Workshop on Model Theory, Automorphism Groups, and Weighted Automata

on the occasion of the 3Cth birthday of

Prof. Dr. rer. nat. habil. Manfred Droste

Dresden, June 17, 2016

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Preface

We mark the 60th birthday of our friend Manfred Droste by a scientific meeting that consists of six invited talks. These invited talks are intended to represent Manfred's research interests in mathematics and in computer science. More specifically they cover infinite Abelian groups, infinite permutation groups, rational languages, weighted automata, and the verification of quantitative models – areas that Manfred contributed to over the last years, still contributes to and will certainly contribute to over the years to come.

We have the pleasure that five of his many collaborators and a former student of his late supervisor agreed to present these talks:

Paul Gastin (LSV, ENS Cachan & CNRS, France)
Kim Larsen (Aalborg, Denmark)
Dugald MacPherson (Leeds, United Kingdom)
Jacques Sakarovitch (CNRS / Telecom-ParisTech, France)
Lutz H. Strüngmann (Mannheim, Germany)
John K. Truss (Leeds, United Kingdom)

The meeting takes place in Dresden where Manfred spent quite some years. The date, June 17, 2016, is not Manfred's actual birthday, but a suitable date for celebrating a West-East-German scientist.*

Dietrich Kuske
Technische Universität Ilmenau
Germany

Heiko Vogler
Technische Universität Dresden
Germany

*For non-Germans and very young Germans: until reunification, June 17 was a national holiday in West Germany celebrating the East German uprising from 1953.

1 Scientific Programme

Friday, June 17, 2016

08:30 - 08:45	opening	
08:45 - 09:45	Jacques Sakarovitch	*Between mathematics and computer science: Mysteries and marvels of rational base numeration systems*
10:00 - 11:00	Dugald MacPherson	*Locally compact permutation groups*
	break	
11:20 - 12:20	Paul Gastin	*10 years of weighted logics for weighted automata*
	lunch	
13:45 - 14:45	John Truss	*1-transitive trees*
15:00 - 16:15	Kim Larsen	*Alternation-Free Quantitative Modal Mu-Calculi*
	break	
16:45 - 17:45	Lutz Strüngmann	*Prediction in the world of Abelian groups*


TECHNISCHE UNIVERSITÄT DRESDEN
Workshop on
Model Theory, Automorphism Groups, and Weighted Automata
June 17, 2016, Dresden, Germany

2 Tutorials

10 years of weighted logics for weighted automata

Paul Gastin

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This talk will survey some of the main results on the relationship between weighted automata and weighted logics. The story started 10 years ago with the introduction of a quantitative (semiring) semantics for MSO logic over words and an equivalence theorem between weighted automata and a restricted weighted MSO logic. Since then, many extensions have been studied. Some extend the word structures to trees, infinite words, pictures, etc. Others concern the quantitative aspect, moving from semirings to more general weight computations. Also, the proof techniques have matured, from low level, carefully mimicking the classical proofs in the boolean setting, to higher level, using various abstract semantics. We illustrate this evolution by introducing a core weighted logic and its abstract semantics as multisets of weight structures. The equivalence between weighted automata and core weighted logic holds at the level of the abstract semantics. Most existing results can be derived easily. We will also demonstrate the versatility of the weighted automata approach by instantiating it into the transducer setting, showing a possible lead towards the design of an alternative logic for transductions.

