DAAST 2010, November 25-26 Vienna, Austria
Program and abstracts

Wednesday

18:00 Welcome reception at Hotel Johann Strauß (Favoritenstraße 12, 1040 Wien) and 1st Registration.

Thursday

09:00-10:00 Julien Cassaigne

10:00-10:30 Coffee break

10:30-11:30 Pedro Silva
11:30-12:30 Søren Eilers

12:30-14:00 Lunch break

14:00-15:00 Avraham Trahtman

15:00-15:30 Coffee break

15:30-16:30 Véronique Bruyère
16:30-17:30 Pavel Martyugin

18:00 Dinner at Restaurant Kruegerl (1010 Wien, Burgring 1)

Friday

09:00-10:00 Dominique Perrin

10:00-10:30 Coffee break

10:30-11:30 Antonio Restivo
11:30-12:30 Mikhail Berlinkov

12:30-14:00 Lunch break

14:00-15:00 Rune Johansen

15:00-15:30 Coffee break

15:30-16:30 Mikhail Volkov

Approximating lengths of reset words

Mikhail Berlinkov

Ural State University, Ekaterinburg, Russia

We prove that unless P=NP, no polynomial-time algorithm approximates within a constant factor the minimal length of reset words for a given synchronizing automaton. Furthermore, we prove that unless P=NP, no polynomial-time algorithm approximates within factor 2 the minimal length of reset words among all valid relabelings of a given synchronizing automaton.

Around Cobham's theorem and some of its extensions

Véronique Bruyère

University of Mons, Belgium

Cobham's theorem states that sets of natural numbers that are recognizable by finite automata in every base are necessarily a finite union of constants and arithmetic progressions. More precisely, such a situation happens as soon as the set of natural numbers is recognizable in two bases that are multiplicatively independent, like 2 and 3, or 2 and 6. It follows that the set of powers of 2 are recognizable only in bases that are a power of 2.

In this talk, we present some extensions of Cobham's theorem, first to sets of tuples of natural numbers, second to sets of real numbers and finally to sets of tuples of real numbers.

In the context of real numbers, the automata are non-deterministic Büchi automata, or weak deterministic Büchi automata. We will explain what is the appropriate statement of Cobham's theorem in this context, and we will see that the hypothesis on the bases has to be modified. The study is based on properties of automata, number theory and logical characterizations.

Dynamics of Rauzy graphs for low complexity words

Julien Cassaigne

Institut de mathématiques de Luminy, Marseille, France

The Rauzy graphs G_n, or factor graphs, describe the set of finite words of each length n that occur in a given infinite word u. They may also be viewed as a sequence of finite automata that produce finer and finer approximations of the language of factors of u. Here we are interested in how the shape of G_n evolves when n grows. In particular, when the factor complexity of u grows slowly, they may only have finitely many different shapes and their dynamics has some similarity with continued fraction expansions. This allows to characterize certain classes of words, and to make a little progress on the difficult question of determining which complexity functions are realizable.

Flow invariants for irreducible sofic systems

Søren Eilers

University of Copenhagen, Denmark

Whereas the signed Bowen-Franks group provides a complete and easily computable invariant for flow equivalence of irreducible shifts of finite type, we are very far from being able to provide complete invariants for irreducible sofic shifts. In joint work with Boyle and Carlsen we have managed to prove classification results for various subclasses of sofic systems, and I intend to give an overview of these results with an emphasis on what invariants turn out to be complete there. Perhaps this may lead to ideas of what kind of invariants could be used in general.

On the structure of covers of sofic shifts

Rune Johansen

University of Copenhagen, Denmark

A canonical cover generalizing the left Fischer cover is introduced and used to prove that the left Krieger cover and the past set cover of an arbitrary sofic shift can be divided into natural layers. These results are used to investigate the structure of the covers and to find the range of a flow-invariant.

Synchronizing Words and Carefully Synchronizing Words

Pavel Martyugin

Ural State University, Ekaterinburg, Russia

A deterministic finite automaton with totally defined transition function is called synchronizing if there exists a word which maps all states of this automaton to one state. We consider a synchronization for automata from some subclasses of the class of all deterministic automata. For automata from these subclasses we discuss the maximal length of the shortest synchronizing word. We also discuss the complexity of checking whether a given automaton is synchronizing or not and the complexity of finding the length of the shortest synchronizing word. We also consider the generalization of the synchronization to the class of automata with partially defined transition function. Such generalization is called careful. For careful synchronization we consider the same problems as for synchronization.

