

From Lawvere to Brandenburger-Keisler: multi-agent forms of diagonalization and self-reference

Samson Abramsky

The talk will present an analysis of the Brandenburger-Keisler ‘paradox’, showing it as a fixpoint result analogous to the Lawvere fixpoint lemma, and analyzing exactly which logical resources are needed for it.

Towards an Intuitionistic Foundation for Interactive Computation

Simon Kramer

We propose an intuitionistic foundation for interactive computation via a Curry-Howard isomorphism from interactive intuitionistic logic defined via a classical modal logic of interactive proofs. Our proposal is an interactive analog of the Gödel-Kolmogorov-Artëmov definition of intuitionistic logic as embedded into a classical modal logic of proofs, and of the Curry-Howard isomorphism between intuitionistic proofs and typed programs. That is, terms viewed as proofs are descriptions of constructive deductions, terms viewed as programs are prescriptions for computations, formulas viewed as propositions are proof goals, and formulas viewed as types are program properties. To agents, interactive proofs are message terms that induce the knowledge of their proof goal with their intended interpreters, and interactive computations are message communications between distributed interlocutors that compute that knowledge from the meaning of the communicated messages.

How to verify an epistemic protocol with dynamic epistemic logic

Jan van Eijck

Verifying an epistemic protocol involves creating a formalized version of the protocol in a suitable logical language, and next showing (i) that the steps of the protocol are in one to one correspondence with the steps in its formalized version, (ii) that the formalized version satisfies certain correctness conditions, and (iii) hence, that the original version also satisfies these conditions. We will show that DEL is a suitable medium for carrying out this program for an interesting example protocol.

Formal Logic as a Methodology for Communicating Mathematics

N. Raja

Formal logic has for long been believed to be an impractical means for communicating mathematics. We reexamine such beliefs in the backdrop provided by recent advances in the field of ‘Interactive Proof Checking’ with the associated development of powerful tools such as ‘Proof Assistants’.

The role of communication in games of imperfect information

Sunil Simon

The standard presentation of multi-player imperfect information games involve specifying players' uncertainty relation along with the game structure. The uncertainty relation however need not reflect any structural property of the game itself. It follows from the celebrated result of Peterson and Reif (1979) that in such a setting for zero sum games, the question of determining the "winner" is in general undecidable. The crucial element which yields undecidability is the fact that players are not allowed to communicate with each other. We propose a framework to model games of imperfect information where communication is explicitly represented. Here a player's information partition is generated in a structural manner rather than being presented as part of the game formalism. We analyse how restricting modes of communication influence the various algorithmic question of interest in the case of both zero sum and non zero sum games.

Doxastic Attitudes and Group Communication

A. Baltag

The way a listener will revise her beliefs after hearing an announcement depends on the listener's doxastic attitude towards the speaker (i.e. her opinion about the reliability of information coming from this particular source). I present a dynamic-epistemic logic that makes explicit such doxastic attitudes: for each pair (i, j) of agents, we are given a doxastic transformation $\tau_{\{i,j\}}$, that describes the way listener j will change her beliefs when hearing a statement announced by speaker i . This gives us a graph of doxastic attitudes, describing the agent's trust (or distrust) towards each others' announcements. I analyze the notion of "sincerity" in this setting, showing that it can be formalized in general in terms of fixed points of such doxastic transformations. I also analyze the "persuasiveness" of a communication act, showing there is a tension between the need for persuasiveness and the need for sincerity: to be persuasive, one often needs to go beyond what is known. This gives us a way to distinguish various types of lies: half-lies, "sincere exaggerations" etc. Next, I consider the issue of the revision of doxastic attitudes: due to various things (including inconsistencies!), one may have to revise one's doxastic attitude towards a speaker. Essentially, this means revising one's own belief-revision method! To pre-encode this higher-level revision, we need to extend the above setting, considering sequences (τ, τ', \dots) of doxastic attitudes for each pair (i,j) of agents. I apply this to various Moore sentences and to the Surprise Examination paradox.

Merging beliefs by sincere persuasive communication

Sonja Smets

This talk is based on my recent joint work with Alexandru Baltag in which we investigate the issue of reaching doxastic agreement among the agents of a group by ζ sharing ζ information via successive acts of sincere, persuasive public communication within the group. The topic relates to

"preference aggregation" in Social Choice theory, where the problem is to find a natural and fair γ merge γ operation (subject to various naturalness or fairness conditions), for aggregating the agents' preferences into a single group preference. Our proposal is a more γ dynamic γ approach to this issue. We study the topic within a doxastic/epistemic setting, interpreting the agents' preference relations as γ doxastic preferences γ or γ doxastic plausibility γ orders. Dynamically speaking, γ merging γ preference relations means finding a prescribed sequence of announcements and speakers (a protocol) that, when applied to any arbitrary multi-agent preference model, produces a new model in which all the agents' preference relations are the same. The announcements induce successive belief revision in the listeners, depending on the doxastic attitude that they have towards the speakers (their opinions concerning the reliability of the information coming from these sources). When the new relations are the result of a specific merge operation, we say that we have γ realized γ this operation via the given communication protocol. One would then like to know what types of merges are realizable when we are given all the agents' initial doxastic attitudes towards each other. We give some answers in this respect, as well as some open questions.

The perils of talking too much

Natasha Alechina

The talk attempts to give a formal modal of a well-known phenomenon of failing to communicate or process information due to having to process too many messages.