Paul Gastin's publications

Paul Gastin's common publications with Manfred Droste

Alternation-Free Quantitative Modal Mu-Calculi

Kim Larsen

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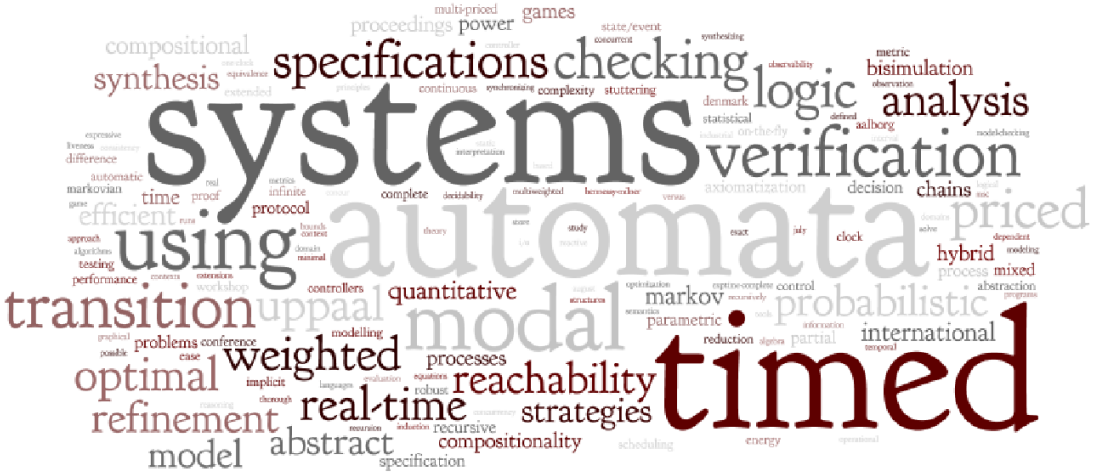
Quantitative behavioural models have been extensively studied in order to address important non-functional properties of reactive systems related to timing-constraints, resource-consumption as well as performance properties. Popular quantitative modelling formalisms include timed automata, priced timed automata as well as a large variety of Markov process models. Complementing these quantitative modelling formalisms is a similarly large collection of logical specification formalisms. In this talk we shall consider three quantitative extensions of the (alternation-free) modal mu-calculus related to real-time, weighted and probabilistic systems. In particular we will examine them in terms of adequacy with respect to suitable behavioural equivalences, expressiveness, decidability, compositionality as well as complete axiomatizations.



Kim Larsen's publications

Locally compact permutation groups

Dugald MacPherson
(joint work in progress with Cheryl Praeger and Simon Smith)

