List of the (abstracts of the) talks [1]

Jorge ALMEIDA: *On fixed points of the lower set operator.*

Lower subsets of an ordered semigroup form in a natural way an ordered semigroup. Large families of fixed points for the induced operator on pseudovarieties of ordered semigroups are obtained which include all examples found in the literature.
This is joint work with A. Cano, O. Klima, and J.-E. Pin.

Mikolai BOJANCZYK: *MSO+U*

MSO+U is an extension of monadic second-order logic, which adds a quantifier U, called the unbounding quantifier. A formula UX.phi(X) says that phi(X) is true for arbitrarily big finite sets X. The weak fragment (only quantification over finite sets) is decidable over infinite words and trees, while the full logic is undecidable over infinite trees. The decidability results for trees use profinite techniques, while the undecidability results uses descriptive set theory (in fact, the undecidability result is conditional on the set-theoretic assumption V=L).

Olivier CARTON: *Normality and Automata.*

We strengthen the theorem that establishes that deterministic finite transducers can not compress normal infinite words. We prove that, indeed, non-deterministic finite transducers, even augmented with a fixed number of counters, can not compress normal infinite words. However, there are push-down non-deterministic transducers that can compress normal infinite words. We also obtain new results on the preservation of normality with automata selectors. Complementing Agafonov's theorem for prefix selectors, we show that suffix selectors also preserve normality. However, there are simple two-sided selectors that do not preserve normality.
Joint work with V. Becher and P. Heiber (University of Buenos Aires)

Namit CHATURVEDI: *Toward a Structure Theory of Regular Infinitary Trace Languages.*

Mazurkiewicz Traces model concurrent behaviours of distributed systems. We introduce families of deterministic Buechi and deterministic Muller asynchronous automata – characterizing specific families of omega-regular trace languages – that allow for the first time a Borel-like classification of regular infinitary trace languages.

Lorenzo CLEMENTE: *Unified Analysis of Collapsible and Ordered Pushdown Automata via Term Rewriting.*

We model collapsible and ordered pushdown automata with term rewriting, by using trees as a simple encoding of higher-order stacks and multiple stacks, respectively. We show a uniform preservation of regularity result for the resulting class of term rewriting systems, which is obtained by extending the classic saturation-based approach. This result is interesting in itself, and it does not seem to follow from the rich literature on preservation of recognizability for term rewrite systems. Moreover, it generalizes and unifies recent saturation-based analyses for collapsible and ordered pushdown systems.

Thomas COLCOMBET: *Cost-functions and cost-automata*

Regular cost-functions offer an extension to regular languages in which it is possible to express very mild quantitative properties. Informally, it is possible to make a distinction between 'a

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few' and 'a lot' in a rigorous way. The results offer generic tools for answering questions such as : "is it possible to reach the fixpoint of an MSO-formula over trees in a few number of iterations" ? Solving this question amounts for instance to decide whether there is a uniform bound k such that it is possible to reach the fixpoint over any tree input in at most k iteration. In this talk I will present the notions of cost-functions and cost-automata over words and trees, give examples, and states the central results of this theory.

Bruno COURCELLE: *Recognizable sets of graphs : algebraic and logical aspects.*

In order to be interesting, algebras of finite graphs must have countable sets of operations. We adapt accordingly the notion of recognizability, defined usually for finitely generated algebras. We prove the recognizability theorem, saying that monadic second-order definable sets of graphs are recognizable, by means of infinite "fly-automata". These automata can be implemented and used for obtaining FPT algorithms with respect to clique-width or tree-width as parameter. The implementation issues will be exposed by I. Durand.

Luc DARTOIS: *Adding Modular Predicates.*

In this talk, I will give an overview of the results obtained within the FREC project about the adding of modular predicates to fragments of logic over finite words, especially the algebraic characterization of this operation.
This is a joint work with Charles Paperman.

Laure DAVIAUD: *Asymptotic behaviour of max-plus and min-plus automata.*

This talk will present results about the description of functions computed by max-plus and min-plus automata. These functions associate each word to non-negative integers including infinity. Questions such as equivalence or comparison are undecidable problems, but we will give decidable results that approximate the behaviour of these automata.
This talk is based on joint works with Thomas Colcombet and Florian Zuleger.

