The Ackermann Award 2006

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Members of EACSL Jury for the Ackermann Award

The second **Ackermann Award** is presented at this CSL'06. Eligible for the 2006 **Ackermann Award** were PhD dissertations in topics specified by the EACSL and LICS conferences, which were formally accepted as PhD theses at a university or equivalent institution between 1.1. 2004 and 31.12. 2005. The jury received 14 nominations for the **Ackermann Award 2006**. The candidates came from 10 different nationalities from Europe, the Middle East and India, and received their PhDs in 9 different countries in Europe, Israel and North America.

The topics covered the full range of Logic and Computer Science as represented by the LICS and CSL Conferences. All the submissions were of very high standard and contained outstanding results in their particular domain. The jury decided finally, to give for the year 2006 two awards, one for work on the *model theory of hybrid logics - modal logics extended with nominals*, and one for work on *mathematical structures arising in the theory of coalgebras and providing semantics for recursive specifications.* The 2006 **Ackermann Award** winners are, in alphabetical order,

– Balder ten Cate from the Netherlands, for his thesis
  Model Theory for Extended Modal Languages,
  issued by Amsterdam University, The Netherlands, in 2005
  Supervisor: Johan van Benthem

– Stefan Milius from Germany, for his thesis
  Coalgebras, Monads and Semantics,
  issued by the Technical University of Braunschweig, Germany, in 2005
  Supervisor: Jiří Adámek

The Jury wishes to congratulate the recipients of the Ackermann Award for their outstanding work and wishes them a successful continuation of their career.

The Jury wishes also to encourage all the remaining candidates to continue their excellent work and hopes to see more of their work in the future.

Balder Ten Cate

Citation. Balder ten Cate receives the *2006 Ackermann Award* of the European Association of Computer Science Logic (EACSL) for his thesis

Model Theory for Extended Modal Languages,

in which he substantially advanced our understanding of model theoretic and computational aspects of extensions of modal logic and their use in computer science.

Z. Ésik (Ed.): CSL 2006, LNCS 4207, pp. 622–626, 2006.

Background of the thesis. Modal logics are of fundamental importance in many branches of computer science. They allow to tailor logical formalisms so that they combine the expressive power needed in particular applications with good algorithmic and model-theoretic properties. A fundamental feature of modal logics is their invariance under notions of behavioural equivalence such as bisimulation. Well-known and fundamental results in the model theory of modal logic reveal that propositional modal logic is equivalent to the bisimulation-invariant fragment of first-order logic, and that an analogous relationship holds for the modal μ-calculus and monadic second-order logic.

In many applications, it is necessary or at least convenient to extend modal logics with nominals (i.e., constants for naming elements of the underlying structure) and operators to handle them. These logics are called hybrid logics and they relate to, say, first-order logic with constants in the same way as basic modal logics relate to purely relational first-oder logic. Balder ten Cate's thesis is mainly a mathematical investigation into hybrid logics and other extended modal logics. It encompasses a wide range of topics in the analysis of extended modal logics, covering many new results on fundamental model theoretic features of hybrid logics and other more expressive modal logics, and puts these results into a wider framework of abstract modal model theory. For instance, the celebrated Goldblatt-Thomason Theorem states that a first-order formula defines a modally definable frame class if, and only if, it is preserved under taking generated subframes, disjoint unions and bounded morphic images, and its negation is preserved under taking ultrafilter extensions. Many results in ten Cate's thesis are motivated by the question whether similar chracterisations can be given for the frame classes definable in extended modal logics, such as hybrid logics or modal logic with propositional quantifiers.

Abstract model theory studies model theoretic propertis of logics on a general, abstract level. A fundamental result in this context is Lindström's Theorem stating that no proper extension of first-order logic has both the compactness and the Löwenheim-Skolem property. Abstract model theory has been successful in providing a unifying perspective of model-theoretic properties of logics, typically of powerful extensions of first-order logic, but it does not really cover aspects of computational logics. A more general perspective of ten Cate's work is to contribute to the development of an abstract model theory for computational logics, devoted to logics that arise in computer science, and to those properties that are relevant for their computational applications.

Ten Cate's thesis. The thesis, entitled *Model Theory for Extended Modal Languages* is written with great lucidity and sophistication. It develops the abstract model theory of hybrid languages in the spectrum running from the basic modal language to full first-order logic. The results of the thesis are too numerous to enumerate them, so let us just mention a few highlights.

- A systematic frame-definability theory for hybrid languages is developed, including Goldblatt-Thomason style characterizations. This is a highly non-trivial enterprise in terms of model-theoretic proof techniques, and new frame constructions.

- In this context, a very interesting, although negative, result is that the set of first-order formulae preserved under ultrafilter extensions is highly undecidable (Π^1_1-hard).
- The thesis contains a striking syntactic analysis of the 'Bounded Fragment' first studied by Feferman and Kreisel, and later by Areces, Blackburn and Marx, allowing us a much better grip on what it is and does.
- Balder ten Cate has proved a general interpolation theorem showing that only very few hybrid logics have interpolation. This is one of the first major classification results in the abstract model theory of fragments of first-order logic (where standard proofs often do not work, as they presuppose the full power of first-order encoding).
- He has contributed an interesting analysis of second-order formalisms such as modal logic with propositional quantifiers, inside of which he characterises for instance the standard modal fragment via finite depth and bisimulation invariance, and the intersection with first-order logic as the bounded fragment.

There is much more to the thesis. In addition, ten Cate makes complexity-theoretic investigations of hybrid logics, suggesting a new style of abstract model theory: mixing expressivity with concerns of computational complexity. In doing so, he also provides a sustained study of satisfiability preserving translations between various modal and hybrid logics.

