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Tutorials for Decision Procedures
Exercise sheet 8

Exercise 1: Decision Procedure for quantifier-free $T_{\mathsf{cons}} \cup T_E$
Apply the decision procedure for quantifier-free $T_{\mathsf{cons}} \cup T_{\mathsf{E}}$ to decide satisfiability of the following $\Sigma_{\mathsf{cons}} \cup \Sigma_{\mathsf{E}}$-formulae:

(a) $y = cons(cdr(x), car(x)) \wedge x = cons(car(y), cdr(y))$

(b) $y = cons(cdr(x), car(x)) \wedge x = cons(car(y), cdr(y)) \wedge car(x) \neq cdr(x)$

(c) $\neg atom(x) \wedge y = cons(cdr(x), car(x)) \wedge z = cons(cdr(y), car(y)) \wedge z \neq x$

Exercise 2: Satisfying Interpretation for T_{cons}
Take the result of applying the congruence closure algorithm on the following formula:

$$y = cons(cdr(x), car(x)) \wedge x = cons(car(y), cdr(y)).$$

Give a satisfying Interpretation I. Under this interpretation, what is the value of the term $cons(x, cons(car(x), car(y)))$?

Exercise 3: Deciding $T_{\mathbb{Q}}$
Apply the Dutertre-de-Moura algorithm to decide the $T_{\mathbb{Q}}$-satisfiability of the following $\Sigma_{\mathbb{Q}}$-formulae. Give a satisfying $T_{\mathbb{Q}}$-interpretation if it exists.

(a) $x_1 + 2x_2 \geq 1 \ \wedge \ 2x_1 + x_2 \geq 1 \ \wedge \ x_1 + x_2 \leq \frac{1}{2}$

(b) $x_1 + 2x_2 \geq 1 \ \wedge \ 2x_1 + x_2 \geq 1 \ \wedge \ x_1 + x_2 \leq 1$

(c) $x_1 - 2x_2 \geq 0 \ \wedge \ x_1 + 2x_2 \geq 1 \ \wedge \ x_1 + x_2 \leq \frac{3}{4}$

(d) $x_1 - 2x_2 \geq 0 \ \wedge \ x_1 + 2x_2 \geq \frac{1}{2} \ \wedge \ x_1 + x_2 \leq \frac{3}{4}$