PACM$\wedge$N
PROGRAMME & ABSTRACTS

VERONA, 20–22 MARCH 2024

TIMETABLE

Wednesday 20		Thursday 21		Friday 22	
9:45	—*welcome*—	09:30	M. Baaz	09:30	P. Baroni & M. Giacomin
10:00	H. Herbelin	10:20	E. Orlandelli	10:30	C. Proietti
10:50	—*break*—	11:00	—*break*—	11:10	—*break*—
11:20	M. Palazzo & L. Roversi	11:30	M. Cristani	11:40	E. Pavlovic
12:00	M. Calosci	12:10	F.A. D'Asaro	12:30	A. Ragot
12:40	—*lunch break*—	12:50	—*lunch break*—	13:00	—*lunch break*—
14:45	T. Studer	14:45	S. Negri	14:45	H. Schwichtenberg
15:25	E. La Rosa	15:35	S. Niki	15:35	I. Petrakis
16:05	—*break*—	16:15	—*break*—	16:15	—*break*—
16:35	C. Perini Brogi	16:45	H. Ishihara	16:45	N. Koepp
17:15	M. Tesi	17:35	—*closure*—	17:25	G. Manara
17:55	—*closure*—			17:55	—*farewell*—
		20:00	—*social dinner*—		

ABSTRACTS

Quantifier shifts.

Matthias Baaz (Vienna University of Technology).

Abstract. Quantifier shifts are one of the oldest deduction methods. The position of quantifiers obtainable by quantifier shifts has considerable influence on the complexity of proofs. A calculus for quantifier shifts is developed. Furthermore, for nonclassical logics it is shown that the presence of all classical quantifier shifts corresponds to the admissability of standard Skolemization.

An introduction to computational argumentation.

Pietro Baroni & Massimiliano Giacomin (University of Brescia).

Abstract. The talk aims at providing an introduction to computational argumentation, an interdisciplinary research field whose main goals are the study of formal models of argumentative processes and the development of software applications based on these models. Broadly speaking, computational argumentation aims to support knowledge representation and automated reasoning in a variety of contexts, characterized by the presence of uncertain, incomplete and typically conflicting information. These range from legal controversies to medical reasoning and from e-democracy to scientific debates, just to give some examples. The talk will illustrate the main aspects of computational argumentation, including argument construction, identification of conflicts between arguments, and the assessment of argument acceptability. A special emphasis will be devoted to the theory of abstract argumentation frameworks and their semantics: a simple, yet powerful, formalism to assess the acceptability of arguments based on the attacks between them.

Universal algebra in UniMath.

Matteo Calosci (University of Florence).

Abstract. Presentation of a library for Universal Algebra in the UniMath framework by M.C., G. Amato, M. Maggesi and C.P. Brogi. Our work deals with multi-sorted signatures, their algebras, and the basics for equation systems. We show how to implement term algebras over a signature without resorting to general inductive constructions (currently not allowed in UniMath) still retaining the computational nature of the definition. We prove that our single sorted ground term algebras are instances of homotopy W-types. From this perspective, the library enriches UniMath with a computationally well-behaved implementation of a class of W-types. Moreover, we give neat constructions of the univalent categories of algebras and equational algebras by using the formalism of displayed categories, and show that the term algebra over a signature is the initial object of the category of algebras. Finally, we showcase the computational relevance of our work by sketching some basic examples from algebra and propositional logic.

Strength and Robustness of Arguments in Defeasible Logic.

Matteo Cristani (University of Verona).

Abstract. In argumentation theory, there is a long stream of attempts to describe (often not in a formal fashion) the ability of an argument to prove a given thesis in terms of its *strength*, sometimes called also *robustness*. These two terms have also been employed within the conceptualization of the notion of fallacy, for instance by Hintikka, and often counterargued as in Woods referential study "The concept of fallacy is empty". The hope of these formulations was to devise correctly the idea that something *has a better support* than its opposite. In this presentation I will show that, when accommodating the idea of argumentation within Defeasible Logic, we have the opportunity to identify in a formal way the above idea. In particular we show that strength and robustness are two slightly and subtly different concepts that have to do with support and counterargument in a different way. The resulting theoretical framework is shown to be able to identify fallacies (provided that these have specific reliable meaning, that I support only partially) as *fragile and weak* arguments on a given thesis, while we also provide some meaning to other similar informal notions in argumentation theory such as *ideological falsum* (popularly known as fake news), *open lies* (hoaxes), or *tortuous arguments* (conspiracy theories).

(Inductive) Logic Programming for Explainable AI.

