Theory of Hybrid Systems Informatik 2
RWTH AACHEN UNIVERSITY

Satisfiability Checking - WS 2023/2024

Series 11

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Exercise 1: Subtropical satisfiability

Find a satisfying assignment for $2xy^2 + x^2y - 2xy - 2x^2y^2 = 0$ using the subtropical satisfiability method as shown in the lecture. If you need to identify the real roots of a univariate polynomial of degree larger than two, please use WolframAlpha (`https://www.wolframalpha.com`).

Exercise 2: Subtropical satisfiability

Assume that the subtropical satisfiability method found a solution $s = (s_1, \ldots, s_d)$ for a constraint $p(x_1, \ldots, x_d) > 0$ based on a separating hyperplane with normal vector $n = (n_1, \ldots, n_d) \in \mathbb{R}^d$. Further, we assume that the corresponding monomial dominates p at s. Let $i \in \{1, \ldots, d\}$.

Prove the following statements:

1. If $n_i > 0$ then for all $s'_i \in \mathbb{R}_{>0}$ with $s'_i > s_i$ there exist $s'_1, \ldots, s'_{i-1}, s'_{i+1}, \ldots, s'_d \in \mathbb{R}_{>0}$ such that $p(s'_1, \ldots, s'_d) > 0$.
2. If $n_i = 0$ then for all $s'_i \in \mathbb{R}_{>0}$ there exist $s'_1, \ldots, s'_{i-1}, s'_{i+1}, \ldots, s'_d \in \mathbb{R}_{>0}$ such that $p(s'_1, \ldots, s'_d) > 0$.
3. If $n_i < 0$ then for all $s'_i \in \mathbb{R}_{>0}$ with $s'_i < s_i$ there exist $s'_1, \ldots, s'_{i-1}, s'_{i+1}, \ldots, s'_d \in \mathbb{R}_{>0}$ such that $p(s'_1, \ldots, s'_d) > 0$.