Tool Interoperability in the Maude Formal Environment

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- it allows the execution of several instances of each tool

Motivation

The Example of Readers and Writers

We want to check in the `R+W` system that it is never the case that more than (i) one writer or (ii) writers and readers share a critical resource at the same time. A state is represented by a term

$$\langle r, w \rangle$$

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- `R+W` needs to be executable, i.e., its equations ground Church-Rosser and terminating, and its rewrite rules ground coherent with respect the equations
- for initial state $\langle 0, 0 \rangle$, the set of initial states is infinite, so we apply a state abstraction in `R+W-ABS` which needs to be checked executable

Outline

1. Tools in the Environment
2. Design and Main Features
3. Demo

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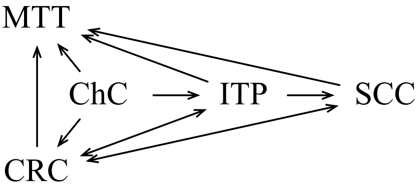
  ground confluence and sort-decreasingness of equational specifications
- ChC *Maude Coherence Checker*
  ground coherence of rewrite specifications
- ITP *Inductive Theorem Prover*
  inductive properties of equational specifications

Tool-dependency Graph in MFE

One important aspect in the integration task is the interaction complexity due to the nontrivial dependencies among tools



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- MFE is modeled in Maude as an interactive object-based system where tools are objects, the communication mechanism is message passing, and user interaction is available through Full Maude
- integration and interoperation of tools within MFE is module-centric given that its main purpose is to support formal analysis of Maude modules
- although some classes and functionality are provided in MFE, it imposes no constraint on how each tool should model its particular domain or maintains its internal state

Main Classes

The object-oriented model of MFE consists of three main classes

`Proof` class of proof objects that keep the state of specific proof requests

`Tool` class of tool objects that keep the life-cycle of proof objects

`Controller` inherits from Full Maude's `DatabaseClass` and provides a centralized entry point for handling user request

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- each command is encapsulated as a message in the object configuration
- each tool object and the controller object have a module defining the signature of commands it can handle
  - the controller handles any command it can parse
  - if the controller receives a command it cannot parse, then it delegates the message to the *active* tool
  - if the tool can parse the delegated command, then it notifies the controller and handles the command
  - otherwise, it will notify the failure to the controller, which in turn will output an error message to the user

Commands in MFE

MFE provides the following user commands:

`(select tool <tool-name> .)` sets `<tool-name>` as the *active* tool

`(MFE help .)` shows MFE's help information

`(show global state .)` shows the state of the environment

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The tools available in MFE's current release provide at least the following commands:

`(<tool-name> help .)` shows the help information of tool `<tool-name>`

`(show state .)` shows the state of the tool

Proof Obligations

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- when all proof obligations in the verification task of a module's property are discharged, the corresponding tool notifies the success result to the user or to the tool originating the verification task

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- MFE offers the following command for keeping track of proofs obtained outside the environment

  ```
  (trust .)
  ```

External Utilities

For tools which depend on external utilities not directly available from Maude such as MTT and SCC, we have extended the latest release of the Maude system with *built-in* operators associated with appropriate C++ code that interacts with the external tools

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Obtaining and Using MFE

The tool, the pimped version of Maude, and more examples are available at

http://maude.lcc.uma.es/MFE

Thank you!