Group Announcement Logic

Thomas Ågotnes

Group announcement logic (GAL) is an extension of public announcement logic with constructs (well known from coalition logic) of the form $\langle G \rangle \phi$, where G is a group of agents. In GAL, the meaning of $\langle G \rangle \phi$ is that there exists an announcement that the members of G can jointly and truthfully make, and after that announcement is made public ϕ will be true. GAL can be seen as a variant of arbitrary public announcement logic (APAL), where the quantification is restricted to formulae actually known by the members of G . I will discuss how GAL can be used to express properties such as "there is a sequence of truthful public announcements by agents in G , after which ϕ is true", and the distinction between "agent i knows *that* ϕ can be achieved by a public announcement" and "agent i knows *how* ϕ can be achieved by a public announcement". Depending on the available time, I will also discuss axiomatisation, expressivity and the complexity of the model checking problem. The talk is based on joint work with Philippe Balbiani, Hans van Ditmarsch and Pablo Seban.

Public announcement games

Hans van Ditmarsch

In public announcement logic we can precisely describe what the consequences are of informative actions. Announcements of the form that the agent knows a proposition can be seen as announced by that agent. But before she has made that announcement, there may be different announcements that she could have chosen to make. In this paper we discuss what rational agents should do if they can choose between different actions. We consider situations where each agent has a goal formula that she would like to become true, and where the available actions are public announcements. What will each agent announce, assuming common knowledge of the situation? The truth of the goal formula after the agent's announcement depends on the announcements made by other agents, hence we have a game theoretic scenario. We discuss possible solutions of such public announcement games.

Representation of communication in language and its consequences

Arie Verhagen

We use language to coordinate our contributions to joint projects, but language use is also itself a joint activity (Clark 1996). Several grammatical constructions exhibit structural and functional features that are best explained as a consequence of the fact that they are dedicated to managing intersubjective coordination in communication (Verhagen 2007). I will illustrate this by means of certain combinatorial properties of sentential negation in discourse. The special role of sentential negation for managing communication provides a basis for explaining why *litotes* double negation (as in *X is not impossible*) is more coherent in a certain kind of discourse context than its non-negated counterpart (*X is possible*), despite their apparent descriptive (and sometimes logical) equivalence. Evidence includes a study of event related brain potentials (ERPs).

Clark, Herbert H. (1996). *Using Language*. Cambridge: Cambridge University Press.

Verhagen, Arie (2007). *Constructions of Intersubjectivity. Discourse, Syntax, and Cognition*. Oxford: Oxford University Press [2nd ed.; 1st ed. 2005].

A theory of interfaces

Sophie Pinchnat

Rule-following, Meaning and Coordination

Giacomo Sillari

In this talk, I seek to establish a link between Wittgenstein's *Philosophical Investigations* and the more recent philosophical literature infused with formal techniques. As a case in point, I suggest that there are correspondences between Wittgenstein's analysis of rule-following and David Lewis's seminal game-theoretic account of convention. In the context of philosophy of language, I

will expand on the parallel between Wittgenstein's famous builder-assistant language-game and Lewis's seminal notion of signaling games.

The Toulmin Argument Model in Artificial Intelligence. Or: How Semi-Formal, Defeasible Argumentation Schemes Creep into Logic

Bart Verheij

Argumentation Theory and Modal Logic

Davide Grossi

Abstract: I will briefly introduce the field of abstract argumentation theory and present a formalization of some fragments of the theory in modal logic. I will show how a number of key notions in argumentation theory can obtain a natural formulation within appropriate modal languages. This opens up the possibility to directly import results and techniques from modal logic to argumentation theory. As examples of such application we will present proof procedures based on semantic games (e.g., model-checking games). Also, by resorting to the notion of bisimulation, we will address the question of when two argumentations can be considered to be "the same".

Communication in Petri nets

Kamal Lodaya

Modelling Intentions and Agency in Dynamic Epistemic Logic

Ben Rodenhäuser

We observe that Dynamic Epistemic Logic (DEL) in its current form lacks a comprehensive analysis of the concept of an action. DEL plays out its strength in modelling the effects epistemic events have on the information states of agents. However, the way in which an action originates in an agent's mental state has not received sufficient attention. Put differently, no formal DEL correlate to the notion of "someone doing something based on a mental state" is available. We argue for the usefulness of having such a notion to analyze, explain and understand intelligent interaction and present first steps towards a minimalist theory of knowledge, intention, and action.

PDL for procedural changes

Yanjing Wang

In this talk, we report the ongoing work on Propositional Dynamic Logic with so-called ζ future-shaping modalities ζ , which constrain the possible (sequences of) actions in the future. The introduction of the new modalities is motivated by the analysis of epistemic protocols, where the meta knowledge of the protocol itself is crucial. The new logic can be regarded as an extension to Dynamic Epistemic Logic disguised in PDL format. We will demonstrate the use of our logic by some examples, if time permits.

A dynamic logic of knowledge and access

Eric Pacuit

A recurring issue in any formal model representing agents' (changing) informational attitudes is how to account for the fact that the agents are *limited* in their access to the available inference steps, possible observations and available messages. This may be because the agents are not logically omniscient and so do not have unlimited reasoning ability. But it can also be because the agents are following a predefined *protocol* that explicitly limits statements available for observation and/or communication. Within the broad literature on epistemic logic, there are a variety of accounts that make precise a notion of an agent's "limited access" (for example, *Awareness Logics*, *Justification Logics*, and *Inference Logics*). This paper interprets the agents' *access set* of formulas as a constraint on the agents' information gathering process limiting which formulas can be observed.

(Joint work with Tomohiro Hoshi.)