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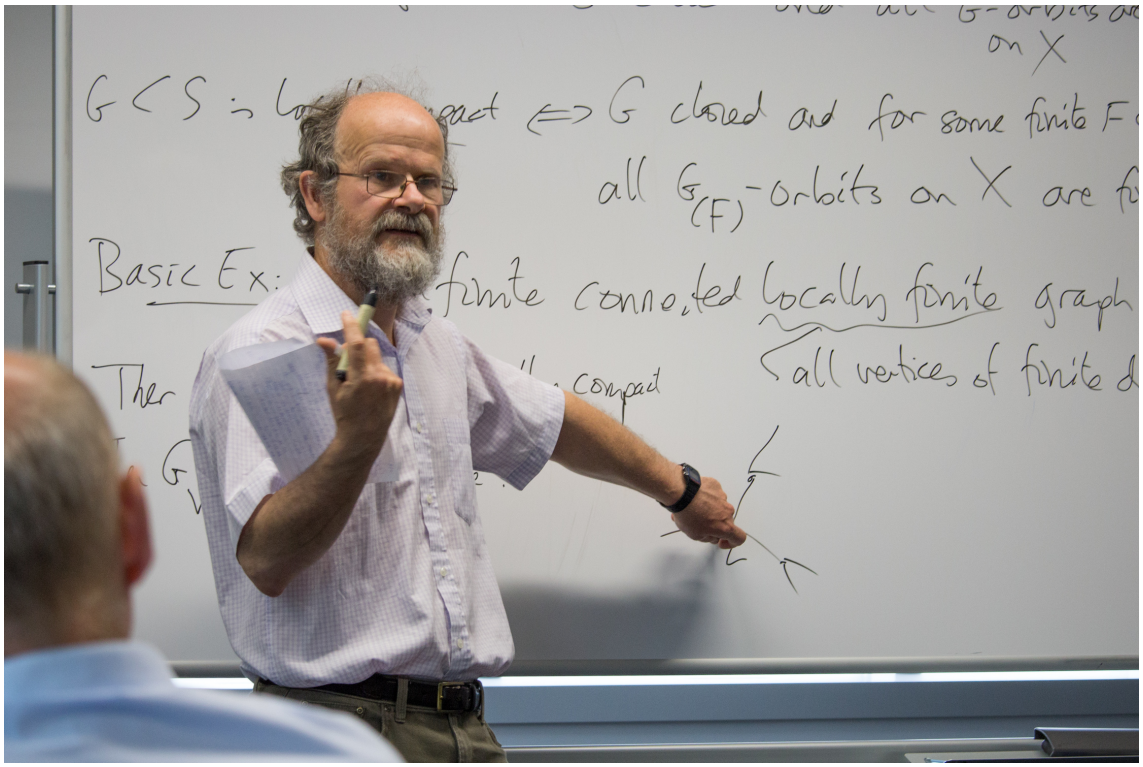
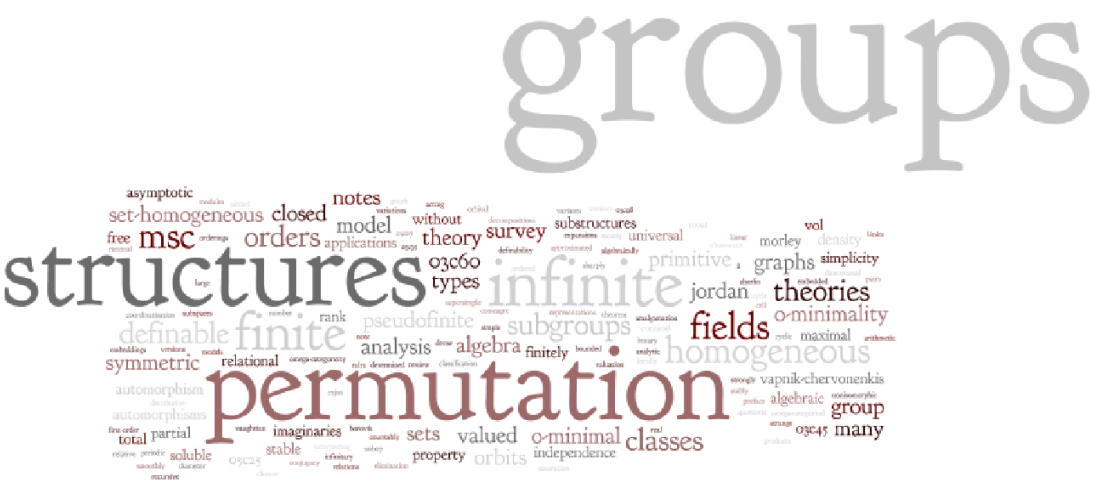
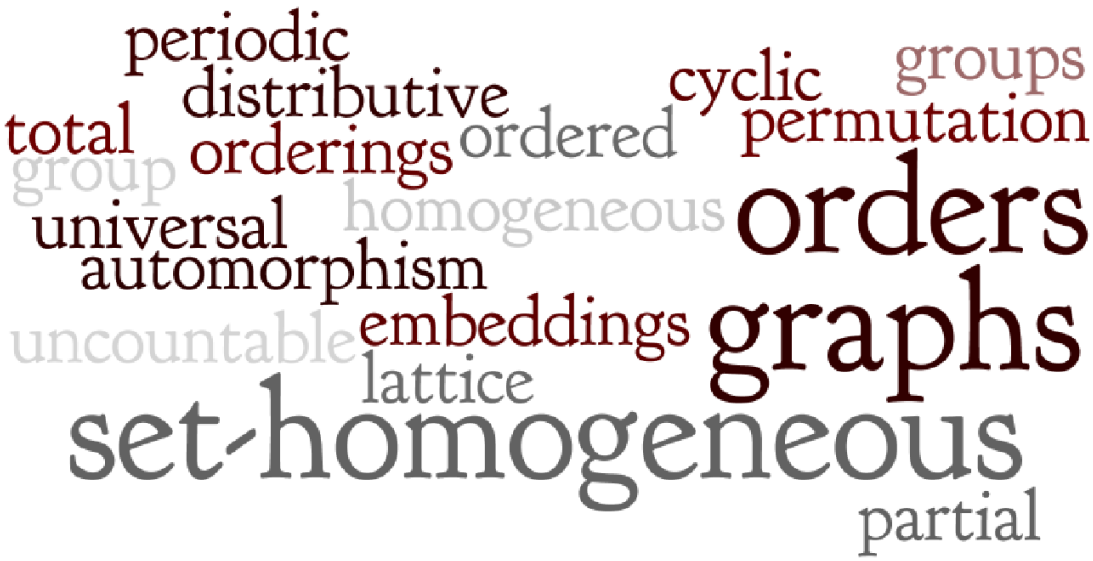
The symmetric group S on a countably infinite set X carries a natural topology, and a subgroup is locally compact if the pointwise stabiliser of some finite set has all its orbits on X finite. We are particularly interested in uncountable locally compact permutation groups which are also primitive as permutation groups. Automorphism groups of finite degree graphs provide an obvious place to look for examples, but it is hard to find examples with a higher degree of transitivity. I will discuss examples, some results saying that certain locally compact permutation groups do not have a 'transitive extension', and various notions of maximality for subgroups of S – maximality subject to being closed, or locally compact, or having all suborbits (orbits of the point stabiliser) finite.





