Names:

Project 2: SATPlan and the Tower of Hanoi

CSCI 561

Fall 2018

The *Tower of Hanoi* is a classic puzzle consisting of round disks stacked on pegs. One must move all disks to the final peg, subject to the following constraints:

1. Only one disk can be moved at a time.
2. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack.
3. No disk may be placed on top of a smaller disk.

Answer the following questions:

1. (15 pts) Create PDDL domains (operators and facts) for the following Tower of Hanoi instances (it is possible that the PDDL operators will be the same):
   (a) Three pegs and two disks.
   (b) Three pegs and four disks.
2. (10 pts) Download one or more of the following planners and use them to produce plans for your PDDL domains:
   - Blackbox: https://www.cs.rochester.edu/u/kautz/satplan/blackbox/
   - Madagascar: http://research.ics.aalto.fi/software/sat/madagascar/
   - TMKit: http://tmkit.dyalab.org/

   What plans are produced by each planner for each instance (two and four disks)?
3. (15 pts) Encode the two-disk instance as a Boolean formula using the SATPlan method.
4. (10 pts) Find the satisfying assignments for two-disk boolean formula using your DPLL implementation.
   (a) What is the satisfying assignment?
   (b) What is the corresponding plan?
5. **Extra Credit:** Compare the performance/scalability of your DPLL implementation with one or more state-of-the-art SMT solvers such as:
   - Z3: https://github.com/Z3Prover/z3
   - CVC4: http://cvc4.cs.stanford.edu/web/

   (Note: you might find the Lisp TIME macro and SBCL's statistical profiler (http://www.sbcl.org/manual/#Statistical-Profiler) useful to evaluate performance).
6. **Extra Credit:** Optimize your DPLL implementation. For example, you could improve the implementation of `DPLL-CHOOSE-LITERAL`. Discuss the optimizations you implement and characterize the speedup (for example, using `TIME` or SBCL's statistical profiler).

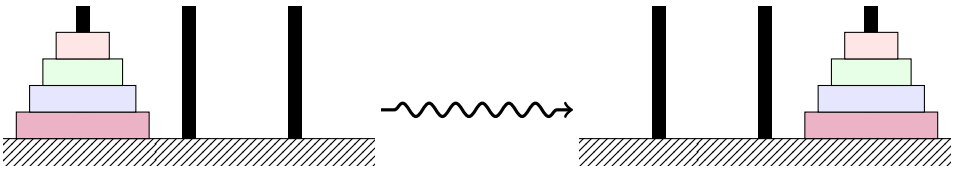

Figure 1: Tower of Hanoi Puzzle with 3 pegs and 4 disks.