Syntactic invariants for sofic shifts

Dominique Perrin

Université Paris-Est, France

In this talk, I will present a survey of the material covered in the chapter "Symbolic Dynamics" (coauthored by Marie-Pierre Béal, Jean Berstel, Soren Eilers and myself) of the Handbook of Automata in preparation. One of the results is the description of the syntactic graph of an automaton and its invariance under the symbolic conjugacy of automata.

Minimality Conditions on Automata

Antonio Restivo

Universitá degli studi di Palermo, Italy

In this talk we investigate the minimality problem of (strongly connected) DFAs by varying the set of final states. In other words, we are interested on how the choice of the final states can affect the minimality of the automata. State-pair graph is an useful tool to investigate such a problem. The choice of a set of final states defines a coloring of this graph and the minimality corresponds to a property of the colored graph. A particular attention is devoted to the analysis of some extremal cases such as, for example, the automata that are minimal for any choice of final states (uniformly minimal automata) and the automata that are never minimal, under any assignment of final states (never-minimal automata). More generally, we seek to characterize those families of automata and show that some of them are related to well-known objects in a different context (e.g. multiple-entry automata and Fisher covers of irreducible sofic shifts in Symbolic Dynamics). Next, we study the complexity of the related decision problems and show, in some cases, how to derive a polynomial algorithm. In the case of never-minimal automata the problem of the existence of a polynomial algorithm is open. We remark that this last problem is related to the "syntactic monoid problem".

Fixed points of endomorphisms over special confluent rewriting systems

Pedro V. Silva

University of Porto, Portugal

Gersten proved in the eighties that the fixed point subgroup Fixφ of an automorphism φ of a free group F_n is f.g. Cooper gave an alternative proof, proving also that the fixed points of the continuous extension of φ to the boundary of F_n is in some sense finitely generated. Such results were generalized to further classes of groups and endomorphisms in subsequent years.

On the other hand, Cassaigne and the author considered monoids defined by special confluent rewriting systems, generalizing some of the features of the F_n case. In fact, the undirected Cayley graph of these monoids is hyperbolic and has a quite convenient (compact) completion for the prefix metric: infinite reduced words. Uniformly continuous endomorphisms (algorithmically characterized) admit a continuous extension to the boundary.

In 2009, the author pursued this same approach to prove finite generation properties for both finite and infinite fixed points, centered on two properties of endomorphisms: boundary-injectivity and bounded length decrease. In the group case, the first property provides new proofs for already known results for monomorphisms of free groups and more generally free products of cyclic groups, as well as a new result on the infinite fixed points for monomorphisms of the latter.

However, all these results require uniform continuity for the prefix metric, i.e. injectivity in the group case. Thus it was a natural follow-up to consider arbitrary endomorphisms. Goldstein and Turner's beautiful proof for free group endomorphisms strongly requires group inversion, and the unique monoids of our type which embed into groups are free products of free monoids and cyclic groups. So free products of cyclic groups become the crucial case, and the proof can be generalized after overcoming some technical dificulties brought by finite order elements. We obtain thus a fully automata-theoretic proof of a result of Sykiotis, which may offer some insight into the algorithmic aspects of the problem. With respect to computability of Fixφ, we can generalize Maslakova's theorem to endomorphisms of $A^* * F_n$ whose restriction to F_n is an automorphism.

The distribution of length of synchronizing words and upper bound on the length.

A.N. Trahtman

Bar-Ilan University, Israel

The synchronizing word of a deterministic automaton is a word in the alphabet of colors on its edges that maps states of the automaton to a single state. A coloring of edges of a directed graph is synchronizing if the coloring turns the graph into a deterministic finite automaton possessing a synchronizing word. The talk discusses the distribution of length of synchronizing words of relatively small automata found by some programs of the package TESTAS. The study was encouraged by well known Černy conjecture. Some new information will be presented. The solution of the road coloring problem has stimulated a lot of generalizations, connected mostly with Černy conjecture. Results in this area also are a topic of the talk. The information will be illustrated by a graph visualization program.

P(l)aying for synchronization.

Mikhail Volkov

Ural State University, Ekaterinburg, Russia

Two topics will be presented: synchronization games and synchronization costs.

In a synchronization game on a deterministic finite automaton, there are two players, Alice (Synchronizer) and Bob (Desynchronizer), whose moves alternate. Alice who pays first wants to synchronize the given automaton, while Bob aims to make her task as hard as possible. We answer a few natural questions related to such games.

Speaking about synchronization costs, we consider deterministic weighted automata, that is, deterministic automata in which each transition has a certain price being a non-negative integer. The problem is whether or not we can synchronize a given automaton within a given budget. We determine the complexity of this problem.