A most striking impression when one reads this thesis is that of an unusual mathematical maturity in research and writing. The results are embedded into a convincing high-level account that provides perspective and contributes to a coherent bigger picture. The exposition is very clear and admirably manages to be concise and rigorous without becoming notationally or formally heavy. In fact, the writing is skillful and to the point in an exemplary fashion.

Biographic Sketch. Balder David ten Cate was born on June 15, 1979 in Amsterdam, the Netherlands. In 1998 he received his B.A. (Propedeuse) in Psychology from the Vrije Universiteit of Amsterdam. In 2000 he received his M.Sc. in Artificial Intelligence from the Vrije Universiteit of Amsterdam. Both degrees were given *cum laude* (with distinction). In 2005 he received his Ph.D. from the University of Amsterdam, under the supervision Johan van Benthem.

Balder ten Cate has done first research in natural language semantics, and then in the model theoretic and computational aspects of various extensions of modal logic. He now works on a project on the foundations of semi-structured data and XML-query languages.

Stefan Milius

Citation. Stefan Milius receives the *2006 Ackermann Award* of the European Association of Computer Science Logic (EACSL) for his thesis

Coalgebras, Monads and Semantics,

in which he advances considerably our understanding of category-theoretic methods in the study of a wide variety of recursive behavioural specifications in a unified setting.

Background of the thesis. Recursive definitions are a central topic in Computer Science. One major tradition in the field has been *algebraic semantics*, which studies the structure of recursive program schemes, and their interpretations. A more recent and currently very lively area of work is in *coalgebraic semantics*, which uses category-theoretic methods to study a wide variety of recursive behavioural specifications in a unified setting. These research directions have hitherto been rather separate, both from each other, and from other approaches in semantics.

Milius' thesis. This thesis contains a number of striking contributions, which show a rich interplay between algebraic and coalgebraic methods, and open up new directions in the study of recursion schemes. Moreover the treatment is carried out in a general setting, unifying existing approaches, and allowing for interesting new examples.

Some main contributions are as follows:

– A description of free iterative theories generated by an arbitrary finitary endofunctor. This simplifies and substantially generalizes some of the main results obtained by the Elgot school. The proof is an elegant combination of methods of algebra and coalgebra.
– Elgot algebras. An elegant axiomatization is given of the algebras over the monad corresponding to a free iterative theory. Again, there is a pleasing interplay between algebraic and coalgebraic notions, e.g. in the result that the Elgot algebras of a given "iteratable" functor are the Eilenberg-Moore algebras of a certain monad related to final coalgebras.
– New insights and a powerful unifying perspectives are developed for the semantics of recursive programs and program schemes. The treatment encompasses domain-theoretic and metric space based approaches, and includes interesting examples such as fractals.

The thesis is based on a number of substantial journal papers, with a well-written overview. The mathematical development is notable for its clarity and generality. It seems likely that this work will stimulate further research, and open up some new directions in the fruitful interplay of algebra and coalgebra, and in the study of recursion.

Biographic Sketch. Stefan Milius was born on June 3, 1975 in Magdeburg, Germany. In 2000, he received an MA in Mathematics from York University Toronto, Canada and a Diploma in Computer Science from the Technical University of Braunschweig, Germany. He wrote his Ph.D. thesis under the supervision of Prof. Jiří Adámek and received his Ph.D. (Dr.rer.nat.) in October 2005 from the Technical University of Braunschweig *summa cum laude* (with distinction).

From 1998 till 2000 he was a Fellow of the German National Academic Foundation (Studienstiftung des Deutschen Volkes). In 2000 he was given the Award for excellent achievments as a student from the Technical University of Braunschweig. His work concentrates on category theoretic aspects of computer science.

The Ackermann Award

The EACSL Board decided in November 2004 to launch the EACSL Outstanding Dissertation Award for Logic in Computer Science, the **Ackermann Award**, The award[1]. is named after the eminent logician Wilhelm Ackermann (1896-1962), mostly known for the Ackermann function, a landmark contribution in early complexity theory and the study of the rate of growth of recursive functions, and for his coauthorship with D. Hilbert of the classic *Grundzüge der Theoretischen Logik*, first published in 1928. Translated early into several languages, this monograph was the most influential book in the formative years of mathematical logic. In fact, Gödel's completeness theorem proves the completeness of the system presented and proved sound by Hilbert and Ackermann. As one of the pioneers of logic, W. Ackermann left his mark in shaping logic and the theory of computation.

The **Ackermann Award** is presented to the recipients at the annual conference of the EACSL. The jury is entitled to give more than one award per year. The award consists of a diploma, an invitation to present the thesis at the CSL conference, the publication of the abstract of the thesis and the citation in the CSL proceedings, and travel support to attend the conference.

The jury for the **Ackermann Award** consists of seven members, three of them ex officio, namely the president and the vice-president of EACSL, and one member of the LICS organizing committee. The current jury consists of S. Abramsky (Oxford, LICS Organizing Committee), B. Courcelle (Bordeaux), E. Grädel (Aachen), M. Hyland (Cambridge), J.A. Makowsky (Haifa, President of EACSL), D. Niwinski (Warsaw, Vice President of EACSL), and A. Razborov (Moscow and Princeton).

The first **Ackermann Award** was presented at CSL'05 in Oxford, England. The recipients were Mikołaj Bojańczyk from Poland, Konstantin Korovin from Russia, and Nathan Segerlind from the USA. A detailed report on their work appeared in the CSL'05 proceedings.

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[1] Details concerning the Ackermann Award and a biographic sketch of W. Ackermann was published in the CSL'05 proceedings and can also be found at `http://www.dimi.uniud.it/ eacsl/award.html`.