Exercises 5 April 12, 2019

[3] **1** Implement the algorithm by Fu and Malik for partial maxSAT, using the support for unsatisfiable cores in `python/z3`.

[3] **2** Check satisfiability of the following formulas using DPLL(T).

(a)

$$\mathsf{a} \approx \mathsf{b} \wedge \mathsf{b} \approx \mathsf{c} \wedge (\mathsf{f}(\mathsf{a}) \not\approx \mathsf{f}(\mathsf{c}) \vee \mathsf{f}(\mathsf{a}) \not\approx \mathsf{f}(\mathsf{b}))$$

(b)

$$\mathsf{f}(\mathsf{a}) \approx \mathsf{g}(\mathsf{f}(\mathsf{b}),\mathsf{a}) \wedge \mathsf{f}(\mathsf{f}(\mathsf{b})) \approx \mathsf{g}(\mathsf{a},\mathsf{a}) \wedge (\mathsf{f}(\mathsf{b}) \approx \mathsf{b} \vee \mathsf{f}(\mathsf{b}) \approx \mathsf{a}) \wedge \mathsf{g}(\mathsf{b},\mathsf{a}) \approx \mathsf{a} \wedge$$
$$(\mathsf{f}(\mathsf{a}) \not\approx \mathsf{a} \vee \mathsf{f}(\mathsf{g}(\mathsf{b},\mathsf{a})) \not\approx \mathsf{g}(\mathsf{a},\mathsf{a}))$$

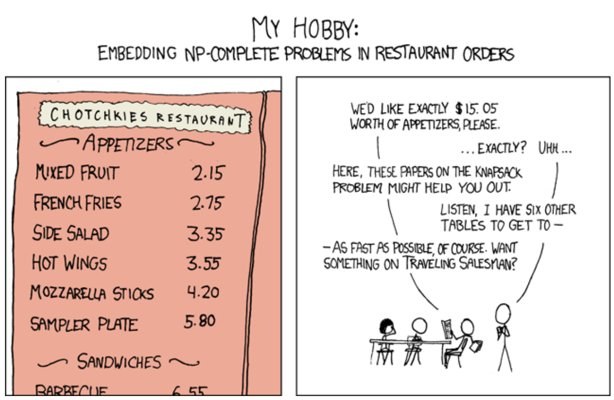
[2] **3** Solve the 3-coloring problem for the state map of Austria using uninterpreted functions by encoding it in SMT-LIB 2 (or `python/z3`). To that end, define sorts `state` and `color` as well as a constant for every state. Then assert that neighboring states have different colors.

Hint: use an additional constraint of the form

```
(forall ((C1 color) (C2 color) (C3 color) (C4 color)) (not (distinct C1 C2 C3 C4)))
```

to demand that there exist only three colors.

4



[2] (a) Help the waiter: use an SMT encoding with linear arithmetic to determine a possible combinations of starters. Are there multiple solutions?
You can formulate the problem in `SMT-LIB2` and solve it with the Z3 web interface, or use the Python bindings.

[1] ⋆(b) Field survey: Pose an NP complete problem to a waiter, document the reaction on video and submit it.

[3] ⋆ 5 Imagine a village of monkeys where each monkey owns at least two bananas. As the monkeys are well-organised, each tree contains exactly three monkeys. Monkeys are also very friendly, so every monkey has a partner. Encode the problem to SMT-LIB format and find a model. How many monkeys, bananas, and trees are there according to the model? Do you think this is the minimal possible model?

Hint: The file monkeys.smt2 shows how monkeys can own bananas.