Fabio Aurelio D'Asaro (University of Verona).

Abstract. In my talk, I will present some recent research in Explainable Artificial Intelligence (XAI) and some novel application of Inductive Learning of Answer Set Programs (ILASP) I have recently carried out in three main areas. The talk will be organized into three main sections, each focusing on a distinct line of research: (i) Event Calculus and its applications towards constructing transparent support to decision making, (ii) ILASP for explaining preference learning systems, (iii) ILASP in the context of learning Abstract Argumentation Frameworks. Abstract Argumentation Frameworks (AFs) are a powerful approach to reasoning about conflicting information. In this section, we will glimpse at the use of ILASP to learn AFs semantics. Remarks on challenges and future research directions in this rapidly evolving field will conclude the talk.

Proofs as programs and refutations as evaluation contexts.

Hugo Herbelin (Inria - IRIF).

Abstract. We will present an interpretation of sequent calculus proofs as interactions between a program and its evaluation context, then introduce a notion of positive/negative polarity and connect sequent calculus proofs with adjunctions.

Constructive uniform spaces.

Hajime Ishihara (Toho University).

Abstract. We give a definition of a uniform space with the spirit of Sambin's notion of a basic pair, and construct a completion of a uniform space and a product of uniform spaces. Then we show some natural properties of the completion and the product.

Strong Negation in TCF.

Nils Koepp (LMU Munich).

Abstract. We introduce strong negation in the theory of computable functionals TCF, a common extension of Plotkin's PCF and Goedel's system T, by defining simultaneous-recursively strong negation A^N, P^N of formulas A and predicates P. As a special case of the latter, strong negation of an inductive predicate is given by a coinductive predicate (and vice versa). We may prove $A^N \to \neg A$, where $\neg A = A \to \bot$ is weak negation, as well as appropriate versions of EFQ and DNE, which justifies the name. Some properties usually exhibited by other negation schemas fail e.g., in general we have neither $A \to A^{NN}$ nor $(A \to B) \to B^N \to A^N$. Finally, we present some examples, revealing the naturality of our definition.

Epsilon Modal Logics.

Elio La Rosa (LMU Munich - MCMP, University of Vienna - IVC).

Abstract. In this talk, I present a new class of Modal logics structurally analogous to Hilbert's Epsilon Calculus, and based on new 'epsilon modalities'. These are connectives indexed by formulas selecting a world-witness satisfying their index (if any) through an arbitrary choice function. The obtained 'Epsilon Modal logics' are conservative over a language with standard modalities, and generalise many properties of Epsilon Calculus at the propositional level. Remarkably, the two systems are proven mutually embeddable. This correspondence carries over to applications. Epsilon terms have been interpreted as indefinite descriptions in linguistics, 'ideal objects' of mathematical properties in Hilbert's Program, and used to define 'theoretical terms' of scientific theories explicitly over their own laws by Carnap. On intensional grounds, epsilon modalities can be read as indefinite description of states, 'ideal worlds' abstracting over mathematical structures, and used to explicitly define 'theoretical contexts' of scientific theories respectively.

On non commutative logic and process calculi.

Giulia Manara (Paris Cité University, Roma Tre University), joint work with Matteo Acclavio, Fabrizio Montesi, Giovanni Bernardi.

Abstract. The calculus of communicating systems (CCS) is a process calculus for the specification and modelling of discrete communicating systems. In this talk we define a sequent calculus operating on formulas encoding CCS processes capturing the operational semantics for the recursion-free fragment of CCS. We establish a correspondence between executions of processes and (branches of) proofs. We show that these rules are derivable in a sequent system extending the multiplicative and additive linear logic with a non-commutative connective and we prove cut-elimination for this system. We conclude by discussing future research directions.

Reasoning with strong negation.

Sara Negri (University of Genoa), joint work with N. Kamide.

Abstract. Gurevich logic is an extended constructive three-valued logic obtained from intuitionistic logic by adding a connective $\sim$ of *strong negation*, with the following axiom schemata, where $\neg$ is intuitionistic negation:

1. $\sim\sim A \supset\subset A$, 2. $\sim\neg A \supset\subset A$, 3. $\sim A \supset \neg A$, 4. $\sim(A \wedge B) \supset\subset \sim A \vee \sim B$,

5. $\sim(A \vee B) \supset\subset \sim A \wedge \sim B$, 6. $\sim(A \supset B) \supset\subset A \wedge \sim B$.

Nelson logic, also known as Nelson's constructive three-valued logic N3, is the intuitionistic negation-less fragment of Gurevich logic.

