LANFOR

Groupe de Travail sur les Langages Formels

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S.Julia and G.Sénizergues

Abstracts

Automata coverings

Jacques Sakarovitch
(CNRS/ENST, Paris)

Abstract Three invited lectures on the notion of automata coverings and its applications.
Lecture 1 : Synchronization of automata
Lecture 2 : Uniformization of rational relations
Lecture 3 : A skimming theorem for rational power series

References
A construction on automata that has remained hidden, TCS 204 (1998) 205–231.
Synchronized relations (in collaboration with Ch. Frougny) TCS 108 (1993) 45–82
On the representation of finite deterministic 2-tape automata (in collaboration with M. Pelletier) TCS 225 (1999) 1–63
Eléments de téorie des automates,à paraître.
The slides of the talks can bre accessed at URL:
http://www.i3s.unice.fr/ julia/LANFOR/essai/essai.html

A finite state version of the Kraft-McMillan theorem

Marie-Pierre Béal
(Joint work with F. Bassino and D. Perrin)
(Institut Gaspard-Monge, Marne-la-Vallée)

Abstract We introduce the notion of super-state automaton constructed from another automaton. This construction is used to solve an open question about

enumerative sequences of leaves of rational trees. We prove that any N-rational sequence $s = (s_n)_{n\geq 0}$ of nonnegative integers satisfying the Kraft inequality $\sum_{n\geq 0} s_n k^{-n} \leq 1$ is the enumerative sequence of leaves by height of a k-ary rational tree. This result is a finite state version of the Kraft-McMillan theorem. We then use it to completely characterize the series that are the enumerative sequence of nodes in a k-ary rational tree.

A categorical approach for node rewriting in graphs. (The pullback approach)

Hélène Jacquet
(LaBRI, Bordeaux I)

Abstract The main goal of my talk was to show that an approach based on the categorical concept of *pullback* - in the category of directed graphs (with multi-edges and loops) - can provide a framework to describe node rewriting in graphs. The distinctive feature of this formalism lies in two facts : first, the labelling of a graph is done thanks to a morphism to a particular graph - called *the alphabet graph* - and second, a rule is defined as a morphism to this alphabet graph too. It follows that the application of a rule to a graph is automatically given by the pullback of this couple of morphisms. The relationship between the well-known NLC and $edNCE$ approaches is investigated and it is demonstrated that for each underlying $edNCE$ generated language, one can obtain one equivalent pullback generated language. Finally, pullback rewriting can be extended to hypergraphs and furthermore to *structured graphs* which can be seen, in some sense, as a generalization of graphs.

Keywords Graph, Hypergraph, Graph rewriting, Language, Product, Pullback, Node, Categories

References A uniform approach to graph rewriting: The pullback approach, Michel Bauderon. In Manfred Nagl, editor, *Graph-Theoretic Concepts in Computer Science*, volume 1017 of *Lecture Notes in Computer Science*, pages 101–115, 1995.
Categorical product as a generic graph rewriting mechanism, M. Bauderon and H. Jacquet.. To appear in *Applied Categorical Structures*, 1998.
Une approche catégorique de la réécriture de sommets dans les graphes, Hélène Jacquet, *Thèse de Doctorat, Université Bordeaux 1*, 1999.

Asynchronous sliding block maps

Olivier CARTON
(Joint work with Marie-Pierre Béal)
(Institut Gaspard-Monge, Marne-la-Vallée)

Abstract We define a notion of asynchronous sliding block map that can be realized by transducers labeled in $A^* \times B^*$. We show that, under some conditions, it is possible to synchronize this transducer by state splitting, in order to get a transducer which defines the same sliding block map and which is labeled in $A \times B^k$, where k is a constant integer. In the case of a transducer with a strongly connected graph, the synchronization process can be considered as an implementation of an algorithm of C. Frougny and J. Sakarovitch of synchronization of rational relations of bounded delay. The algorithm can be applied in the case where the transducer has a constant integer transmission rate on cycles and has a strongly connected graph. It keeps the locality of the input automaton of the transducer. We show that the size of the sliding window of the synchronous local map grows linearly during the process, but that the size of the transducer is intrinsically exponential. In the case of non strongly connected graphs, the algorithm of C. Frougny and J. Sakarovitch does not keep the locality of the input automaton of the transducer. We give another algorithm to solve this case without losing the good dynamic properties that guarantees the state splitting process.

