CO3

a COnverter for proving COfluence of COnditional TRSs

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CO3 is a tool for proving confluence of conditional term rewriting systems (CTRS) by using a transformational approach. The tool is based on the result in [4]: the tool first transforms a given normal 1-CTRS into an unconditional term rewriting system (TRS) by using the *SR transformation* [6] or the *unraveling* [3, 5], and then verify confluence of the transformed TRS. This tool is basically a converter of CTRSs to TRSs. The main expected use of this tool is the collaboration with other tools for proving confluence of TRSs, and thus this tool has very simple and lightweight functions to verify properties such as confluence and termination of TRSs. The tool is available from `http://www.trs.cm.is.nagoya-u.ac.jp/co3/` via a web interface.

The tool supports *normal 1-CTRSs* without any strategy and theory (specified by `STRATEGY` and `THEORY`, resp.), the class of which includes *TRSs*. Due to a technical reason as shown below, the tool is working for *weakly left-linear* CTRSs which are not TRSs. To enter the competition, the scope of the tool was modified to *oriented 1-CTRSs*.

The main technique in this tool is based on the following theorem: a weakly left-linear normal 1-CTRS $\mathcal{R}$ is confluent if one of $\mathbb{SR}(\mathcal{R})$ and $\mathbb{U}(\mathcal{R})$ is confluent [4], where the (optimized) SR transformation [6] and the sequential (optimized) *unraveling* are denoted by $\mathbb{SR}$ and $\mathbb{U}$, resp. For proving confluence and termination of TRSs, CO3 is using the following very fundamental (sufficient) conditions: (Confluence) "orthogonality" and "termination and joinability of all the critical pairs"; (Termination) "non-existence of SCCs in the *estimated dependency graph* [1]" and "the *dependency pair theorem* [1, Theorem 7] with the *reduction order* based on term-size and variable-occurrence [2, Example 5.2.2]".

The main new feature for CoCo 2015 is to drop *infeasible* rewrite rules. Implemented sufficient conditions for infeasibility are (1) "non-unifiability for the both sides of conditions under $REN(CAP(\cdot))$ in [1]", (2) "left-to-right unreachability of conditions at the root position", and (3) "trivial divergence of evaluating conditions".

References

[1] T. Arts and J. Giesl. Termination of term rewriting using dependency pairs. *Theor. Comput. Sci.*, 236(1-2):133–178, 2000.

[2] F. Baader and T. Nipkow. *Term Rewriting and All That.* Cambridge University Press, 1998.

[3] M. Marchiori. Unravelings and ultra-properties. In *Proc. ALP 1996*, vol. 1139 of *LNCS*, pp. 107–121. Springer, 1996.

[4] N. Nishida, M. Yanagisawa, and K. Gmeiner. On proving confluence of conditional term rewriting systems via the computationally equivalent transformation. In *Proc. IWC 2014*, pp. 24–28, 2014.

[5] E. Ohlebusch. Termination of logic programs: Transformational methods revisited. *Appl. Algebra Eng. Commun. Comput.*, 12(1/2):73–116, 2001.

[6] T.-F. Şerbănuţă and G. Roşu. Computationally equivalent elimination of conditions. In *Proc. RTA 2006*, vol. 4098 of *LNCS*, pp. 19–34. Springer, 2006.