Regular Separability of One Counter Automata

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The separability problem of languages from a class $\mathcal{G}$ by languages from a class $\mathcal{F}$ asks whether for two given languages $K, L \in \mathcal{G}$ there exists a language $S \in F$ such that K is included in S and L has an empty intersection with S. In the talk I will present the following result: separability of languages of one counter nets by regular languages is decidable and actually PSPACE-complete. One counter net is one counter automaton without zero tests.

This contribution is one in the sequence of results regarding regular separability of different subclasses of VASS languages. Earlier results are decidability of regular separability of $\mathbb{Z}$-VASS languages [1] and decidability of modular and unary separability of VASS reachability sets [2]. All these works belong to the line of research investigating decidability issues for separability properties of classes of languages broader than regular languages.

In the talk I plan to present the history of the problem, state the main result and then sketch techniques used to prove it. The technique is novel and quite easy to describe. For a one counter net $\mathcal{A}$ we design a sequence of finite automata $\mathcal{A}_n$ approximating $\mathcal{A}$. Automata $\mathcal{A}_n$ satisfy the following properties:

- for all $n \in \mathbb{N}$ it holds $L(\mathcal{A}) \subseteq L(\mathcal{A}_n)$;

- for all $n \mid m$ it holds $L(\mathcal{A}_m) \subseteq L(\mathcal{A}_n)$;

- for every regular language K disjoint from $L(\mathcal{A})$ there is $n \in \mathbb{N}$ such that K is also disjoint from $L(\mathcal{A}_n)$.

So $L(\mathcal{A}_n)$ form a sequence of roughly decreasing overapproximants of $L(\mathcal{A})$. Because of their properties we can show that for two OCNs $\mathcal{A}$ and $\mathcal{B}$ languages $L(\mathcal{A})$ and $L(\mathcal{B})$ are regular separable iff they are separable by $L(\mathcal{A}_n)$ for some $n \in \mathbb{N}$. I plan to present the above result and explain briefly how the main contribution follows from it.

The talk will be based on the joint work with Sławomir Lasota. This work is not published yet, but is accepted to LICS 2017 conference.

References

[1] Lorenzo Clemente, Wojciech Czerwinski, Slawomir Lasota, and Charles Paperman. Regular separability of parikh automata. *CoRR*, abs/1612.06233, 2016.

[2] Lorenzo Clemente, Wojciech Czerwinski, Slawomir Lasota, and Charles Paperman. Separability of reachability sets of vector addition systems. In *34th Symposium on Theoretical Aspects of Computer Science, STACS 2017, March 8-11, 2017, Hannover, Germany*, pages 24:1–24:14, 2017.