Some Algorithms to test ω-codes

Xavier AUGROS
(I3S, Nice)

Abstract

Let Σ be a finite alphabet. We denote by Σ^* (respectively Σ^ω) the set of words (resp. infinite words) over Σ. Given L subset of Σ^*, the language L^* (resp. L^ω) is the set of finite words (resp. infinite words) factorizable over L. A language L is a code if every word of L^* has a unique factorization over C. L is an ω-code if every word of C^ω has a unique factorization over L.

We give two algorithms which test if a given language L is an ω-code without using the power-*omega* of L:

- the first one, for finite languages, is the construction of a graph, called graph of delay, which can be seen as an automaton that recognize finite or infinite words with at least two factorizations over L.

- and the second one, for rational languages.

Reference
L. Staiger,"On infinitary finite length codes', *Theoretical Informatics and Applications*, 24(4):483–494, 1986.

Window-Accumulated Subsequence matching Problem is linear
Irène Guessarian
(Joint work with Luc Boasson, Patrick Cegielski and Yuri Matiyasevich)
(LIAFA, Paris)

Abstract
Given two strings, text t of length n, and pattern $p = p_1 \dots p_k$ of length k, and given a natural number w, the subsequence matching problem consists in finding the number of size w windows of text t which contain pattern p as a subsequence, i.e. the letters $p_1, \dots, p_k$ occur in the window, in the same order as in p, but not necessarily consecutively (they may be interleaved with other letters). Subsequence matching is used for finding frequent patterns and association rules in databases. We generalize the Knuth-Morris-Pratt (KMP) pattern matching algorithm; we define a non-conventional kind of RAM, the MP–RAMs which model more closely the microprocessor operations; we design an $O(n)$ on-line algorithm for solving the subsequence matching problem on MP–RAMs.

On effective decidability of the homeomorphism problem for equational non-compact surfaces
Olivier LY
(LABRI, Bordeaux)

Abstract Here is investigated an interpretation of graph rewriting system as surface gluings. A graph is usually represented as a topological space made of points and edges. As a generalisation, a hypergraph having hyperedges of arity 3 can be interpreted as a topological object made of triangles. Following this way, equational hypergraphs can be used to define some non-compact surfaces. We show that the homeomorphism problem regarding this kind of non-compact surfaces is decidable. The main point consists in encoding of the space of ends by regular languages of infinite words. These languages are then studied using a method due

to Head which based on a special kind of boolean algebras.

T(A) = T(B)?

Géraud Sénizergues
(LABRI, Bordeaux)

Abstract The equivalence problem for deterministic pushdown transducers with inputs in a free monoid X^* and outputs in a linear group $H = \mathrm{GL}_n(\mathsf{Q})$, is shown to be *decidable*.
We first reduce the problem to the equivalence problem for deterministic rational series on the alphabet associated with a dpdt $\mathcal{M}$ and with coefficients in the group H. We then exhibit a *formal system* which generates only equivalent pairs of such series. Conversely, every pair of equivalent series admits a *regular proof*. Using previous works on test-sets, we show that the set of "regular" proofs is recursively enumerable.
As a corollary, the equivalence problem for dpdt's from a free monoid X^* into a free group $\mathrm{F}(Y)$ (or, a fortiori, a free monoid Y^*), is decidable.

Keywords
deterministic pushdown transducers; rational series; finite dimensional vector spaces; matrix semi-groups; test-sets; complete formal systems.

Reference
report nr 1209-99, LaBRI, can be accessed at
URL:http://www.labri.u-bordeaux.fr/~ges