LANFOR 95

report by the organisers:
Igor Litovsky (Nice) and Géraud Sénizergues (Bordeaux 1)

The meeting of the group **LANFOR** (**FOR**mal **LAN**guages) of AFCET was held in Gourette (Pyrénées atlantiques, France) from 21/03/95 (evening) up to 25/03/95 (morning).

Nineteen searchers have joined the meeting. They were coming from the universities of Bordeaux 1, Marne la vallée, Montréal, Nice, Paris 8, Paris 11, Tsukuba.

Hubert Comon (a prominent searcher in the field of Rewriting, Logics and other connected topics), gave 3 didactic conferences on the theme:

Term Rewriting and Formal language theory.

(H. Comon has a current position of Research Director of CNRS at LRI, Paris 11 university,
`E-mail : comon@lri.lri.fr`).

We give below the abstracts of the other conferences.

Kronecker product of graphs and local computations in graphs

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Local computations on graphs are formalized as modifications of labels (or states) attached to vertices or edges. Modifications are decided locally: there exists a constant k such that a new label attached to a vertex or to an edge depends solely on the part of the graph which is at distance less than k. When studying the power and the limitations of local computations we can used a powerful tool: covering. It is useful for proving negative result: if a family of graphs is recognizable by local computations, it must be closed under covering.

In order to construct a covering of a given graph, we can use the Kronecker product by the complete graph with two vertices. So we decide to study some properties of the Kronecker product linked to automorphism, cut-edge, cut-vertex, planarity, and graphs minors. Then we used the constructions to get impossibility results on local computations.

Sur les mots obtenus par substitution

by Srećko Brlek
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Il y a plusieurs manières de générer des mots infinis sur un alphabet fini: itération de morphismes, automates, grammaires, substitution, etc.. Nous nous proposons de donner un aperçu des propriétés qui sont étudiées dans le cas spécifique des substitutions. Soit Σ un alphabet fini, une substitution est une fonction $f : \Sigma^n \longrightarrow \Sigma^m, m \geq n$, et on engendre un mot infini en itérant la fonction f comme suit:

$$\begin{aligned} u_0 &= u[1]u[2]u[3]\cdots u[n] \\ u_k &= u.f(u[k*n+1]\cdots[k*(n+1)]) \end{aligned}$$

Nous donnerons quelques résultats généraux concernant la périodicité, la récurrence, la densité, et regarderons de plus près certains exemples de mots obtenus par substitution: mot de Kolakoski, suite denombrant les nombres triangulaires, suite auto-similaires, etc....

Cyclic languages and languages of stabilizers by Olivier Carton

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We prove that cyclic languages are the boolean closure of languages called languages of stabilizers. The result is used to give another proof of the rationality of the zeta function of rational cyclic languages. We also introduce a hierarchy of cyclic languages characterized by chains of idempotents.

Object grammars : enumerations, bijections and substitutions

by Isabelle Dutour
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The formalism for *object grammars* is a generalization of algebraic grammars. An object grammar can be viewed as a extension for Schützenberger methodology. We use a system of recursive equations in order to define a set of combinatorial objects such as words, trees, graphs or polyominoes. Applications are in the fields of *enumerations* and *bijection buildings*.
One can build some bijections between the set of objects generated by *isomorphic* objects grammars. The main result is that starting from two objects grammars of dimension 1 and degree ≥ 2, we are able to construct two isomorphic objects grammars by executing some sequences of substitutions, known also as transformations by *unfolding*.

Number Representation and Automata Theory

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Finite automata are a simple model of computation since only a finite memory is required. Addition base k, where k is an integer ≥ 2, is a function computable by a finite automaton.

We consider the representation of positive integers in a system defined by a linear recurrent sequence, like the sequence of Fibonacci numbers. An integer may have several representations. The function of normalization maps any representation of an integer to the normal one, obtained by a greedy algorithm. Addition is a special case of normalization. We give conditions on the linear recurrence under which normalization can be computed by a finite automaton.

Similarly one can represent a real number in base β, where β is a real number > 1, for instance the golden mean. We show that normalization is computable by a finite automaton on any alphabet if and only if β is a Pisot number.

We show that there is a finite automaton mapping the Fibonacci representation of any integer onto its expansion in base the golden mean φ, provided the latter is folded around the radix point. So the set of φ-expansions of all the integers is a context-free linear language. These results are actually proved in the more general case of quadratic Pisot units. Conversely, only quadratic Pisot units have this property.

These questions are related to Number Theory and Symbolic Dynamics.

