EFIT Assignment Applied Logic

Fri 25 2021

16:30 - 18:00, R10

Teacher: Jurjus

For all exercises, deliver:

* Original puzzle
* Z3 input or Python code, ***including explanation of the clauses  
  (no screenshots please for the z3 input, either a separate .smt file, or text in a document that can be copied)***
* Z3 output (text or screenshot)
* Additional explanation of your approach

Exercise 1 (5 points)

Let z3 solve the following Alphametic puzzle:

KANSAS + MAINE + NEVADA = STATES

Exercise 2 – Water pouring (10 points)

We have 3 jugs of water, with capacities 8, 5 and 3 liters respectively.  
Initially, there is 8 l of water in the first jug, and the other two jugs are empty.  
We want, after a couple of times pouring water from one jug to another, to reach a situation where the 8 l and 5 l jugs each contain 4 l of water, and the 3 l can is empty.

But the jugs are irregularly shaped and unmarked, so that it is impossible to accurately measure any quantity of water that does not completely fill a jug. Moreover, no water can be spilled, and each step pouring water from a source jug to a destination jug stops when either the source jug is empty or the destination jug is full, whichever happens first.

Use z3 to show how to reach the wanted end-situation.   
(Hint: It can be done, in 10 or fewer water-pouring-steps).  
Extract a human readable answer from the z3 output: for each step, describe the contents of the 3 jugs after that step.

(Hint:   
Proposal for a model, where (C j t) represents the contents of jug number j at step t: (declare-fun C (Int Int) Int)

(One more hint: the data from the puzzle allows you to conclude that the total amount of water remains constant, and at each step, one of the jugs remains unaltered.)

Exercise 3 The 5 switches problem (10 points)

We have 5 on/off switches in a row.  
Initially, the first two are ‘on’, the next three are ‘off’.

In a finite number of steps, we want to reach the state where all five switches are ‘on’, but in every step, we are restricted: we can only ‘flip’ or ‘toggle’ two switches (no more and no less) at the same time.

Find out, using z3, whether or not this can be done in 7 steps.

(If it cannot be done in 7 steps, explain why.)

*Good luck!*