max planck institut
informatik

Universität
des
Saarlandes
FR Informatik

Uwe Waldmann **May 17, 2022**

Tutorials for "Automated Reasoning II"
Exercise sheet 3

Exercise 3.1:
The conditions of Thm. 1.8 are a bit stronger than necessary. Can you think about weaker conditions that are still sufficient to prove the theorem (with almost the same proof)?

Exercise 3.2:
Is the theory of abelian groups stably infinite? Give an explanation. (Hint: If $(G_1, +_1, 0_1)$ and $(G_2, +_2, 0_2)$ are abelian groups, then the cartesian product $(G_1 \times G_2, +, 0)$ with $(x, y) + (x', y') := (x +_1 x', y +_2 y')$ and $0 := (0_1, 0_2)$ is again an abelian group.)

Exercise 3.3:
Find a simple example that demonstrates that the deterministic Nelson-Oppen combination procedure remains incomplete for the combination of non-linear real arithmetic and EUF if we change the calculus in such a way that not only entailed equations but also entailed negated equations are propagated.

Exercise 3.4:
Use the CDCL(EUF) calculus to determine whether the following set of clauses is satisfiable or not:

$$f(a, b) \not\approx f(a', b') \quad (1)$$

$$g(g(c)) \not\approx c \quad (2)$$

$$g(d) \approx c \ \lor \ g(g(c)) \approx c \quad (3)$$

$$a \approx a' \ \lor \ c \approx d \quad (4)$$

$$b \approx b' \ \lor \ c \approx d \quad (5)$$

Exercise 3.5:
Normalization of the input literals is an important part of the pre-processing that takes place in an SMT solver before running the actual CDCL($\mathcal{T}$) algorithm. How would you normalize literals in linear integer arithmetic?

Bring your solution (or solution attempt) to the tutorial on May 24.