Dugald MacPherson's publications



Dugald MacPherson's common publications with Manfred Droste

Between mathematics and computer science: Mysteries and marvels of rational base numeration systems

Jacques Sakarovitch

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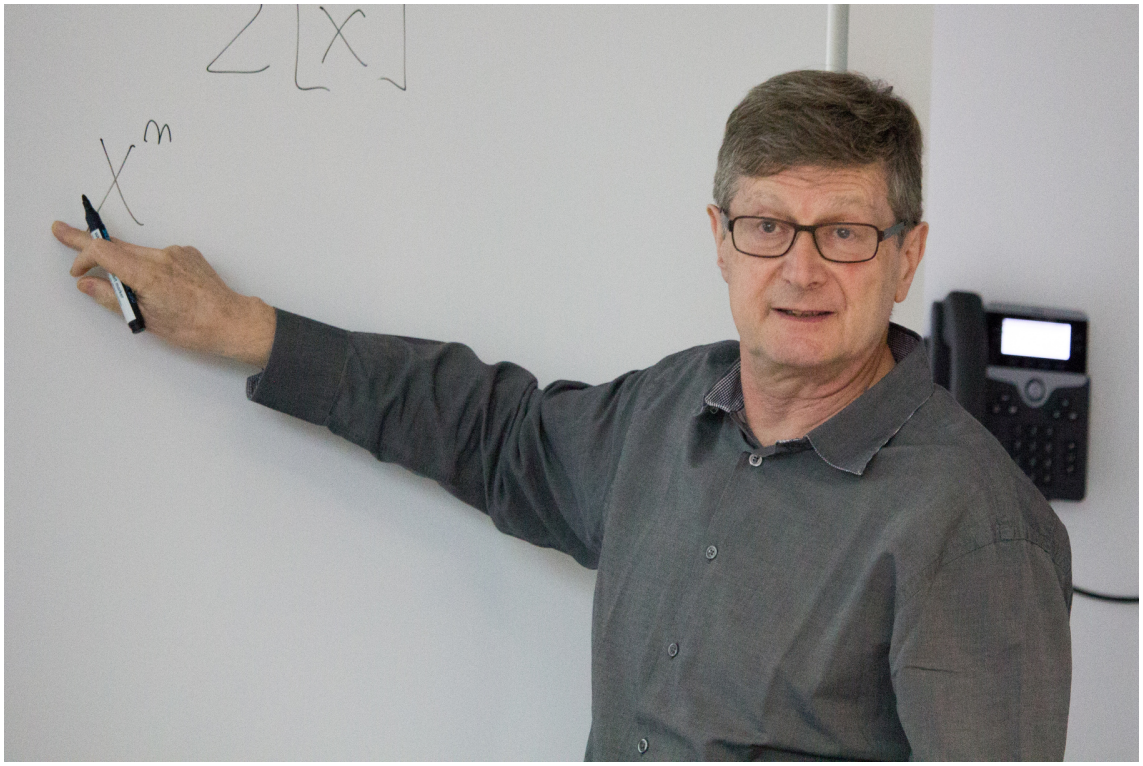
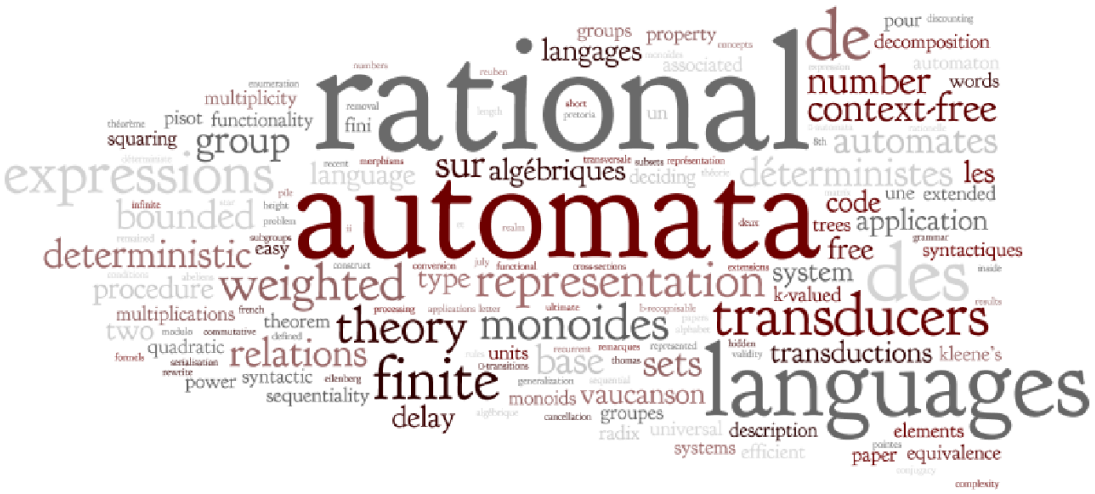
The definition of numeration systems with rational base, in a joint work with S. Akiyama and Ch. Frougny (*Israel J. Math.* 2008), has allowed to make some progress in a number theoretic problem, by means of automata theory and combinatorics of words. At the same time, it raised the problem of understanding the structure of the sets of the representations of the integers in these systems from the point of view of formal language theory.

At first sight, these sets look rather chaotic and do not fit well in the classical Chomsky hierarchy of languages. They all enjoy a property that makes them defeat, so to speak, any kind of iteration lemma. On the other hand, these sets also exhibit remarkable regularity properties.

During the recent years, these regularities have been studied in a series of joint papers with my student V. Marsault. In particular, we have shown a kind of autosimilarity property and that periodic signatures are characteristic of the representation languages in rational base numeration systems.

These languages still keep most of their mystery. The partial results which will be presented call for further investigations on the subject even stronger.