Volker DIEKERT: *Recognizable Languages are Church-Rosser Congruential.*

The talk is based on a joint work with Kufleitner, Reinhardt, and Walter. The result was presented first at ICALP 2012 in Warwick. It shows that for each recognizable language L there exist some finite confluent and length-reducing semi-Thue system S such that L is a finite union of congruence classes with respect to S. This settled a long standing conjecture in formal language theory which dates back to a JACM publication by McNaughton, Narendran and Otto in 1988. Substantial steps towards the solution were done by Reinhardt and Therien concerning group languages and in 2011 in a joint work of the speaker with Kufleitner and Weil for aperiodic languages. The solution for the aperiodic languages and the general case became possible by proving in each of these cases a much stronger result, thereby "loading the induction".

Irène DURAND: *Courcelle's Theorem in Practice.*

Courcelle's theorem states that : "Monadic second-order model checking is fixed-parameter tractable for tree-width and clique width." During many years, people have said that this theorem is very nice but not very useful because in most cases, computing the automaton is not tractable. One of the aim of this work is to show that the theorem can be used in practice.

Nathanaël FIJALKOW: *Profinite Techniques for Probabilistic Automata.*

We consider probabilistic automata over finite words, and develop a profinite theory for them. We use this framework to formalize the notion of convergence speeds in probabilistic automata. This allows us to provide a fine analysis of the decidable cases for the value 1 problem. We give a characterization of the Markov Monoid algorithm (previously introduced by Gimbert, Oualhadj and the author), and show that this algorithm is in fact optimal, in the following sense : it captures exactly all polynomial behaviours, and no algorithm can capture non-polynomial behaviours.

Mai GEHRKE and Jean-Éric PIN: *From profinite words to ultrafilters on words : a research programme*

In two earlier papers, Gehrke, Grigorieff and Pin proved the following results :
(1) Any Boolean algebra of regular languages can be defined by a set of equations of the form u = v, where u and v are profinite words.
(2) Any Boolean algebra of languages can be defined by a set of equations of the form u = v, where u and v are ultrafilters on the set of words.
These two results can be summarized by saying that Boolean algebras of languages can be defined by ultrafilter equations and by profinite equations in the regular case. We will discuss some consequences and some hopes regarding these two results.

Thomas GENET: *Towards static analysis of functional programs using term rewriting and tree automata.*

Tree Automata Completion is an algorithm computing, or approximating, terms reachable by a term rewriting system. For many classes of term rewriting systems whose set of reachable terms is known to be regular, this algorithm is exact. Besides, the same algorithm can handle **any** left-linear term rewriting system, in an approximated way, using equational abstractions. Thanks to those two properties, we will see that regular languages and tree automata completion provide a promising alternative for automatic static analysis of functional programs.

Hugo GIMBERT: *Two-Player Perfect-Information Shift-Invariant Submixing Stochastic Games Are Half-Positional.*

We show that two-player stochastic games with perfect-information and shift-invariant submixing payoff functions are half-positional, i.e. in these games the maximizer has a positional optimal strategy. This extension of our previous result for one-player games relies on an interesting existence result about the existence of epsilon-subgame-perfect strategies.

Pierre-Cyril HEAM: *Tree automata with a fixed number of constraints.*

Emmanuel JEANDEL: *Decision problems for matrix automata.*

Matrix automata are generalizations of probabilistic automata where the underlying matrices are not supposed to be stochastic, A key example being the class of quantum automata as defined by Moore and Crutchfield. I will give some criteria for the language recognized by a matrix automaton to be regular, and (un)decidability results for the decision problems associated to them.

Manfred KUFLEITNER: *Ehrenfeucht Fraisse Games on Omega-Terms.*

Identities of omega-terms are an effective way of defining classes of regular languages. We show how to translate omega-terms u, v into linear orders. The translation we propose has the

property that a winning strategy for Duplicator in the EF game for some first-order fragment on the linear orders corresponds to membership in the class defined by the identity $u = v$. A surprising application of this line of work is the word problem for omega-terms over some variety of finite monoids. This is joint work with Martin Huschenbett.

Denis KUPERBERG: *Quasi-weak cost functions on infinite trees.* Abstract : I will present

results on cost functions on infinite trees, and in particular properties of a class of function called quasi-weak. This class is one of the two generalizations to cost functions of the class of weak languages. I will explain how it was naturally defined, describe its good closure and decidability properties and equivalent formalisms, and finally show how it can by applied to decide weak definability for Büchi languages of infinite trees.

