

Report on
Confluence Competition 2015



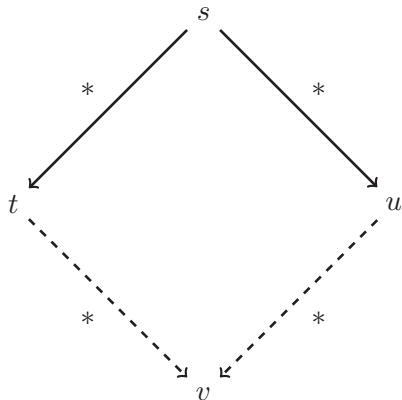
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CADE-25, August 7, Berlin

Confluence

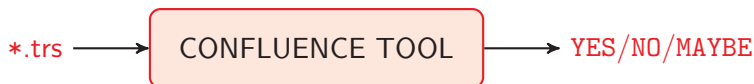


- ▶ A rewrite system \mathcal{R} is **confluent** if for any $t \mathcal{R} \stackrel{*}{\leftarrow} s \stackrel{*}{\rightarrow} \mathcal{R} u$, there exists v such that $t \stackrel{*}{\rightarrow} \mathcal{R} v \mathcal{R} \stackrel{*}{\leftarrow} u$, where $\stackrel{*}{\rightarrow} \mathcal{R}$ is the reflexive transitive closure of a rewrite step $\rightarrow \mathcal{R}$.
- ▶ **Confluence** guarantees unique results of computations.

Confluence Tools

109.trs

```
1 (VAR x y z)
2 (RULES
3   join(x,meet(x,y)) -> x
4   meet(x,join(y,z)) -> join(meet(x,y),meet(x,z))
5   meet(x,x) -> x
6   join(x,x) -> x
7   meet(meet(x,y),z) -> meet(x,meet(y,z))
8   meet(x,y) -> meet(y,x)
9   join(join(x,y),z) -> join(x,join(y,z))
10  join(x,y) -> join(y,x)
11 )
12 (COMMENT Theory of Distributive Lattice from [PS81])
13
```



CoCo 2015: Description

- ▶ 4th Confluence Competition (annually, from 2012)
- ▶ Four competition categories (and two demonstration categories)
- ▶ The score is computed in percent of solved vs. supported problems. 60 sec. timeout for each problem.
- ▶ The problem sets consist of randomly selected 100 problems from Cops (Confluence problems database).
- ▶ StarExec was used as the execution platform.¹



¹Thanks are due to StarExec team for preparing an excellent platform.

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A detailed description can be found at the *Competition Description of CoCo 2015* contained in the proceedings of CADE-25.

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CoCo 2015: Categories

- ▶ **TRS**: first-order term rewrite systems
- ▶ **CTRS**: conditional term rewrite systems

$$\left\{ \begin{array}{l} \text{fib}(0) \quad \rightarrow \quad \text{pair}(s(0), 0) \\ \text{fib}(s(x)) \rightarrow \text{pair}(w, y) \leftarrow \text{fib}(x) = \text{pair}(y, z), +(y, z) = w \end{array} \right\}$$

- ▶ **HRS^{new!}**: higher-order term rewrite systems

$$\left\{ \begin{array}{l} \text{map } (\lambda n. f \ n) \ [] \quad \rightarrow \quad [] \\ \text{map } (\lambda n. f \ n) \ (x : xs) \rightarrow (f \ x) : (\text{map } (\lambda n. f \ n) \ xs) \end{array} \right\}$$

- ▶ **CPF**: certification category



- ▶ **Demonstration categories^{new!}** ('pre'-competition categories)

CoCo 2015: Entrants

	categories	# of tools	# of authors
<i>CoCo 2012</i>	TRS/CPF	4	8
<i>CoCo 2013</i>	TRS/CPF	4	10
<i>CoCo 2014</i>	TRS/CTRS/CPF	7	15
<i>CoCo 2015</i>	TRS/CTRS/HRS/CPF/Demo	11	31

- ▶ TRS Category: ACP, CoLL-Saigawa, CSI
- ▶ CTRS Category: CO3, ConCon, CoScart
- ▶ HRS Category: ACPH, CSI^{ho}
- ▶ CPF Category: ACP+CeTA, ConCon+CeTA, CSI+CeTA
- ▶ Demonstration Categories: AGCP, NoCo

CoCo 2015: Entrants

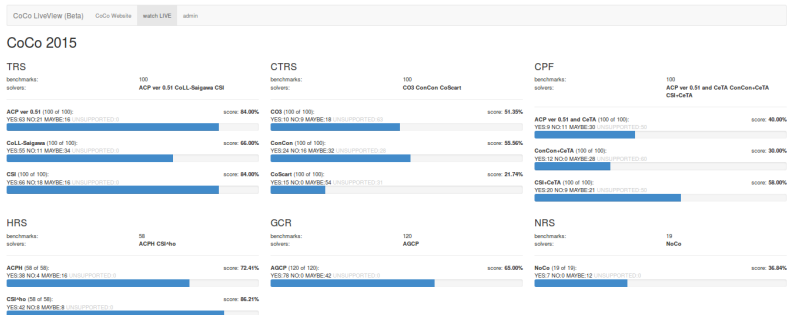
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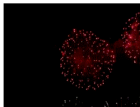
1 page system descriptions of tools can be found at the *CoCo 2015* webpage and in the *proceedings of IWC 2015*.

