

Jacques Duparc
Thomas A. Henzinger (Eds.)

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Computer Science Logic

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Preface

The Annual Conference of the European Association for Computer Science Logic (EACSL), CSL 2007, was held at the University of Lausanne, September, 11–15 2007. The conference series started as a program of International Workshops on Computer Science Logic, and then in its sixth meeting became the Annual Conference of the EACSL. This conference was the 21st meeting and 16th EACSL conference; it was organized by the Western Swiss Center for Logic, History and Philosophy of Science, and the Information Systems Institute at the Faculty of Business and Economics at the University of Lausanne.

The first day of the conference was a joint event with the European Research Training Network GAMES¹.

The CSL 2007 Program Committee considered 116 submissions from 30 countries during a two-week electronic discussion; each paper was refereed by three to six reviewers. The Program Committee selected 36 papers for presentation at the conference and publication in these proceedings.

The Program Committee invited lectures from Samson Abramsky, Luca de Alfaro, Arnold Beckmann, Anuj Dawar, Orna Kupferman, and Helmut Seidl; the papers provided by the invited speakers appear at the beginning of this volume.

Instituted in 2005, the Ackermann Award is the EACSL Outstanding Dissertation Award for Logic in Computer Science. It was sponsored for the first time by Logitech S.A., headquartered near Lausanne in Romanel-sur-Morges, Switzerland². The award winners for 2007, Dietmar Berwanger, Stéphane Lengrand, and Ting Zhang, were invited to present their work at the conference. Citations for the awards, abstracts of the theses, and biographical sketches of the award winners can be found at the end of the proceedings.

We generously thank the Program Committee and all referees for their work in reviewing the papers, as well as the members of the local organizing team (Christian W. Bach, Jérémie Cabessa, Alessandro Facchini, Elisabeth Fournier, Thomas Strahm, Henri Volken). We also thank the Swiss National Science Foundation, the Swiss Academy of Sciences, and the Western Swiss Center for Logic, History and Philosophy of Science, which provided financial support.

June 2007

Jacques Duparc
Thomas A. Henzinger

¹ *Games and Automata for Synthesis and Validation*, coordinated by Erich Grädel.
<http://www.games.rwth-aachen.de/>

² We would like to thank Daniel Borel, Co-founder and Chairman of the Board of Logitech S.A., for his support of the Ackermann Award for the years 2007–09. For a history of this Swiss company, consult <http://www.logitech.com>.

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Full Completeness: Interactive and Geometric Characterizations of the Space of Proofs (Abstract)^{*}

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Abstract. We pursue the program of exposing the intrinsic mathematical structure of the “space of a proofs” of a logical system [AJ94b]. We study the case of Multiplicative-Additive Linear Logic (MALL). We use tools from Domain theory to develop a semantic notion of proof net for MALL, and prove a Sequentialization Theorem. We also give an interactive criterion for strategies, formalized in the same Domain-theoretic setting, to come from proofs, and show that a “semantic proof structure” satisfies the geometric correctness criterion for proof-nets if and only if it satisfies the interactive criterion for strategies. We also use the Domain-theoretic setting to give an elegant compositional account of Cut-Elimination. This work is a continuation of previous joint work with Radha Jagadeesan [AJ94b] and Paul-André Mellies [AM99].

1 Introduction

One can distinguish two views on how Logic relates to Structure:

1. **The Descriptive View.** Logic is used to *talk about* structure. This is the view taken in Model Theory, and in most of the uses of Logic (Temporal logics, MSO etc.) in Verification. It is by far the more prevalent and widely-understood view.
2. **The Intrinsic View.** Logic is taken to *embody* structure. This is, implicitly or explicitly, the view taken in the Curry-Howard isomorphism, and more generally in Structural Proof Theory, and in (much of) Categorical Logic. In the Curry-Howard isomorphism, one is not using logic to *talk about* functional programming; rather, logic *is* (in this aspect) functional programming.

If we are to find structure in the proof theory of a logic, we face a challenge. Proof systems are subject to many minor “design decisions”, which does not impart confidence that the objects being described — formal proofs — have a robust intrinsic structure. It is perhaps useful to make an analogy with Geometry. A major concern of modern Geometry has been to find *intrinsic*, typically

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coordinate-free, descriptions of the geometric objects of study. We may view the rôle of *syntax* in Proof Theory as analogous to coordinates in Geometry; invaluable for computation, but an obstacle to finding the underlying invariant structure.

A particularly promising line of progress in finding more intrinsic descriptions of proofs, their geometric structure, and their dynamics under Cut-elimination, has taken place in the study of proof-nets in Linear Logic [Gir87], and the associated study of Geometry of Interaction [Gir89]. On the semantic side, the development of Game Semantics and Full Completeness results [AJ94b] has greatly enriched and deepened the structural perspective.

We build on previous joint work with Radha Jagadeesan [AJ94a] and Paul-André Melliès [AM99]. We study Multiplicative-Additive Linear Logic. We use tools from Domain theory to develop a semantic notion of proof net for MALL, and prove a Sequentialization Theorem for this notion [Abr07]. We also give an interactive criterion for *strategies*, formalized in the same Domain-theoretic setting, to come from proofs, and show that a “semantic proof structure” satisfies the geometric correctness criterion for proof-nets if and only if it satisfies the interactive criterion for strategies. We also use the Domain-theoretic setting to give an elegant compositional account of Cut-Elimination.

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The Symbolic Approach to Repeated Games (Abstract)

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Abstract. We consider zero-sum repeated games with omega-regular goals. Such hgames are played on a finite state space over an infinite number of rounds: at every round, the players select moves, either in turns or simultaneously; the current state and the selected moves determine the successor state. A play of the game thus consists in an infinite path over the state space or, if randomization is present, in a probability distribution over paths. Omega-regular goals generalize the class of regular goals (those expressible by finite automata) to infinite sequences, and include many well-known goals, such as the reachability and safety goals, as well as the Büchi and parity goals.

The algorithms for solving repeated games with omega-regular goals can be broadly divided into *enumerative* and *symbolic*/ algorithms. Enumerative algorithms consider each state individually; currently, they achieve the best worst-case complexity among the known algorithms. Symbolic algorithms compute in terms of sets of states, or functions from states to real numbers, rather than single states; such sets or functions can often be represented symbolically (hence the name of the algorithms). Even though symbolic algorithms often cannot match the worst-case complexity of the enumerative algorithms, they are often efficient in practice.

We illustrate how symbolic algorithms provide uniform solutions of many classes of repeated games, from turn-based, non-randomized games where at each state one of the players can deterministically win, to concurrent and randomized games where the ability to win must be characterized in probabilistic fashion. We also show that the symbolic algorithms, and the notation used to express them, are closely related to *game metrics* which provide a notion of distance between game states. Roughly, the distance between two states measures how closely a player can match, from one state, the ability of winning from the other state with respect to any omega-regular goal.