Parallel Algorithms for Finite Automata Problems

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Abstract. Finite automata are among the most extensively studied and well understood models of computation. They have wide ranging applications - for example, in image compression, protocol validation, game theory and computational biology just to mention only some recent ones. Here we will attempt to present a comprehensive survey of parallel algorithms for many fundamental computational problems on finite automata. It is well known that fundamental analysis problems involving *deterministic* finite automata have polynomial time algorithms, but the problems become hard when the input automata are nondeterministic. A similar difference is observed for parallel algorithms: most problems involving DFA as input have NC algorithms, while such algorithms are unlikely with NFA as input.

The class of problems we will study include the following: (1) The classical decision problems such as containment, equivalence and minimization. (2) Ranking and unranking, lexical successor, lexically first string of a given length, etc. (3) Coarsest partition problems for sets and relations. (4) Finding a homing sequence, a synchronizing sequence and related problems. (5) Converting regular expression to NFA.

Many of the NC algorithms for these problems use transitive closure computation and hence are not practical. In some cases, we are able to establish efficient algorithms (*on average*) that avoid transitive closure computations. We also discuss issues involved in practical implementations of these algorithms and present results on the performance of some parallel algorithms in practical experiments. Finally, we list a number of open problems and provide some possible directions in attacking them.

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