Saturday

Session 1: Logic and Computer Science

Equality in Type Theory - key concepts behind Homotopy Type Theory

9:15am
Saturday

Stéphane Graham-Lengrand
CNRS

Type theory is a family of logical systems with computer-friendly features. Some of the most expressive systems have therefore been implemented in the form of proof assistant software such as Coq, Agda, Matita, Lean, etc, where developing mathematical proofs is akin to programming. Mathematical objects are typed, and in the modern view of type theory, proofs themselves are considered as mathematical objects on a par with e.g. functions and integers. Proofs can be quantified over, and equalities between proofs stated. For instance, we will see that a proof that A implies B is a (total) function from A to B. Proofs of equalities, however, have not connected so well with familiar programming concepts. Indeed, generalising to rich type theories the understanding of equality that we have, based on reflexivity and Leibniz's principle, is often counter-intuitive. I will show, with a live Coq demonstration, some of the main questions about equality proofs, such as properties J and K and the John Major equality. Finally, I will explain how homotopy theory has shed light on these questions, opening up one of the most 'in vogue' area of research in the field, Homotopy Type Theory.

Decision theory with resource-bounded agents

10:00am
Saturday

Joe Halpern
Cornell

There have been two major lines of research aimed at capturing resource-bounded players in game theory. The first, initiated by Rubinstein, charges an agent for doing costly computation; the second, initiated by Neyman does not charge for computation, but limits the computation that agents can do, typically by modeling agents as finite automata. We review recent work on applying both approaches in the context of decision theory. For the first approach, we take the objects of choice in a decision problem to be Turing machines, and charge players for the "complexity" of the Turing machine chosen (e.g., its running time). This approach can be used to explain well-known phenomena like first-impression-matters biases (i.e., people tend to put more weight on evidence they hear early on) and belief polarization (two people with different prior beliefs, hearing the same evidence, can end up with diametrically opposed conclusions) as the outcomes of quite rational decisions. For the second approach, we model people as finite automata, and provide a simple algorithm that, on a problem that captures a number of settings of interest, provably performs optimally as the number of states in the automaton increases. Perhaps more importantly, it seems to capture a number of features of human behavior, as observed in experiments.

This is joint work with Rafael Pass and Lior Seeman. No previous background is assumed.

Infinitary formulas in the theory of logic programming

10:45am
Saturday

Vladimir Lifschitz
University of Texas

The semantics of logic programs can be defined by translating rules into the language of propositional logic and then referring to the definition of a stable model of a set of propositional formulas. If a rule contains aggregates, such as calculating the sum of a set of integers, then the translation uses infinitely long conjunctions and disjunctions. Infinitary formulas play an important role in several recent publications in which formal methods are applied to logic programming.

Session 2: Logic and Physics

Back and forth between logic and relativity theory

2:15pm
Saturday

Judit Madarász
Alfréd Rényi Institute of Mathematics

We describe a fruitful interaction between logic and relativity theory. This interaction began in the Vienna Circle, and lead to an enormous development of mathematical logic. Our group in Budapest uses this powerful tool, mathematical logic, to formalize and analyze ideas and predictions of relativity. The main role of logic is to give statements unambiguous meanings. We seek also a deeper understanding of relativity itself. This work in turn led to an improvement of definability theory of first order logic: a more powerful and intuitively attracting new version of definability emerges. This is part of a convergence of ideas of many other researchers (e.g., Shelah and van Benthem). We are testing this new definability on relativity again. E.g., we can contribute to the Erlangen Program by providing a precise meaning in which Minkowskian geometry and its symmetry group, the Poincaré group, are definitionally equivalent.

The invariant content of equivalent theories

3:00pm
Saturday

Hans Halvorson
Princeton University

Scientists and philosophers frequently make claims about which theories are equivalent, and which are inequivalent. Such claims play a central role in determining which debates are genuine versus “merely semantic,” and also about whether two research programs are actually in competition with each other. What’s more, the very notion of equivalence we adopt determines to a great extent how we understand the relationship between our theories and the world.