Partial confluence for a rational, basic and noetherian semi–Thue system over a rational set is decidable

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We give here a sketch of the algorithm which proves the above theorem. The notion of meta–rules for rational semi–Thue systems (STS for short) leads us to consider the notion of meta–critical pairs. It is proved that rational STSs have a finite number of meta critical pairs which are built as pairs of rational languages. These meta critical pairs, once put in LL.UI normal form (LL.UI stands for Leftmost Longest, Until Irreducible) remain pairs of rational sets

A given rational, basic and noetherian STS T is partially confluent over a rational set L iff for each meta critical pair put in LL.UI normal form:(U, V) and given a word $m \in U \cup V$, the following property holds: $L_m = L_{U \cup V}$

with $L_m = \{p\#v\#s/p, s \in IRR(T), v \in U \cup V, pms \rightarrow [T]_{LL.UI} \in L\}$

and $L_{U \cup V} = \{p\#v\#s/p, s \in IRR(T), v \in U \cup V, pvs \rightarrow [T]_{LL.UI} \in L\}$

On ω-codes generators of ω-languages

by S. Julia
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We consider languages L of infinite words called ω-languages over Σ, a finite alphabet. A language W of finite words is said to be an ω-code when each ω-words obtained by infinite concatenation of non-empty words of W has one and only one decomposition over W. Deciding whether a rational ω-language is generated by an ω-code is an open problem which admits some partial solutions. Indeed, the main one, due to I.Litovsky (1991) claims that one can decide whether an ω-language L have a prefix-free code as generator. Further results can be obtained considering classes strictly included between prefix code and ω-code ones. Moreover, if we assume that LL^{-1} is generating by a suffix code, we can decide whether L has a generator ω-code or not.

Dummy Elimination By Self-labelling

by Aart Mideldorp
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Termination is one of the fundamental properties of term rewriting systems. Since termination is undecidable in general it is important to develop methods that make the task of proving termination easier. In this talk we are concerned with two such methods, Zantema's distribution elimination and the recent dummy elimination technique of Ferreira and Zantema. We apply self-labelling, a particular kind of Zantema's semantic labelling, to both methods, resulting in stronger results. The power of self-labelling is illustrated on a few other examples as well. The talk is based on joint work with Maria Ferreira, Hitoshi Ohsaki, and Hans Zantema.

Zigzag codes and defect theorem

by Bruno Patrou
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Our talk concerns the zigzag operation introduced by M. Anselmo and which is an extension of the star operation. First we recall some notions known for the star operation: the definition of code, of free and stable submonoid and also the defect theorem in connexion with the notion of free hull. In the second part we see how to extend these notions to the zigzag operation. The definitions of z-code and z-freeness are relatively natural. Also is the definition of z-stability but much more complicated. Concerning the notion of z-free hull, we see that a language can have several z-free hulls (when the free hull is unique). We give a language having an infinity of z-free hulls (but which is not regular). At last, we see that the defect theorem is not always verified by each z-free hull of a given language but it is an open problem to know if every language has at least one z-free hull verifying the theorem.

Automorphism groups of context-free graphs

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We study here the automorphism group of context-free graphs (this kind of graphs was introduced by Muller and Schupp in 1983). The automorphism group of a context-free graph is proved to be finitely generated if and only if the stabilizer of a vertex is finite. An algorithm is given to construct a set of generators if the group is finitely generated. It is then shown that a finitely generated group is context-free if and only if it is the automorphism group of a deterministic rooted context-free graph.

Simulating Forward-Branching Systems with Constructor Systems

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Strongly sequential constructor systems admit a very efficient algorithm to compute normal forms. Thatte found a transformation that allows us to simulate any orthogonal system with a constructor system. Unfortunately, this transformation does not generally preserve strong sequentiality. On the other hand, the class of forward-branching systems contains the class of strongly sequential constructor systems. Moreover, it admits a reduction algorithm similar to the reduction algorithm of the strongly sequential constructor class. In this talk, we present a new transformation which transforms any forward-branching system into a strongly sequential constructor system. The size of the system increases only modestly over that of the original one in many practical situation. We give an algorithm for this transformation and we show its correctness and completeness. The new system is then proved to be equivalent to the input system, with respect to the behavior and the semantics.

The Chromatic Number of Oriented 3-bounded Graphs

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Let G and H be two (oriented) graphs. An homomorphism from G to H is a mapping μ from $V(G)$ to $V(H)$ such that for any (arc) edge (x, y) in $E(G)$, $(\mu x, \mu y)$ is an (arc) edge in $E(H)$. If there exists an homomorphism from G to H, we will write $G \to H$ and say that G is H-colorable. The chromatic number of an undirected graph G may be equivalently defined as the minimal order of an undirected graph H such that there exists an homomorphism from G to H. By considering now oriented graphs (that is antisymmetric directed graphs), we obtain a natural generalisation of the notion of chromatic number. In this paper, we study the chromatic number of oriented 3-bounded graphs. We know that this chromatic number is at most 16. We show that this bound can be decreased to 11 and conjecture that there exists no such connected graph with chromatic number greater than 7.