The primary formal difficulty in developing a natural deduction system for logics of strong negation lies in the requirement of having rules for $\neg$ and $\sim$ without $\bot$. This is solved using the rules of *explosion*, of $\neg$-*introduction*, and of *excluded middle*:

$$\frac{\neg A \quad A}{C}\,\text{Exp} \qquad \frac{\begin{matrix}[A] & [A]\\ \vdots & \vdots \\ C & \neg C\end{matrix}}{\neg A}\,\neg\text{I} \qquad \frac{\begin{matrix}[\neg A] & [A]\\ \vdots & \vdots\\ C & C\end{matrix}}{C}\,\text{Em}$$

The following are presented:

- Natural deduction and G3-style sequent calculi systems for Gurevich and Nelson logic.
- A translation between the natural deduction and sequent calculi introduced, with an indirect proof of normalization as a consequence of cut elimination.
- A syntactic embedding of Gurevich logic into intuitionistic logic.
- A classical sequent calculus with strong negation, used as a platform for obtaining classical logics of strong negation, such as Avron and De-Omori logics.
- A Glivenko theorem for embedding classical logic with strong negation into Gurevich logic.

References

[1] N. Kamide and S. Negri, Unified natural deduction for logics of strong negation, ms., 2023.
[2] N. Kamide and S. Negri, G3-style sequent calculi for Gurevich logic and its neighbors, ms., 2023.

Provable contradictions in relevant connexive logics of Francez and Weiss.

Satoru Niki (Ruhr University Bochum).

Abstract. Nissim Francez (2019) introduced a relevant subsystem of the implication-negation fragment of Heinrich Wansing's connexive logic C. Later, Yale Weiss (2022) formulated a semilattice semantics for this logic and also for an intermediate system which validates the mingle axiom. Weiss also demonstrated a remarkable feature of these systems that is preserved from C: they prove contradictions, i.e. a pair of a formula and its negation. One way to understand the negation in these logics is through a bilateralistic lens, where falsification is taken as a primitive concept on a par with verification. A question then is how the derivability of contradictions is related to these notions. In this talk, I present a couple of perspectives, one proof-theoretic and one relevantistic, through which provable contradictions can be seen to necessitate a balance between verification and falsification.

Nested sequents for quantified modal logics.

Eugenio Orlandelli (University of Bologna).

Abstract. This talks introduces nested sequents for quantified modal logics. In particular, it considers extensions of the propositional modal logics definable by path conditions and seriality with varying, increasing, decreasing, and constant domains. Each calculus is proved to have good structural properties: weakening and contraction are height-preserving admissible and cut is (syntactically) admissible. Each calculus is shown to be equivalent to the corresponding axiomatic system and, thus, to be sound and complete. Finally, it is argued that the calculi are internal—i.e., each sequent has a formula interpretation—whenever the existence predicate is expressible in the language.

Reversible computation, algorithmic expressiveness, negation.

Matteo Palazzo & Luca Roversi (University of Torino).

Abstract. The interest about Reversible computation started in relation to its possible greener foot-print, as compared to the Classical computation. Currently, computational models, or programming languages, that can express Reversible computations result interesting in all those cases in which the current state of a computation has to be traced back to a previous state, possibly avoiding the two obvious solutions:

(i) storing every details about the intermediate states;
(ii) finding every intermediate state by exhaustive search among all the possible alternatives.

Immediate examples are: debugging, text editing, compression, ciphering. We will present FOREST, a reversible computational model with the following features:

(i) FOREST computations always terminate;
(ii) FOREST can be used as a structured paradigmatic reversible programming language;
(iii) FOREST can simulate every primitive recursive function;
(iv) algorithmically speaking, FOREST is strictly more expressive than existing computational models that can simulate all the primitive recursive functions.

We will conclude by an attempt to interpret the operation ""inverting a term in FOREST"" as ""negating a term in a suitable deductive system"" linked to Deep-inference formalism.

Proof theory of free logics.

Edi Pavlovic (LMU Munich - MCMP).

Abstract. Free logics are a family of first-order logics which came about as a result of examining the existence assumptions of classical logic. What those assumptions are varies, but the central ones are that (i) the domain of interpretation is not empty, (ii) every name denotes exactly one object in the domain and (iii) the quantifiers have existential import. Free logics reject the claim that names need to denote in (ii), and positive free logic concedes that some atomic formulas containing non-denoting names (including at least self-identity) are true, negative free logic treats them as uniformly false, and neutral free logic as taking a third value. These various logics also have complex and varied axiomatizations and semantics, and the present work is a part of an ongoing project to offer, using proof-theoretic means, an orderly examination of the various systems and their mutual relations. We refine the presentations of positive and negative free logics, offer one for neutral free logic, and then finally examine further extensions of the framework.