I will discuss several explications of the notion of theoretical equivalence, and in particular one given by Clark Glymour in the 1970s, and a recent generalization thereof (called “Morita equivalence” by Barrett and Halvorson). I then explain how these criteria for equivalence bear on recent discussions in philosophy of physics and in metaphysics.

Categorically Comparing Formulations of Yang-Mills Theory

4:00pm Saturday

Sarita Rosenstock

University of California, Irvine

I'll discuss the prospect of using a category theoretic method of physical theory comparison, due to Weatherall and Halvorson, to explore various formulations of classical Yang-Mills theory and how they relate to one another. This case study reveals the richness of the method in organizing and revealing the structure of and relationships between physical theories in order to resolve philosophical questions in the foundations of physics. In particular, the category theoretic method can help determine the ontological commitments of a physical theory, and what is at stake in choosing one formalism over another.

Reasoning about Classical and Quantum Interaction

4:45pm Saturday

Sonja Smets

University of Amsterdam

In this presentation I focus on a unified logical setting which brings together the work on Dynamic Quantum Logic (DQL) [1,2] and Dynamic Epistemic Logic (DEL) [3,4,6] in order to reason about both classical and quantum information flow. DQL is used to model the non-classical behavior of quantum systems from an operational perspective, while Dynamic Epistemic Logic is used to model the epistemic states as well as the communication, observations and other informational actions of classical agents. Bringing DQL and DEL together allows us to focus on different applications in which both classical agency and quantum resources play a role. In this context, we pay specific attention to the multi-agent quantum protocols (studied in quantum information theory) in which complex situations are presented which use different types of informational dynamics (classical and quantum). The success of such quantumprotocols relies not only on the properties of quantum systems but often also on assumptions which involve classical communication and the agents' epistemic states. Hence, a pure quantum setting alone cannot fully capture, in any explicit way, all those features of both the classical and quantum information flow involved in such multi-agent quantum protocols. To fully specify these complex classical-quantum scenarios, we use the above mentioned logical framework which unites the probabilistic extensions of DQL and DEL. Besides the standard quantum properties such as non-locality and entanglement as well as the epistemic properties of classical agents, other specific features about the classical-quantum interaction refer to the epistemic effects and the ontic effects (see [5]) that result from performing observations or measurements on a quantum system, as well as to the agent's local "control" (i.e. the fact that classical agents may have only access to a part of a quantum system). I will illustrate how to model these specific features in our logical setting by using specific quantum information protocols as examples. The results in this presentation are based on joint work with A. Baltag at the University of Amsterdam.

[1] A. Baltag and S. Smets "LQP: The Dynamic Logic of Quantum Information", Mathematical Structures in Computer Science, 16(3):491-525, 2006.

[2] A. Baltag and S. Smets, "A Dynamic-Logical Perspective on Quantum Behavior", Studia Logica, 89:185-209, 2008.

[3] A. Baltag and L. S. Moss, S. Solecki. "The logic of public announcements, common knowledge, and private suspicions". In I. Gilboa, editor, Proceedings of TARK 98, pp. 43-56, 1998.

[4] A. Baltag and L. Moss, "Logics for Epistemic Programs", Synthese, 139:165-224, 2004.

[5] A. Baltag and S. Smets, "Logics of Informational Interactions", Journal of Philosophical Logic, 44(6):595-607, 2015.

[6] J. van Benthem, Logical Dynamics of Information and Interaction, Cambridge University Press, 2011.

Sunday

Session 3: Philosophical Logic

Survey of Truthmaker Semantics

9:30am
Sunday

Kit Fine
New York University

I provide an outline of truthmaker semantics and consider some of its applications.

