AGCP

System Description for CoCo 2017

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AGCP (Automated Ground Confluence Prover)

A ground confluence prover for many-sorted TRSs

- **An entrant of GCR category**
- **Written in Standard ML of New Jersey (SML/NJ)**
- **Methods:**
  - **rewriting induction**

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- **An entrant of GCR category**
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- **Methods:**
  - **rewriting induction (extended)**
  - **transformation (added)**
  - **disproving (added)**
- **Other efforts:**
  - **new input format**

Improvements of the Rewriting Induction Approach for proving GCR

[Aoto/Toyama/Kimura, FSCD 2017]

1. Addition of rules for straight inductive definition
   * pattern complementation and generation
   * pattern instantiation

2. Dealing with non-orientable constructor rules
   * soundness of an extended rewriting induction system and new GCR criterion

3. Disproving mechanisms
   * disproving rule in rewriting induction
   * incorporation of CR disproving methods

Extended Rewriting Induction

Expand

$$\frac{\langle E \uplus \{s^{\circ} \doteq t\},\ H\rangle}{\langle E \cup \{s'_i \doteq t_i\}_i,\ H \cup \{s \to t\}\rangle} \quad \begin{array}{l} u \in \mathcal{B}(s), \\ \{s_i \to t_i\}_i = \mathrm{Expd}^{\succ}_{u}(s,t), \\ s_i \xrightarrow{\succsim}{}^{*}_{H\leftrightarrow} s'_i \end{array}$$

Simplify

$$\frac{\langle E \uplus \{s^{\circ} \doteq t\},\ H\rangle}{\langle E \cup \{s' \doteq t\},\ H\rangle} \quad s \xrightarrow{\succ}_{\mathcal{R}^{\circ}\cup H} \circ \xrightarrow{\succsim}{}^{*}_{H\leftrightarrow} s'$$

Modify

$$\frac{\langle E \uplus \{s \doteq t\},\ H\rangle}{\langle E \cup \{s' \doteq t\},\ H\rangle} \quad s \xrightarrow{\approx}_{\mathcal{R}} s'$$

Delete

$$\frac{\langle E \uplus \{s^{\circ} \doteq t\},\ H\rangle}{\langle E,\ H\rangle} \quad s \to^{=}_{H} t$$

Theorem. Suppose that $\mathcal{R}^{\succ}$: LL&SQR, $\mathcal{R} \subseteq \succsim$, $\mathcal{R}^{\approx} \subseteq \mathcal{R}_c$, $\mathcal{R}_c$: GCR. If $\langle \mathrm{CP}_{\succsim}(\mathcal{R}), \emptyset\rangle \stackrel{*}{\rightsquigarrow} \langle \emptyset, H\rangle$, then $\mathcal{R}$: GCR.

Various Minor&Major Improvements

1. Check redundancy of sorts and remove redundant rules.

2. Compute (possibly multiple) candidates for the partition $\mathcal{F} = \mathcal{D} \uplus \mathcal{C}$ of function symbols.

3. Select constructor rules from $\mathcal{R}$ and construct a constructor subsystem $\mathcal{R}_c$ by the rule instantiation procedure.

4. For each $f \in \mathcal{D}$, construct multiple candidates of defining rules for f using the rule complementation procedure and construct $\mathcal{R}_0$ from $\mathcal{R}_c$ by adding a candidate for each.

5. **Find a reduction quasi-order $\succsim$ satisfying conditions of the Theorem for $\mathcal{R}_0$. If it fails try another candidate of defining rules; if the candidates are exhausted, try another partition $\mathcal{F} = \mathcal{D} \uplus \mathcal{C}$. Run rewriting induction to obtain $\langle \mathrm{CP}_{\succsim}(\mathcal{R}_0) \cup (\mathcal{R} \setminus \mathcal{R}_0), \emptyset \rangle \overset{*}{\rightsquigarrow} \langle \emptyset, H \rangle$ for some H or $\langle \mathrm{CP}_{\succsim}(\mathcal{R}_0) \cup (\mathcal{R} \setminus \mathcal{R}_0), \emptyset \rangle \overset{*}{\rightsquigarrow} \bot$. If it succeeds, return `YES` or `NO` accordingly. If the number of rewriting induction steps exceeds a limit, then try another candidate of defining rules.**

6. **Run the ground non-confluence check incorporated from the methods for disproving confluence. If it fails, return `MAYBE`.**