CoCo 2019 Participant: MædMax 1.7*

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MædMax is a completion tool: given a set of first-order equations $\mathcal{E}$ as input, it performs standard, ordered, or normalized completion in the attempt to derive a (ground) complete presentation of $\mathcal{E}$. It can also act as an equational theorem prover: if in addition to $\mathcal{E}$ a goal equation $s \approx t$ is provided as input, it will check whether there is a substitution σ such that $s\sigma \leftrightarrow^*_{\mathcal{E}} t\sigma$ holds.

In contrast to traditional completion tools, MædMax implements *maximal completion*. It is thus fully automatic in that no reduction order is required as input; instead, a suitable orientation of equations is detected by solving a maxSMT optimization problem. Details on this approach can be found in the initial proposal of maximal completion by Klein and Hirokawa [1] and a recent system description of MædMax [3].

MædMax is written in OCaml and available under the BSD license at

http://cl-informatik.uibk.ac.at/software/maedmax

CoCo 2019. In version 1.7 released for CoCo 2019 an infeasibility mode was added to participate in the new INF category. In this mode MædMax uses only one single technique to establish infeasibility, employing the above mentioned theorem proving capabilities. We briefly outline the idea.

Suppose $\mathcal{R}$ is the unconditional TRS of a given CTRS $\mathcal{C}$, and the condition c is given as a sequence of pairs of terms $s_1 \approx t_1, \ldots, s_k \approx t_k$. Then c is infeasible whenever there is no substitution σ such that $s_i\sigma \to^*_{\mathcal{C}} t_i\sigma$ holds for all $1 \leqslant i \leqslant k$ (in case of an *oriented* CTRS). Now, it is obviously a sound overapproximation to ensure that there is no σ such that $s_i\sigma \leftrightarrow^*_{\mathcal{R}} t_i\sigma$ for all $1 \leq i \leq k$. Thus MædMax uses a fresh function symbol c and attempts to decide the goal $\mathsf{c}(s_1, \ldots, s_k) \approx \mathsf{c}(t_1, \ldots, t_k)$ with respect to $\mathcal{R}$ considered as a set of input equalities. This task can be achieved using the aforementioned equational theorem proving techniques. Moreover, MædMax can output an XML certificate for such an infeasibility proof which is checkable by the proof checker CeTA. Further details can be found in [2].

Since this criterion for infeasibility constitutes an overapproximation, MædMax can only return YES answers in its infeasibility mode. The results of CoCo 2019 show that the supported technique is not very powerful compared to other tools. However, an upside of the approach is that it can also be used for CTRSs with other condition types than *oriented*.

References

[1] D. Klein and N. Hirokawa. Maximal completion. In *Proc. 22nd RTA*, volume 10 of *LIPIcs*, pages 71–80, 2011. doi: 10.4230/LIPIcs.RTA.2011.71.

[2] C. Sternagel and S. Winkler Certified Equational Reasoning via Ordered Completion In *Proc. 27th CADE*, 2019, to appear.

[3] S. Winkler and G. Moser MædMax: A Maximal Ordered Completion Tool In *Proc. 9th IJCAR*, volume 10900 of *LNCS*, pages 472–480, 2018. doi: 10.1007/978-3-319-94205-6_31.

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