Jacques Sakarovitch's publications

Jacques Sakarovitch's common publications with Manfred Droste

Prediction in the world of Abelian groups

Lutz H. Strüngmann

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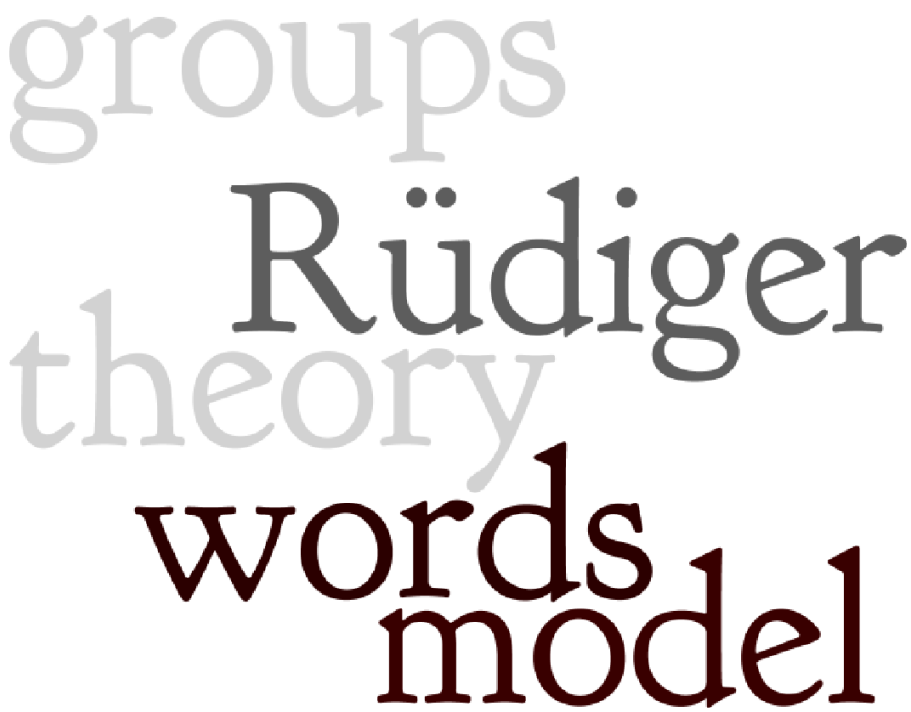
Since the solution of Whitehead's famous problem on the vanishing of the group of extensions of an Abelian group with the group of integers, the application of methods from set-theory and infinite combinatorics has become an essential tool in the theory of Abelian groups. Working in different extension models of the usual Zermelo-Fraenkel set-theory plus the axiom of choice (ZFC), independence results as well as existence results for complicated Abelian groups with prescribed properties have been obtained in abundance during the last decades. Basically, there are three different techniques/principles that are widely used: Jensen's diamond principle that holds for instance in Goedel's constructible universe, the method of forcing for constructing models of ZFC and Shelah's Black Box which is valid in ZFC. In this talk we will explain the basic ideas of these three *prediction methods/principles* and present some easy examples as well as a few more sophisticated applications in the theory of Abelian groups.

Lutz Strüngmann's publications



Lutz Strüngmann's common publications with Manfred Droste

1-transitive trees

John K. Truss
(joint work with K. M. Chicot)

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By tree (or lower semilinear order) here is understood a partial order in which any two elements have a common lower bound and for which the elements below any fixed element are linearly ordered. The intuition is that a tree may branch upwards but not downwards. In his memoir (Memoirs of the AMS vol 57 number 334 (1985)), based on part of his PhD thesis, Manfred Droste gave important information about the structure of countable trees under some transitivity assumptions. Specifically, he gave a description of all the countable 2-transitive trees (which means that for any two 2-element chains there is an automorphism taking the first to the second, and similarly for 2-element antichains). This was extended in work with Holland and Macpherson to 'weakly' 2-transitive trees (which requires the same condition, but just for chains). The current work extends this to the 1-transitive case, which gives rise to a much larger class again. It is noted that the branches (maximal chains) do not need to be 1-transitive linear orders, but are 'lower' 1-transitive, and furthermore, branches do not need to be isomorphic, but just 'lower isomorphic' (appropriate weakenings of '1-transitive' and 'isomorphic'). An outline of methods for describing all such trees will be presented; a key point is to analyze the possible behaviour of cones at points where the tree branches ('ramification points').

John Truss's publications

John Truss's common publications with Manfred Droste