From Knowing Correlations to Knowledge-as-Correlation

10:15am
Sunday

Alexandru Baltag
University of Amsterdam

Informationally, a question can be encoded as a variable, taking various values ("answers") in different possible worlds. If, in accordance to the recent trend towards an interrogative epistemology, "To know is to know the answer to a question" (Schaffer), then we are lead to paraphrasing the Quinean motto: To know is to know the value of a variable. There are two issues with this assertion. First, questions are never investigated in isolation: we answer questions by reducing them to other questions. This means that the proper object of knowledge is uncovering correlations between questions. To know is to know a functional dependence between variables.

Second, when talking about empirical questions/variables, the exact value/answer might not be knowable, and instead only "feasible answers" can be known: this suggests a topology on the space of possible values, in which the open neighborhoods of the actual value represent the feasible answers (knowable approximations of the actual value).

In this talk I focus mainly on the first issue. I investigate a logic of epistemic dependency, that can express knowledge of functional dependencies between (the values of) variables, as well as dynamic modalities for learning new such dependencies. This dynamics captures the widespread view of knowledge acquisition as a process of learning correlations (with the goal of eventually tracking causal relationships in the actual world).

There are interesting formal connections with Dependence Logic, van Benthem's Generalized Semantics for first order logic, as well as Inquisitive Logics, and philosophically with Situation Theory and the conception of "information-as-correlation". Time permitting, I sketch the road to formalizing the second issue (of using a topological setting to formalize dependencies between empirical questions). I argue that knowability in an empirical context amounts to the continuity of the functional correlation. To know is to know a continuous dependence between variables.

A Semantic Hierarchy for Intuitionistic Logic

11:00am
Sunday

Wesley Holliday
University of California, Berkeley

Session 4: Logic and Language

The Logic and Grammar of Prominence

2:15pm
Sunday

Una Stojnić
New York University

The growing consensus is that certain modal expressions mandate a semantics thats inherently non-propositional and a logic that invalidates certain classical patterns of inference. Consequently, alternative accounts have been proposed which advocate an understanding of an utterance's meaning as inherently dynamic, as a "context change potential" that characterizes the way in which the utterance affects the context in which it has been uttered. Moreover, the alternative semantics are non-classical, designed to invalidate the problematic inference patterns. The dynamic approach is thus presented as a competing alternative to propositional and classical accounts, one that requires a radical reconceptualization of how we should think of meaning. I argue, by contrast that the two approaches to meaning are not in tension. While modal discourse does require assigning a dynamic level of meaning, once the dynamics is captured correctly, it both preserves classical patterns of inference, and delivers, and crucially interacts with, non-trivial propositional content.

Generics and Generality

3:00pm
Sunday

Frank Veltman
University of Amsterdam

'Birds can fly', 'Birds lay eggs', 'Dutchmen are good sailors', 'Frenchmen eat horse meat, 'Boys dont cry': Sentences of the form 'P's are Q' can express all kind of things: some seem to say that Q is a universal property of the P's, some that Q is a property P's normally have, some that Q is a typical property of the P's, and some have a normative flavour.

Still, I think it is possible to give a uniform account of their logical properties, be it in a framework in which the meaning of a sentence is not equated with its truth conditions but with its (potential) impact on the intentional state of an addressee. Keywords: expectations, non-monotonic logic, coherence.

From explicit to implicit semantics...and back?

4:00pm
Sunday

Tania Rojas-Esponda
Google

Explicit machine learning approaches to semantics, such as parsing to a logical form, are often viewed as remote from implicit approaches, where no expert annotations or structures are used. How can explicit and implicit approaches inform each other? We discuss a semantic parser as an example of the explicit approach. Then we consider a next sentence prediction system that learns implicitly directly from conversation corpora. Finally, we discuss ways to use explicit approaches in order to understand and improve implicit systems.

Deep learning of interpretable gradient-symbolic representations for question-answering

4:45pm
Sunday

Paul Smolensky

Johns Hopkins University

I will review theoretical work showing how Tensor Product Representations (TPRs) can be used to compute recursive symbolic functions and perform basic inference using neural network computation over distributed vectorial representations. Then I will discuss a recent study of end-to-end deep learning of TPRs in a model performing question-answering on the Stanford Question Answering Dataset (SQuAD).
