SYNASC09 - Advances in the Theory of Computing

On the Existence of Complete Disjoint NP-Pairs

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Abstract—Disjoint NP-pairs are an interesting model of computation with important applications in cryptography and proof complexity. The question whether there exists a complete disjoint NP-pair was posed by Razborov in 1994 and is one of the most important problems in the field. In this paper we prove that there exists a complete disjoint NP-pair which is computed with access to a very weak oracle (a tally NP-oracle). In addition, we exhibit candidates for complete NP-pairs and apply our results to a recent line of research on the construction of hard tautologies from pseudorandom generators.

A depth-first algorithm to reduce graphs in linear time

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Abstract—A redex in a graph G is a triple r = (u, c, v) of distinct vertices that determine a 2-star. Shrinking r means deleting the center c and merging u with v into one vertex. Reduction of G entails shrinking all of its redexes in a recursive way, and, at the same time, deleting all loops that are created during this process. It is shown that reduction can be implemented in O(m) time, where m is the number of edges in G.

Factorizations of Regular Hedge Languages

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Abstract—Regular hedge languages are an extension of regular tree languages that received renewed attention since their recognition as a suitable formal model of XML schemata. They share many properties with regular languages, but their study is more difficult because we need to analyze regularities of sequences of trees instead of words. In this paper we show that one
shared property is the existence of only finitely many language factors and the possibility to arrange them in a factor matrix with several remarkable properties. We outline an algorithm for the computation of the factor matrix and indicate a concrete application of the factor matrix of an RHL to the solution of a practical problem.

Algorithms for Identifying Sequence Patterns with Several Types of Occurrence Constraints

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Abstract—In this paper we present efficient algorithmic techniques for identifying several types of patterns related to sequences, like the problem of detecting the maximum weight contiguous subsequence which has the structure of a permutation with repetitions, the problem of finding a shortest non-(contiguous subsequence) of a sequence, and an online problem related to the constrained guessing of a secret sequence.

Classes of Szilard Languages in NC^1

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Abstract - We prove that Szilard languages of context-free grammars (CFGs), with no restriction on derivations, can be simulated by an indexing alternating Turing machine (indexing ATM) in logarithmic time and space. The same result holds for leftmost Szilard languages associated with context-sensitive grammars (CSGs). Since the class of languages recognizable by an indexing ATM in logarithmic time equals the UE-uniform NC^1 class [9], we obtain that the above classes of Szilard languages are included in NC^1. The inclusions are strict, since there exist languages in NC^1 that cannot be Szilard languages of CFGs or CSGs.

A Methodology for Parallel and Distributed Languages Development Based on Denotational Semantics

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Abstract—Using the continuation semantics for concurrency technique, denotational semantics can be used both as a formal specification and as a general method for designing compositional prototypes for parallel and distributed languages. A denotational specification produces an element of a classic powerdomain structure. A denotational prototype designed with continuation semantics for concurrency produces incrementally a single execution trace, and uses a random number generator to model the nondeterminism of a ”real” distributed language. We prove that the (single) trace produced by the denotational prototype is always an element of the collection of traces that is produced by the denotational specification; this result is independent of the random number generator that is given as a parameter to the denotational prototype. We present a parallel and distributed language development methodology based on denotational semantics. We illustrate this methodology on the particular example of a CSP-like language extended with communication on multiple channels and synchronization based on join patterns. We employ techniques of metric semantics in designing and relating a denotational specification and a denotational prototype for such a language.