Sylvain LOMBARDY: *Conjugacy and stabilization of weighted automata.*

The conjugacy is an algebraic relation between two automata. It implies the equivalence of the behaviours and, in many cases, the equivalence of weighted automata implies the existence of a chain of conjugacies. We focus in this talk on stabilization procedures, which are a way to build conjugate pairs of automata and we show that determinization, sequentialization or reduction of automata are particular cases of stabilization.
Join work with Marie-Pierre Béal and Jacques Sakarovitch.

Arthur MILCHIOR: *Deterministic automata, numbers, and weak logic.*

In this talk, we will consider set of tuples of integers (resp. reals). If such a set is recognized by a finite deterministic automaton (resp. a Büchi automaton) reading base b number, then it is definable in the logic FO[+,<,V_b] (resp. FO[+,<,X_b]) where V_b (resp. X_b) is a predicate that depend on the basis b. We are going to give idea of algorithms that decide, in polynomial time, if the set accepted by an automaton, could be defined in a less expressive logic FO[+,<], FO[<,Mod], FO[+1,mod].

Thomas PLACE-Marc ZEITOUN-Lorijn van ROOIJEN:
Separation : what is it ? why should you try it ?
Deciding levels 2 and 5/2 in the first-order quantifier alternation hierarchy.
Separation by first-order logic.
Separation by the 2-variable fragment of first-order logic.

In this series of three talks, we will present the separation problem and our motivations for it, and how it can be used to investigate the expressive power of logical fragments.
First talk : We will present a generalized view on the separation problem of word languages. Then, we will explain how this can be used to give decidable characterizations for levels 2 (boolean combination of formulas with a single alternation) and level 3 (formulas with two alternations) in the first-order logic quantifier alternation hierarchy.
We will then present two instances of the separation problem over words in the following talks.

Gabriele PUPPIS: *On the use of guards for logics with data.*

I will present an extension of algebraic techniques to the study of data languages - i.e. languages over an infinite alphabet. More precisely, I will focus on the class of data languages recognized by orbit-finite data monoids, originally defined by Bojanczyk. I will then present a logic, called rigidly guarded MSO, that captures exactly the same class of data languages and prove a result akin to Schutzenberger-McNaughton-Papert Theorem : a data language is definable in rigidly

guarded FO iff it is recognized by an aperiodic orbit-finite data monoid. The talk represents joint work with Thomas Colcombet and Clemens Ley.

Fabian REITER: *Distributed Graph Automata.*

Inspired by distributed algorithms, I introduce a new class of finite graph automata that recognize precisely the graph languages definable in monadic second-order logic. For the cases of words and trees, it has been long known that the regular languages are precisely those definable in monadic second-order logic. In this regard, the automata proposed in this talk can be seen (to some extent) as a generalization of finite automata to graphs.

Sylvain SALVATI: *TBA*

Sam van GOOL: *The boundedness problem : towards a duality approach.*

In this talk I will report on the state of a currently in-progress research project joint with Mai Gehrke and Lorijn van Rooijen. Our goal in this project is to provide a unified, duality-theoretic setting for deciding boundedness problems of several classes of weighted automata. Starting from the observation that several tropical semirings may be viewed as lattices of downsets of the natural numbers with addition, we show how structures that are built from these using simple duality methods can be used to study the boundedness problem. As a test case, we set in this light the well-known decision procedure for boundedness of distance automata given by Leung (1998), also basing ourselves on ideas from Torunczyk (2011).

Igor WALUKIEWICZ: *Models of the lambdaY-calculus for weak monadic second-order logic.*

The talk is based on a joint work with Sylvain Salvati. LambdaY-calculus is simply typed lambda calculus with fixpoint operators. This calculus faithfully models control in higher-order programs. The semantic of a program represented by a lambdaY-term is a tree reflecting the control flow of the program.
We describe a model construction calculating properties of trees generated by lambdaY-terms : the value of term in a model determines if the tree generated by the term has the given property. The construction works for all properties expressible in weak monadic second-order logic. This construction allows to obtain a (decidable) typing system for the model-checking problem. It gives a "verification by evaluation" approach to model-checking, and it opens a possibility of modular verification of large programs.