function, as often found in electronic networks (with diodes or memristors) and recurrent neural networks (with rectified linear units). Here, we study the nature of Boolean logic arising in a 2-dimensional system of absolute value equations, provide working examples of 12 (out of 16 possible) 2-input Boolean logic gates and prove that the XOR, XNOR, AND, and NAND gates are unrealizable. This unrealizability is of a fundamentally different nature than the unrealizability of just the XOR and XNOR gates by linear classifiers. Thus, it defines a fundamentally new classification of Boolean functions and it is an open question if there are other fundamental classifications of Boolean functions defined by their realizability on non-trivial systems of equations arising from mathematical models of physical systems.*