CoCo 2015: Live View

The competition ran **live** at the last session of the 4th International Workshop on Confluence (IWC 2015), Sunday, August 2.



This competition is finished

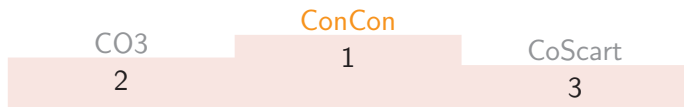


CoCo 2015: Winners

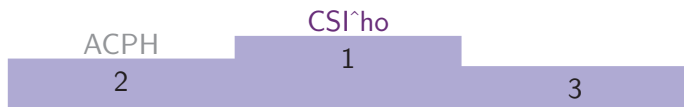
▶ TRS Category



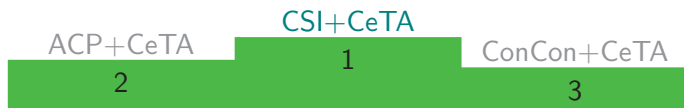
▶ CTRS Category



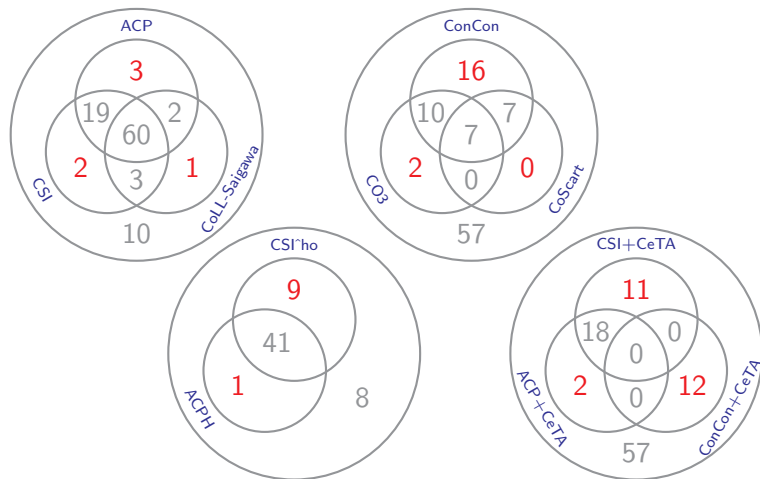
▶ HRS Category



▶ CPF Category



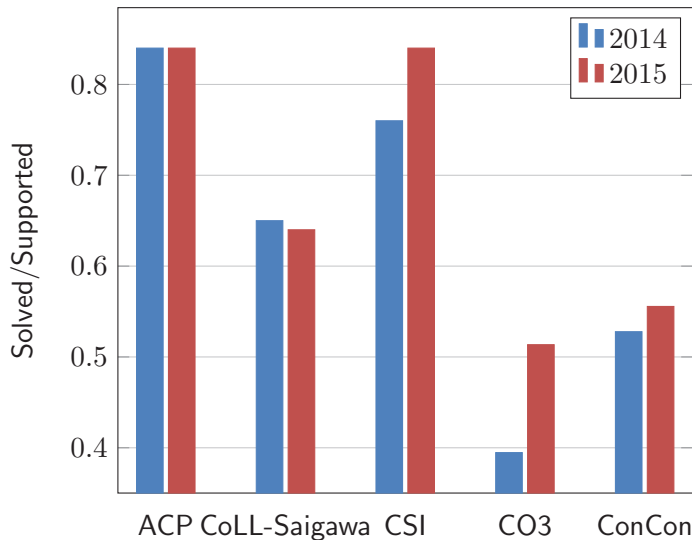
CoCo 2015: Numbers of Solved/Unsolved Problems



More details can be checked at

<http://coco.nue.riec.tohoku.ac.jp/2015/>

CoCo 2015: Progress (for entrants of 2014 & 2015)



CoCo 2015: Simple Unsolved Problems

- ▶ TRS Category: **Cops #126**

$$\{ f(f(x, y), z) \rightarrow f(f(x, z), f(y, z)) \}$$

- ▶ CTRS Category: **Cops #489**

$$\left\{ \begin{array}{l} \text{even}(0) \rightarrow \text{true} \\ \text{even}(s(x)) \rightarrow \text{true} \Leftarrow \text{odd}(x) = \text{true} \\ \text{even}(s(x)) \rightarrow \text{false} \Leftarrow \text{even}(x) = \text{true} \\ \text{odd}(0) \rightarrow \text{false} \\ \text{odd}(s(x)) \rightarrow \text{true} \Leftarrow \text{even}(x) = \text{true} \\ \text{odd}(s(x)) \rightarrow \text{false} \Leftarrow \text{odd}(x) = \text{true} \end{array} \right\}$$

- ▶ HRS Category: **Cops #432**

$$\left\{ \begin{array}{l} \text{app} (\text{abs} (\lambda x. f x)) y \rightarrow f y \\ \pi_1 (\text{pair } x y) \rightarrow x \\ \pi_2 (\text{pair } x y) \rightarrow y \\ \text{pair} (\pi_1 x) (\pi_2 x) \rightarrow x \end{array} \right\}$$

Much challenge remains. You can check more at **Cops database**.

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Thank you very much!