

Exercise 1: (SMT solving with DPLL(T)) [4 Points]

Solve the following SMT formula with the theory of equalities and uninterpreted functions using the DPLL(T) algorithm.

$$g(a) = c \wedge [f(g(a)) \neq f(c) \vee g(a) = d] \wedge c \neq d$$

Exercise 2: (Core-Guided MaxSAT solving) [4 Points]

Solve the following formula as a MaxSAT problem using the Core-Guided MaxSAT algorithm MSU3.

$$(x_3 \vee x_4 \vee \bar{x}_1 \vee x_5) \wedge (\bar{x}_3 \vee x_4 \vee x_5) \wedge (x_3 \vee \bar{x}_4 \vee \bar{x}_1) \wedge (x_1 \vee x_2) \wedge (x_1 \vee \bar{x}_2) \wedge (\bar{x}_1 \vee \bar{x}_5) \wedge (\bar{x}_3 \vee \bar{x}_4 \vee x_5)$$

Exercise 3: (Weighted Partial MaxSAT to MaxSAT) [4 Points]

Show that any Weighted Partial MaxSAT problem instance (with positive integer weights) can be translated into a MaxSAT problem instance.

Exercise 4: (Longest Path as Weighted Partial MaxSAT) [5 Points]

Describe how to encode the Longest Simple Path Problem https://en.wikipedia.org/wiki/Longest_path_problem for a graph with positive edge weights to Weighted Partial MaxSAT.

Exercise 5: (Einstein's puzzle) [8 Points]

Encode Einstein's puzzle (below) into CNF and solve it with a SAT solver. Using your encoding and a SAT solver find out what is the highest number of constraints that can be dropped (of the 15 constraints) to still have a unique solution and which constraints can be dropped.

Einstein's puzzle: There are five houses of different colors next to each other on the same road. In each house lives a man of a different nationality. Every man has his favorite drink, his favorite brand of cigarettes, and keeps pets of a particular kind. The question to be answered is: Who keeps fish?

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| 1. The Englishman lives in the red house. | 7. The owner of the yellow house smokes Dunhills. | 12. The man who keeps horses lives next to the Dunhill smoker. |
| 2. The Swede keeps dogs. | 8. The man in the center house drinks milk. | 13. The German smokes Prince. |
| 3. The Dane drinks tea. | 9. The Norwegian lives in the first house. | 14. The Norwegian lives next to the blue house. |
| 4. The green house is just to the left of the white one. | 10. The Blend smoker has a neighbor who keeps cats. | 15. The Blend smoker has a neighbor who drinks water. |
| 5. The owner of the green house drinks coffee. | 11. The man who smokes Blue Masters drinks bier. | |
| 6. The Pall Mall smoker keeps birds. | | |