

CISC-499 Projects 2014–15

Kai Salomaa
School of Computing, Queen’s University
ksalomaa [AT] cs [DOT] queensu [DOT] ca

1. Transforming regular expressions to finite-state machines

Given a regular expression of length n , what is the worst-case size of the minimal deterministic finite automaton (DFA) for the language? An exponential upper bound is known but average regular expressions can be implemented more efficiently.

The main goal of this project is to generate libraries of “random” regular expressions and determine their state complexity. The regular expression-to-DFA transformations, as well as, the minimization of the DFAs can be automated using the *Grail* environment.

The second goal is to find different types of “bad” examples: regular expressions where the equivalent minimized DFA is large.

Grail is a symbolic computation environment for finite-state machines and language objects. It provides a large collection of operations to convert finite-state machines to regular expressions or vice versa.

2. Finite automata on trees: implementing basic operations

Tree automata are an extension of finite automata that operate on trees instead of strings. Many of the well known constructions and algorithms for finite automata extend in a natural way to tree automata that process inputs from the leaves to the root.

The goal of this project is to implement some basic operations for tree automata: (for example) the cross-product construction and the determinization of nondeterministic automata. One should design a suitable symbolic (Grail like) representation for the tree automata.

If desired, this project can be expanded for a group of 2 people: the expanded version could include (for example) simulation of automata on generalized trees where the number of children of a node is not limited. The transitions of an automaton operating on the unranked trees are specified using regular expressions.

3. Other projects

I have available some additional topics – please come to see me in my office or send me email. If you have your own idea for a project related to my research, please come to talk with me about it.