Proof systems for interpretability logics.

Cosimo Perini Brogi (IMT Lucca), joint work with Sara Negri and Nicola Olivetti.

Abstract. I will discuss an original family of labelled sequent calculi G3IL* for classical interpretability logics. They are designed on the basis of Verbrugge semantics (a.k.a. generalised Veltman semantics) for the corresponding axiomatic calculi. To my knowledge, this is the most extensive and well-behaving class of analytic proof systems for modal logics of interpretability currently available in the literature. I will address the design choices leading to these sequent calculi and prove (in a modular way) that each of them enjoys excellent structural properties, namely, admissibility of weakening, contraction and, more relevantly, cut.

Strong and complemented negation in constructive mathematics.

Iosif Petrakis (University of Verona).

Abstract. We introduce strong and complemented negation in Bishop-style constructive mathematics BISH. While weak negation $\neg A$ of a formula A in BISH corresponds to the weak complement of a subset, its strong negation $\sim A$ corresponds to the strong complement of a subset. We present some basic properties of $\sim A$, and we study tight formulas i.e., formulas for which one can show that $\neg\sim A \Rightarrow A$. We introduce complemented formulas in BISH i.e., appropriate pairs of formulas in BISH that correspond to complemented subsets. Complemented formulas form a swap algebra, and the swap of a complemented formula is its complemented negation.

Games for Abstract Argumentation.

Carlo Proietti (CNR - ILC), joint work with Davide Grossi.

Abstract. We introduce the proof-theory of abstract argumentation by presenting some proof-procedures for its solution concepts (or semantics). A proof procedure provides a constructive method to show that an argument is justified according to the standards provided by a given solution concept. In the simplest cases—corresponding to grounded, credulously preferred and ideal solutions—procedures can be provided as simple dialogue games (two-person, zero-sum) between a proponent and an opponent, where players alternate moves by selecting one attacker of the arguments previously chosen by their adversary. Other solution concepts, however, require more articulated procedures that can be retrieved by leveraging evaluation games for modal logic.

Untyped nets and Second order quantifiers.

Adrien Ragot (Sorbonne Paris North University, Roma Tre University), joint work with Lorenzo Tortora de Falco and Thomas Seiller.

Abstract. We introduce untyped nets with pointers; hypergraphs equipped with special hyperedges called pointers. We discuss how to represent proofs of second order multiplicative linear logic in untyped nets and give a proposition for a correctness criterion; showing that - as in the quantifier free case - the notion of contractibility and of acyclic and connected switchings are related.

A theory of computable functionals.

Helmut Schwichtenberg (LMU Munich).

Abstract. We describe a theory of computable functionals (TCF) which extends Heyting's arithmetic in all simple types by (i) adding inductively and coinductively defined predicates, (ii) distinguishing computationally relevant (c.r.) and non-computational (n.c.) predicates, (iii) adding realizability predicates, and (iv) allowing partial functionals defined by equations (possibly non-terminating, like corecursion). The underlying (minimal) logic has just implication and universal quantification as primitive connectives; existence, disjunction and conjunction are inductively defined. The axioms of TCF are the defining axioms for (co)inductive predicates, bisimilarity axioms and invariance axioms stating that "to assert is to realize" (Feferman 1978) for realizability-free formulas. Using these one can prove in TCF a soundness theorem: the term extracted from a realizability-free proof of a formula A is a realizer of A. TCF is implemented in the Minlog proof assistant.

Simplicial Complexes for Epistemic Logic.

Thomas Studer (University of Bern).

Abstract. In formal epistemology, group knowledge is often modeled as the knowledge that the group would have if the agents shared all their individual knowledge. However, this interpretation does not account for relations between agents. In this work, we propose the notion of synergistic knowledge, which makes it possible to model different relationships between agents, e.g., groups of agents having access to shared objects. To do so, we present a novel semantics for modal logic based on simplicial complexes.

Sequents vs hypersequents for deontic logics.

Matteo Tesi (Vienna University of Technology), j.w.w. Agata Ciabattoni.

Abstract. Enhancing cut-free expressiveness through minimal structural additions to sequent calculus is a natural step. We focus on Aqvist's system F with cautious monotonicity (CM), a deontic logic extension of S5, for which we define a sequent calculus employing (semi) analytic cuts. The transition to hypersequents is key to develop modular and cut-free calculi for F+CM and G, also supporting countermodel construction.