CISC-499 Projects 2013–14

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1. **Transforming regular expressions to finite-state machines**

   Given a regular expression of length n, what is the worst-case size of the minimimal 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. **Template-guided recombination**

   Template-guided recombination (TGR) is a formal model for the gene descrambling process occurring in certain unicellular organisms (stichotrichous ciliates). The mechanism by which these genes are descrambled is of interest both as a biological process and as a model of natural computation.

   This project studies template guided recombination as an operation on strings and languages with a goal to better understand its computational capabilities. A goal is to implement a TGR simulator with *Grail*-like input/output format that can be used in experiments to study the complexity of the operation. *Grail* is a symbolic computation environment for finite-state machines and language objects.

   Optionally the project may include experiments on the state complexity of the TGR-operation.

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.